PROCEEDINGS

OF THE

ROYAL PHYSICAL SOCIETY

OF

EDINBURGH.

FOR THE PROMOTION OF ZOOLOGY AND OTHER BRANCHES OF NATURAL HISTORY.

VOL. XVI.

1904–1906.

EDINBURGH:
PRINTED FOR THE SOCIETY, AND PUBLISHED AT
THEIR ROOMS, 1 INDIA BUILDINGS.

MDCCCCVI.

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SESSION 1904-1905.

No. 1. VOL. XVI. PAGES 1-24.

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EDINBURGH: M'FARLANE & ERSKINE.

DECEMBER 1904.

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PROCEEDINGS

OF THE

ROYAL PHYSICAL SOCIETY.

SESSION CXXXIV.

I. *Morphological Variations in* Vipera berus. Size and Scaling. By Gerald Leighton, M.D., F.R.S.E.

(Received 10th October 1904; read 24th October 1904.)

It is an axiom in zoological classification that morphological characters alone are to be taken into consideration, and in the classification of serpents the characters utilised for this purpose are the number and arrangement of the scales of the body. By this means alone are specific characters determined. It matters not what colour the reptile may be, apparently even it is of no consequence if the colour is constant in the two sexes, even the actual size to which the reptile grows is thrust on one side as of no importance, provided only that the scaling arrangements conform to the type laid down as specific. A more artificial and unnaturally restricted way of looking at an animal could hardly be imagined. But nature does not trouble herself much about specific characters, she leaves that to the morphologists. The production of hard and fast lines by which species can be separated, is not the object of natural life, but rather that animals should vary and develop along those lines which best enable them to meet the conditions under which they have to exist. Those which do not thus vary are unhesitatingly crushed out of existence. Hence, of course, such a hard and fast line as is laid down for species of serpents to conform to, must be honoured as much in the breach as in the observance, and so we find that in a series of adders hardly two can be found which are what is called "typical" in their specific scaling arrangements. And so it comes to pass that there is a variety of snake in these Isles which does not grow to the size of the average adder, is of the same colour in the two sexes, and is very limited in its distribution, but which, because its scales happen to be arranged in the way authorities have decided is that of the adder, is likewise classed as *Vipera berus*. I refer to the small red viper. Even in its temper and disposition this snake is unlike the adder, a fact with which country folks, where the red viper occurs, are quite familiar with, but which systematists consider of no importance, if they are aware of it. Anyone who has seen specimens of the two reptiles together, is strongly tempted to think that those who are responsible for classing them as the same species never had a similar opportunity. But their scales are similarly arranged; that is quite sufficient.

During the time I have been working on this subject, I have obtained several specimens of the small red viper, which are now in the University Zoology Museum, where the two reptiles can be compared. In the last five years I have taken or examined about five hundred British adders, but I have only seen four of these red vipers, a fact which in itself is strongly against them being of the same species. Their very rarity is the difficulty in investigating them; they have not been observed with their young, nor have they been known to pair with the common adder. So, as they conform to the adder scaling, adders they must be under present arrangements. What follows will, I think, show how extremely variable this scaling is, and to what extent its limits have to be stretched to include all adders within its range.

G. A. Boulenger, the distinguished ophiologist of the British Museum, is the only person who has paid much attention to the variations of the adder in Great Britain. He has laid down the limits of scaling recorded, in the following paragraphs, which it is necessary to quote to show the great variation which obtains.

"(*a*) *The Syncipital Shields.*—In British specimens they are nearly always well developed. In one specimen only (from Hampshire) I find the frontal much reduced and the parietals broken up into scales, the specimen in this respect agreeing with *V. aspis* . . . Any such extreme specimens . . . are worth recording and preserving.

"(*d*) The number of labial shields, not being always the same, has to be counted on both sides of the animal. In 35 out of 74 cases I find 8 shields, in 30 cases 9, in 4 cases 10, in 4 cases 7, in 1 case 6. Continental specimens have much more frequently 9 than 8 shields. *V. aspis* has from 9 to 11.

"(*e*) The number of scales round the eye (prae-, sub-, and post-oculars) varies between 6 and 11 in British specimens, the two extreme numbers occurring only once in my lists, 8 or 9 being the usual number.

"(5) *The Scaling of the Body.*—The scales number 21 across the middle of the body. But there are exceptions. In one specimen from Petersfield I counted 23 scales, and in another from Scotland only 19. . . . Such exceptional specimens should be recorded and preserved.

"(6) *The Ventral Shields.*—In 37 British specimens I have counted 137 to 146 ventral shields (exclusive of the anal) in males, 139 to 154 in females. . . . The limit of variation on record (sexes not discriminated) is from 124 to 159.

"(7) *The Sub-caudal Shields.* . . . The number (counting each pair as one, and not reckoning the terminal, conical, or spine-like shield) is 35 to 40 in males, 28 to 35 in females. In one male I find as few as 33. The number of sub-caudals is stated to vary between 25 in males and 48 in females." (Quoted from the *Zoologist,* March 1892.)

The following records of scaling variations in my own specimens will show how far they agree with and differ from those hitherto recorded. The actual work of counting these scales is most laborious and tedious, in fact, it is quite an hour's work to count and verify by recounting the scaling of a single specimen, as the slightest distraction of the attention is apt to lead one to make a mistake. For greater convenience of reference, I have arranged my results in tabular form, instead of recording each specimen separately, as of course I did in the notes from which these tables are compiled. I shall deal with the head shields afterwards.

Scaling Variations in *Vipera berus.*

Explanation of Terms and Signs in the Tables.

"m" means millimetres.
"Labials" means the upper Labial scales.
"Gastrosteges" means the Ventral scales.
"Urosteges" means the Sub-caudal scales.
"& a" means "in addition to the 'anal' scale."
"& t" means "in addition to the 'terminal' scale."
"R" means the right side.
"L" means the left side.
"Rows" means the number of rows of scales across the middle of the body.

Note.—The measurements given in inches are the somewhat rough measurements noted on arrival of specimen by tape measure. The measurements in millimetres are the exact measurement, done with great care by a metric measure. It is useful to have both given.

No. of Specimen.	Total Length.	Tail Length.	Total in Inches.	Sex of Adder.
1	480 m.	70 m.	19	Male.
2	660 m.	70 m.	26	Female.
3	500 m.	70 m.	20	Male.
4	530 m.	70 m.	21	Male.
5	495 m.	60 m.	$19\frac{1}{2}$	Male.
6	480 m.	60 m.	19	Male.
7	490 m.	70 m.	$19\frac{1}{2}$	Male.
8	590 m.	58 m.	$23\frac{1}{2}$	Female.
9	535 m.	50 m.	$21\frac{1}{4}$	Female.
10	505 m.	50 m.	20	Female.
11	495 m.	50 m.	$19\frac{1}{2}$	Female.
12	470 m.	65 m.	$18\frac{1}{2}$	Male.
13	490 m.	70 m.	$19\frac{1}{2}$	Male.
14	610 m.	65 m.	24	Female.
15	530 m.	70 m.	21	Male.
16	480 m.	65 m.	19	Male.
17	630 m.	65 m.	25	Female.
18	610 m.	90 m.	24	Male.
19	650 m.	65 m.	$25\frac{1}{2}$	Female.
20	610 m.	65 m.	24	Female.
21	530 m.	70 m.	21	Male.
22	625 m.	65 m.	$24\frac{3}{4}$	Female.
23	470 m.	65 m.	$18\frac{1}{2}$	Male.
24	260 m.	26 m.	$10\frac{3}{8}$	Female.[1]
25	440 m.	65 m.	$17\frac{1}{2}$	Male.[2]
26	565 m.	60 m.	$22\frac{1}{3}$	Female.
27	530 m.	55 m.	21	Female.
28	620 m.	78 m.	$24\frac{1}{2}$	Male.
29	590 m.	78 m.	$23\frac{1}{2}$	Male.
30	610 m.	83 m.	24	Male.
31	648 m.	60 m.	$25\frac{1}{2}$	Female.
32 (Sent to Zoo alive.)				
33	580 m.	78 m.	23	Male.
34	635 m.	60 m.	25	Female.
35	610 m.	65 m.	24	Female.
36	635 m.	65 m.	25	Female.
37	515 m.	85 m.	$20\frac{1}{4}$	Male.
38	610 m.	85 m.	24	Male.
39	510 m.	65 m.	20	Female.
40	490 m.	60 m.	$19\frac{1}{2}$	Female.
41	395 m.	60 m.	$15\frac{1}{2}$	Female.

[1] A specimen of the small red viper.

[2] A new variety of Melanism production.

No. of Specimen.	Labials.	Gastrosteges.	Urosteges.	Rows.	Sex.
1	R.8, L.8	143 & a.	41 & t.	21	Male.
2	R.8, L.8	148 & a.	32 & t.	21	Female.
3	R.8, L.8	142 & a.	38 & t.	21	Male.
4	R.8, L.9	142 & a.	38 & t.	21	Male.
5	R.8, L.9	142 & a.	38 & t.	21	Male.
6	R.9, L.8	137 & a	32 & t.	21	Male.
7	R.9, L.7	142 & a.	38 & t.	21	Male.
8	R.8. L.8	142 & a.	28 & t.	21	Female.
9	R.8, L.9	148 & a.	31 & t.	21	Female.
10	R.9, L.9	151 & a.	32 & t.	21	Female.
11	R.8, L.8	143 & a.	31 & t.	20 to 17	Female.
12	R.?,[1] L.9	141 & a.	38 & t.	21	Male.
13	R.9, L.7	142 & a.	38 & t.	21	Male.
14	R.9, L.8	152 & a	32 & t.	21	Female.
15	R.9, L.9	143 & a.	36 & t.	21	Male.
16	R.8, L.8	140 & a.	33 & t.	19	Male.
17	R.8, L.8	148 & a.	30 & t.	21	Female.
18	R.7, L.7	143 & a.	45 & t.	21	Male.[2]
19	R.9, L.10	149 & a.	32 & t.	21	Female.
20	R.8, L.8	151 & a.	33 & t.	21	Female.
21	R.9, L.8	144 & 2a.	39 & t.	21	Male.
22	R.8, L.8	148 & a.	32 & t.	21	Female.
23	R.9, L.8	145 & a.	40 & t.	21	Male.
24	R.9, L.9	144 & a.	32 & t.	21	Female.[3]
25	R.8, L.8	147 & a.	37 & t.	18, 19, & 20	Male.[4]
26	R.8, L.8	142 & a.	32 & t.	21 to 17	Female.
27	R.8, L.9	144 & a.	38 & t.	21	Female.
28	R.8, L.8	144 & a.	38 & t.	21	Male.
29	R.9, L.9	140 & a.	40 & t.	21	Male.
30	R.9, L.9	132 & a.	41 & t.	21	Male.
31	R.9, L.8	144 & a.	32 & t.	21	Female.
32 (Sent to Zoo alive.)					
33	R.10, L.10	142 & a.	39 & t.	21	Male.
34	R.9, L.9	147 & a.	32 & t.	21	Female.
35	R.8, L.9	144 & a.	31 & t.	21	Female.
36	R.9, L.9	150 & a.	33 & t.	21	Female.
37	R.8, L.7	144 & a.	41 & t.	21	Male.
38	R.8, L.9	144 & a.	39 & t.	21	Male.
39	R.8, L.8	144 & a.	32 & t.	21	Female.
40	R.8, L.9	144 & a.	32 & t.	21	Female.
41	R.8, L.9	140 & a.	32 & t.	21	Female.

[1] This specimen was too mutilated to count these.

[2] A new colour variation, uniform green.

[3] A small red viper.

[4] A new variety of Melanism production.

The Syncipital Shields.—These in a typical *Vipera berus*, in addition to the supraocular shield, include three large symmetrical shields on the top of the head, namely, the single frontal shield and the two parietals. In the specimens whose body scaling is tabulated above, the most important variations in these syncipital shields were the following:—

In No. 1 each parietal was broken up into three small shields, which is an approximation to what obtains in *Vipera aspis.*

In No. 24 there were two shields articulating with each parietal which are not usually present, which might be described as two accessory parietals.

In No. 28 the frontal shield is small, and the parietals are represented by a number of small scales, like the arrangement in *Vipera aspis.*

In No. 29 the scales round the eye are 10 in number.

In No. 28 the scales round the eye are 8 in number.

In No. 30 the scales round the eye are 9 in number.

In No. 34 the two parietals are represented by a number of small shields, these being irregular in shape and size, as in *V. aspis.*

In No. 35 a somewhat unusual arrangement, but one which I have seen before, is present. The frontal is entirely surrounded by 12 small shields, except posteriorly, where it is in contact with the parietals. In addition, in front of the frontal are the usual seven small shields, filling up the space between that shield and the canthals.

In No. 37 the two supraocular shields are in contact with the frontal, the usual small scales which intervene being absent.

These are the most conspicuous variations in the syncipital shield in the series under notice.

In no specimen was more than one row of scales present between the eye and the labials.

Summary of Variations.

(*a*) The measurements given above indicate that adult male adders vary in length from 18 to 24 inches.

(*b*) Also that adult females vary in length from $19\frac{1}{2}$ inches to 26 inches.

That is to say, that males do not reach the maximum length shown in females, the difference being generally from one-half to one inch. I have previously shown this in the measurements of another series (in "British Serpents"). This series here confirms what I there stated, and it is of importance, because G. A. Boulenger did not find the difference constant in a series he examined. The small red viper is omitted in this estimate, as that reptile never grows to more than 15 inches in either sex.

(*c*) The upper labial scales in this series vary from 7 to 10 in number, the former figure occurring four times, the latter twice.

(*d*) The gastrosteges or ventral scales in the males in this series vary from 132 in one case to 147, also in one case. The former figure, 132, has never been recorded for males before, so far as I am aware, the lowest being 137.

(*e*) In the females of the series the gastrosteges vary from 140 in one case to 152, also in one case.

(*f*) The urosteges, or sub-caudal shields, in the series vary in males from 32 to 45, the lower and the higher figures being both beyond the limits of the figures given in G. A. Boulenger's article quoted.

(*g*) In the females of the series, the urosteges vary from 28, the lowest recorded, to 38, the latter figure being 2 more than mentioned as occurring.

A British adder, therefore, may possess from 6 to 10 labial scales (Boulenger records one with 6); from 17 to 23 rows of scales across the body (Boulenger records one with 23); from 132 to 154 ventral scales, the former figure recorded in this series, the latter by Boulenger; the sub-caudal shields from 28 to 45, both here recorded; the scales round the eye vary between 6 and 11; the parietals may be represented by the arrangement found in *Vipera aspis* instead of that in *Vipera berus;* and other variations may be present which this research does not deal with.

I have undertaken this laborious counting simply to give weight to my argument that it is an unsound and unscientific principle to lay down, that scaling, and scaling only, is to be taken into consideration in determining the validity of a species. Of all the characters of adders, their scaling is the character which is most liable to variation, yet it is regarded as of specific importance. Size and colour, even when constant and not varying nearly so much as scaling does, are disregarded as of no importance in settling species validity; otherwise it would be at once seen that the small red viper is no more an adder than it is any other serpent. Its size and colour are *always* different from those of *V. berus*, but it has the same scaling as is set down characteristic of the adder. There seems to me no valid reason why it should *not* have this same scaling, but it is surely absolutely insufficient to class the reptile as an adder on that account, seeing the great differences in other characters. The more one studies scaling, the more one sees how uncertain it is in a species, how greatly it varies, and what wide limits have to be set in order that it may include all that occurs in those snakes which are undoubtedly of the same species.

II. *On the Trapezium* (os multangulum majus) *of the Horse.*

By O. Charnock Bradley, M.B., F.R.S.E.

(Read 24th October 1904.)

The palæontological evidence of the evolution of the horse is now so considerable, that the constitution of the equine manus and pes offers few morphological problems apart from those which are associated with the similar parts of mammals in general. But before the discovery of fossil remains of its predecessors, it was not by any means easy to account for the striking reduction in number and modification in form of the carpal, tarsal, metacarpal, and metatarsal bones, and the bones of the digit of the modern horse. So far as can be discovered from the recorded views of those living before the middle of the eighteenth century, no suspicion that the horse was other than a monodactyl animal ever entered into the minds of morphologists. Buffon and Daubenton were evidently the first to trace any features which could be held as showing that the horse has more digits than one. Daubenton

(1753) sought to bring the horse into line with man by asserting that the main metacarpal bone is the representative of the 2nd, 3rd, and 4th human metacarpals; the rudimentary metacarpals of the horse corresponding to the metacarpals of the thumb and little finger of man.

A century later (1853) Joly and Lavocat expressed a somewhat similar view. They also considered the horse to be a pentadactyl animal, in which fusion of some bones has taken place; but they differed from Daubenton in being of opinion that the chief metacarpal has been produced by

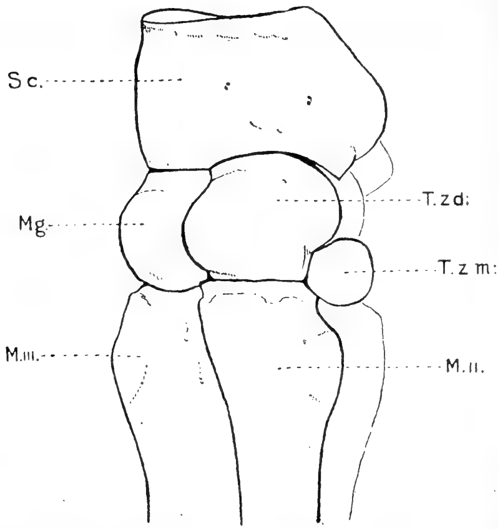

Fig. 1.

fusion of the 3rd and 4th bones only. It is further averred by them that the third phalanx bears witness to the fusion of the 3rd and 4th digits. As is well known, the 3rd phalanx of the adult horse most frequently possesses a notch of greater or less depth about the middle of its sharp convex border. It is difficult to say when this notch was first observed, but early in the last century it was held to be produced by shoeing. Joly and Lavocat denied this, the then generally accepted explanation, and suggested that the notch was neither more nor less than an indication of the point of union of two phalanges.

Arloing (1) also, at one time, was of opinion that the chief metacarpal bone of the horse consists, in reality, of the 3rd and 4th metacarpal bones; an opinion shared by Chauveau.[1]

It is evident from the above that the earlier thinkers inclined to the supposition that the reduction in the number of metacarpal bones of the horse has been produced by the union of previously independent structures; a supposition engendered by the then domination of comparative anatomy by human anatomy. The application of the "fusion" hypothesis was not confined to the metacarpus, but was extended to the carpus: Daubenton, for instance, stating that if there are not eight bones in the horse's carpus, it is because the trapezoid is blended with the magnum.

The testimony of the rocks has convinced morphologists that the reduction in the number of both carpal and metacarpal bones is due to the gradual reduction in size, and final disappearance of elements present in the predecessors of the horse. Since it is only proposed to devote attention to the frequency of occurrence of a carpal bone, which there is no reason to doubt is at present in process of disappearance, it is quite beyond the province of the present short communication to consider the evidence of fossil remains. It will suffice to say that there is abundant proof that the trapezium bone (*os multangulum majus, os carpale primum*) was present in the carpus of the extinct animals from which the modern horse has descended. Further, it is a constant component of the carpus of present-day allied genera of the horse.

In the horse, as we now know it, the trapezium is not infrequently entirely absent. That this has been recognised for a considerable time is shown by an examination of the older text-books dealing with the anatomy of the horse. For example, Percivall (2), writing in 1858, states (p. 52) that "it (the carpus) is composed of seven small bones: in some instances an eighth has been found."

Modern writers are naturally more precise in their statements, as may be gathered from the following quotations

[1] Both Arloing and Chauveau have changed their opinions, in accordance with facts unknown at the time of the appearance of their earlier publications.

taken from representative French, German, and English anatomists.

Chauveau and Arloing (3) state (p. 133) that "beaucoup d'anatomistes ne décrivent que sept os dans le carpe du Cheval: quatre à la rangée supérieure, trois à la rangée inférieure. Mais il n'est pas rare de voir un os pisiforme accolé à la face interne du trapézoïde, ce qui parte le nombre des os du carpe à huit." In another place they give rather more detail. "Le quatrième ou trapèze, quand il existe, se présente avec la forme et le volume d'un pois. Il est articulé avec le face postérieure du trapézoïde."

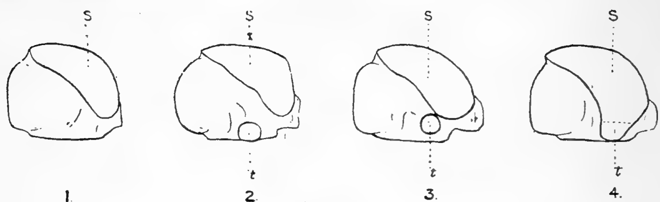

Fig. 2

Ellenberger and Baum say: "Das *Os carpale primum* (*Os multangulum majus*) ist ein zuweilen fehlender, kleiner, rundlicher, ungefähr erbsengrosser Knochen, welcher fast ganz vom radialen Seitenband umschlossen wird und meist eine kleine, mit C_2, seltener eine zweite, mit dem medialen Griffelbein artikulirende Gelenkfläche besitzt."

In a still more recent German publication (Martin, 6) we read (p. 190) that the "Os carpale primum ist ein kleiner, etwa erbsengrosser, sehr häufig fehlender Knochen, welcher im medialen Seitenbande des Fusswurzelgelenkes und am $Carpale_2$ gelagert ist. Für letzteren Knochen besitzt er eine kleine Gelenkfläche, zuweilen auch eine solche für das $Metacarpale_2$."

M'Fadyean (5), as the representative of British writers, states: "The bone, which is only exceptionally present, is the trapezium—the innermost bone of the lower row" (p. 115). "The trapezium. When present this bone is of small dimensions, and articulated with the back of the trapezoid. It is rounded in form, and occasionally double the size of a common pea, though generally it is much smaller" (p. 117).

From the above extracts it is seen that the trapezium is held to be inconstant in its occurrence, about the size of a pea when it is present, and of variable articulation. Though these general facts are to be gathered from the text-books, I am not aware that any more precise statements are to be found in any publication. Seeing that the trapezium is the bone of the carpus which has been most materially affected by the process of reduction in number of the digits, it appeared to the present writer that it would be well to make some more detailed observations on its frequency of occurrence, its size, and its articulation. To this end the carpuses of twenty-nine horses were prepared in such a way that there was no possibility of the trapezium being overlooked if present.

It was found difficult to estimate the size of the bones by the eye; and measurements by means of calipers did not seem to afford any very precise information, because of the great diversity in the stature of the animals from which the bones were obtained. It was concluded that the best means of denoting the size of the trapezium would be by computing an index for each bone, taking the trapezoid from the same carpus as being 100. The bones being irregular in form, it was decided to abandon the use of calipers, and to estimate the cubic capacity of each bone instead. This was done by noting the amount of water displaced. In order to guard against any error produced by absorption during the process of estimation, each bone was soaked in water for some time, then the adhering water was removed from the surface with a cloth, after which the estimation was made.

After the cubic capacity (size) of the trapezoid and trapezium had been ascertained, an index was computed according to the following formula:—

$$\frac{\text{Size of trapezium} \times 100}{\text{Size of trapezoid}}.$$

The following table, in which the size of the bones is given in cubic centimetres, contains the results of the examination of twenty-nine animals. Certain specimens, where only one carpus could be obtained, are omitted.

TABLE I.

		Size of Trapezoid.	Trapezium. Size.	Trapezium. Articulation.	Index.
1.	R.	5	·1	None.	2
	L.	5	·8	With C_2 and Mc_2	16
2.	R.	4	·2	With C_2	5
	L.	4	·3	With C_2	7·5
3.	R.	...	No Trapezium.		
	L.	...	No Trapezium.		
4.	R.	...	No Trapezium.		
	L.	..	No Trapezium		
5.	R.	...	·1	With C_2	
	L.	...	·1	With C_2	
6.	R.	...	...	None.	
	L.	...	No Trapezium.		
7.	R.	...	No Trapezium.		
	L.	...	No Trapezium.		
8.	R.	7	·5	With C_2 and Mc_2	7·14
	L.	6	·3	With C_2	5
9.	R.	4	·2	With C_2	5
	L.	3·8	·2	With C_2	5·26
10.	R.	9·2	·5	With C_2	5·43
	L.	9	·7	With C_2	7·77
11.	R.	...	No Trapezium.		
	L.	...	No Trapezium.		
12.	R.	..	No Trapezium.		
	L.	...	No Trapezium.		
13.	R.	6	·4	None.	6·66
	L.	6·2	·3	None.	4·83
14.	R.	...	No Trapezium.		
	L.	...	No Trapezium.		
15	R.	...	No Trapezium.		
	L.	...	No Trapezium.		
16.	R.	...	No Trapezium.		
	L.	...	No Trapezium.		
17.	R.	...	No Trapezium.		
	L.	...	No Trapezium.		
18.	R.	...	No Trapezium.		
	L.	...	No Trapezium.		
19.	R.	...	No Trapezium.		
	L.	...	No Trapezium.		
20.	R.	4·8	·1	With C_2	2·08
	L.	...	No Trapezium.		
21.	R.	10·5	1	With C_2	9·52
	L.	10·2	·9	With C_2	8·82
22.	R.	...	No Trapezium.		
	L.	...	No Trapezium.		
23.	R.	2	·1	None.	5
	L.	...	No Trapezium.		
24.	R.	10·8	1·4	With C_2 and Mc_2	12·96
	L.	11	1·3	With C_2 and Mc_2	11·81
25.	R.	...	No Trapezium.		
	L.	...	No Trapezium.		
26.	R.	...	No Trapezium.		
	L.	...	No Trapezium.		
27.	R.	12	1	With C_2 and Mc_2	8·33
	L.	13	1·4	With C_2 and Mc_2	10·76
28.	R.	9·5	·5	With C_2	5·26
	L.	...	No Trapezium.		
29.	R.	...	No Trapezium.		
	L.	8·3	·1	None.	1·20

Note.—In No. 5 the other bones had been lost before the size of the trapezoid had been estimated. In No. 6 the trapezium was diseased.

If the carpuses are considered in pairs, the table on the preceding page may be compressed as follows :—

TABLE II.

Trapezium.	No. of Animals.	No. of Animals.	Per Cent.	Per Cent.
Absent—	...	14	...	48·27
Present—				
1. Both sides, .	10		34·48	
2. One side only .				
(*a*) Right, .	4		13·79	
(*b*) Left, . .	1		3·44	
		15		51·72
		29		99·99

From this it is seen that a trapezium is present, either on one or both sides of the body, in 52 per cent. of animals. This number agrees sufficiently closely with a statement made by Martin (6), who says that a trapezium occurs in about half the number of carpuses examined.

If each carpus is taken separately, *i.e.*, without regard to the condition on the other side of the body, it is found that a trapezium is present in 43 per cent. of cases, as here shown :—

TABLE III.

Trapezium.	No. of Carpuses.	No. of Carpuses.	Per Cent.	Per Cent.
Absent—	...	33	...	56·89
Present—				
(*a*) Right, . . .	14		24·14	
(*b*) Left, . . .	11		18·96	
		25		43·10
		58		99·99

It is noteworthy that the breed of horse has, so far as this investigation shows, no effect upon the presence or absence of the trapezium.

The statement that the trapezium is about the size of a pea, while sufficiently descriptive for ordinary purposes, is not to be taken as absolutely accurate. The indices given above range from 1·20 to 16; thus showing a very considerable variation in the relative size of the trapezoid and trapezium. The 22 trapezia which are mentioned above may be placed in four arbitrary groups, according to their indices. Fourteen of the 22 are found to be contained in the group of bones whose indices range from 5 to 9·99. Four have an index below 5; three come between 10 and 14·99; and only one is so large as to have an index of 15 or over. The outline drawing (Fig. 1) shows the relative size of the trapezium and trapezoid in a carpus in which the trapezium was slightly larger than the average.

When the absolute size of the trapezium is taken into account, it is found to vary from 0·1 c.c. to 1·4 c.c.; the variation not depending entirely upon the stature of the animal, though it does so in the main. In this connection it is perhaps worth noting that, where both limbs of the same animal contain trapezia, the two bones are most frequently of nearly equal size. The only exception given in Table I. being carpus No. 1, in which the right trapezium (0·1 c.c.) is much smaller than the left (0·8 c.c.).

In regard to the articulation of the trapezium, the commonly accepted statement is sufficiently correct. Out of the 25 bones, 6 were found to be entirely non-articular, *i.e.*, they were completely embedded in ligament. Of the remaining 19 bones, only 6 articulated with the trapezoid and the second metacarpal bone. About half (13) of the trapezia found in the material used for this investigation had only one articular surface, viz., for the trapezoid. The articular area on the trapezoid for the trapezium varies in extent, of course, in conformity with the degree of development of the trapezium. In addition, it also differs in its level. In some cases it is placed so high as to be continuous with the articular surface for the scaphoid. In other examples it is at the lowest part of the trapezoid; this latter position occurring, naturally, in those instances where the trapezium articulates with the metacarpal bone. Fig. 2 contains outline sketches of different trapezia illustrating this point.

At first sight the variation in level of the trapezium appears of no moment. But the fact is of some interest when taken in conjunction with the circumstance that the trapezium in some modern allies of the horse (*Tapirus indicus*, for example) extends from the scaphoid to the metacarpus, thus articulating with three bones—scaphoid, trapezoid, and second metacarpal. It would have been particularly interesting to find a specimen in which the trapezium actually articulated with the scaphoid in addition to the trapezoid. But, though trapezium and scaphoid closely approximated each other in one or two instances, no definite articulation could be demonstrated. It is not unreasonable to expect that, if a larger number of animals be examined, such an articulation may be found.

Bearing in mind that two bones have been described as occurring in the position of the trapezium, great care was exercised in order that such a circumstance, if present, should not be overlooked. In no instance, however, was more than one small bone found. It seemed possible that one of the two bones which are mentioned by the older writers (Percivall, for instance[1]) might have been a sesamoid developed in connection with one or other of the two tendons inserted in the region of the median side of the carpus. But no such sesamoid bone was found. It was concluded, therefore, that the occurrence of two small bones at the inner (median) side of the carpus is rare.

A minor question suggested itself during these observations. Is it possible that the trapezium has disappeared by fusion with the trapezoid, rather than by a gradual reduction in size terminating in extinction? This mode of loss of identity would bring the trapezium into line with the os centrale, which, as is now generally accepted, has

[1] Percivall (2), p. 54. (Trapezium) "Not invariably present: in some instances two are found."

blended with the scaphoid. If this were the case, we might reasonably expect that the trapezoid would bear some evidence of the fusion, in the same way that the scaphoid does (as shown by Leboucq, 7). No such evidence could be detected. This, in conjunction with the exceedingly small size of the trapezium in some animals, leads to the conclusion that the trapezium is following in the steps of the metacarpal bone, with which it was originally connected.

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Explanation of Figures.

Fig. 1. Outline drawing of the inner (medial) side of the horse's carpus. Sc. = Scaphoid. Mg. = Magnum. Tzd. = Trapezoid. Tzm. = Trapezium. M.II. and M.III. = Second and Third Metacarpal bones.

The trapezium in the carpus from which this drawing was made is slightly larger than the average.

Fig. 2. Outlines of four trapezoids. 1 is from a carpus in which there was no trapezium. 2, 3, and 4 illustrate the different levels at which the articular surface for the trapezium may occur. *s* = surface for scaphoid. *t* = surface for trapezium. In 4 the surfaces for scaphoid and trapezium are continuous.

Both figures were made from photographs of the actual bones.

III. *Scotia Collections.—Note on the Gonostyles of two Antarctic Siphonophora.* By Professor J. Arthur Thomson, M.A. [Plate I.]

(Received 14th November; read 28th November 1904.)

Mr W. S. Bruce has been good enough to entrust to me three interesting and somewhat puzzling specimens collected by the Scottish Antarctic Expedition off the South Orkneys. They seem to be the separated gonostyles of some large Siphonophore colony, and as such they certainly deserve to be recorded, since we have very little knowledge of Siphonophora from the far south. In the report on the "Southern Cross" collections, Mr E. T. Browne mentions the nectocalyces of a Diphyid, and a specimen of an Agalmid (*Halistemma*), about 6 to 10 inches long; in the *Antarctic Manual*, Mr A. E. Shipley refers to an abyssal Discalid, *Disconalia pectyllis.*

Specimen A. was obtained in July 1903 in Scotia Bay, South Orkneys, on the surface of the water, in a hole which had been cut in the ice. The depth of water at that place was 20 to 30 fathoms; the temperature 29° F. Specimen B. was dredged from among mud and pebbles in December 1903 in Scotia Bay, South Orkneys; the temperature 31° F. Specimen C. was dredged from 9 to 10 fathoms in May 1903 in Scotia Bay. It is in several respects very different from A. and B., and I have therefore referred in the title to *two* Antarctic Siphonophora. Other specimens, which I have not seen, were found in summer, floating on the ice-free surface of the bay. Specimens B. and C. were allowed to die slowly in sea-water, and were then preserved in formol. Their general structure is quite clear, but such delicate organisms require more elaborate treatment if they are to be used for histological analysis. Nevertheless the sections that have been made reveal many interesting details.

Specimen A. measures 4 inches in length by 0·7 inch in maximum diameter. It narrows gradually to one end, where there is a definite opening at the top of a small conical elevation (see Fig. I., *O.*). The other end is blunt and blind.

There is a large internal cavity, and the internal surface is continuously covered with triangular processes (1·6 to 1·8 mm. in length) projecting into the lumen (Fig. II., *T.P.*). The outer surface is densely covered with elongated, capitate, "tentacular bodies" (2 to 3 mm. in length, with a diameter of ·3 to ·35 mm. in the stalk, and ·4 to ·5 mm. in the head) (Fig. II., *Cn.*). The first half-inch of the body shows two somewhat bare annular zones, which are perhaps in part artificial. Among the capitate "tentacular bodies" in the distal half of the specimen, there are numerous spherical or flask-shaped structures (Fig. II., *Gn.*) from 1 to 2 mm. in height. Some of the spherical structures bear tentacular bodies, sometimes 1 mm. in length (Fig. III.). The natural colour—a strong orange-red—has disappeared entirely, and left a yellowish white.

I do not know how a specimen of this kind—which does not seem to be a viable animal—can be interpreted except as the separated gonostyle or sexual palpon of a large Siphonophore colony. But it is remarkable that no other trace of any Siphonophore was seen in these regions, and a colony whose gonostyles measure 4 (A.), 6 (B.), and 8½ (C.) inches in length must be a very conspicuous object. In A. and B. the terminal opening at the narrow end is very definite, and not in any way torn or jagged; it probably represents the communication between the gonostyle and some central cavity of the colony, *e.g.*, the central siphon. What I have called "tentacular bodies" are probably *stalked cnidospheres.* As to the nature of the spherical or flask-shaped structures, there can be no doubt that they are *gonophores.* There is distinct evidence of a medusoid bud of complex structure, and with reproductive elements. In one case a very distinct ovum was seen. It may be suggested that the triangular internal processes are absorptive in function.

Specimen B. measures 6 inches in length by 0·8 inch in diameter at one end and 0·2 inch at the other. Its shape resembles an elongated club, and the proximal end (corresponding to the handle of the club) is almost bare of stalked cnidospheres. In other respects it agrees with A.

Specimen C. measures $8\frac{1}{2}$ inches in length by 0·4 inch in diameter, and is slightly narrower at one end. It differs from A. and B. in the fact that several—as many as seven—gonophores occur on one stalk, which may also bear several cnidospheres (Fig. IV.). The stalk bearing the gonophores and stalked cnidospheres may be 7 mm. in length, with a basal diameter of 0·7 mm. It seems to me likely that C. belongs to a different species, but it may be that an unknown Siphonophore colony has dimorphic sexual palpons. The fact that the specimens were found floating freely, suggests that the gonostyles of Siphonophora may sometimes be set adrift, and may enjoy a brief period of independent viability.

The specimens have not been particularly studied histologically, but a few points of interest may be noted.

(*a*) The body-wall shows a wrinkled ectoderm of large elongated covering cells, among which, on the gonophores and stalked cnidospheres, there are numerous very distinct elongated oval stinging-cells or cnidoblasts.

(*b*) Beneath the ectoderm is a strongly-developed muscular layer (Fig. II., *M.*), about 0·1 mm. in thickness, often showing over a dozen fibrils side by side, and with a curious suggestion of cross-striation. This muscular layer, in thinned form, is continued up the stalks of the gonophores for some distance.

(*c*) Then follows a very definite transparent middle lamella (Fig. II., *m.l.*), which is continued below the ectoderm into the gonophores and stalked cnidospheres, and internally along the triangular processes. A piece of it, isolated without breakage, appeared to have a fibrillar structure. The apparent striation of the muscular layer seems to be due to an outward extension of processes from the middle lamella, between which the fibrils are interwoven.

(*d*) The endoderm consists of very large vacuolated cells. Some of those next the middle lamella appear to have muscular roots.

(*e*) The internal isosceles-triangular processes usually narrow into one layer of cells on each side of an inward continuation of the middle lamella. In other cases the triangular processes are broader, as if two adjacent filaments had joined and had enclosed a cavity; in some of these there were two prolongations from the middle lamella (Fig. II., *T.p'*.). Some of the large clear cells of the triangular processes look as if they were amœboid. Various inclusions were seen in the (endoderm) cells of the triangular filaments, some doubtless food-particles, others perhaps symbiotic Algæ.

(*f*) In some cases a narrow canal was seen entering the base of the gonophore. This crosses the body-wall, and communicates with the central cavity of the gonostyle between two adjacent triangular filaments (Fig. II., *C*.). Thus the cavity of the gonophore communicates freely with the cavity of the gonostyle.

If the interpretation given be correct, that these specimens are the separated gonostyles of a Siphonophore colony, or of two closely-related Siphonophore colonies, the question of further classification arises. But this is hardly answerable. I have not been able to find any description of a gonostyle which agrees with what I have observed. All that one can venture to say is that the complete animal is a Siphonophore of large size, with mouthless gonostyles bearing fixed gonophores.

IV. *Note on* Limax tenellus (Müll.), *with Exhibition of Living Examples from the "Forth" Area.* By WILLIAM EVANS, F.R.S.E.

(Read 24th October 1904.)

The three examples of *Limax tenellus* now exhibited were, along with several others, found by me in The Forest, Clackmannanshire, on 3rd September 1904, and have since been kept in a box filled with damp moss and pieces of fir bark. For food, they have been given various kinds of woodland fungi (*Russula* and other Agarics, and *Boletus*).

This pretty little slug has a rather interesting history. Though apparently described by Müller so long ago as 1774, and certainly by Nilsson in 1822, it remained little known even on the Continent till within comparatively recent years.

In Britain it was first recorded by Joshua Alder in 1848, in his "Catalogue of the Mollusca of Northumberland and Durham," a specimen having been received by him from a wood at Allansford, on the Derwent, in the latter county (*Trans. Tyneside Nat. Field Club*, vol. i. p. 125). This record was repeated by Forbes and Hanley in their "History of British Mollusca," published in 1853, and a figure of the species given from a coloured drawing, by Alder, of the Allansford specimen. Jeffreys, in the first volume of his "British Conchology," published in 1862, seemed to doubt the validity of the species (vol. i. p. 139), but in the Appendix to his work, published in 1869, he inserted a description of it, and recorded its occurrence at North Mavine in Shetland (vol. v. p. 156). In 1878 and 1888 there were records from the south-west of Scotland and Yorkshire respectively, but not much weight was attached to these (*cf.* Roebuck's paper in *Annals Scot. Nat. Hist.*, October 1904), and gradually the name of *Limax tenellus* was dropped out of the British list. It was reintroduced, however, in September 1903, in the part of Mr J. W. Taylor's splendid "Monograph of the Land and Freshwater Mollusca of the British Isles" then issued, but solely on the strength of the old records. "This little species," it is there remarked, "is comparatively seldom observed, owing to the prevailing ignorance of its habits of life, and it is to be hoped that the claims of this species to rank as a British species will be firmly established, now that attention is drawn to these peculiarities." Its predilection in Germany for pine-clad heaths and pine forests in general, where it feeds on *Boleti* and other fungi during the autumn, is then commented on.

On reading the above-mentioned account of its habits, I made a note of the localities in the "Forth" area most likely to hold the species, and had tried some of them for it without success, when, on 3rd ult., I received word from Mr W. D. Roebuck, F.L.S., Leeds, that he had got undoubted *Limax tenellus* from Mr Robert Godfrey, of Edinburgh, by whom they were collected in the pine forest of Rothiemurchus, Inverness-shire, in the end of August. All credit is due to Mr Godfrey for his discovery, which has been recorded by Mr Roebuck in his paper referred to above. When Mr Roebuck's letter reached me, I was about to start for a natural history ramble in Clackmannanshire, where some of the woods I had made a note of are situated, and the afternoon of that day (3rd September) found me at a particular spot I had in view in the extensive pine woods known as Clackmannan Forest. Here I soon had the good fortune to discover what I was in search of. On the underside of almost the first rotten branch lifted was a small yellowish *Limax,* which there could be little doubt was the long-looked for *L. tenellus.* A couple of hours close searching yielded nine in all. One was on a red-topped fungus, *Russula emetica,* but most of them were under chips of wood and pieces of bark lying on the ground beneath the fir trees. The largest specimen measured 37 mm. when crawling at full stretch; 25 mm. was about their average length. Three of them have been shown to Mr Roebuck, and he has confirmed my identification. They all belong to the waxy-yellow variety to which Held gave the name *cereus,* and which is apparently the type of the species. A piece of white paper drawn across the body of one was stained pale gamboge-yellow by the mucus. A colourless slime was given off by the foot-sole. The only other slugs met with in the wood were about an equal number of *Arion subfuscus,* and one *A. minimus.*

Limax tenellus will doubtless be found in the course of time in other localities within the "Forth" area, but I do not think it can be common in the district. At any rate, since finding it in Clackmannan Forest, I have looked for it without success in a number of likely woods in the Lothians, Stirling, Fife, and Kinross. In the meantime, Mr Roebuck has received it from near Aberdeen, near Dunkeld, and Epping Forest, thus proving it to have a very wide range in Britain.

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PROCEEDINGS

OF THE

ROYAL PHYSICAL SOCIETY

FOR THE

PROMOTION OF ZOOLOGY AND OTHER BRANCHES OF NATURAL HISTORY.

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No. 2. Vol. XVI. Pages 25-48.

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V. *Scotia Collections.—On the Tentacles of an Antarctic Siphonophore.* By JOHN RENNIE, D.Sc., University of Aberdeen. [Plate II.]

(Received 12th December 1904; read 19th December 1904.)

Amongst some material kindly entrusted to me by Mr W. S. Bruce for examination, there occurred a number of long vermiform structures, which, on a preliminary examination, appeared both from external characters and consistency suggestive of a Polyzoon of the group Ctenostomata. A closer investigation, however, has revealed the fact that these bodies are the separated tentacles of an unknown Siphonophore. They present one or two features of interest, which, considering the limited number of forms belonging to the group which are known from Antarctic regions, I have thought worth recording.

Professor J. Arthur Thomson has quite recently,[1] from material of the same collection, described the detached gonostyles of a Siphonophore. He agrees with me in thinking that they must be referred to a different type from that to which these tentacles belong. The localities and dates of capture are different, the sizes of the two organs represented are disproportionate, and, in particular, such histological characters as could be compared, particularly the cnidoblasts, show distinctive features.

The tentacles were taken in the drifting net (1 to 100 fathoms) on 5th March 1904, in 72° 31′ S. lat., 19° 00′ W. long. The surface temperature was 29°·2 F.

In all there are thirteen parts, nearly every one of which is obviously incomplete. The longest piece measures 4 feet 3 inches in length, the others range from 2 feet to 3·3 inches. They are circular in section, are thicker at the attached end than at the free, to which they taper very gradually (Pl. II. Fig. 1). The extreme diameter measurements of all the pieces are 7 mm. and $1\frac{1}{2}$ mm. respectively. The surface is of a pale brown colour, and is covered by very minute, approximately oval or circular, elevations closely set

[1] *Proceedings* of this Society, 28th November 1904.

together (Pl. II. Fig. 2). Over all there is a wrinkled appearance, with here and there a ring-like constriction (Pl. II. Figs. 1 and 2, *a*). These latter have no definite distribution upon the tentacles, and appear, together with the wrinklings, to be incidental to the state of contraction of the organ. The consistency is gelatinous but firm, and the tentacles are not readily broken. They bear no tentillæ or specialised "urticating organs." Since the state of preservation is not particularly good, they were probably detached from the parent organism some time before capture. This is all the more probable, as they appear to be the only parts of it which were found, and, judging by the great length of the tentacles, a single colony is likely to be of considerable size.

Serial sections, both transverse and longitudinal, were made, and these, though useful in illustrating the general structure, have not been satisfactory as regards histological detail. A reference to the figures, however, will show that one or two points of interest have been made out. Plate II. Fig. 3 is a transverse section. There is a marked general resemblance between its appearance and that of a typical stolon. The epidermis *b*, covering the minute elevations already referred to, consists of masses of small rounded cells. doubtless in part sensory, intermingled with which are numerous stinging cells. These are the best preserved of all the elements; they are of large size, their long axis measuring 25 μ. The coiled lasso is particularly well seen (see Pl. II. Fig. 5). These cells were seen to be grouped in "batteries" upon the papillæ. Passing inwards from the external layer, the ectodermal longitudinal muscle cells form a series of radially directed bands. These bands are double, and at their inner ends are widened out so as to form longitudinal canals (*c*) of some size, and more or less folded. On the walls facing the cavity of these canals are cells similar to those of the outer layer (except cnidoblasts). From this it appears not unlikely that the canals are formed by a folding of the outer wall, from which they are shut in by the apposition of the outer parts of the original folds. Plate II. Fig. 4 is a longitudinal section through the region of these canals. The mesoglea, which is indicated (*d*) in both sections, fills most of the space, while centrally there is a large endodermal canal (*e*).

The noteworthy features of possible diagnostic value are—

(1) The large size of the tentacles, indicating an organism of some bulk;

(2) The absence of tentillæ and of localised stinging "organs" (*boutons urticants*);

(3) The specially well-developed ectodermal longitudinal muscular canals, and a large endodermal canal.

Although these data are barely sufficient for positive identification, the characters point to the family Apoleminæ, of which the genus *Apolemia,* a Mediterranean form which reaches a size of 2 to 3 metres, and whose tentacles are without tentillæ, appears to be near the form at present described.

VI. *Further Additions to the List of Spiders from the Edinburgh District.* (Third Supplement.) By Prof. G. H. Carpenter, B.Sc., M.R.I.A., and William Evans, F.R.S.E.

(Read 19th December 1904.)

Our last communication to the Society on this subject was made in 1899, and is contained in the *Proceedings* for that year (Vol. XIV. pp. 168-181). Since then, Evans, though not working specially at the Spiders, has continued to some extent his search for additional species and fresh records in various parts of the district, with the result that we are now able to add fourteen species,[1] some of them of very considerable interest, to our former lists. Up to the middle of 1899, the number of species recorded for the district was 191, from which, however, one has to be deducted as explained farther on, leaving a total of 190 to that date. The 14 species now recorded brings the number up to 204; but one of them, namely, *Hasarius adansonii,* it has

[1] A probable fifteenth—*Drassus sylvestris,* Bl.?, imm. ♂—is held over till the doubt can be removed by the capture of an adult specimen.

to be said, is an "alien" not likely to be found outside hot-houses and conservatories. If to the above number be added those species included in our "Upper Forth" list (*Ann. Scot. Nat. Hist.*, 1897), which are not in the "Edinburgh" lists, and two or three taken by the late James Hardy in the neighbourhood of Cockburnspath, it will be found that the recorded Spider-fauna of the "Forth" area comprises 220 species or thereby. Doubtless, a good many more still remain to be discovered.

Of the species here recorded, several[1] are not only additions to the local list but to the Scottish list as well, thus greatly extending their known range in Britain; while some have been met with but a few times anywhere in these islands. Nor are the present additions by any means confined to the small, inconspicuous species (what may be called the micro-araneida), seeing they include such fine species as *Chiracanthium carnifex*, *Philodromus rufus*, *Meta menardi*, and *Pisaura mirabilis*.

In our original paper and first and second supplements, we recorded *Diplocephalus* (*Plæsiocrærus*) *alpinus* (Cb.) from a number of localities.[2] Since then the differences between this form and the closely allied *D. latifrons* (Cb.) have been more fully investigated by Mr Cambridge (cf. *Proc. Dorset Nat. Hist. Field Club*, vol. xxiii., 1902, pp. 23-4), and a re-examination of the specimens we preserved shows that they belong to the latter form, and not to *D. alpinus*, which must therefore be struck off our list. *D. latifrons* was included in our 1899 supplement.

As regards species already on the list, fresh localities for many of the less common ones have been noted. Some of the more interesting of these records are given in a separate list at the end of this paper.

We desire again to tender our best thanks to the Rev. O. P. Cambridge, F.R.S., from whom we have received, as heretofore, invaluable assistance in the determination of a number of our specimens.

[1] These appear to be *Leptyphantes pinicola*, *Lophomma herbigradum*, and *Philodromus rufus*.

[2] *Proc. Roy. Phy. Soc.*, Vol. XII. pp. 573-4; Vol. XIII. p. 314; Vol. XIV. p. 177.

LIST OF ADDITIONAL SPECIES.

Order ARANEIDEA.

Prosthesima petiverii (Scop.).

Drassus ater, Bl. Spid. Gt. Brit. and Irel.
Prosthesima subterranea (Koch).

A number of adult ♂s and ♀s of this velvety black Drassid were found under stones on the south side of Blackford Hill, Edinburgh, on 14th July 1900. They were very quick in their movements and difficult to capture among the close-set stones and grass. In Scotland, this species has been recorded from Berwickshire and Castle Douglas (Cambr., *Entomologist*, 1877, p. 158).

Chiracanthium carnifex (Fabr.).

Clubiona erratica, Bl. Spid. Gt. Brit. and Irel.

On 13th July 1901, half a dozen females of this rather handsome, greenish spider were found, along with their eggs, in their characteristic white cocoons on heath at Clackmannan Forest. Though common in the Highlands of Scotland, the species appears to be rare in this district, and we are glad to be able to add it to our list.

Leptyphantes pinicola, Sim.

Among some spiders from this district, which we sent to the Rev. O. P. Cambridge in October 1895, he has recently identified an adult male of this species, as recorded by him in a paper "On New and Rare British Spiders," published in the *Proc. Dorset Nat. Hist. Field Club*, vol. xxiv. (1903) p. 152. The specimen was obtained in the vicinity of Edinburgh,—either on or close to the Pentland Hills,—in the autumn of 1895.

Leptyphantes tenebricola (Wid.).

Two specimens, ad. ♂ and ♀, of the true *Linyphia tenebricola* of Wider, were captured in Pomathorn Dean, Penicuik, Midlothian, on 1st December 1901. They were submitted to Mr Cambridge (cf. *Proc. Dorset Nat. Hist. Field Club*, vol. xxiii., 1902, p. 20).

Lophomma herbigradum (Bl.).

Neriene herbigrada, Bl. Spid. Gt. Brit. and Irel., and Cambr. Spid. Dors.

An adult ♀ of *L. herbigradum* was taken at Bavelaw Moss, near Balerno, on 16th May 1900. We are indebted to Mr Cambridge for its identification. This appears to be the first record for Scotland.

Diplocephalus picinus (Bl.).

Walckenaëra picina, Bl. Spid. Gt. Brit. and Irel., and Cambr. Spid. Dors.

On 22nd October 1901, an ad. ♂ and two ♀s of this very small spider were found among withered leaves at the edge of a wood near Gifford, East Lothian. The late Morris Young took this species near Paisley many years ago—the only previous Scottish record we know of.

Pocadicnemis pumila (Bl.).

Walckenäera pumila, Bl. Spid. Gt. Brit. and Irel., and Cambr. Spid. Dors.

This has been taken on two occasions, namely,—near Gorebridge, 8th May 1900, two ad. ♂s and one ♀ among grass on a sunny bank; and on Bavelaw Moss, 16th May 1900, an ad. ♂ obtained by sweeping heather. Has been recorded from Berwickshire and Renfrewshire.

Cnephalocotes obscurus (Bl.).

Walckenäera obtusa, Bl. Spid. Gt. Brit. and Irel., and Cambr. Spid. Dors.

An ad. ♂ of this rare species was got under a board at Fairmilehead, near Edinburgh, on 2nd March 1900. It has been recorded from near Paisley by the late Morris Young (*Ann. Scot. Nat. Hist.*, 1894, p. 185).

Tapinocyba pallens (Cb.).

Erigone pallens, Cambr. Proc. Zool. Soc. Lond., 1872, p. 753.

Two ad. ♂s of this interesting form were found under moss at the foot of a fir tree in Roslin Glen, Midlothian, on 22nd December 1900: identification confirmed by Mr Cambridge. The species was first taken in the British Isles by Evans, near Lanark, in December 1899 and October 1900, and it has recently been found in Lancashire

(Cambr., *Proc. Dorset Nat. Hist. Field Club*, vol. xxi., 1900, p. 23, and vol. xxiv. p. 159; and Evans, *Handb. Nat. Hist. Clyde*, 1901, p. 324).

Meta menardi (Latr.).

Epeira fusca, Bl. Spid. Gt. Brit. and Irel.

On 6th June 1902, two ad. ♀s of this large cave-frequenting species were procured from crevices in the roof of the underground passage, known as Bruce's Cave, beneath Hawthornden House, Midlothian (Evans, *Ann. Scot. Nat. Hist.*, 1902, p. 186). Elsewhere in Scotland, it has been found near Berwick, Aberdeen, Trossachs, Loch Ard, and several places in the Clyde area. It is an interesting addition to our local list.

Xysticus kochii, Thor.

Xysticus viaticus, Cambr. Spid. Dors.

An ad. ♀, which Mr Cambridge refers to this form, was found among some spiders kindly collected for us by Mr James Baxter in the neighbourhood of Peebles in August 1899. Has been taken near Aberdeen by Professor Trail.

Philodromus rufus, Walck.

Philodromus clarkii, Bl. Spid. Gt. Brit. and Irel., and Cambr. Spid. Dors.

An ad. ♀ of this rare spider was taken at Morningside, Edinburgh, on 11th March 1904. [I captured it in my house: it was running on the sleeve of my coat, but how it came there I cannot say. Possibly it was brought into the house on flowers from a shop or garden.—W. E.] There are only three previous records of the occurrence of the species in Britain—all in England. Abroad it is known from France and Spain (Simon), and Hungary (Kulczynski).

Pisaura mirabilis (Clk.).

Dolomedes mirabilis, Bl. Spid. Gt. Brit. and Irel.
Ocyale mirabilis, Cambr. Spid. Dors.

On 13th July 1901, five of the large bell-shaped webs or cocoon-shelters of this fine spider, containing many young, were found on tall heath in a "moss" near Forest Mill, Clackmannanshire. One brood of young was brought home and placed in a fern-case, where some of them lived till they were a fair size. This, one of the largest of British spiders, is common on heaths in the Highland districts of Scotland, but it is evidently very local in this neighbourhood, and we have pleasure in adding it to our list.

[**Hasarius adansonii** (Sav.).]

A ♂ of this interesting Salticid was obtained from one of the hot-houses at the Royal Botanic Garden, Edinburgh, in December 1904. [It was found on an orchid by my son, W. Edgar Evans.—W. E.] In this country this South European species probably lives only in green-houses, whence it has frequently been recorded, though only once before from Scotland, namely from plant-houses at Paisley in 1893 (Morris Young).

APPENDIX.

ADDITIONAL LOCALITIES FOR SPIDERS ALREADY ON THE EDINBURGH LIST.

By William Evans.

I take this opportunity of placing on record the following further localities in which I have recently met with some of the rarer and less known spiders (Araneidea) recorded from the Edinburgh district in previous papers by Professor Carpenter and myself. As regards Phalangidea, the only recent note worth mentioning is that three specimens of *Nemastoma chrysomelas* (Herm.) were obtained on the Bonnytoun Hills, Linglithgowshire, in August 1901. For further records of Chernetidea in the district, see my notes in *Ann. Scot. Nat. Hist.*, 1901, pp. 53 and 241, and 1903, pp. 120 and 249.

Dysdera crocota, C. L. K.—Dunbar, ad. ♀ under stone, May, and ad. ♂ and ♀, 23rd June 1900; Bo'ness, in cellar, ad. ♂, July 1902 (from Mr R. Godfrey). The discovery of ad. ♂s places the identification beyond doubt (see remarks in previous papers).

Drassus cupreus, Bl.—Ad. ♂, Balerno, May 1900. Identification confirmed by Mr Cambridge. No doubt this is the common *Drassus* here.

Prosthesima electa (C. L. K.).—Links at east end of Largo Bay, 3 ♂s and 2 ♀s, 26th May 1900. The spot is about half a mile east of where the single example was got in June 1897.

Theridion pallens, Bl.—Two ad. ♂s, Clackmannan Forest, May 1900; two, Castle Campbell, Dollar, July 1901.

Linyphia hortensis, Sund.—Ad. ♂, Craigmillar Quarry near Edinburgh, 29th May 1901.

Porrhomma microphthalmum (Cb.).—Bavelaw Wood, near Balerno, ad. ♂ under bark on decayed fir log, 9th December 1899 (submitted to O. P. C.).

Tmeticus abnormis (Bl.).—Abbey Craig, near Stirling, ad. ♀, October 1901.

Tmeticus reprobus (Cb.).—Dalmeny beach, Linlithgowshire, ad. ♂ and several ♀s, 23rd March 1901.

Sintula diluta (Cb.).—Ad. ♂, among leaves in wood, Port Seton, November 1900; ad. ♂, and several ♀s, in Moss, Pomathorn Dean, Penicuik, December 1900.

Diplocephalus cristatus (Bl.).—Abbey Craig, ad. ♂ and ♀, October 1901.

Diplocephalus beckii (Cb.).—Ad. ♂, in moss, Roslin Glen, 22nd December 1900. Identification verified by Mr Cambridge.

Diplocephalus fuscipes (Bl.).—Two small ♀ spiders from Pomathorn Dean, December 1900, were referred by Mr Cambridge to his *Tmeticus neglectus*, which he now regards as the female of *D. fuscipes* (*Proc. Dorset Nat. Hist. Field Club*, vol. xxiv., 1903, pp. 155).

Aræoncus humilis (Bl.).—Ad. ♂ and ♀, Hope Terrace, Edinburgh, August 1899; several ♂s and ♀s, Levenhall, Musselburgh, July 1900.

Minyriolus pusillus (Wid.).—Pomathorn Dean, a score of ad. ♂s and ♀s, among moss, etc., under a fir tree, 1st December 1900.

Walckenäera nudipalpis (Westr.).—Ad. ♂ and ♀, Swanston, March 1900; ad. ♂, Glencorse Woods, March 1901.

Cornicularia cuspidata (Bl.).—Ad. ♂ and ♀ in moss off wall, Glencorse, November 1899; ad. ♂, Threipmuir, February 1903.

Epeira cucurbitina (Clk.).—Ad. ♀ off fir, Clackmannan Forest, July 1903.

Epeira triguttata (Fabr.) = *E. agalena*, Wlk.—The Forest, Clackmannan, three, off firs, July 1901; near Gifford, several ♀s, June 1904; var. *youngii*, Cb., ♀ off spruce, Tynehead, August 1901 (named by Mr Cambridge).

Epeira umbratica (Clk.).—Ford, near Dalkeith, an ad. ♀ under bark on dead ash, May 1903.

Epeira quadrata (Clk.).—Kelphope, Lammermuirs, several ♀s on heather, October 1902.

Tarentula (*Trochosa*) *andrenivora* (Wlk.).—North Queensferry, ad. ♀, June 1900; bank of stream, near Saltoun, East Lothian, ♀, August 1902.

Lycosa lugubris, Wlk.—North bank of Esk above Polton, ad. ♂, 29th May 1902.

Lycosa monticola (C. L. K.).—Ad. ♂s and ♀s common on links east of Largo, May 1900. Identification confirmed by Mr Cambridge.

Neon reticulatus (Bl.).—Abbey Craig, near Stirling, a few specimens, October 1901; Kelphope, Lammermuirs, a good many, October 1902.

VII. *Scotia Collections.—On* Decalopoda australis, *Eights—an old Pycnogonid rediscovered.* By T. V. Hodgson, Biologist to the National Antarctic Expedition. [Plates III. and IV.]

(Received 17th January 1905 ; read 23rd January 1905.)

Among the Pycnogonids collected in M'Murdo Bay by the "Discovery" were several individuals having a pair of ambulatory appendages more than those hitherto allotted to the group. It was thought that this find was of sufficient interest to justify its immediate publication to the zoological world, so a description of this exceptional species was accordingly sent to the *Annals and Magazine of Natural History* for last December. Having heard that Mr W. S. Bruce, of the Scottish National Antarctic Expedition, had also secured a Pycnogonid with five pair of legs, I, somewhat rashly perhaps, hazarded the suggestion that it might prove to be the same species,—a wide distribution of South Polar species is suspected, and to a considerable extent realised. Soon after the publication of that paper, Mr W. S. Bruce very kindly handed me his collection of Pycnogonids for description. I received them on 9th December, and at once perceived that his species was a far finer and more interesting one than that taken by the "Discovery," and therefore its examination was undertaken forthwith. At the same time a single specimen of a *Pentanymphon* was found among a large number of an, as yet, undetermined species of *Nymphon* from Station 325 Scotia Bay, South Orkneys. Notwithstanding certain differences, I am not at present prepared to regard this individual as specifically distinct from *P. antarcticum.* The body is more robust than the average specimens from M'Murdo Bay, and the walking legs shorter. The proportions of the various joints is apparently the same as in the type species, the tarsus and propos being, however, sub-equal in length. These two joints vary in size on the different appendages of the specimen, one of which is smaller than the rest. The denticulate spines of the ovigerous legs present some probable differences from the type, but are so much worn as to be utterly useless as a specific character. When examined under a compound lens, the body appears to be minutely scabrous; but this is true of the M'Murdo Bay specimens, though in a less pronounced and varying degree.

While at the Natural History Museum in London, my friend Dr W. T. Calman drew my attention to a communication by James Eights, M.D., to the *Boston Journal of Natural History*, vol. i., 1837, concerning a certain *Decalopoda australis*. On looking up the paper, I at once recognised the species as identical with that taken by the Scottish Expedition. Eights' description, generic and specific, is here republished verbatim, and my own, which is taken from the recently-captured specimens from the South Orkneys, follows and is at greater length.

"Genus **Decalopoda.**

"*Thorax.* Elliptical, composed of five segments, separated from each other by slightly impressed articulations; anterior one produced into a head-like process. Contracted behind, and having on its superior surface a sub-conic tubercle with two eyes placed on each side; segments terminated at each extremity by a tubular joint, to which are attached ten perfect legs. *Rostrum* longer than the thorax, tubular, clavate, arcuated downward, with a triangular aperture at its apex; inserted into the anterior portion of the head-like process below. *Chelicerœ* rather longer than the rostrum, inserted on each side of its base, above, bi-articulate, and terminated by a forceps composed of a finger and thumb, much curved, and meeting only a short distance along their tips, the superior finger alone movable. *Palpi* setaceous, ten-jointed, longer than the rostrum, inserted beneath the cheliceræ. *Egg-bearing organs* attached to a process at the base of the palpi, ten-jointed, with a terminal incurved nail. *Legs* cylindrical, composed of a three-jointed coxa, one-jointed femur, and a two-jointed tibia and tarsus, the latter terminated by a simple, slightly curved claw. *Abdomen?* attached to the posterior segment of the thorax by a movable articulation, small, sub-clavate, and perforated at its extremity by an anal incision.

"D. australis.

"Entire animal of a bright scarlet; disc of the thorax convex, beneath slightly so; on the superior surface of the tubular joints, near the margin, are situated about four very small rigid spines; basal joint of the cheliceræ elongated. *Palpi* with the third and fifth joints elongate, the former of greater length than the latter. *Egg-bearing organs* with the three first joints small and sub-equal, fourth and sixth elongate, the remainder nearly equal; the four terminal joints are prehensile, and have their inner margins dentated, the teeth arranged in about four longitudinal rows. *Legs* long and nearly equal, posterior pair rather smaller; joints of the coxæ short and sub-equal. Thighs about twice the length of the coxæ, furnished with small spines at their superior extremity. The first joint of the tibia equal in length to the thigh, the other rather longer. *Tarsi* as long as the thigh; the last joint of the tibia and those of the tarsi, each armed at their extremities beneath, with four rigid spines. *Eyes* very small. *Teguments* pergamineous. *Habitat.* Sea in the vicinity of the New South Shetland Islands."

I have summarised the foregoing characters as follows, without, it is hoped, losing any of the essential points. The setaceous character of the palps is the only feature in which the South Orkney specimens do not agree with those of the South Shetlands.

Genus **Decalopoda**, Eights.

Body, including lateral processes, elliptical, smooth, not always distinctly segmented, with five pair of ambulatory appendages; cephalic portion wide, with a constricted neck.

Proboscis—longer than the body, clavate, bent downwards.

Abdomen—Long, slender, sub-clavate.

Mandibles—Three-jointed, chelate, well developed.

Palps—Ten-jointed.

Ovigerous legs—Ten-jointed, terminating in a claw, the last four joints with several rows of non-denticulate spines.

Decalopoda australis, Eights.

Body with a group of three or four very small, rigid spines upon the dorsal surface of the lateral processes.

Proboscis—Minute spines irregularly distributed over dorsal surface.

Mandibles—Base of chelæ very short, fingers much curved and devoid of teeth.

Palps—The third joint is considerably the longest; the three terminal joints are sub-equal and shorter than the seventh.

Walking legs smooth, with a few small spines at the distal extremity of the joints. The second tibia is the longest joint, the first being only a little shorter, and the femur a little shorter still.

In comparing the South Orkney specimens with Eights description, one is struck by the accuracy of that naturalist; but, according to modern requirements, some small points have been overlooked.

First with regard to colour, Eights describes his specimens as being bright scarlet, and the body and coxæ of the figure have been so coloured. The South Orkney specimens, after being in spirit for more than a year, do not show any trace of such a colour. Some of the specimens are an extremely light straw colour, without any trace of pigment except in one or two cases, where a little is irregularly distributed at the extremity of the proboscis. Other specimens are a rich olive-brown colour, which is considerably darker on the proboscis, mandibles, and palps. In one specimen, the extremities of some of the legs are equally darkly pigmented. The colour notes taken at the time, and which have been forwarded to me, show that some of the specimens were bright scarlet as Eights describes them, others were a very dark red, and in the latter case the proboscis is almost black. The scarlet colour appears to be uniformly distributed over the body and limbs, the proboscis and adjacent parts being darker than the rest.

One specimen shows a distinct segmentation, two others show it very indistinctly, and the remainder not at all.

The cephalon is separated from the rest of the body by a narrow neck, and in the centre of it is a short and stout ocular tubercle, with four well-developed eyes.

The proboscis is longer than the body, exclusive of the abdomen, but not so long as the two together. It is much swollen just beyond the middle, where it bends downwards at a considerable angle. The mouth is small.

Along the middle line of the proboscis is a narrow band of small spines which can hardly be said to have a regular arrangement. More laterally, there are two or three rows of spines not always well defined; the inner one comprises several spines, the outer one may comprise only one or two. On the whole, these are larger than the spines of the median band. There may be one or two spines on the ventral surface just behind the bend.

The mandibles are well developed and three-jointed. They arise from the wide extremity of the cephalon at the sides of the proboscis. The first joint is long, reaching almost to the beginning of the median enlargement of that organ; the second joint is very small, and constitutes the angle in the direction of the appendage—seen from the side, its dorsal margin presents a sinuous outline, and its distal extremity is very deep. The chela is articulated near the ventral angle, and lies close underneath the first joint. The hand is very small, both fingers are slender and much curved, like a pair of calipers, the lips overlap. There is no trace of teeth, nor are there any setæ on the appendage.

The ten-jointed palps rise on the ventral surface of the body close against the proboscis.[1] The first two joints are very short and wide; the third is considerably the longest of the series; the fourth is quite small; the fifth is long, slightly constricted about two-thirds of its length—this and the sixth are together equal in length to the third; the seventh is a little longer than the sixth; and the remaining three are sub-equal in length, each one being more slender

[1] It is doubtful if the first is really a joint or a process of the body.

than the preceding one. In none of the specimens are the palps setaceous, and this is the discrepancy between Eights' description and these South Orkney examples.

The ovigerous legs rise from a small outgrowth of the ventral surface of the body immediately behind the palps, and nearer to the middle line. The first three joints are quite small; the fourth is long, and only a little shorter than the sixth; the fifth is about half the length, and, as with the fourth, its distal diameter is greater than the proximal, it is also somewhat curved. The four terminal joints are sub-equal in length, bent on each other to form a loop which is so characteristic of the genus *Colossendeis.* Each joint is furnished with four rows of non-denticulate spines, though on the terminal joint these spines are less regularly arranged, and a fifth row may be distinguished. The spines vary a good deal in form and size, the larger ones are trenchant blades, bent rather close against the surface from which they spring.

Of the three coxæ, the first is by a little the shortest and the middle one is the longest, but these differences are very small. The first coxæ bears both dorsally and ventrally at its distal extremity a narrow and shallow groove which runs along the greater part of the joint; this groove is rendered conspicuous by a deeper colour, and its distal extremity is marked by a very short, stout spine. The other coxæ have a similarly coloured line laterally, and this is continued right to the extremity of the limb.

The limbs are quite smooth, and, except a few spinous setæ at the extremity of the joints, do not present any peculiar features. In point of size the difference is hardly noticeable without measurement. The fifth leg is the smallest, the first comes next, and the fourth is intermediate between the third and fifth. The second and third are sub-equal, and the largest.

The proportion of the various joints is approximately the same, variation being confined to very narrow limits.

The second tibia is the longest joint of the appendage, the first being a trifle shorter, the femur a little shorter still.

The tarsus is longer than the propos, but the two together are shorter than the femur.

On the dorsal extremity of the femur are five minute spines, one median, and a pair on each side separated from the median one by a considerable interval. On the first tibia there are no spines at all, but traces of them exist in one specimen.

On the second tibia, and the tarsus at the distal extremity, are two pairs of long spines situated ventro-laterally. A pair of spines exists at the extremity at the propos underneath the claw.

All these spines are tolerably regular in their occurrence, but one may be absent or reduced in size, and an additional one may be present. The median spine on the ventral surface of the three terminal joints is advantageously missing, but this turns up in one or two instances.

The generic differences between *Pentanymphon* and *Decalopoda* are too obvious to need special mention. *Pentanymphon,* without the extra pair of legs, could hardly be separated from *Nymphon* except by a series of minute characters which seems to find favour at the present day. *Decalopoda,* on the other hand, is distinct from all known genera, but is most nearly allied to *Colossendeis.* The well-developed three-jointed mandibles separate it sharply. The palps, more particularly the ovigerous legs, together with the ill-defined segmentation of the body, place it unquestionably in close relation to that genus.

Fifteen specimens of this interesting species were taken at Station 325 between May and August 1903, in 9 to 10 fathoms, Scotia Bay, South Orkney Islands.

Eights says: "They are to be found in considerable numbers in connection with the fuci thrown up by the waves along the shores of the islands, after being detached by the motion of the large masses of ice, from the bottom of the sea."

He further speaks of having obtained many specimens, all being furnished with "egg-bearing organs."

My best thanks are due to Mrs L. E. Sexton for the great

care and skill she has displayed in the preparation of the drawings. I am also indebted to the Council of the Marine Biological Association for accommodation at their Plymouth Laboratory during the examination of certain of the South Polar Collections.

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VIII. *The Black-backs of the Bass.* By William Evans, F.R.S.E., M.B.O.U.

(Read 19th December 1904.)

It has long been known that a small colony of Herring Gulls (*Larus argentatus*, Gmel.), and a few Black-backed Gulls, annually make their nests on the grassy slopes near the summit of the Bass. But, whereas the ornithologists who visited the Rock during the first half of last century seem all to have regarded the Black-backed Gulls they observed breeding there as Great Black-backs (*Larus marinus*, Linn.), only Lesser Black-backs (*Larus fuscus*, Linn.) have been found by those who have carefully examined the birds in recent years. In fact, the breeding of *L. fuscus* on the Bass was proved, as we shall see, some forty years ago. The question thus raised is, Has there been a change of species, or were the older naturalists wrong in their identification? The point is of considerable importance, for, if it could be established beyond doubt that no mistake was made, it would show that formerly the breeding-range of the Great Black-back on the east coast of Britain extended much farther south than it now does. So far as I know, *L. marinus* has, at the present time, no breeding-station on our east coast south of the Moray Firth. It is quite conceivable, of course, that a pair may now and then take it into their heads to breed in the neighbourhood of their winter haunts on the shores of south-east Scotland, but such cases, if they do occur, must be extremely rare. A few apparently adult, but non-breeding birds, not unfrequently remain behind throughout the summer months.

The earliest reference I can find to the breeding of any of the larger gulls on the Bass is contained in Professor John Walker's account of the Rock, published along with his other "Essays" on Natural History in 1808, but written, it is supposed, probably not later than 1774. Walker there states that on the occasion of his visit to the Bass—date not given—he found two birds which Ray, who was there on 19th August 1661, did not notice, one of them being "*Larus fuscus*"—he gives it no English name. At first sight it might be thought that we have here a record of the Lesser Black-backed Gull; but it has to be remembered that in this country the name *L. fuscus* was at that time erroneously applied to the Herring Gull—see the works of Pennant, Bewick, and Montagu. It is therefore highly probable that Walker meant the Herring Gull; indeed, Fleming in his "Zoology" of the Bass (1847), assumes, without comment, that this is so.

Disregarding, then, Walker's observation, the first published definite record of Black-backs nesting on the Bass, seems to be that contained in the following statement made by Selby in 1833 in his "British Ornithology" (vol. ii. p. 508). We there read that the "breeding-stations" of the Great Black-backed Gull "are on the Steep-holmes and Lunday Islands in the Bristol Channel, Souliskerry in the Orkneys, the Bass Island in the Firth of Forth, and one or two other stations upon the Scottish coast."

The next piece of evidence, in order of publication, is contained in the very interesting account of a partially domesticated Great Black-back, communicated by Dr Patrick Neill of Canonmills, Edinburgh, to Audubon, who printed it in the third volume (pp. 312-315) of his "Ornithological Biography," issued in 1835. Neill's account of this bird ought to be read in full; it is, however, too long for reproduction here. The following are the chief facts narrated:—In the course of the summer of 1818, Neill had a "big scorie" brought to him "by a Newhaven fisher-boy, who mentioned that it had been picked up at sea, about the mouth of the Firth of Forth. The bird was not then fully fledged: it was quite uninjured: it quickly learned to feed on potatoes and kitchen refuse, along with some ducks; and it soon became more familiar than they, often peeping in at the kitchen window in hopes of getting a bit of fat meat, which it relished highly." It used to follow his servant about the doors, "expanding its wings, and vociferating for food." After two moults it began to assume "the dark plumage of the back, and the shape and colour of the bill of the *Larus marinus*, or Great Black-backed Gull." A pair of Lesser Black-backs which he also then possessed "had never allowed the newcomer to associate with them." Being perfectly tame, the precaution of cutting its quills to prevent flight was not taken. Accordingly in the spring of 1822, as might have been anticipated, it disappeared, and its owner gave up all expectation of ever hearing more of it. To his surprise it returned, however, to its old haunts in the garden, in the end of October, when it was secured; but, not seeming to like confinement, it was soon allowed its liberty again. Though after this more cautious and shy than formerly, it still continued to frequent the garden and adjoining mill-pond till the beginning of March 1823, when its visits ceased, and they "saw no more of him till late in the autumn of that year." Year after year this disappearing and returning of "Neill's gull," as the village boys called it, went on, and was duly noted till 1835 at least, when Audubon's volume was published, the latest extract from Neill's common-place book being as follows:—"11th March 1835: The Black-backed Gull was here yesterday, but has not been seen to-day; nor do I expect to see him till November." In closing the account of this bird Neill remarked: "A few pairs of the Great Black-backed Gull breed at the Bass Rock yearly, and it seems highly probable that my specimen had originally been hatched there."

In 1836 MacGillivray, who had visited the Bass on 13th May 1831, and again, along with Audubon, on 19th August 1835, published his "Rapacious Birds," in which (p. 176) is given a list of the birds he observed on the island. Three gulls are included, namely, *Larus marinus, L. argentatus,* and, of course, the Kittiwake. In his "History of British Birds," vol. v. (1852), he does not mention having seen either species of Black-back on the Bass; but he describes (p. 535) the young of *L. marinus* "when about a week old," from "two specimens taken from the Bass Rock, in the end of June 1824, by Mr De Jersey." I am not aware, however, of any character by which chicks of the two species can be distinguished with certainty, so that unless the parents were properly identified, this record is not so convincing as might at first appear. It is not unworthy of remark that in the same volume (p. 540) MacGillivray describes two adult male Lesser Black-backs which "were shot near North Berwick (also) in the end of June 1824." Of course they may not have been breeding in the neighbourhood.

In 1843 Part IV. of Sir Wm. Jardine's "Birds of Great Britain" (Nat. Lib. Series) was published, and there (p. 300) we find, under Great Black-backed Gull, the following statement by that well-known ornithologist. "We have ourselves," he writes, "observed a few pairs breeding on the Bass Rock in the Firth of Forth, and in one or two similarly insulated situations."

My next quotation is from the Rev. R. B. Graham's description of the Parish of North Berwick, published in 1845 in vol. ii. of the "New Statistical Account of Scotland." The article is dated April 1839, and contains (p. 321) the following "statement of the birds that breed on the Bass," as furnished to the compiler by the keeper of the island:—

"The Solan Goose or Gannet, measuring 6 feet from tip to tip of the wings; the large black gull, about 5 feet; the large blue gull, about 4 feet 9 inches; the kittiwake, about 3 feet 7 inches; the common marrot, or guillemot, about 2 feet 8 inches; the puffin or Tommy-norrie, about 2 feet; the razor-billed marrot, or common puffin, about 2 feet 4 inches; the falcon or hawk, the large raven, the eider-duck, and the cormorant [shag?]; with innumerable flocks of smaller birds not peculiar to the Bass." It is added (p. 322) that, "The eggs of the sea-fowls that are sold, are those only of the black and blue gull, at 1s. 6d. a dozen." If the measurement given for the "large black gull," namely, about 5 feet, being 3 inches more than that given for the herring gull, was taken from a bird obtained on the Bass, it points undoubtedly to *L. marinus* rather than to *L. fuscus.*

We come now to the volume entitled "The Bass Rock," dated December 1847. The article on the Zoology was contributed by Dr Fleming, but it throws little or no light on our subject, beyond an indication of the scarcity of the birds at that time, and the probable cause. This is what he says:—"The Black-backed Gull, *Larus marinus,* is enumerated among the feathered inhabitants of the Bass, in the Statistical Account to which we have already referred. We observed one single bird during one of our visits, and while performing its usual evolutions, uttering its well-known warning cry to all to *beware.*" And of the Herring Gull:—"This still occurs, but in very limited numbers." Referring to the disturbance and persecution to which the birds breeding on the Bass were then subjected—the fashion of shooting sea-birds in the breeding season sprang up about this time—he remarked that "the list . . . in one season, would not in all probability correspond in every particular with that of another season, the difference arising from causes sufficiently obvious."

At this stage, an entry in Oates's "Catalogue of Eggs in the British Museum," vol. i. (1901), p. 212, naturally falls to be noticed. It is as follows—*Larus marinus*:—"1. Bass Rock, Salvin-Godman Coll." About two years ago, I asked Mr Howard Saunders if he could tell me the history of this specimen, and received from him the following reply:—"I have been to the British Museum to-day and examined the egg in question. It certainly looks like an egg of *Larus marinus,* and you know that there is a 'character' about the egg of that bird, not quite indisputable, it is true. Still I should say the odds are strongly in its favour. The entry in Salvin's own writing in his carefully kept Catalogue is—

'*L. marinus:* an egg I bought in 1853 in Edinburgh, said to be that of Great Black-backed Gull from the Bass Rock, where the bird certainly does breed.'" The dimensions of this egg, as I have since ascertained from the Museum, are—axis, 3·0 in.; diameter, 2·05 in. A Great Black-back's it undoubtedly seems to be, but one feels there is a link awanting to connect it for certain with the Bass.

I may here state that, in the beginning of 1902, I also wrote to Prof. Newton, inquiring whether there was anything in Wolley's notes or collection of eggs relating to the Black-backs of the Bass, and received from him an answer in the negative. At same time, he kindly mentioned that in his own collection are three eggs given to him in 1846, as Great Black-back's from the Firth of Forth, by a schoolfellow who went to spend his holidays at or near Edinburgh, "and which, from their size," he adds, "I believe to be right." Prof. Newton thinks that, at that time, a dealer would have no particular object in giving a wrong locality.

Part of my boyhood was spent in East Lothian, and between 1860 and 1864 I heard a good deal about the birds then breeding on the Bass from my father and Dr Charles Nelson of Pitcox, who visited the Rock together on several occasions during that period. My own first visit to Canty Bay, where the lessee of the Rock lives, also occurred then, but I have no clear recollection of the eggs exposed for sale there. This much, however, I can say, namely, that I was brought up in the belief that the Black-backs frequenting the Bass were the Lesser species, and that two eggs obtained from there in 1862 as such, were among the treasures of my first collection. One of them, with the card to which they were glued, bearing the name, locality, and date printed on it by myself at the time, is still in existence. These eggs were too small for Great Black-back's, and under the circumstances are not likely to have been Herring Gull's.

A. G. More, in his paper "On the Distribution of Birds in Great Britain during the Nesting-season" (*Ibis,* 1865), shows both species of Black-backed Gull as occurring in his province XIV., in which Berwickshire and Haddingtonshire are includued, but he gives no locality or authority.

Dr R. O. Cunningham, in his paper on the Gannet (*Ibis*, 1866), gives a list of "The principal birds that breed on the Bass," and in it the only Black-back mentioned is *L. marinus.* He states that he visited the Rock in 1862; but he does not tell us which of the species he names were observed by himself. Confidence in the list is not increased by the inclusion of the Common Gull (*L. canus*) and the Cormorant.

We now come to a very important record, namely, that of E. T. Booth, contained in the Catalogue of Birds in his Museum at Brighton (1876), and in his "Rough Notes" on British Birds. The Catalogue states (p. 173, and Index, p. 7) that case No. 217 contains a pair of Lesser Black-back Gulls, with their eggs, obtained on the Bass Rock in June 1867. When in Brighton a number of years ago (1887), I visited the Museum and took special note of this interesting case. In Part V. of "Rough Notes," issued in 1883, Booth gives (under Gannet) "a list of birds that usually breed on the Bass," as observed by himself: among them are the Lesser Black-back, "seldom more than a pair or two," and the Herring Gull, "scarcely more plentiful than the last"—has found "as many as three nests in one day." He had never noticed the Great Black-back nesting there. This is what he says in his article on that species (Part IX., 1885): "The Bass Rock was formerly stated to be frequented during the nesting-season; but this resort must, according to my own observations, have been deserted for nearly five-and-twenty years." The following extract from the Catalogue (p. 179) explains the scarcity of the Gulls:—"Some years ago, these birds [Herring Gulls] were plentiful on the Bass, where they nested every season. The person who hired the Rock, finding that the Jackdaws which had recently taken up their quarters in the rabbit-burrows near the summit were very destructive to the eggs of the sea-fowl, endeavoured to destroy them by laying down poisoned bread and butter; this, however, was greedily devoured by the larger species of gulls, who suffered

PROCEEDINGS

3951

OF THE

ROYAL PHYSICAL SOCIETY

FOR THE

PROMOTION OF ZOOLOGY AND OTHER BRANCHES OF NATURAL HISTORY.

SESSION 1904-1905.

No. 3. VOL. XVI. PAGES 49-96.

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EDINBURGH: M'FARLANE & ERSKINE.

JUNE 1905.

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in consequence, and since that time there have been but two or three pairs of either Herring Gulls or Lesser Black-backs about the Rock."

In June 1869 I landed on the Bass and found the Gulls just as Booth has described, that is to say, one or two pairs of *L. fuscus* and a few of *L. argentatus;* and I heard the same account of the result of the poison laid down for the Jackdaws.

The *Scottish Naturalist* for 1873 (vol. ii. pp. 54-56) contains some "Notes on the Birds of the Bass Rock" by Mr James Lumsden, in which it is implied that the Herring Gull, the Kittiwake, the Common Gull, the Great Black-back, and the Lesser Black-back *all* bred there at that time; but seeing his list of birds is made up of "those observed or heard of from authentic sources," during a visit to the Rock in August (1872), it may, as far as the present inquiry is concerned, be dismissed without further comment.[1]

On 30th July 1873 the Berwickshire Naturalists' Club visited the Bass, but the account of the excursion (*Proceedings*, vol. vii. p. 17), instead of telling us what birds were seen on that occasion, adopts, practically verbatim, the list given in the Statistical Account of 1845 (to which I have already referred), and that, too, without acknowledgment.

On 24th May 1883 I spent five or six hours on the Bass, and paid particular attention to the gulls, with the view of obtaining identified eggs. There were only two or three pairs of Lesser Black-backs to be seen, and I succeeded in watching one of the birds on to its nest. An egg taken measures $2{\cdot}7 \times 1{\cdot}8$ in.; another Bass egg is $2{\cdot}6 \times 1{\cdot}8$ in. There were a good many (10 to 15) pairs of Herring Gulls about, and several were watched to their nests also. On 5th June 1884 the numbers were practically unaltered, and five or six years later they seemed still to be much the same, at anyrate in the case of the Black-backs, though the Herring Gulls were liable to some fluctuation. It was

[1] A random statement by Col. Drummond-Hay (*Scottish Naturalist*, 1881, p. 5) that the nearest breeding-stations of the Great Black-backed Gull to the Tay are the Bass and the Isle of May may also be safely neglected.

therefore rather a surprise to me when in 1896 Messrs W. Eagle Clarke and T. G. Laidlaw reported, that on 13th June they had found between 20 and 30 pairs of Lesser Black-backs nesting on the Rock, and not more than 6 to 8 pairs of Herring Gulls.[1] In 1897 the Black-backs were again present in force; on 12th June I estimated them at not less than 25 to 30 pairs, and found quite a number of their nests. The Herring Gull was represented by 2 or 3 pairs only. On 24th June 1899, however, when my next visit was made, I found the old proportions restored—there were 15 to 20 pairs of *L. argentatus*, but not more than 4 pairs of *L. fuscus* could be detected. And so matters stood, I was told, at the beginning of the nesting season of 1901, the year the erection of the lighthouse was begun; but when I was on the island with the Berwickshire Naturalists' Club on 19th June, very few of the larger gulls remained, the majority having been scared away by the workmen. The establishment of a lighthouse on the Bass probably means its gradual desertion by these gulls, which, nesting as they do on the grassy top, are now liable to continual disturbance. There seemed to be very few about the Rock last summer—from the deck of the steamer I could make out only 3 or 4 Herring Gulls and a single Lesser Black-back flying around. [1905, *May* 27.—Landed on the Bass to-day: found just two pairs of *L. fuscus* nesting, and 15 to 18 pairs of *argentatus*.—W. E.]

All the evidence I have been able to gather on the subject having now been given, what conclusions can be drawn from it? It clearly proves two things, namely—(1) that the naturalists who visited the Bass during the first half of last century were unanimous in regarding the Black-backs that then bred there as belonging to the greater species, *Larus marinus;* and (2) that since about 1860, however, the lesser species, *L. fuscus,* alone has been ascertained to nest there.

[1] The Lesser Black-backed Gull is included among the birds breeding on the Bass in an article by Mr Eagle Clarke in Pollock's "Dictionary of the Forth," 1891, but he had not, he tells me, personally visited the Rock at that time.

More than this we shall probably never be able to settle. One can hardly imagine that the earlier ornithologists were altogether wrong in their identification; yet, unfortunately it cannot, I think, be said that they have left behind them any *conclusive* evidence on the point.[1] At same time, I see no good reason why a pair or two of Great Black-backs should not in those days have resorted to the Bass for the purpose of rearing their young. An odd pair may even have occasionally done so since, but to my mind this is unlikely. My experience has led me to form the opinion that the Great Black-back is a winter visitor to the "Forth," while the Lesser Black-back is as essentially a summer visitor.

IX. *On the Distribution of the Pelagic Organisms in Scottish Lakes.* By James Murray.

(Read 23rd January 1905.)

The survey of the Scottish lochs is now so nearly completed, that it is possible to review the more important facts in the distribution of the organisms which constitute the plankton. For districts not visited by the Lake Survey, information as to the Crustacea is supplied by the numerous observations of Dr Scott (1 and 2) on the lochs of the mainland and islands; while Messrs West (4) have done valuable work on the phytoplankton of the Highlands and the Outer Hebrides. Mr Scourfield (5) has also studied the Entomostraca of part of the central Highlands, and has examined many collections sent by us from other districts.

The plankton of lakes does not at first sight appear to offer a very promising subject for the study of geographical distribution, as it is known to be of a nearly uniform character over vast areas. As stated by Dr C. Wesenberg-Lund (6) in a paper read before the Royal Society of Edinburgh on 23rd January 1905, "freshwater plankton is very homogeneous from Pole to Pole"; "the plankton

[1] The somewhat parallel case of the alleged former nesting of the Common Gull (*L. canus*) at St Abb's will no doubt occur to some. The existence for generations of a large colony of *L. fuscus* on the Farne Isles may, perhaps, also be noted.

of Greenland is similar to that of North Africa." Some of the smaller plankton organisms have probably a world-wide range. In such a limited area as Scotland, it would not, then, be surprising if there were no important variation of the plankton over the whole country. This is far from being the case. The plankton of the extreme north differs greatly from that of the south; that of the west from that of the east. Scotland appears to be favourably situated for the study of fresh-water plankton, as from its geographical position it forms a meeting place for the northern and southern zooplankton, the eastern and western phytoplankton. All classes of organisms in the plankton do not exhibit equally this difference of character between the north and the south, the east and the west; it is most marked among the Crustacea, especially of the genus *Diaptomus*, and in the Desmids.

Rotifera.

The pelagic Rotifera of the Scottish lakes form a very small society. There are only about a dozen common species, which are distributed over the whole of the mainland and islands, some of them being the commonest of all plankton organisms; a few rare species are found in one or two lochs. There is no indication of the restriction of any species of Rotifera to definite regions of the country, except the occurrence in many lochs of North Uist and Shetland of *Plœsoma hudsoni*, a much larger species than the common *P. truncatum* of the mainland. This apparent limitation, however, may arise merely from insufficient observations of fresh material.

Crustacea.

Among the Cladocera, the genus *Bosmina* includes two species which are dominant in the east and west respectively.

Bosmina obtusirostris, Sars, prevails over the whole of central, west, and north Scotland, and the islands, being in extensive districts the only species; it is not wholly absent in the east, but is rarer there.

Bosmina longirostris (O. F. Müller) is the common species in the shallow waters of the east and south, but occurs here and there in the Highlands, as in Loch Ness, where, however, it is a littoral form. Dr Scott has recorded it from a considerable number of lochs in the north and west, the Shetland Islands, Uist, and Barra. Mr J. Hewitt has also recently noted it from a number of lochs in Lewis. I have not in a single instance found the species in the plankton of the lochs in those districts. I consider it probable that, as Dr Scott in many instances made his examination from the shore, while we invariably worked from boats, it will be found that where *B. longirostris* occurs it will be a littoral species, while *B. obtusirostris,* as in Loch Ness, is the true pelagic form.

Daphnia hyalina, Leydig, var. *lacustris,* varying to var. *galeata,* is common over nearly the whole of Scotland. I think it probable that in parts of the lowlands of the east and north it is replaced by *D. cucullata,* Sars, but the distribution of the latter species has not yet been worked out.

The distribution of all the species of *Diaptomus* is of the greatest interest. Four species are common in the plankton of the whole or some part of the country,—these are *D. gracilis, D. laciniatus, D. laticeps,* and *D. wierzejskii;* there is a single record of another species, *D. baccilifer,* which was found in Loch Earn; *D. castor* is found only in small ponds, and is rare, though widely distributed.

Diaptomus gracilis, G. O. Sars, is found in almost every loch on the mainland, is very rare in Orkney, and appears to be absent from the Shetland Islands, Uist, and Barra. Mr Hewitt tells me that it is frequent in Lewis. It has been found at a greater altitude than any of the other species, being the only species in most of the highest lochs surveyed.

Diaptomus laciniatus, Lilljeb., is commoner in Lewis than elsewhere; is frequent in Sutherland, Ross, and Inverness; occurs in Loch Shiel, Loch Lomond, and Loch Doon; and has its eastern limit, so far as known, in som small lochs in the extreme west of Aberdeenshire, where it was found by Mr R. M. Clark (3). It is more alpine than the two following species, and in some districts, as in the neighbourhood of the Great Glen, for instance, it occupies the hill lochs, while *D. laticeps* takes its place in those at a lower level. Elsewhere it is found in lochs very little above sea-level, such as Loch Lomond and Loch Shiel, but those lochs are always in mountainous districts, while *D. laticeps* and *D. wierzejskii* are often found in lowland districts.

Diaptomus laticeps, G. O. Sars, is very closely related to the following species, *D. wierzejskii.* The most conspicuous difference between them is found in the process on the antepenultimate joint of the right antenna of the male, which is pectinate in *D. wierzejskii*, plain in *D. laticeps.* In certain lochs of Sutherland, various gradations between the two forms of process have been observed, along with the typical forms of both species, and I regard *D. hircus*, Brady, as such an intermediate form; nevertheless, I have in this study of distribution kept the two species apart, in deference to the opinion of Mr Scourfield and other authorities who consider them to be good species, and because, although the differences between them may be of little systematic importance, they must have some physiological significance, since their distribution is widely different, *D. wierzejskii* being a purely northern form, while *D. laticeps* has an extensive range on the west. *D. laticeps* is the commonest species of the genus, after *D. gracilis*, being found in Shetland, Sutherland, Ross, Perth, and Argyle, common in the Outer Hebrides and Inverness, and having its eastern limit in some small lochs of Perthshire, very close to those Aberdeen lochs in which Mr Clark found *D. laciniatus.* The area of distribution of this species in Scotland corresponds approximately with that of *D. laciniatus*, but in spite of this general agreement, the two species are almost completely separated: though they often occupy adjacent lochs, I know of only a few lochs in which both species occur together.

D. wierzejskii, Richard, is very abundant in Shetland, common in the Outer Hebrides, and occurs in a few lochs in Sutherland, and one loch in Ross. I have recorded it as occurring in some hill lochs of central Perth, but those records really refer to *D. laticeps*, which at that time I united with *D. wierzejskii* as a mere form.

Both *D. laticeps* and *D. wierzejskii* are undoubtedly much commoner in the districts in which they occur than the figures in the accompanying Table would indicate; but in a great many lochs only immature animals were obtained, and in that case it is impossible to tell to which species they belong, though it is known that it must be one of those two. This is also true of *D. laciniatus*, though that is recognisable at an earlier stage than the others.

PHYTOPLANKTON.

Messrs W. and G. S. West have studied the algæ of the plankton in a large number of the Scottish lochs. Much of their work is not yet published, and the published papers do not deal with a sufficiently wide area to enable us to take a comprehensive view of the distribution of the phytoplankton in general; only in the case of the more conspicuous of the Desmids of the plankton, where their work has been supplemented by the observations of the Lake Survey, are we able to review the distribution over the whole country. Messrs West have pointed out the extreme richness of the Desmid-flora of the Scottish plankton, and have shown that the most conspicuous species in it are of a distinctly western type, being found in Europe only in the western portions of the British Isles, Scandinavia, and in some cases Lapland; while in North America they are frequent in the eastern parts of the United States and in Nova Scotia. In the appended Table I have only traced the distribution of a few of the Desmids of this western type, as they alone present features of interest.

Micrasterias wallachii, Grun., though not cited by Messrs West as belonging to the western type, is included, as it is a rare plant, and its distribution is therefore of interest. It has been found in seven lochs,—Lochs Burraland and Littlester, in Shetland; Lochs nan Cuinne, Leum a Chlamhain, and Ruar, in Sutherland; Lochs Bhaic and Nan Eun, in Perthshire.

In preparing the accompanying Table to illustrate the distribution of some Crustacea and Desmids, I have tried to show the relative abundance of each species rather more accurately than can be done by the usual mode of using variants of common (c, cc, ccc) and rare (r, rr, rrr), as is often done. To this end I have divided Scotland into ten convenient districts, and taken the loch as a unit. The figures in the columns, then, under each district, and opposite each species, indicate the number of lochs in that district in which that species was found. When exact data are not available, the following signs are employed:—* indicating that a species has been noted by Dr Scott, † that it has been observed by the Lake Survey, although the number of lochs cannot be given.

Distribution of some Crustacea and Desmids in the Scottish Lakes.

Species.	Districts.										Totals.
	Orkney and Shetland (34 lochs examined).	Outer Hebrides (61 lochs examined).	Sutherland and Caithness (42 lochs examined).	Ross-shire (46 lochs examined).	Inverness-shire (76 lochs examined).	Perthshire and W. Aberdeen (44 lochs examined).	Argyleshire (45 lochs examined).	Ayr and Galloway (35 lochs examined).	Mid-East Scotland (15 lochs examined).	South-East Scotland (9 lochs examined).	
Diaptomus gracilis, G. O. Sars,	1	...	23	40	54	25	34	24	9	6	216
,, *laciniatus*, Lilljeb., . .	...	12	9	7	6	*	2	1	...	...	37
,, *laticeps*, G. O. Sars, .	4	11	8	2	13	4	2	...	...	...	44
,, *wierzejskii*, Richard, .	21	5	4	1	...	...	...	...	..	...	31
Bosmina obtusirostris, Sars, .	16	39	35	37	59	22	31	16	4	...	259
,, *longirostris* (O. F. Müller),	*	*	*	*	*	2	1	*	2	4	9
Staurastrum ophiura, Lund, .	...	5	16	6	3	4	...	11	...	...	45
,, *arctiscon*, Lund, . . .	...	1	10	9	1	3	...	5	...	...	29
,, *sexangulare*, Rabenh., .	...	3	2	1	...	1	1	1	...	...	9
,, *brasiliense*, Nordst., .	...	3	2	4	2	...	1	3	...	...	15
,, *anatinum*, Cooke & Wills,	6	7	7	†	†	2	...	...	...	...	22
,, *longispinum*, Archer, .	...	10	8	4	4	...	2	1	...	...	29
,, *grande*, Buln., . . .	...	1	9	1	...	...	1	4	...	...	16
,, *lunatum*, Ralfs, var. *planctonicum*, West.,	4	8	3	2	7	2	6	1	...	...	33
,, *pseudopelagicum*, West.,	†	†	†	†	†	†	†	...	...	...	...
,, *jaculiferum*, West., . .	†	†	†	†	†	†	†	...	...	...	...
,, *curvatum*, West., . .	9	8	1	1	...	1	2	1	...	...	23
,, *megacanthum*, Lund, .	...	1	2	1	...	...	1	...	...	...	5
Micrasterias furcata, Agh., .	...	2	6	...	1	1	...	3	...	...	13
,, *wallichii*, Grun., . .	2	...	3	...	..	2	...	...	...	...	7

The most important fact which emerges from a study of the distribution of the various species included in the Table, is that many of them occupy areas which coincide approximately. *Diaptomus laticeps, D. laciniatus,* and the Desmids of the western type, alike extend over the whole of Scotland north of the Caledonian Canal, and into the Outer Hebrides; south of the Great Glen they are confined to the west coast and some of the central counties, being entirely absent, so far as we know, from all the eastern counties south of the Moray Firth. All have their eastern limit in some small lochs about the extreme western corner of Aberdeenshire. There are some minor differences in the details of distribution—*D. laciniatus* is absent from the Orkneys, Shetland, North Uist, and Barra; it extends a little farther south than *D. laticeps*; the western Desmids extend still a little farther south, to the shores of the Solway Firth.

Having regard to the distribution of plankton, therefore, Scotland may be divided into two regions—(1) northern and western, characterised by several species of *Diaptomus* and many species of Desmids; (2) eastern, characterised by the absence of those species.

The eastern region, it may be noticed, is principally lowland, the western mainly highland; but the chief distinction between them is not merely that of alpine and lowland, as large districts of the north, where the northern Crustacea and the western Desmids attain their maximum development, are lowland in character.

Although the peculiar Desmids and Crustacea are associated in the same area in Scotland, the Desmids are at the eastern limit of their range, the Diaptomidæ at the western—the species of *Diaptomus* of the two sides of the Atlantic being entirely distinct. *D. laciniatus* extends into Scandinavia and the extreme north of Russia, and is also found in the alpine lakes of Switzerland. *D. wierzejskii* has been found in many places sufficiently far apart—Madrid, Saxony, the Kola Peninsula. *D. laticeps* is found in Scandinavia.

The peculiar association of species belonging to so many different regions, which we find in the plankton of the west and north of Scotland, offers a problem in distribution, the solution of which may be difficult. The conditions which combine to produce this remarkable admixture of forms are no doubt sufficiently complex, and I shall here only touch upon some suggestions that have been put forward in explanation of some of the facts.

Dr Lund (6), in discussing the abundance of Desmids in the Scottish plankton, suggests that they are in great part directly derived from the surrounding bogs by being washed out into rivers, and so carried into the lochs, that some of them may have become adapted to a pelagic life, and modified in accordance with it, and that the peaty water of the Scottish lochs, being favourable to Desmid life, may account for their greater abundance in Scotland than elsewhere. These are no doubt explanations of some of the facts; peat-bogs are the headquarters of the Desmids, and a large number of the Desmids which we find in the plankton can be recognised as having come from that source; but we have a very large number of truly pelagic species, some of which are rare in the bogs but common in the plankton; and we have also the numerous species unknown in Europe, except in this narrow littoral strip of Britain and Scandinavia. There must surely be somewhere else in Europe extensive sphagnum swamps, and lakes deriving peaty water from them, but it is only here that the rich Desmid-flora is found. The species of Desmids so abundant in our plankton are not even in the peat-bogs of the rest of Europe. Some of our clearest and least peaty lochs, Loch Morar for instance, are very rich in Desmids; and some very peaty lochs are poor, Loch Ness for instance.

Another theory is that the lochs which are richest in Desmids are only found in the older geological formations, but this does not accord with the facts, as I find that such lochs occur in all the formations from the Lewisian to the Tertiary at least; and it will, I think, be found that some of these lochs lie entirely in glacial deposits.

Sir John Murray points out that when the area occupied by the rich western flora of Desmids is plotted out on a map, it corresponds very closely with the area of greatest rainfall. A connection between this fact and the abundance of Desmids might be supposed in two ways: granting that peaty-water is favourable to Desmids, we may suppose that the heavier rainfall washes out more peaty matter from the bogs and carries it into the lochs; or that it prevents the accumulation of other substances in solution which would be deleterious to Desmids.

Considering the fact that the Desmids of the western type have a distribution entirely littoral, occupying only those countries bordering the North Atlantic on both sides, I think it highly probable that the conditions determining their limits will be found to be mainly climatic, and that the proximity of the ocean is one of these, whether by its effect on the mean temperature of the adjacent fresh-water lochs, or by affecting the rainfall.

If the western Desmids have had their origin in North America, and have reached our shores from that source, it is difficult to account for their failure to spread farther over Europe, unless there is some climatic check upon their advance.

A prominent feature of the Scottish plankton is the Arctic character of its Crustacea. Dr Lund cites the following species as belonging to the Arctic association of plankton Crustacea :—*Holopedium gibberum*, *Bythotrephes longimanus*, *Diaptomus laciniatus*, *Daphnia hyalina*, and *Bosmina obtusirostris*. All of those except the *Daphnia* and *Bosmina* are summer species, and die off in winter. They form about one-half of the total number of species of Crustacea in the Scottish plankton, which is very poor in Entomostraca; in quantity they greatly preponderate during the summer. The other common Crustacea in the plankton are *Diaptomus gracilis*, *Cyclops strenuus*, *Leptodora kindtii*, and *Polyphemus pediculus*.

Diaphanosoma brachyurum is characteristic of our smaller lakes, rarely occurring in the open water of the larger ones. *Leptodora*, *Polyphemus*, and *Diaphanosoma* are also summer forms. *Diaptomus laticeps* and *D. wierzejskii*, though not included by Dr Lund in the Arctic association, must also, I think, be considered as purely northern species.

Apart from the species of the genus *Diaptomus,* the distribution of which is indicated in the preceding Table, the Arctic Crustacea, which are so abundant in the Scottish plankton in summer, are not confined to the western or northern portions of the country, but range over the whole length and breadth of Scotland.

Although we are here considering only the Scottish plankton, another fact of interest in connection with the geographical distribution of the Arctic species of Crustacea will appear if we extend our view over the whole of Great Britain, as we are enabled to do by Mr Scourfield's tables of distribution, given in his Synopsis (5).

The whole of Great Britain is characterised by a successive dropping out of the Arctic species of Crustacea as we proceed from north to south. First, *Diaptomus wierzejskii* ceases in the extreme north, then *D. laciniatus* in Ayrshire, *D. laticeps* (if we include with it *D. hircus*) in Wales. The rest of the Arctic species of Crustacea, which are common over the whole of Scotland, extend also into the north of England, Wales, and in some cases the midlands; but, with the one exception of *Daphnia hyalina,* they are all absent from the south and east of England. The south and east of England forms, therefore, a well-marked region, distinguished, first of all, by the absence of all the Arctic Entomostraca except *Daphnia hyalina.* The demarcation of this region from the rest of England is emphasised by other peculiarities. Many species of Crustacea of a more southern type have the same limitations as those of the Arctic type just referred to, that is to say, they are of general occurrence in Scotland, the north of England, usually Wales and the midlands, but they are absent or are rare in the south and east. In addition to those negative characters marking off this region from the rest of Great Britain, positive characters are found in the presence in this area of three or four species of Entomostraca, which are absent from the north of England and from Scotland, and of several others which are common in the south but rare in the north.

The features distinguishing this region of England from the rest of Great Britain will be most graphically exhibited in the Table which follows. In this Table, in addition to the truly pelagic species, whether Arctic or southern, I have included a number of Cladocera, less pelagic, or confined to shallow waters, in order to show that the same limits of distribution affect a considerable number of species. From the Table, it will appear that there are eight species common in the north and quite absent from the south, five which are common in the north and rare in the south, four which are absent from the north and present in the south, and two which are rare in the north and common in the south.

DISTRIBUTION OF SOME CRUSTACEA IN SCOTLAND, NORTH ENGLAND, AND SOUTH AND EAST ENGLAND.

SPECIES.		
Bosmina obtusirostris, . .	Com. in N. Eng. and Scot.	Absent in S. and E. Eng.
Bythotrephes longimanus, .	,, ,,	,, ,,
Holopedium gibberum, . .	,, ,,	,, ,,
Diaptomus laticeps, . . .	,, ,,	,, ,,
Latona setifera, ...	,, ,,	,, ,,
Daphnia galeata (typical),	,, ,,	,, ,,
Alonopsis elongata, . . .	,, ,,	,, ,,
Streblocerus serricaudatus,	,, ,,	,, ,,
Leptodora kindtii, . . .	,, ,,	Rare in S. and E. Eng.
Ceriodaphnia quadrangula,	,, ,,	,, ,,
Alona rustica, ...	,, ,,	,, ,,
Chydorus barbatus, . . .	,, ,,	,, ,,
Leptorhynchus falcatus, .	,, ,,	,, ,,
Simocephalus exspinosus, .	Absent in N. Eng. and Scot.	Present in S. or E. Eng.
,, *serrulatus,* .	,, ,,	,, ,,
Leydigia acanthocercoides, .	,, ,,	,, ,,
Ceriodaphnia pulchella, .	,, ,,	,, ,,
,, *megalops,* .	Rare in N. Eng. and Scot.	Common ,,
Bosmina longirostris, . .	,, ,,	,, ,,

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X. *A Possible Mode of Inheritance of Adaptive Characters.* By Cecil B. Crampton, M.B., C.M.

(Received 10th March; read 27th March 1905.)

In a former paper to the Society, I suggested that plants and animals have diverged in their evolution, owing to a difference in their anabolism in relation to the stability or instability of its products, and that this stability increases in plants until it destroys the vitality of the cell, while in animals the instability increases until katabolism gets the upper hand of anabolism, with resulting death (1). This does not refer to somatic death, or death of the organism as a whole, but rather to death of the individual cells, which takes place throughout the life of the animal or plant, and only indirectly leads to somatic death, through a want of mutual co-operation in the different tissues. One ideal form of anabolism is growth without differentiation, and which there is no reason to think would not continue indefinitely if no specialisation took place. Nearest this ideal type is that in which parts or cells retain their powers of giving rise to a new individual, and this must differ for the scale of specialisation arrived at by each form. A gradual divergence from this type is seen in those cells which retain some powers of regeneration, through those in which cell division is still found, to the extreme cases in which all powers of this kind have been lost, and which, at the same time, usually show the greatest degree of specialisation.

As a result of fertilisation in higher plants, a meristem is formed, which continues to branch and grow apically or interstitially during the life of the plant, its cells giving rise by growth and division to all the specialised tissues. Their marked capability of regeneration shows that these meristem cells retain, in greater degree than the specialised cells, the power of reconstructing the whole plant. This power is also found, in certain cases, in cells which have undergone some degree of specialisation, and then seems to depend in part on a sufficient number of cells being associated together. The whole of these cells, which retain this power, must be looked upon as a germinal area, the germinal powers of which fade with imposed specialisation; and there seems to be no hard and fast line between the cells which constitute this area, in its narrowest sense, such as has been called the track of the germ cells, and others which have undergone some small amount of specialisation.

There is now reason to believe, from the studies of botanists, that, in the formation of spores by tetrads, a halving of the number of chromosomes occurs in the nuclei of the dividing cells, and that this reduced condition accompanies the life cycle of the plant until a union of gametes once more restores the original number. During that part of the life cycle in which this reduced condition of the chromatic substance obtains, there is a very wide power of regeneration in all cells, even though, as in the higher mosses, some degree of specialisation is attained. The whole plant in this part of the life cycle must constitute a part of this germinal area, even though special gametes are set aside to perpetuate the species. By union of the gametes, a doubling of the chromosomes in the nucleus is brought about, and, at the same time, what has been usually termed a double ancestry, and this is retained until the halving process is again gone through in spore formation.

In the Metazoa, from fertilisation of the egg, a generation is formed which in many ways resembles the meristem growth of plants. In the lower forms, long-continued asexual growth and budding is common, sterilised tissues, formed by, and accompanying other cells, which can reconstruct the animal in its entirety. In some cases a new generation takes its origin from one or more cells, as an outgrowth on or in the original creature, while in others, from time to time, a series of destructive and reconstructive processes, termed metamorphosis, occurs, causing great changes in the morphology and physiology of the animal. In these outgrowths, gametes, in time, are formed, and have been found, in some instances, to have wandered into the new growth from the older type. An inclusion of the germinal material also takes place in these forms where the destructive and reconstructive metamorphosis obtains.

In comparing animals with plants, there should occur a time in the life cycle of the former, when the homologues of spores are formed, these giving rise, after a number of divisions, to the conjugating gametes. There is, at present, no definite point which can be fixed upon as homologous in this respect, and authorities seem to differ as to the stage in which reduction takes place. It is noteworthy that when, in animals, a generation which bears gametes occurs as an outgrowth on a former generation, although the other cells of the body are capable, in some degree, of regeneration, no buds are thrown off which can exist independently. It would seem then that, in these cases, a certain degree of sterilisation is imposed on this generation from its very beginning, and that the cells in it which produce the gametes have found their way into it by migration from the parent form. Dr Beard, in his embryological researches, has come to the conclusion that the cells which go to form the gametes in the mammal, wander into the embryo from the trophoblast, and in the fish from the yolk-sac and blastoderm, and these he looks upon as an older generation, upon which the embryo has come to lead, for a time, a parasitic existence (2). There seems good reason for having faith in this origin of the germ cells in the higher animals, as it seems the most easily understandable method of explaining how continuity of germ cells can take place. From what is known of the power of regeneration, it at first seems unnecessary to consider that all the cells of the embryo must be destined for sterilisation. So long as division of the cells continues, a remnant of the germinal power persists, and this must be very considerable in those cases where there is regeneration of a whole limb. A point in favour of the view of a migration of the primary germ cells to their position in the embryo, is the very localised position of the reproductive organs, and it is difficult to understand, on a theory of the origin of germ cells from the embryo, how they could retain their primitive character and always come to lie in the same position, unless they constituted a kind of meristem, from which all the other tissues are budded off.

Every cell, in the Metazoon or the Metaphyte, must be considered as a separate organism, which is kept along the right lines of development partly by association with its fellows. The development and specialisation of the compound individual would depend on the resultant of the individual tendency of each cell to develop along lines inherited from its forerunners, and the help or restriction imposed upon it by the other cells of the group in relation to the total environment. There will thus be, as in "the struggle of parts" suggested by Roux, an adaptation of the different parts to one another, through a struggle for existence in their mutual adjustment to their surroundings. A change in one cell will affect the neighbouring cells, and cells at a distance, by transmission of stimuli and by means of alteration in the nutrition and the production of chemical bodies. The development will be governed partly by the symbiosis, which will be the more complex according to the complexity of the creature. In this connection should be remembered the effect of symbiosis on specific development in lichens, as also the effect of external conditions on plant rudiments and developing embryos. But there is also the common reservoir of sap, lymph, or blood, which is the chief environment of the cell community. From it the cells receive their nourishment, and into it they pass their products of metabolism, and alteration in it is known to be a source of much change amongst them. All the cells of the group are derived from one initial cell, and their degree of specialisation depends on the amount of divergence in their metabolism from that of their mother. They all carry the same stamp of heredity, and the different parts they play in the life of the group must depend, on the one hand, on the kind of metabolism they are forced to undergo by their environment, the effect of the rest of the body upon them, and, on the other hand, on the tendency of all the cells derived from the initial cell to develop along certain lines marked out by heredity.

Each cell, by specialisation, gives preference to a certain function, or set of functions, which were dormant in the mother-cell, but only capable of perfect action by gradual obliteration of the many other functions originally present in a dormant condition. The functions are thus limited in number by specialisation, but those that are left are rendered more capable. Arrest of specialisation, through the form of nutrition or otherwise, may leave the cell with many functions lying in a dormant condition, capable of specialisation if necessity calls for it, when the environment of the body will force the cell to take up the position required of it. On the other hand, should the cell be not too far advanced in specialisation, and therefore have retained the greater part of the functions of the individual in a dormant state, it may, through change in the nutrition, or by being compounded with other cells which help to supply its deficiencies, be forced to begin a new development on its own account, thus reconstructing the whole individual again. The capability of regeneration of the whole individual, as in regeneration of parts, would, in fact, seem to depend, in some cases, on a sufficient number of cells being left in mutual co-operation.

The following remarks from "The Cell in Development and Inheritance" (3) may here be quoted :—"It is but a step from this to the very interesting suggestion of Driesch, that the nucleus is a storehouse of ferments which pass out into the cytoplasm, and there set up specific activities. Under the influence of these ferments, the cytoplasmic organisation is determined at every step of development, and new conditions are established for the ensuing change. This view is put forward only tentatively as a 'fiction' or working hypothesis; but it is certainly full of suggestion. Could we establish the fact that the number of ferments, or formative substances in the nucleus, diminishes with the progress of differentiation, we should have a comparatively simple and intelligible explanation of the specification of nuclei and the limitation of development." Applying this hypothesis to the foregoing remarks in this paper, heredity would depend on the property of the nucleus to give rise to enzymes in certain directions or of a certain character, under appropriate stimulus. The effect of the cells upon one another, in development, would be to impose upon the nucleus of the cell a tendency to set free enzymes that adjusted the cell to meet the necessities of the community. Natural selection, by elimination of individuals, and the internal adjustment by the struggle for existence amongst the organisms of the community, would bring about the necessary co-operation in development, or symbiotic characters. There would be a constant elimination of those cells which did not work for the good of the community. The tendency of these enzymes, in the specialisation of plant tissues, would be to the formation of tissues of greater stability, while the reverse would be the case in the specialisation in the tissues of animals. Regeneration would be due to the effect of stimulus on the nuclei of cells not too far advanced in specialisation, which, by means of the regulation of the cells upon one another, would bring about the restoration of the missing part.

It is known to be through enzymes, in many cases, that the food is brought into the condition capable of assimilation by the tissue cells; and it is likely enough that it is through enzymes, or some related chemical bodies, that this material is built up into the very living matter of the cell itself. Animals and plants of enormous dimensions arise, by the process of nutrition, from microscopic beginnings; and what is the stimulus that transforms all this food into living material? The strictly specific modes of operation of the enzymes that have been studied in animals and plants must be remembered, and not only the great variety of purposes to which they are applied, but the extraordinary relation occurring between the amount of the enzyme and the amount of the material it can convert. According to Pfeffer in his "Physiology of Plants" (4), their production is regulated in connection with the stage of development arrived at, as well as by stimulus from external agency, and "the production and excretion of enzymes exhibit a regulatory connection with one another, as is indeed the case with every metabolic function."

In the union of gametes a further complication is induced, a doubling of the qualities in the germ cell. All the cells, from this onward, have the double qualities imposed upon them. For each correlated property or function, formerly present in the gamete, a couple to it is presented, which may be like it from identical inheritance, or may differ from it more or less in degree. The experiments in breeding by Mendel, Ewart, Bateson, and others, have shown that these couples may segregate, or separate again, when gametes are once more produced, and it is inferred that this is brought about by a halving of the qualities in sporogenesis or gametogenesis. The halves of these couples are termed allelomorphs by the authorities on these experiments, and in this case the allelomorphs are said to have segregated (5). In other cases, however, it is noted that segregation may be incomplete or absent, and it is considered that there may be, in some cases, a breaking up of the allelomorphs, followed by recombination. Again, when the allelomorphs are unlike one another, it is found that one may show itself in the animal or plant in undiminished intensity, or even exceed it, or, on the other hand, may be intermediate in character, or some character may present itself which is unlike either. In the first case the character is said to be "dominant," while the one that does not show itself is said to be "recessive." The work of Bateson (6), coupled with these experiments, has demonstrated that variation is usually, or perhaps always, more or less discontinuous in origin. They have also produced strong evidence for what was first insisted upon by Weismann, viz, that variation arises in the germ cells, and is not imported into them from the somatic cells of the body. It also gives rise to the question as to what produces dominance of certain characters over others. It is the opinion of some of these authorities on breeding, that dominance is usually with the phylogenetically older character. Should the dominance be shown to have some connection with the adaptation of the individual to its surroundings, it should be brought about by some form of natural selection. Although the theory that the properties of the germ cells are directly derived from those of the soma, has been undermined by the theory of the continuity of the germ cells, a possibility of some direct or indirect mode of transmission of the properties acquired by the body in reacting to its surroundings, has, to some scientists, ever been a necessity. Darwin was strongly of this opinion, and put forward his theory of pangenesis as a possible method of explaining how it could be brought about. Then Weismann's theory of the germ plasm arose, which completely negatived all inheritance of adaptive qualities; and this led to much division of opinion between those who did and those who did not consider this method of transmission a necessity of organic development.

Since then the work of embryologists, and the experiments of breeders, have gradually strengthened, if not conclusively proved, a continuity of the germ cells, and yet the faith in some method of inheritance of adaptive qualities, either direct or indirect, has not abated, and indeed may be said to have gained ground. The following passages, taken from an abstract of a paper by Dr Beard, may here be quoted (7).

In this abstract he gives what he calls his "Understudy Theory of Heredity," set up by the author as one result of the discovery of a morphological continuity of germ cells. After some observations, he remarks: "For various reasons every egg or sperm must be regarded as containing one complete set of all the characters or qualities necessary to form an individual of the species. At fertilisation two sets of these are somewhat loosely joined together. In the developing embryo only one complete set of characters is made use of, and, while the other corresponding qualities remain more or less dormant in its cells, that set or pack actually employed may be made up of any characters taken from either of the two packs, but so as to make up one complete pack. Turning then to the germ cells, each of these possesses the duplicated set, and later on, at the so-called 'reduction,' *i.e.*, at the final division of the oogonia into oocytes, and of the spermatogonia into spermatocytes, prior to the formation of conjugating cells or gametes, the twofold set becomes diminished to one pack only by the elimination of one complete pack. The true meaning of the reduction of chromosomes is the elimination of one set of characters or qualities, such that if among those of the original sets there be any unsuitable ones these are rejected. The union of two sets of characters at conjugation is in animals retained by the germ cells, until the period of reduction, by the embryonic cell, until the commencement of its development, when it becomes latent, and in plants during the whole life period of the flowering plant. The two sets cannot be identical at the start. As living entities, they must be influenced by the total environment, nutrition, climate, disease, toxins, etc. To all these influences they will react. The effect of all the factors will be a different one on the differently constituted characters. Some it will favour, and these will flourish and increase in import; others will be unfavourably influenced or neglected, and these will diminish. At the reduction there will be a settling up, and if the environment have not been a constant one, some of the characters will have become better than other corresponding ones, a new pack will be chosen, and the less favourable characters will be rejected. This elimination of characters may, on occasion, become an elimination of complete individualities, or, what is the same thing, as a casting out of 'ancestors.' Moreover, because the two sets have been conjoined under the influences of the environment, and have reacted to this, the process becomes a self-adjusting mechanism, the up and down oscillations of the characters of the two sets endeavouring to follow and compensate the changes in the environment, and the result must be genetic variation. This process may be defined as germinal election and elimination in adaptation to the environment."

Dr Beard therefore postulates a "germinal election," and looks upon it as acting in accordance with the environment. He does not put forward any mechanism that would account for the suppression of certain characters and the retention of others, but evidently considers the soma in adaptation to its surroundings as indirectly affecting the germ cells, and in some way producing survival of like qualities in them.

Experiments have shown that the serum of blood of certain animals has a specific chemical reaction in relation to the blood of other animals (8),—the injection of the blood of one animal into that of another, giving to the serum of the latter new properties antagonistic to the blood cells of the former. The immunity produced by infection in zymotic diseases, and the whole system of antitoxin treatment, seem to have bearings in the same direction, viz., the formation of enzymes, or some chemical bodies, which are antagonistic in their relation to one another. Related to this question is the effect of commencing maturation of the germ cells in producing secondary sexual characters, and the effect of the thyroid gland upon the rest of the body. Castration prevents the development of secondary sexual characters, and removal of the thyroid gland has very marked effects. In the latter case, that some enzyme or chemical body is the active agent, seems to be shown by the results of administering the gland in the form of an extract for medicinal purposes. Other glands of the body, such as the adrenal, seem to have similar relations to the chemistry of the body, and it seems probable, indeed, that all tissues form some characteristic chemical bodies as a part of their metabolism, which have further relations to the other tissues. In the theory of pangenesis brought forward by Darwin to explain the method of accumulation of acquired characters in the germ cells, there has always been the difficulty of the orientation of qualities brought from different parts of the body in forming a morphological basis for heredity, and research has further shown a greater and greater difficulty in accepting any direct transmission of characters from the soma to the germ cells. That positive characters can be directly passed from the soma to the germ cell seems therefore out of court, but, on the other hand, there is no possible reason that negative characteristics should not be stamped by the body upon the germ cells by elimination. Darwin's theory of Natural Selection as applied to the evolution of species, which has been shown to be so potent a cause in all forms of evolution, is in reality but a stamping of a negative facies upon a species, any positive variation, on the theory of the continuity of the germ cells, being evolved in the germ cell itself. This theory of elimination, which has proved so effective in accounting for the evolution of species and for evolution in general, might well be applied to the results of adaptation upon the body and their reflection upon the germ cells. If we have two sets of qualities derived from the two parents, and if, as modern research indicates, these qualities are apposed in sexual transmission, there is a possible mechanism by which only those properties in the germ cell shall be transmitted, which are the couples of those properties in the body which have been successful in adaptation to their surroundings. These latter must, in the dual personality, either destroy or render latent the corresponding properties derived from the other parental gamete. It might be, that the one is rendered latent, and the other dominates the metabolism of the cell, and as to which becomes dominant would depend largely on the external environment in the delicate adjustment of the organism to its surroundings.

It may be that there is a perpetual struggle throughout life for dominance in the metabolism of the cell, and that a change in the environment might throw the balance of the dominance to one side or the other. It is evident that activity in metabolism would be entirely related to the dominant half, and it may be that it is the products of this activity, in the form of enzymes or some like chemical bodies, which render latent the other half, and perhaps in time cause its obliteration. We have, in the evidence of antagonistic secretions of the tissues, something which may help us in understanding how this dominance might be attained. If cells have the power of secreting material which is detrimental to other cells antagonistic to their kind of metabolism, or which favours the growth of those of like metabolism, it is not improbable that that half of the cell which is dominant, in accordance with reaction to the environment, may suppress the other parental characteristics. Such emanations, acquired by protective habit, though mingling together in the fluids of the body, may keep their specific character and react upon the germ cells. There would have to be a peculiar emanation for each correlated property coupled by amphimixis. During life each individual that reacted to the surroundings would, in each characteristic, become more like one parent, or more unlike both, or would in fact have its individuality more stamped upon it. This individuality would gradually stamp itself upon the germ cells, which might therefore vary in hereditary qualities at different periods in the life of the individual. Heredity would follow slowly upon change in the individual under changed conditions of existence. Should the properties derived from the two parents be not active in metabolism in relation to the adaptation of the body to its surroundings; or, in other words, should these properties exist as a part of heredity, and having no present relation to adaptation, no emanation would take place tending to select these properties, and separation of the qualities would take place, according to Mendel's law, in the formation of the gametes. This indirect adjustment of the germ cells to the successful properties of the body in adaptation, would take place in that part of the life cycle which is chiefly reacted upon in adaptation to the surroundings. This would be more noticeable in the sporophytic generation of the higher plants and in the gamete-bearing generation of the higher animals, physiological election taking place during that period. The effect of this would be that the gametic halves, instead of remaining in passive relation awaiting a possible separation by reduction, would be stirred to nearer union by the chemical stimuli, and the effect of reduction would be a mere halving of a new compound consisting of the successful properties in relation to adaptation.

Since writing the above, my attention has been drawn by a review in *Nature*, for January 1905, to Dr H. M. Vernon's book on *Variation in Animals and Plants*, from which I quote the following passages:—"Through what agency is the environment enabled to act on the germ plasm? To me the only conceivable one is a chemical influence, through products of metabolism and specific internal secretions. We have seen in a previous chapter that the products of metabolism of an organism may exert a retarding influence on its own growth, and in some cases a stimulating effect on the growth of other organisms. Physiological research of the last few years has shown that most of the organs and tissues of the body have specific internal secretions, which, passing into the general circulation, may exert an influence of vital importance on the general metabolism of the organism. Thus extirpation of the thyroid gland produces symptoms which in many animals end fatally, but which may be diminished or suppressed by feeding on the gland substance, or injection of extracts of it. Extirpation of the suprarenal glands results in much more speedy death, and here again the injection of extracts may delay the fatal issue."

Dr Vernon gives several other examples, and then goes on to say:—"Does it not seem distinctly probable, therefore, that every tissue in the body to some extent affects every other tissue? Each may have its own specific products of metabolism, and perhaps specific internal secretions, which, passing into the general circulation, may in turn stimulate or depress, or otherwise affect, every other tissue in the body. Whenever a change in the environment acts upon the organism, therefore, it to some extent affects the normal excretions and secretions of some or all of the various tissues, and these react not only on the tissues themselves, but also to a lesser degree upon the determinants representing them in the germ plasm."

This "specific secretion hypothesis," as it is termed by Dr Vernon, has a striking resemblance to the hypothesis put forward in this paper. It differs, however, in his basing his hypothesis on Weismann's determinants. He also gives no recognition to the suppression of one set of the dual characters in the tissue cells, which is necessarily the foundation of the hypothesis here put forward. In conclusion, I may say that if the hypothesis of Driesch, that the nucleus is a storehouse of ferments which set up activities in the cytoplasm, were shown to be the right one, we should have, not only an explanation of the specification of nuclei and limitation of development as quoted above, but a possible explanation of how the beautiful adjustments, which animals and plants undergo in relation to their surroundings, could be indirectly handed on in inheritance, and this without entailing the destruction of individuals to the extent that is required by the ordinary interpretation of natural selection. That natural selection has far-reaching powers in all these adjustments has to be admitted without doubt, and the hypothesis advanced in this paper is but a carrying of natural selection into the tissue cells as individuals, which work in a kind of symbiosis in their complex relations to one another. If this be true, there is no reason to doubt that, by the doubling of inheritance in the union of gametes, the war of elimination may be carried into the far recesses of the cell, and that "a germinal election and elimination in adaptation to the environment" (9) may be a source of variation in the germ cells.

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3. Wilson, "The Cell in Development and Inheritance," p. 323.
4. Pfeffer, Ewart, "Physiology of Plants," English translation, vol. i. pp. 375, 501.
5. Bateson, "President's Address to British Association, 1904."
6. Bateson, "Materials for the Study of Variation."
7. Beard, J., "Heredity and the Cause of Variation."
8. Metchnikoff, "Nature of Man," p. 49.
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XI. "*Scotia*" *Collections: Scottish Antarctic Expedition.—Report on the Antipatharians.* By Professor J. ARTHUR THOMSON, M.A.

(Read 27th March 1905.)

Mr W. S. Bruce, leader of the Scottish Antarctic Expedition, sent to me for examination and report a collection of twelve specimens of Antipatharians, made in the course of the "Scotia" voyage.

The collection, though small, may be of interest in regard to the geographical distribution of this primitive and extremely divergent order of Zoantharians. As the Antipatharians, or Antipathidea, form what must be called, relatively speaking, a small order, it is not surprising to find that the "Scotia" collection included in its twelve specimens only three species. It is more remarkable that these all belong to the genus *Bathypathes,* established by the late Mr George Brook in his "Challenger" Report. The specimens were preserved in formol, but this seems a quite unsuitable fixative for such forms, as far as histological details are concerned. Sections were made of the best of the specimens, but they were unsatisfactory. Where there are no calcareous structures to deal with, Bles's fluid might perhaps be tried in the future.

Order ANTIPATHARIA, or ANTIPATHIDEA.

Family **ANTIPATHIDÆ.**

Sub-Family SCHIZOPATHINÆ, Brook.

Genus *Bathypathes,* Brook.

1. *Bathypathes patula,* var. *plenispina,* Brook.

I entrusted five specimens, which I thought might be new, to Mr John Anderson, a student in the Advanced Course of Zoology in the University of Aberdeen, who gave me a detailed description of them, and made sections and preparations. But his conclusion, which I have carefully verified, was that all the specimens belonged to *Bathypathes patula,* var. *plenispina,* of which the "Challenger" Collection had one specimen. There is therefore no need to print

Mr Anderson's description, though a few of his data may be of service.

Three of the five specimens were attached to small stones. All were gracefully curved pinnate colonies, with the branches nearly, but not quite, opposite, and not quite in one plane. The lower branches make an acute angle with those of the opposite side, but this angle increases with the following branches till the two at the very top make a very large obtuse angle with one another.

In four of the specimens the total length of the stem was found to be 18·5, 17, 16·5, and 16·5 cm. Three of the four had ten branches on each side, while the longest specimen had twelve branches on one side and thirteen on the other. The branches occur in pairs with such strict uniformity that one might suspect the loss of a branch. But there is no hint of this.

The branches on one specimen were measured, and the lengths in centimetres from the base upward are given in the following Table:—

Branch.	Right Side. Length in cm.	Left Side. Length in cm.
1	2·4	2·5
2	Broken off.	2·5
3	5·2	3·5
4	6·8	4·7
5	7·6	5·5
6	7·6	6·0
7	8·5	6·5
8	7·5	6·5
9	5·6	6·3
10	4·7	4·0

Thus, on one side, branch 7 is longest, on the other branches 7 and 8 are of equal length. The lower and higher branches are shorter than the more central, and the gradation of the graceful colony is on the whole regular.

"Isolated" zoöids occur both on the main stem and on the branches; they are disposed on only one side of the branches, at fairly regular intervals; their bases are connected by cœnenchymatous outgrowths. They correspond to the *Bathypathes*-type, and from Brook's point of view they illustrate dimorphism occurring in trios—two elongated "gonozoöids" with a globular "gastrozoöid" between them.

The axis of the stem and branches is dark brown in colour when looked at with the naked eye. The spines, broad at the base, and tapering to a point, arise at right angles to the axis, and four longitudinal rows are visible from one aspect. The movement of the gas and liquid within the axis showed that it was hollow, as cross sections confirmed.

The specimens agree well with the description which Brook gave of *Bathypathes patula*, var. *plenispina*, *e.g.*, as to the acute angle between the lower branches and the four rows of spines visible from one aspect. But it may be noted that the "Challenger" specimen was only 12 centimetres in length, and had only three pairs of branches. The type specimen of *B. patula* had, however, 9-11 branches.

The jar containing the specimens is labelled "Cod Bank," 1st December 1903.

2. *Bathypathes alternata*, Brook.

A fine and well-preserved specimen, measuring 24 cm. in height by 18 cm. in breadth across the lowest branches, seems referable to *Bathypathes alternata*, of which the "Challenger" Expedition also obtained but a single example. Of the total height, 10 cm. go to the sterile part and 14 cm. to the pinnate frond.

The specimen agrees in general with Brook's description, but it is bigger and stronger, the branches are far more numerous (20 on one side, 21 on the other), and the axial spines are more regular. The "Challenger" specimen was only 18·5 cm. in height, and had 12 branches on one side, 13 on the other. It was said to be more slender than *B. patula* and with smaller zoöids, but the reverse is the case with Bruce's specimen of *B. alternata*, which is probably older and more vigorous than the colony obtained by the "Challenger."

There is no locality marked for this specimen.

3. *Bathypathes bifida*, n. sp.

Six interesting specimens of what seems to be a quite new form were trawled on the 18th March 1904, in lat. 71° 22′ S., long. 16° 34′ W. Each is firmly attached to a small stone, and all the six specimens are practically the same in size and form. A slender basal piece rises vertically from the stone to a height of 15 mm., and then bifurcates into two long branches which extend in opposite directions, at first almost at right angles, and gradually curving slightly upwards to a length of about 16 cm. There is no hint of any continuation of the short main stem or of any breakage; there is a slight re-entrant angle at the origin of the two branches.

The axis is almost hair-like, 1 mm. in diameter at the very base, 0·2 mm. in the branches. It appears black at a distance, but is reddish brown under low power. It bears four rows of low conical, yellowish or brownish, spines, which have broad bases and blunt tips. The spines measure 0·1 to 0·05 mm. in height, and are separated along any one line by intervals varying from 0·2 to 0·3 mm. It is most unfortunate that all the six specimens are almost quite bare of zoöids. Three or four are left, isolated from one another, and agree with the *Bathypathes* type. The most remarkable feature is the length of the lateral tentacles—up to 3 mm. Brook described four species of *Bathypathes*, and L. S. Schultze has described a fifth from the "Valdivia" expedition. Our new form is quite distinct from any of these.

Brook regarded *Bathypathes* and its allies as dimorphic. He thought that the zoöids occurred in trios—two gonozoöids with a gastrozoöid between them. From the little we have seen, we incline to the view expressed by Dr G. C. Bourne that there is but one kind of zoöid, which appears to be divided into three parts—two reproductive and one gastral, each with two tentacles.

XII. *Notes on the Lower Carboniferous Fishes of Eastern Fifeshire.* By Dr R. H. Traquair, F.R.S., F.G.S. [Plate V.]

(Read 16th January 1901; appeared without figures in the *Geological Magazine* for March 1901, pp. 110-114.)

Not much has as yet been done in the way of cataloguing the fossil fishes of the Lower Carboniferous rocks of Eastern Fifeshire. A few species and localities were noted by the late Rev. Thomas Brown in 1860,[1] and by Mr Kirkby in 1880,[2] and the late Mr Robert Walker published a paper in 1872,[3] in which he described what he supposed to be a new species of *Amblypterus* (*A. anconoæchmodus*) from the oil-shale works at Pitcorthie, near Anstruther. In this paper Mr Walker drew attention to the abundance and variety of fish-remains in the oil-shale and ironstone worked at that locality, promising to describe them in detail afterwards—a promise which he was never able to fulfil. After his death in 1881, his important collection of fish-remains from this and other localities in East Fife was acquired by the Edinburgh Museum, and largely forms the basis of the present list. I myself have also done some collecting in this region; and a good many years ago the Museum acquired a number of specimens collected by Mr W. T. Kinnear at Ardross, some of which are of great interest.

The district in question is comprised in Sheets 41 and 49 of the Geological Survey Map of Scotland. All the species here noted are from Lower Carboniferous rocks, the horizons represented being the Upper part (oil-shale group) and the Lower part of the Carboniferous Limestone Series. Here I may note that in 1890[4] I included the Teleostomi

[1] "Notes on the Mountain Limestone and Lower Carboniferous Rocks of the Fifeshire Coast, from Burntisland to St Andrews," *Trans. Roy. Soc. Edin.*, vol. xxii. (1860) pp 385-404.

[2] "On the Zones of Marine Fossils in the Calciferous Sandstones of Fife," *Quart. Jour. Geol. Soc.*, vol. xxxvi. (1880) pp. 559-590.

[3] 'On a New Species of *Amblypterus* and other Fossil Fish-remains from Pitcorthy, Fife," *Trans. Geol. Soc. Edin.*, vol. ii., part i., pp. 119-124. With Plate.

[4] "List of the Fossil Ganoidei and Dipnoi of Fife and the Lothians," *Proc. Roy. Soc. Edin.*, vol. xvii. (1890) pp. 385-400.

and Dipnoi of the region in a list of the fishes of these orders occurring in Fife and the Lothians, published by the Royal Society of Edinburgh. The present list, however, includes the Elasmobranchs as well, and also a few additional species now described as new.

CALCIFEROUS SANDSTONE SERIES.

Elasmobranchii.

1. *Pleuracanthus horridulus*, Traq. Pitcorthie
2. *Diplodus parvulus*, Traq. Pitcorthie.
3. *Cladodus unicuspidatus*, Traq., n.sp. Near Rock and Spindle.
4. *Callopristodus pectinatus* (Ag.). Rocks east of St Andrews; Pitcorthie.
5. *Oracanthus armigerus*, Traq. Teeth at Ardross.
6. *Gyracanthus* sp. Rocks east of St Andrews; Pittenweem. Not sufficiently well preserved for specific determination.
7. *Sphenacanthus serrulatus*, Ag. Pitcorthie.
8. *Sphenacanthus Fifensis*, Traq., n.sp. Rocks east of St Andrews.
9. *Euphyacanthus semistriatus*, Traq. Ardross.
10. *Tristychius arcuatus*, Ag. Pitcorthie.
11. *Tristychius minor*, Portlock. Pitcorthie.
12. *Cynopodius crenulatus*, Traq. Pitcorthie.
13. *Acanthodes sulcatus*, Ag. Ardross.

TELEOSTOMI.

Crossopterygii.

14. *Rhizodus Hibberti* (Ag.). Rocks on shore east of St Andrews; Pitcorthie.
15. *Rhizodus ornatus*, Traq. Pitcorthie; Pittenweem.
16. *Strepsodus striatulus*, Traq. Pittenweem.
17. *Strepsodus minor*, Traq. Pitcorthie.
18. *Cœlacanthopsis curta*, Traq., n.g. and s.p.

Actinopterygii.

19. *Elonichthys Robisoni* (Hibbert). Pitcorthie.
20. *Elonichthys striatus* (Ag.). Pitcorthie.
21. *Elonichthys pectinatus*, Traq. Ardross.

22. *Rhadinichthys ornatisimus* (Ag.). Kiness Burn, near St Andrews.
23. *Rhadinichthys carinatus* (Ag.). Pitcorthie; Corn Ceres, near Kilrenny.
24. *Rhadinichthys brevis*, Traq. Pitcorthie.
25. *Nematoptychius Greenocki* (Ag.). Pitcorthie.
26. *Gonatodus punctatus* (Ag.). Pitcorthie. This is the *Amblypterus anconoœchmodus* of R. Walker.
27. *Eurynotus crenatus*, Ag. Pittenweem; Pitcorthie; Corn Ceres; Kenly Mouth, east of St Andrews.

DIPNOI.

28. *Ctenodus interruptus*, Barkas. Pittenweem.

CARBONIFEROUS LIMESTONE SERIES.

Elasmobranchii.

1. *Petalodus acuminatus*, Ag. Ladedda, near St Andrews.
2. *Oracanthus armigerus*, Traq. Largoward.
3. *Sphenacanthus serrulatus*, Ag. Denhead Ironstone, Denhead, near St Andrews.
4. *Acanthodes* sp. Denhead.

TELEOSTOMI.

Crossopterygii.

5. *Rhizodus Hibberti* (Ag.). Denhead.
6. *Rhizodus ornatus*, Traq. Denhead.
7. *Megalichthys* sp. Denhead.
8. *Elonichthys Robisoni* (Hibbert). Denhead.
9. *Elonichthys pectinatus*, Traq. Denhead.
10. *Eurynotus crenatus*, Ag. Denhead.

The above list contains all the species, thirty in number, which are contained in the Natural History Department of the Edinburgh Museum, or in my own collection. Mr Kirkby, however, records *Ctenacanthus* sp. from near the Rock and Spindle, and *Pœcilodus obliquus*, Ag., from a marine limestone of Calciferous Sandstone age on the coast near Randerston Castle.

Notes on Species.

Diplodus.—I have found small *Diplodus*-teeth in shales on the shore at Pittenweem, but which can hardly be safely identified with any known form, or considered as new.

Cladodus unicuspidatus, n.sp. (Plate V. Figs. 1 and 2).—Base flat below; depth from back to front about two-thirds the width from side to side; contour more convex in front than behind. A single slender-pointed cusp arises from the middle of the front of the base, and is erect, straight when seen from the front (Fig. 1), sigmoidally curved when viewed laterally (Fig. 2), covered with delicate-raised ridges which increase in number downwards by intercalation. No trace of lateral cusps. Height of cusp of most perfect specimen $\frac{5}{16}$ inch, width of base laterally about the same.

Under the term *Monocladodus,* Professor Claypole[1] has separated from *Cladodus,* Agassiz, two species from the Cleveland shale, on account of the apparent want of lateral cusps. Allied to *Cladodus,* and also possessing only one cusp, are *Lambdodus* and *Hybocladodus* of St John and Worthen.[2] The present teeth, however, agree so closely with *Cladodus* in all respects, save the want of lateral cusps, and the comparatively short lateral extent of the base, that I prefer leaving them with that genus for the present.

A cluster of these teeth was found by myself many years ago in a septarian nodule on the shore near the Rock and Spindle, east of St Andrews. Owing to the hardness of the matrix, it was impossible to work out the superficial configuration of the teeth, except in two instances, where they happened to be covered by white carbonate of lime.

Sphenacanthus Fifensis, n.sp. (Plate V. Fig. 3).—Length of the largest specimen, $5\frac{3}{4}$ inches; greatest antero-posterior diameter, $\frac{3}{4}$ inch; implanted portion reaching up to $1\frac{3}{8}$ inch in front and $2\frac{3}{4}$ inches behind; form straight and tapering; posterior area slightly concave, its margin showing traces of abraded denticles; anterior margin of exserted portion formed by a sharp median ridge; sides ornamented by

[1] *American Geologist,* vol. xi. (1893) p. 329.

[2] *Geol. Survey of Illinois,* vol. vi.

straight ribs or rounded ridges, which increase in number proximally by bifurcation, and are not nodose.

This spine, of which there are several specimens in the Walker Collection, Edinburgh Museum, differs from *Sph. serrulatus*, Ag., by the multiplication of the lateral ribs by bifurcation instead of intercalation. The want of nodosity of these ribs is of no consequence, as the greatest difference occurs in this respect in different individuals of *Sph. serrulatus*, and also of the closely allied Coal-Measure form, *Sph. hybodoides* (Egerton). In a hard calcareous sandstone from the coast, east of St Andrews.

Cœlacanthopsis curta, n.g. and sp. (Plate V. Fig. 4).—Of this interesting fish only one specimen has been obtained, and that one is unfortunately deficient at the caudal extremity. What remains measures 2 inches in length, and in this the length of the head is contained three times, being also equal to the greatest depth. The head bones are crushed and scarcely decipherable. Vertebral axis notochordal; abdominal region extending for ½ inch behind shoulder-girdle; no ribs are seen, but there is distinct evidence of the ossified air-bladder characteristic of the Cœlacanthidæ. Neural arches united with the neural spines, which are very long, very slender, and closely placed; hæmal arches and spines similar in condition and configuration. On the dorsal aspect, and just above the termination of the abdominal cavity, a set of slender interspinous bones commences, these being short at first but rapidly increasing in length, until they are as long as the neural spines, and then the fish suddenly breaks up about 2 inches from the tip of the snout. Attached to the distal extremities of these interspinous bones are fin-rays, very short anteriorly, and still short at the point of truncation of the specimen. It is probable that similar elements existed on the hæmal aspect of the skeleton, but have been lost. Paired fins not preserved, except a few imperfect rays where the ventrals ought to be. Indications of the presence of scales feeble.

Strikingly new as this little fish is specifically, a word or two must be said as to its family and generic relationship. The ossified air-bladder, and the configuration of its neural and hæmal arches and spines, at once indicate that its family position is in the Cœlacanthidæ, but its differences from any known genus of this family are very strongly marked. We have, firstly, the abbreviated form of the fish, which is certainly not entirely due to *post-mortem* shortening up, as the skeletal parts in front of the place where the specimen is truncated lie nearly quite undisturbed; secondly, the great proportional length of the neural and hæmal spines; thirdly, the apparent absence of the two separate dorsal fins with their compound supporting "axonosts," characteristic of the Cœlacanthidæ. These *may* have been lost in the present specimen, but the tips of the neural spines come so close up to the dorsal margin that there would not have been room for the last-named elements of the form prevalent in the genera of this family. Fourthly, the median fin, which we see beginning just opposite the posterior termination of the abdominal cavity, corresponds, in its relation to its supporting elements, to the caudal of *Cœlacanthus,* but is immensely farther forward in its commencement. It is unfortunate that, owing to the truncation of the fish shortly after the commencement of this fin, we cannot see the extremity of the tail, but enough is shown in the specimen to prove its novelty, both specific and generic. The acquisition of more perfect specimens is, however, urgently to be desired, as it is clear that, if the dorsal fins with their compound axonosts are really wanting in this form, a change must be made in the received definition of the Cœlacanthidæ, as well as of the Actinistian group of the Crossopterygii.—(From Ardross, collected by Mr W. Tait Kinnear, and now in the Edinburgh Museum.)

Eucentrurus paradoxus, n.g. and sp. (Plate V. Figs. 5, 6, 7).—This extraordinary little organism measures $2\frac{3}{8}$ inches in length, of which $\frac{1}{2}$ inch may be allotted to the head, $\frac{3}{4}$ inch to the body, and $1\frac{1}{8}$ inch to the tail. The head is a mass of calcareous matter, in which something suggestive of a broad curved mandible can be seen, but admits of no further description. The body, $\frac{3}{8}$ inch broad in front, is composed of a greyish film, which, when examined by a strong lens, is seen to consist entirely of minute, slender, slightly-curved and sharply-pointed spinelets. The tail is tapering in form, consisting of amorphous-looking calcareous matter, but on each side (assuming that the creature is crushed vertically) is a conspicuous row of double spinelets (Figs. 6 and 7) arranged exactly opposite each other. From a common base arise two spinelets, which are placed close together, and nearly parallel to each other; one of them, the anterior, being only half the length of the posterior one, which just behind the body may attain a length of $\frac{1}{16}$th inch, though towards the end of the tail they become smaller; both spinelets are slender, slightly curved, round in transverse section, smooth externally, sharply pointed, and traversed internally by a central tubular pulp cavity. No trace either of internal skeleton, or of limbs, or fins of any sort, can be seen.

This strange organism is another of the problems of Palæozoic ichthyology, as it is scarcely possible to indicate its systematic position with any degree of certainty. The nature of its dermal armature would incline us to the belief that it is a Selachian, though all other evidence to that effect is wanting.—(From Ardross, collected by Mr W. T. Kinnear, and now in the Edinburgh Museum.)

Explanation of Plate V.

Fig. 1. *Cladodus unicuspidatus*, Traquair, seen from the front; twice natural size. Calciferous Sandstone Series, Rock and Spindle, near St Andrews.

Fig. 2. Another specimen of the same tooth, and belonging to the same mouth, seen from the side.

Fig. 3. *Sphenacanthus Fifensis*, Traquair; natural size. Calciferous Sandstone Series, shore east of St Andrews.

Fig. 4. *Cœlacanthopsis curta*, Traquair; natural size. From the shore at Ardross.

Fig. 5. *Eucentrurus paradoxus*, Traquair; natural size. From the shore at Ardross.

Figs. 6 and 7. Lateral spinelets of the tail region of *Eucentrurus paradoxus;* magnified nine times linear.

XIII. *The Odonata* (Dragon-flies) *of the Forth Area.* By William Evans, F.R.S.E.

(Read 27th March 1905.)

The present paper is another of the series on the fauna of the Edinburgh, or "Forth" area, which I have during the past sixteen years been submitting to the Society. The group now dealt with is a small one, and, I am sorry to say, poorly represented in the district. Nevertheless, it is an exceedingly interesting group, comprising as it does some of the finest insects to be found in this country, while all its members are sufficiently striking to attract attention. The Odonata, although usually included in that very varied assemblage of insects known as the Linnean order Neuroptera, are so marked off by distinctive characters that they stand quite alone, and will doubtless, in time, be generally granted full ordinal rank. The publication in 1900 of Mr W. J. Lucas's beautifully illustrated volume on the British Dragon-flies (7) has given a fresh impetus to the investigation of their distribution.

There are very few published records of Odonata for this area, and these are mostly old and of comparatively little value. The celebrated Belgian authority on the group, Baron Edm. de Selys Longchamps, visited Scotland in 1845, and evidently examined specimens in the collections, among others, of Dr Greville and James Wilson of Edinburgh, but in his "Revision" (5) and "Revue" (6) he seldom indicates any more precise locality than "Scotland" (*cf.* Note by K. J. Morton in *Ent. Mo. Mag.*, 1900, p. 108). Specimens, as we know, were not so carefully labelled with locality and date then as they are now, but De Selys' statements would seem to indicate the former existence in Scotland of species now apparently absent. In giving my own lists of localities in considerable detail, I have in view the interest the information may have to future workers. It is easy to see that restriction—and consequent decrease—rather than expansion of range is likely to be the fate of some of the species as time goes on.

Of the forty or so British Odonata, scarcely one-half occur in Scotland, and of these I have met with only eleven in the Forth area. It is possible that one or two others—*Leucorhinia dubia*, and *Æschna cærulea*, for instance—may yet be discovered among the hills and glens at the head of the valley. As regards the past, we may feel sure that when ponds, peat-mosses, marshes, and meadows were more numerous, so were dragon-flies.

In this district I have heard the name "Fleein' Edder" applied to the larger species. Sibbald, "Historia Animalium in Scotiâ," 1684, says, "Ex non favicantibus apud nos—Perla, the *Adder's boult* or *Dragon-fly*."

I am greatly indebted to my friend Mr K. J. Morton for examining a number of my specimens, and for otherwise imparting to me much information concerning dragon-flies in general.

A list of the works cited is given at the end of the paper. The order of the species and the nomenclature are the same as in Lucas's book (7).

ODONATA.

Family **LIBELLULIDÆ.**

Sympetrum striolatum (Charp.).

While not uncommon in the western division of Scotland, where I have obtained it several times, this is a rare dragon-fly in the eastern section. A specimen in my collection was taken in the Callander district in the early "seventies"; and no doubt the species still occurs in that, the western, portion of "Forth": it has not, however, come under my notice there in recent years. In the neighbourhood of Edinburgh I have only once met with *S. striolatum*, namely, on 27th July 1901, when a single example was discovered basking in the sunshine on a sandy spot by the side of a dry ditch on Luffness Links. It must, I think, have been a wanderer from a distance. About a fortnight before, my wife saw a bright red dragon-fly, the size of this species, settle for a moment on the top of a tramway car at Bruntsfield, a busy part of Edinburgh. Possibly some immigrants had reached us from the east.

De Selys, in 1845, saw this species from Scotland in Dr Greville's collection, but gives (5) no further indication of locality.

Sympetrum scoticum (Don.).

Libellula scotica, Donovan, Nat. Hist. Brit. Ins., xv. (1811), pp. 39, 40. Coloured plate.

Around Edinburgh this interesting species is now comparatively rare, but in the bogs and marshes of Upper Forth it is still at least locally common. Doubtless it was formerly plentiful in Lower Forth also, when more "mosses" existed. Donovan (2, *loc. cit.*) thus wrote of it in 1811: "We have been recently favoured with specimens of this species of *Libellula* by W. E. Leach, Esq., from whom it received the trivial name of Scotica, in reference to the country in which it appears only to have been hitherto discovered. This gentleman informs us it is common in the bogs of Scotland: he first observed it near Loch Awe, in Argyleshire, and afterwards in the bog of Bannockburn, in which latter place it occurs in great abundance." I have seen specimens which were collected on the Bathgate moors by Durham Weir about 1840, and have two I took in the Macbiehill district in 1872. It is a late summer or autumn species, and De Selys (6) suggests that it may occasionally hibernate.

Localities in which I have recently obtained *S. scoticum* are—

Bavelaw Moss, near Balerno, Midlothian, 7th Aug. 1895, ♂; Currie Moor, Pentlands, 11th Sept. 1900, ♀ (from C. Campbell); Balla, Lomonds, Aug. 1895, one; Ochils, west of Glenfarg, common in small marsh, Sept. 1899; between Strathmiglo and Glenfarg, 28th Sept. 1899, one; reservoir, two miles north of Aberdour, Fife, 4th Aug. 1900, ♀; marsh, Clackmannan Forest, 13th July 1901, two ♂s recently emerged; Loch Ard, Aberfoyle, ♀ newly emerged, 31st July 1900, common in Aug.; Strathyre and Balquhidder, Sept. 1902, a few.

Libellula quadrimaculata, Linn.

There is some evidence that this handsome insect was formerly widely distributed around Edinburgh. Now it is rarely seen here. It is still, however, fairly common locally in the Upper Forth district. Duncan, writing in 1840 (3, p. 291), says: "In the neighbourhood of Edinburgh it occurs at Duddingston Loch, among the Pentland Hills, and elsewhere." The only occasion on which I have certainly seen *L. quadrimaculata* anywhere near Edinburgh was on 8th June 1895, when I had the pleasure of watching three flying about a curling-pond, surrounded by trees, near Drumshoreland, Linlithgowshire. In the summer of 1897, a dragon-fly which, from the description given me, was probably also of this species, was seen at the clay-pits, Portobello.

In Upper Forth, where, as already stated, it is still locally not uncommon, I met with a few examples near Aberfoyle in July 1900—on the 31st, one, a ♀, was captured in a boggy hollow on the hills behind the village.

Migratory swarms of *L. quadrimaculata* have frequently been recorded on the Continent, at Heligoland, and even on the south east coast of England (*cf.* articles by J. W. Tutt in *Ent. Record* for 1899, pp. 153, 181, and 213); but the only immigration on this side of the Tweed of which I have a note is thus referred to in a paragraph from a newspaper of 29th June 1900:—"A few days ago, a flight of insects was observed to alight upon the Magdalen field, at Berwick, after coming from the direction of the sea. Some specimens were captured, and they have been identified as 'Libellula quadrimaculata' (Dragon-flies)." Gätke in his fascinating book, "Heligoland as an Ornithological Observatory" (p. 89), states that countless swarms suddenly make their appearance on that island before thunderstorms.

Family **ÆSCHNIDÆ.**

Cordulegaster annulatus (Latr.).

? *Libellula vulgatissima*, Stewart's List of Edinburgh Insects (1), 1809.
? *Æschna forcipata*, List of Dollar Insects (4), 1841, New Stat. Acc., viii. p. 89.

I have never, for certain, seen this grand insect in the district around Edinburgh, and if it occurs at all now it must be very rare. But likely enough it did occur formerly. Lucas (7), quoting De Selys (6), gives as a locality "near Edinburgh,"[1] and I cannot think what the names quoted above can refer to if not to this species. *Gomphus vulgatissimus* (L.) may have occurred here then, but I hardly think so.

De Selys (5) in 1846 recorded *C. annulatus* from Loch Katrine, in the upper portion of "Forth," and it is still locally common there. In July 1900 (27th and 30th) I captured two on boggy ground behind Aberfoyle; and in 1901 a large ♀ was secured at Loch Ard on 4th June, and several of both sexes at Brig o' Turk in July. In August last a pair were taken at the Trossachs by Mrs Morton. It makes its appearance two or three weeks in advance of the next.

Æschna juncea (Linn.).

? *Libellula grandis*, Stewart's List of Edinburgh Insects, 1809.
? *Æshna varia*, List of Dollar Insects, 1841, New. Stat. Acc., viii. p. 89.

Of the larger dragon-flies, this is decidedly the most common in the area, and is the only one which still has many habitats in the district around Edinburgh. Although naturally somewhat local, it is widely distributed throughout "Forth," and while never rare, is more plentiful in some seasons than in others. In 1904, for instance, it was commoner than I have seen it for a good many years past. When a boy, I knew this fine insect well, in all its stages, in and around the ponds in the grounds of Penicuik House; and specimens then captured are still in my collection. I have always admired its powerful flight, as it hawked for flies round the margin of some sedge-girt loch or pool, along the bank of a river or a hill-burn, or by the edge of a fir-wood near the moors. It appears rather later in the season than the previous species, August and September being the

[1] De Selys' words in the "Revue" (6) are: "Commune en Ecosse près d'Edimbourg et aux environs des grands lacs." In the "Revision" (5), four years earlier, they are: "Scotland. Local. Loch Lomond, Loch Katrine.—Mus. Dr Greville, Blyth, etc."

best months for it; but I have frequently seen it on the wing in July, and have occasionally observed it still on the prowl at the approach of evening.

I have little doubt the names quoted above from the old lists refer to this species. The name *juncea* does not appear in the lists. It is of course possible that *grandis* did occur at one time. In the Royal Scottish Museum there is an old specimen of *Æ. juncea* from Greville's collection, labelled "Bathgate."

Localities in which I have taken or otherwise noted *Æ. juncea* are as follows:—

Penicuik Ponds, 1866, etc.; Habbie's Howe, Carlops; Macbiehill; Pentland Hills (Glencorse, Fairliehope, Aug. 1904, and Nether Habbie's Howe, ♂ and ♀, 7th Sept. 1904); Tyne below Haddington, Aug. 1900; Presmennan Loch, Aug. 1894; near Dunbar (D. Bruce); marl-pit, Davidson's Mains, July 1900, one; Currie Moor, Sept. 1900; Malleny Dam, Balerno, Aug. 1893, Aug. 1901, etc.; Bavelaw Moss and Wood, Aug. 1875, Sept. 1893, Aug. 1895, Aug. 1904, several, and other occasions; near Kirknewton, 7th July 1900 and 8th Aug. 1904 (still on wing 6.30 P.M.); Cobbinshaw Moss, 21st Sept. 1904, two; Armadale, one, 27th July 1900 (A. Miller); old quarry, near Bo'ness, July 1901; Dalmeny, July 1901, ♂ (Campbell); marsh on North Queensferry hills, Aug. 1900, three; Thornton, Aug. 1893; near Falkland, Aug. 1895; near Dollar, July 1901; near Callander; Brig o' Turk, 30th July 1901; Balquhidder, Aug. 1902, several.

Family **AGRIONIDÆ.**

Calopteryx virgo (Linn.).

Libellula virgo, Stewart's List of Edinburgh Insects, 1809.
Calepteryx virgo, List of Dollar Insects, 1841, New Stat. Acc., viii. p. 89.

This beautiful insect seems now restricted to a few localities in the upper or highland section of the area, but there is evidence that formerly its range, as might be supposed, was very much wider. According to Stewart (*loc. cit.*) it occurred in the neighbourhood of Edinburgh a century ago, and it is included in a list of insects occurring in the parish of Dollar (4, *loc. cit.*) written in 1841. I have a specimen which was brought to me from the Trossachs many years ago, and in 1894 I was assured that it was still to be found at Loch Vennacher. The only place where I have myself met with this blue-winged "Demoiselle" is in the vicinity of Aberfoyle, where I saw a male in June 1896, but failed to secure it before it flitted across the river. In June 1901 a few specimens were obtained on the banks of a sluggish stream in the same neighbourhood. [Again 30th June 1905.]

Mr Morton has pointed out to me that my Scotch specimens of *C. virgo* ♂, belong to the northern form, which is paler at the bases and tips of the wings than southern examples.

Lestes sponsa (Hansem.).

I have a specimen of this small dragon-fly taken in the early "seventies" in the Callander district, but unfortunately I have no note of the exact locality, and I have failed to find the species again during recent visits to Upper Forth. It is widely distributed in the north and west of Scotland (I have it from several localities), and it is common, according to Mr King (Lucas's "British Dragon-flies"), no farther away than Dalmally, so I have no doubt it is still present in some of the many suitable spots towards the western limits of "Forth." It appears about the beginning of July (in 1893 I took two at Aviemore in June), and continues on the wing till September.

L. sponsa, from "Scotland," was noted by De Selys in Greville's collection in 1845, but no more definite locality is given.

Pyrrhosoma nymphula (Sulz.).

Agrion minium, Selys (5), Ann. Mag. Nat. Hist., 1846, p. 226.

This is the small red dragon-fly that one not unfrequently sees about the margins of peat-pools, ponds, and ditches, and on the adjoining moors and meadows. With a decided preference for moorland districts, it is widely distributed throughout the area, and is still locally common. De Selys (*loc. cit.*) in 1845 noted it in Greville's collection from "Scotland"—likely enough from this district, for there can be no doubt the insect was formerly more plentiful in the vicinity of Edinburgh than it is now. I remember when it occurred in the marshes, now nearly all destroyed, on the Braid Hills.

My localities and dates for it are—

Braid Marshes, 1873; near Penicuik; Loganlea, Pentlands, ♀, 27th May 1895; Bavelaw Moss, June 1895, and 29th and 30th May 1900, fairly common; 15th May, ♂, 27th May and 3rd July 1901, common; June 1904, a good many; meadow near Kirknewton, 7th and 10th July 1900, several; Newpark, June 1895; Drumshoreland, June 1895 and July 1904, a few; near Torphichen, 15th June 1895; pond near Cullalo, Fife, June 1900; Duchray, near Aberfoyle, 27th May 1896; Trossachs Road, Aberfoyle, June, several, and ♂, 27th July 1900.

Ischnura elegans (Lind.).

This, the smallest species we find here, is very widely distributed, and common locally. Unlike the last, it avoids the moorlands, preferring sedgy and weedy ponds, dams, and deep ditches to peat-pools. I have taken it in the following localities:—

Luffness Marshes, Aberlady, June 1890, July to 9th Aug. 1898, and 16th June 1900, a good many; Duddingston Loch, at the curling-pond, 26th July 1900, and 4th July 1902, abundant; marl-pit, Davidson's Mains, July 1900, a few; Malleny Dam, Balerno, July 1901; canal, near Ratho, Aug. 1903; Drumshoreland curling-pond, June 1895, July 1900, and July 1901, common; Kilconquhar Links, June 1897; Otterston Loch, July 1901; Culross, July 1900; mill-pond, Bridge of Allan, 28th June 1901, common; Loch Ard, July 1900, common.

Agrion puella (Linn.).

A. puella, Evans, Ann. Scot. Nat. Hist., 1900, p. 125, and Ent. Mo. Mag., 1900, p. 88.

While common in the greater part of England, the true *Agrion puella* appears to be a rare insect in Scotland. The only occasion on which I have taken it was on 22nd June 1896, when I found a few flitting about an old clay-pit at Bush, near Roslin, county of Edinburgh, as recorded in 1900 (*loc. cit.*). The name *puella* appears in Stewart's Edinburgh List (1), but the record is of doubtful application, for several forms—including the next—were then covered by that name. De Selys (5) seems, however, in 1845 to have identified both *puella* and *cyathigerum* from "Scotland" in Greville's collection.

The distribution of these small blue-bodied species in Scotland is much in need of investigation.

Enallagma cyathigerum (Charp.).

? *Libellula puella* (whole or part), Stewart's List of Edinburgh Insects, 1809.

The elegant little blue-bodied dragon-flies one so often meets with are the males of this species. It is much our commonest dragon-fly, occurring more or less freely in suitable localities—meadows, marshes, banks of streams, ponds, etc.—throughout the area. There is no need to give all the localities in which I have identified it: the following will suffice to show how generally distributed it is.

Braid Hills marshes, formerly common (1873, etc.), still present in 1900; Duddingston Loch, abundant, 1878, July 1889, 1890, 1892, etc.; Penicuik, 1866, etc.; near Borthwick Castle, 6th July 1895; Ormiston, 5th July 1895; Presmennan; Luffness, June 1890; Tyne below Haddington, July 1900; marl-pit, Davidson's Mains, 19th July 1900, etc., common; Canal bank, Kingsknowe, 4th Aug. 1902, a few; near Balerno, 3rd July 1901, etc.; Newpark, July 1901; Drumshoreland, 8th June 1895, 4th July 1901, common; near Torphichen, 15th June 1895; near Bo'ness, June 1900 (R. Godfrey); Otterston Loch, 10th July 1901, ♂s and ♀s, abundant, many just emerging; Burntisland Waterworks, 5th July 1900, common; Thornton; Kilconquhar; Falkland, 14th Aug. 1895; near Culross, July 1900, common; Bridge of Allan, 28th June 1901; Aberfoyle and Loch Ard, 27th July 1900, abundant; Trossachs; Loch Lubnaig.

All of the above-mentioned species, with the exception, perhaps, of *Agrion puella*, have a very wide range in Britain—south of England to north of Scotland; and they are also extensively distributed on the Continent.

Other five species of Odonata are certainly known to occur in Scotland at the present time, namely:—

Leucorhinia dubia (Lind.)—West and north.
Somatochlora metallica (Lind.)—Inverness-shire.
Somatochlora arctica (Zett.)—Highlands.
Æschna cœrulea (Ström.)—Highlands.
Agrion hastulatum, Charp.—Aviemore, Inverness-shire (E. M. M., 1900 and 1903).

The following have also been recorded on good authority (*cf.* Mr Morton's note already referred to on page 87):—

Orthetrum cœrulescens (Fab.)—"Scotland" (De Selys); Kirkcudbrightshire (Buchanan White).

Æschna grandis (L.)—"Scotland" (De Selys); Kirkcudbrightshire (Buchanan White).

Agrion pulchellum, Lind.—De Selys (5), apparently in one of the west coast localities which he visited.

A number of other species are alleged to have been taken in Scotland, but the records are old and vague or otherwise open to doubt.

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5. De Selys, Revision of the British Libellulidæ (*Ann. Mag. Nat. Hist.*, 1846, pp. 217-227).
6. ——— Revue des Odonates ou Libellules d'Europe, 1850.
7. Lucas, W. J., British Dragon-flies (Odonata), 1900.

Note.—The distribution given in Hagen's "Synopsis of the British Dragon-flies" (*Ent. Ann.*, 1857) is merely a repetition of that given by De Selys.

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PROCEEDINGS

OF THE

ROYAL PHYSICAL SOCIETY

FOR THE

PROMOTION OF ZOOLOGY AND OTHER BRANCHES OF NATURAL HISTORY.

SESSION 1905–1906.

No. 4. VOL. XVI. PAGES 97-190.

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EDINBURGH: M'FARLANE & ERSKINE.

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Do.	Part 2 (1891-92),	. .	5/	6/6	
Vol. XII.	Part 1 (1892-93),	. .	5/	6/6	
Do.	Part 2 (1893-94),	. .	12/6	15/	
Vol. XIII.	Part 1 (1894-95),	. .	4/6	6/	
Do.	Part 2 (1895-96),	. .	5/	6/6	
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Vol. XIV.	Part 1 (1897-98),	. .	5/	6/6	
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XIV. *A Catalogue of Land, Fresh-Water, and Marine Crustacea found in the Basin of the River Forth and its Estuary.*

By Thomas Scott, LL.D., F.L.S., Mem. Soc. Zool. de France, etc. [With Map. Plate VI.]

(Read 27th March 1905.)

PART I.—MALACOSTRACA, CLADOCERA, and BRANCHIURA.

Introductory Remarks.

(1) *On the Drainage Area of the Forth.*[1]

The river Forth, from its source on the side of Ben Lomond to where it terminates in the estuary near Kincardine-on-Forth, measures about $64\frac{1}{2}$ miles, and as the length of the estuary is about 48 miles, the total length, from the source of the river to the seaward limits of the estuary, is slightly over 112 miles. Leslie and Herdman describe the Forth estuary as extending to the Vale of Stirling, or about 8 miles farther west than the limit stated here.

The drainage area of the river, including its tributaries, is almost 628 square miles, while that of the estuary is about 1133 square miles, or about 1760 square miles altogether.

The average depth of the estuary scarcely exceeds 15 fathoms. There are one or two places where it reaches to about 40 fathoms, but these are very limited. A considerable portion of the estuary towards its seaward limits ranges from 15 to 30 fathoms in depth; but nowhere is there such deep water as in the Firth of Clyde.

The largest fresh-water lochs within the area are—Loch Katrine, Loch Vennachar, Loch Voil, Loch Lubnaig, and Loch Leven (Kinross). There are a number of smaller lakes, such as Loch Achray, Loch Ard, Lake of Menteith, and others, a few of which, though not yet examined, are

[1] The measurements, etc., given here are obtained chiefly from Part II. of the *Twelfth Annual Report of the Fishery Board for Scotland* (1894), which contains a map of the catchment-basins of all the Scottish rivers, with explanatory notes, giving the lengths of the various rivers, the areas of each river-basin, and other useful information derived from official sources.

not expected to add much to what is already known concerning the fresh-water Crustacea of the district. For a description of the physical geography of the estuary, see the Introduction to Parnell's *Fishes of the Firth of Forth,* and to Leslie and Herdman's *Invertebrate Fauna of the Estuary.*

(2) *On the History of the Crustacean Fauna of the Forth.*

Contributions by Sir Robert Sibbald and Professor Jameson.

Though Sir Robert Sibbald in 1710, and Professor Jameson in 1809, published lists of Forth Invertebrata which are of much interest, the number of Crustacea recorded by them is small, and consists for the most part of the larger species.

Contributions by Harry Goodsir.

The interesting field opened up by the researches of Harry Goodsir, and the success that attended his labours, might have directed some attention to the micro-crustacean fauna of the Firth of Forth, but the so-called "stalk-eyed" forms still continued to be the chief object of study. Even Professor Bell, in his work on the *British Stalk-eyed Crustacea,* could add little to what Goodsir had published on the Schizopoda and Cumacea, but simply transcribed that author's descriptions and drawings.

Contributions by Dr James M'Bain.

The lists of the flora and fauna of the Firth of Forth prepared by Dr James M'Bain, R.N., and which form part of the Appendix to the Rev. Walter Wood's *East Neuk of Fife*—a local but valuable work on the history and antiquities of that part of Fifeshire, published in 1862—marks an important stage in our knowledge of the natural history of the estuary, and, as the author remarks, the lists contained in that work are "more perfect than any which had hitherto been published."

In the list of Crustacea given on pages 375 and 376 of that work, thirty-two species are recorded, the names of which are as follow :—

Stenorhynchus phalangium, now *Macropodia rostrata* (cf. Stebbing, *History of Crustacea*, p. 105).
Inachus Dorsettensis.
Hyas araneus.
,, *coarctatus.*
Eurynome aspera.
Cancer pagurus.
Carcinus mænas.
Portunus variegatus.
,, *depurator.*
,, *marmoreus.*
,, *pusillus.*
Pinnotheres pisum.
Atelecyclus heterodon, now *A. septemdentatus.*
Corystes cassivelaunus.
Lithodes maia.
Pandalus annulicornis, ,, *P. Montagui.*
Pagurus Bernhardus. ,, *Eupagurus Bernhardus.*
,, *ulidianus*, young of *Eupagurus Bernhardus.*
,, *Forbesii*, now (?) *Eupagurus* (or *Spiropagurus*) *sculptimanus.*
,, *Hyndmanni*, ,, *Anapagurus Hyndmanni.*
,, *lævis*, ,, ,, *lævis.*
Porcellana platycheles.
,, *longicornis.*
Galathea squamifera.
,, *strigosa.*
,, *nexa.*
Munida Rondeletii, ,, *M. bamffia.*
Homarus vulgarus, ,, *Astacus gammarus.*
Nephrops norvegicus.
Crangon vulgarus.
Hippolyte varians.
Mysis chamæleon, ,, *Macromysis flexuosus.*

Dr M'Bain, when compiling his list, appears to have overlooked the discoveries of Harry Goodsir, published in 1843; for, with the exception of the *Mysis chamæleon*, all the species recorded belong to the Decapoda. A second omission briefly noticed here, but which is more fully referred to in the sequel, is that of *Calocaris Macandreæ*, Bell. This curious species was obtained by Captain M'Andrew in the stomach of a haddock captured by him in the Firth of Forth in 1851.[1] But the list, notwithstanding these omissions, is of considerable value, as giving a fairly accurate summary of what at that time was known concerning the Crustacea of the Forth estuary.

Contribution by Leslie and Herdman.

The next important contribution to the literature of the Forth Crustacea is contained in Leslie and Herdman's *Invertebrate Fauna of the Firth of Forth*, published in 1881.[2] The authors have not only given the results of a large amount of original research, but they have incorporated, along with their own discoveries, the species recorded by previous observers, so that this work presents the most complete account of the Invertebrata of the estuary published up to that date. The list of Crustacea contained in it, though limited to the two sub-classes Cirripedia and Malacostraca, is considerably extended, and would doubtless have been much larger had the time at the disposal of the authors permitted them to take up the Entomostraca as well; but the animals belonging to this sub-class are, for the most part, microscopic, and on that account, and also because of their great numbers and variety, require a considerable amount of time and patience for their successful study.

Ninety-seven species of Crustacea are recorded in Leslie and Herdman's Catalogue, and they are arranged in the following order:—

Cirripedia, . . .	12	species.
Amphipoda, . . .	20	,,
Isopoda, ...	10	,,
Cumacea (Sympoda), . .	7	,,
Stomapoda (Schizopoda), .	4	,,
Decapoda, . . .	44	,,
Total, . . .	97	,,

[1] Cf. *Hist. of Brit. Crust.*, by Adam White (British Museum), published 1857, p. 99.

[2] *Proc. Roy. Phys. Soc.*, vol. vi. pp. 68-95, 201-231, and 268-315.

Among the Cirripedia mentioned, one species—*Balanus tintinabulum*—is, as stated by the authors, "an inhabitant of the warmer seas, and its occurrence in the Forth is an accidental circumstance."

Among the Amphipoda, *Caprella lobata*, O. F. Müller, is now regarded as synonymous with *Caprella linearis* (Linn.).

Among the Isopoda, *Arcturus* (or *Astacilla*) *gracilis*, Goodsir, is considered by G. O. Sars to be the young of *A. longicornis* (Sow.).

Among the Cumacea, *Cuma Edwardsi*, Goodsir, has been shown to be synonymous with *C. scorpioides* (Montagu).

Among the Schizopoda, *Cynthia Flemingi*, Goodsir, is considered by Canon A. M. Norman to be probably identical with *Leptomysis lingvura*, G. O. Sars, and *Themisto brevispinosa*, Goodsir, to be probably the male of *Mysis* (*Macromysis*) *flexuosus* (Müll.).[1]

Themisto longispinosa, Goodsir, Canon Norman is unable to identify—the description being insufficient.

These and similar changes in arrangement and nomenclature are, however, incidental to the more accurate knowledge we now possess concerning the animals themselves, as well as concerning the discoveries and writings of the earlier authors, but notwithstanding these changes, the work referred to is still indispensable to those who wish to become acquainted with the natural history of the Forth estuary.

Contribution by Dr J. R. Henderson.

A further contribution to the natural history of the estuary was made by Dr J. R. Henderson, in a paper read before the Royal Physical Society of Edinburgh in December 1884, entitled, "Recent Additions to the Invertebrate Fauna of the Firth of Forth." The number of species previously recorded was considerably increased, and as Dr Henderson's attention had been devoted chiefly to the Crustacea, the largest number of the additions occurred in this group. They are as follows:—

[1] Cf. *Ann. and Mag. Nat. Hist.*, Sept. 1892, pp. 245 and 251, footnote.

AMPHIPODA—13 Species, viz.:—

Hyale Nilssoni (Rathke).
Stenothoë pollexiana (Bate), now *Metopa norvegica* (Lillj.).
Ampelisca æquicornis, Bruzel
Iphimedia obesa, Rathke.
Pherusa bicuspis[1] (Kröyer), now ?*Paramphithoë bicuspis* (Kröyer).
,, *fucicola*, Leach, ,, ?*Apherusa Jurinii* (M. Edw.).
Calliopius bidentatus, Norman, now *Paramphithoë bicuspis* (Kröyer).
Aora gracilis, Bate.
Noenia tuberculosa, Bate, ,, *Podoceropsis Sophiæ*, Boeck.
,, *excavata*, Bate, ,, ,, *excavata* (Bate).
Corophium tenuicorne, Norman, ,, *Corophium affine*, Bruzel.
Hyperia oblivia, Kröyer, ,, *Parathemisto oblivia* (Kröyer).
Proto ventricosa, Müll., ,, *Phtisica marina*, Slabber.

ISOPODA—3 Species.

Tanais vittatus, Rathke, now *Tanais Cavolinii*, M. Edw.
Jæra albifrons, Leach.
Idotea linearis (Penn.).

CUMACEA (SYMPODA)—1 Species.

Diastylis lævis, Norman (previously recorded in Leslie and Herdman's *Invertebrate Fauna* as *Alauna rostrata*, Goodsir), now *Diastylis rostratus* (Goodsir).[2]

SCHIZOPODA—2 Species.

Nyctiphanes norvegica (M. Sars).
Podopsis Slabberi (V. Ben.), now *Macropsis Slabberi*.

DECAPODA—2 Species.

Hippolyte pusiola, Kröyer.
Eupagurus pubescens (Kröyer).

[1] *Pherusa bicuspis* is Bate's name, not Kröyer's; and though *Pherusa bicuspis*, Bate, was at one time considered to be synonymous with Kröyer's *Amphithoë bicuspis* (now *Paramphithoë bicuspis* (Kröyer)), it turns out, on the contrary, to be equivalent to *Apherusa bispinosa* (Bate).

[2] It is but right to state that though G. O. Sars regards *D. lævis* as identical with *D. rostratus*, Norman does not agree with that opinion (see note under that species).

It will be observed from the above list that twenty species, exclusive of the *Diastylis,* were at this time added to the Crustacean fauna of the estuary. Two undescribed species belonging to the Amphipoda were also found by Dr Henderson in 1884, but were not recorded till 1894; ere that time, however, they had been described by Professor G. O. Sars. They are entered in the present Catalogue under the names of *Sthenometopa robusta* (G. O. Sars) and *Paramphithoë monocupis,* G. O. Sars.

Contributions by the present Writer in the Reports of the Fishery Board for Scotland, etc.

Although various groups of the Crustacea were receiving more attention than formerly, it was not till 1888 that a list of the Forth Entomostraca was published. In that year I contributed a small paper to the *Sixth Annual Report of the Fishery Board for Scotland,* entitled, "A Revised List of the Crustacea of the Firth of Forth," in which I gave the results of some researches extending over the autumn and winter of 1887, and these included a list of marine Entomostraca. For several years thereafter, my leisure time was devoted chiefly to the study of the Crustacea, and especially of the Entomostraca of the Forth estuary. The work assigned to me by the Fishery Board for Scotland afforded me opportunities for this study such as are seldom enjoyed by the student, and I desire to express my great obligation to the Fishery Board for the many favourable opportunities I have enjoyed for prosecuting the study both of the marine and of the fresh-water Crustacea of Scotland. The results of my researches, under the title of "Additions to the Fauna of the Firth of Forth," were published year by year in the Board's Annual Reports. The last of these papers (No. 8) was published in 1896, in Part III. of the Fourteenth Report. But though no papers have been published since 1896 dealing exclusively with Forth Crustacea, records of new or rare forms from the Forth have appeared occasionally in subsequent Reports, along with the descriptions of species from other parts of Scotland. Papers on the land and fresh-water

Crustacea of the district were also contributed by me to the *Proceedings of the Royal Physical Society* for 1890-94.

Some months ago I decided to collect all the scattered records of Forth Crustacea published by myself in the Annual Reports of the Fishery Board for Scotland and elsewhere, and, adding those published by other writers, or that have been supplied to me by friends interested in the natural history of the district, to prepare a catalogue of the land, fresh-water, and marine Crustacea known to occur within the limits of the basin of the river Forth and of its estuary, in the hope that it might be useful to other students, as former catalogues have been to myself.

Contributions by Professor G. S. Brady, Rev. A. M. Norman, and David Robertson.

In the preparation of this Catalogue, I have been indebted to a paper by Professor G. S. Brady and David Robertson on the "Ostracoda and Foraminifera of Tidal Rivers," and to the excellent monograph of "The Marine and Fresh-Water Ostracoda of the North Atlantic and North-Western Europe" by Brady and Norman, for a considerable number of Forth records of species belonging to that group.

Contribution by Dr and Miss Sprague.

An excellent paper on the Fresh-Water Crustacea of Mid-Lothian, by Dr and Miss Sprague, published in the *Transactions of the Edinburgh Field Naturalists and Microscopical Society* in 1901, has also been very helpful to me.

Contributions by William Evans, F.R.S.E., and Mrs Janet Carphin.

Mr William Evans, F.R.S.E., Edinburgh, has added one or two interesting species, notably the rare terrestrial Isopod, *Platyarthrus Hoffmannseggi*, to the Crustacean fauna of the Edinburgh district, and has also furnished me with a number of additional localities for species already recorded; while Mrs Janet Carphin, in the course of her searches for land and fresh-water Mollusca in the district around Edinburgh, has been successful in capturing in the Union Canal the curious *Argulus foliaceus*[1]—a Crustacean which is the only living representative in Scotland of the Branchiura, a suborder of the Branchiopoda.

One of the many discoveries made by my friend the late Mr James Bennie, of the Geological Survey, was the occurrence, near Edinburgh, of numerous remains of *Lepidurus* (*Apus*) *borealis* belonging to the Phyllopoda, which is also a suborder of the Branchiopoda. This discovery is the more interesting, as no living representative of that suborder is now known to occur in the British Islands.

With the assistance of the works referred to, and of friends interested in the natural history of the district, the compilation of this Catalogue has been more a pleasure than a task. It may also be stated that several valuable monographs of special groups of Crustacea published during recent years, have been of much service to me in the systematic arrangement of the species, and though reference to these will be found throughout the Catalogue, a few of the more important of them may be mentioned here, viz.:—

The Crustacea of Norway, by Professor G. O. Sars of Christiania. Four volumes of this great work have already been published, viz.—Vol. I., the Amphipoda; Vol. II., the Isopoda; Vol. III., the Cumacea; and Vol. IV., the Copepoda-Calanoida. Vol. V., the Copepoda-Harpacticoida, is at present in course of publication.

Résultats des Campagnes Scientifiques accomplies sur son Yacht par Albert Ier Prince Souverain de Monaco—Fascicule xvi., *Amphipodes provenant des Campagnes de l'Hirondelle* by Edouard Chevreux.

Contribution a l'étude des Épicarides: les Bopyridæ, by M. Jules Bonnier.

Les Copépodes du Boulonnaise, by Dr Eugene Canu.

[1] *Ann. Scot. Nat. Hist.*, October 1895, p. 255.

Deutschlands freilebende Süsswasser-Copepoden, by Prof. Otto Schmeil.

Die Asterocheriden des Golfes von Neapel, by Dr W. Giesbrecht, of Naples.

The *Choniostomatidæ: A Group of Minute Parasitic Copepoda,* by Dr H. J. Hansen.

Cladocera-Sueciæ: A Monograph of the Cladocera of Sweden, by Prof. W. Lilljeborg.

Deutschlands Süsswasser-Ostracoden, by Dr G. W. Müller.

Cypriden und Darwinuliden der Schweiz, by Dr A. Kaufmann.

The work by the Rev. T. R. R. Stebbing, F.R.S., entitled *A History of Crustacea,* has been very helpful to me in the general systematic arrangement of the species, and especially of the Malacostraca.

My son, Mr Andrew Scott, A.L.S., has given me valuable assistance with the identification of the Entomostracan species; and I also am greatly indebted to my friend Mr F. G. Pearcey, for rich collections of micro-Crustacea from the Forth estuary and elsewhere.

The Map which accompanies this part of the Catalogue shows approximately the limits of the basin of the river and its estuary. It also shows approximately the positions of the ten Experimental Stations laid down by the Fishery Board for Scotland in the Firth of Forth, since many of the species recorded here were obtained at one or other of these "Stations." The Stations are marked in Roman numerals: Stn. I., Stn. IV., etc.

In arranging the species, I have followed the classification in Stebbing's *Natural History of Crustacea* (page 49), in which the Podophthalma have the first place, while the Cirripedia come last.

The following is the order in which the species in this part (Part I.) of the Catalogue are arranged.

Part I.

Sub-Class I.—MALACOSTRACA.

Order 1. Podophthalma, or Stalked-eyed Crustacea.

Suborder Brachyura,	. .	number of species,	19	
,, Macrura,	. . .	,, ,,	33	
,, Schizopoda,	. .	,, ,,	26	
Total number of species belonging to the Podophthalma,				78

Order 2. Edriophthalma, or Sessile-eyed Crustacea.

Suborder Sympoda (Cumacea),		number of species,	21	
,, Isopoda,	. . .	,, ,,	42	
,, Amphipoda,	. .	,, ,,	145	
Total number of species belonging to the Edriophthalma,				208

Sub-Class II.—ENTOMOSTRACA.

Order 3. Branchiopoda.

Suborder Cladocera,	. .	number of species,	54	
,, Branchiura,	. .	,, ,,	1	
Total number of species belonging to the Branchiopoda,				55
,, ,, recorded in this Part,				341

Part II. will contain a catalogue of species belonging to

the Order Ostracoda, of which there are about	132	species,
,, ,, Copepoda, of which there are about	300	,,
the Sub-Class Cirripedia, of which there are about	13	,,
and adding to these the number given above, viz.,	341	,,
The total number of species for the Forth at present known is about . . .	786	

In compiling this first part, should any species have been overlooked, or should any additional species occur before Part II. is published, they will be noticed in an Appendix to that part.

Sub-Class I. MALACOSTRACA.

Order 1. PODOPHTHALMA.

Suborder **Brachyura.**[1]

Family CANCRIDÆ.

Genus (1) **Cancer,** Linné, 1767.

1. *Cancer pagurus,* Linné.

1767. *Cancer pagurus,* Linn., Syst. Nat., ed. xii., vol. i. p. 1044.

Habitat.—Firth of Forth, from inshore to moderately deep water. Specimens have occasionally been captured in the trawl-net of the Fishery steamer "Garland," at all the experimental stations from above Queensferry to the mouth of the estuary.

Family PORTUNIDÆ.

Genus (2) **Carcinus,** Leach, 1813.

2. *Carcinus mœnas* (Linné).

1767. *Cancer mœnas,* Linn., Syst. Nat., ed. xii., vol. i. p. 1043.

Habitat.—Common everywhere between tide-marks, especially where the shore is rough and provides suitable shelter; also occasionally found in moderately deep water.

Genus (3) **Portunus,** Fabricius, 1798.

3. *Portunus puber* (Linné).

1767. *Cancer puber,* Linn., Syst. Nat., ed. xii., vol. i. p. 1046.

Habitat.—Taken at the mouth of the estuary on deep-sea lines (Leslie and Herdman). This appears to be, so far, the only published record of this species for the Firth of Forth.

4. *Portunus depurator* (Linné).

1767. *Cancer depurator,* Linn., Syst. Nat., ed. xii., vol. i. p. 1043.

Habitat.—Common throughout the estuary, and frequently associated with *P. holsatus.*

[1] In the nomenclature of this suborder, Bell's *British Stalk-eyed Crustacea,* 1853, has been generally followed.

5. *Portunus holsatus*, Fabricius.

1798. *Portunus holsatus*, Fabr., Ent. Syst., Suppl., p. 336.

Habitat.—Firth of Forth (Dr Leach, as *P. lividus*). Commonly met with on the oyster-banks (Henderson).[1] Firth of Forth (White, 1857). One of the more common of the Forth Brachyuræ, but is not mentioned in Wood's List.

6. *Portunus marmoreus*, Leach.

1814. *Portunus marmoreus*, Leach, Malacol. Brit., pl. viii.

Habitat.—At Portobello and Musselburgh, found occasionally on the beach (Howden; L. & H.). Obtained amongst trawl refuse west of May Island (Mihi).

7. *Portunus pusillus*, Leach.

1814. *Portunus pusillus*, Leach, *op. cit.*, pl. ix. figs. 5-8.

Habitat.—Off Prestonpans (Howden). Firth of Forth, common (Norman; cf. White, *Brit. Crust.*, 1857, p. 52). Leslie and Herdman say they have frequently dredged this species near Inchkeith (*Invert. Fauna*, p. 51). I have occasionally observed *P. pusillus* amongst the trawl refuse when at work in Largo Bay.

Genus (4) **Portumnus**, Leach, 1814.

8. *Portumnus latipes* (Pennant).

1777. *Cancer latipes*, Pennant, Brit. Zool., vol. iv. p. 5, pl. i. fig. 4.
1853. *Portumnus variegatus*, Bell, *op. cit.*, p. 85.

Habitat.—At Prestonpans and Port Seton (Howden). Shores of the Firth of Forth (White, *Brit. Crust.*, p. 43). Portobello (Leslie and Herdman). Sandy shore near Gullane (Andrew Scott). Aberlady, 1890 (W. Evans).

Family CORYSTIDÆ.

Genus (5) **Corystes**, Latreille, 1802.

9. *Corystes Cassivelaunus* (Pennant).

1777. *Cancer Cassivelaunus*, Pennant, Brit. Zool., vol. iv. p. 6, pl. vii.

Habitat.—Off Inchkeith (M'Bain). Newhaven (C. W.

[1] "Decapod and Schizopod Crustacea of the Clyde," *Trans. Nat. Hist. Soc. Glasgow* (1886), p. 10.

Peach). Near the Bass Rock (Metzger). Firth of Forth (Edin. Mus.). Aberlady and Kirkcaldy Bays (Leslie and Herdman). Aberlady and Portobello (W. Evans). I have occasionally observed this species among the trawl refuse when at work with the Fishery cruiser "Garland."

Genus (6) **Atelecyclus**, Leach, 1813.

10. *Atelecyclus septemdentatus* (Montagu).

1815. *Cancer* (*Hippa*) *septemdentatus*, Mont., Trans. Linn. Soc., vol. xi., pl. i. fig. 1.
1853. *Atelecyclus heterodon*, Bell, *op. cit.*, p. 153.

Habitat.—Firth of Forth, rare (Goodsir). Firth of Forth (Edin. Mus.). Beach at Portobello (M'Bain). Found in the stomach of a cod-fish (Dr J. A. Smith,[1] and Leslie and Herdman). I have obtained *A. septemdentatus* on one or two occasions.

Family PINNOTHERIDÆ.

Genus (7) **Pinnotheres**, Latreille, 1802.

11. *Pinnotheres pisum* (Linné).

1767. *Cancer pisum*, Linn., Syst. Nat., ed. xii., vol. i., part 2, p. 1039.

Habitat.—Taken off Longniddry and elsewhere (Leslie and Herdman). I have occasionally obtained living specimens —male and female—in the shells of large horse-mussels (*Mytilus modiolus*). Two females from *M. modiolus*, Prestonpans, Feb. 1905 (W. Evans).

Family MACHIDÆ.

Genus (8) **Macropodia**, Leach, 1814.

12. *Macropodia rostrata* (Linné).

1767. *Cancer rostratus*, Linn., Syst. Nat., ed. xii., vol. ii. p. 1014.
1853. *Stenorynchus Phalangium*, Bell, *op. cit.*, p. 13.

Habitat.—Firth of Forth, at Prestonpans (Edin. Mus.). Both Howden, and Leslie and Herdman record this species,

[1] Cf. *Proc. Roy. Phy. Soc. Edin.*, vol. iii. p. 214.

and describe it as generally distributed where the bottom consists of mud and sand. I have frequently obtained it in the neighbourhood of Inchkeith, and off Musselburgh. North Berwick, 1895 (W. Evans).

Genus (9) **Inachus**, Fabricius, 1798.

13. *Inachus dorsettensis* (Pennant).

1777. *Cancer dorsettensis*, Penn., Brit. Zool., vol. iv. p. 12, pl. x. fig. 1.

Habitat.—Howden records obtaining this species on fishermen's deep-sea lines, but no locality is given.

14. *Inachus leptochirus*, Leach.

1815. *Inachus leptochirus*, Leach, Malac. Brit., pl. xxii., B.

Habitat.—Firth of Forth (Rev. G. Gordon; cf. White's *Popular Hist. Brit. Crust.* (1857), p. 19).

Family MAIIDÆ.

Genus (10) **Hyas**, Leach, 1813.

15. *Hyas araneus* (Linné).

1746. *Cancer araneus*, Linn., Fauna Suecica, p. 2030.

Habitat.—Firth of Forth, common in the littoral and laminarian zones.

16. *Hyas coarctatus*, Leach.

1815. *Hyas coarctatus*, Leach, Trans. Linn. Soc., vol. xi. p. 329.

Habitat.—Moderately common in the Firth of Forth, especially in the deeper water.

Family PARTHENOPIDÆ.

Genus (11) **Eurynome**, Leach, 1814.

17. *Eurynome aspera* (Pennant).

1777. *Cancer asper*, Penn., Brit. Zool., vol. iv. p. 13, pl. x. fig. 3.

Habitat.—Taken off Prestonpans and Port Seton (Howden).

Family LEUCOSIIDÆ.

Genus (12) **Ebalia**, Leach, 1817.

18. *Ebalia tuberosa* (Pennant).

1777. *Cancer tuberosa*, Penn., Brit. Zool., vol. iv. p. 19, pl. ix. fig. *a-f*.
1853. *Ebalia Pennantii*, Bell, *op. cit.*, p. 141.

Habitat.—Dredged off the west side of May Island, on moderately hard ground, scarce (Mihi).

19. *Ebalia Cranchi*, Leach.

1815. *Ebalia Cranchi*, Leach, Zool. Miscellany, vol. ii. p. 20.

Habitat.—Firth of Forth (Goodsir). Dredged twice in 25 fathoms about $2\frac{1}{2}$ miles off Dunbar (F. M. Balfour; cf. Leslie and Herdman, Appendix, p. 106).

Suborder **Macrura**.

Family LITHODIDÆ.

Genus (1) **Lithodes**, Latreille, 1806.

1. *Lithodes maia* (Linné).

1767. *Cancer maia*, Linn., Syst. Nat., ed. xii., vol. ii. p. 1046.

Habitat.—Firth of Forth (Howden). Dr Neil obtained young specimens in the stomach of a cod-fish. Leslie and Herdman state that *Lithodes* is not uncommon near the mouth of the estuary. It has been taken, though sparingly, with the "Garland's" trawl-net off the east and west sides of May Island.

Family PAGURIDÆ.

Genus (2) **Eupagurus**, Brandt, 1851.

2. *Eupagurus bernhardus* (Linné).

1767. *Cancer bernhardus*, Linn., Syst. Nat., ed. xii., vol. ii. p. 1049.
1853. *Pagurus bernhardus*, Bell, *op. cit.*, p. 171.

Habitat.—Common in the Firth of Forth. The form recorded by Howden under the name of *P. ulidianus*, is regarded as a small or young *E. bernhardus.*[1]

[1] *History of Crustacea*, by Rev. T. R. R. Stebbing (1893), p. 161.

3. *Eupagurus cuanensis* (W. Thompson).

1843. *Pagurus cuanensis*, W. Thomp., Brit. Assoc. Report (1843), p. 267.

Habitat.—Firth of Forth, occupying the shell of a *Turretella* (F. M. Balfour). This species is apparently rare in the Forth estuary.

4. *Eupagurus pubescens* (Kröyer).

1838. *Pagurus pubescens*, Kröyer, Consp. Crust. Grönl., Naturh. Tidsskr., ser. i., ii. p. 251.
1853. ,, *Thompsoni*, Bell, *op. cit.*, p. 372.

Habitat.—Taken west of May Island in 20 fathoms (Henderson). East of Inchkeith, 9 to 10 fathoms; apparently rare.

[5. *Eupagurus sculptimanus* (Lucas).

1843. *Pagurus sculptimanus*, Lucas, Explo. Scient. de l'Algerie, I. Crust., p. 32, pl. iii. fig. 6.
1853. ,, *Forbesii*, Bell, *op. cit.*, p. 186.

Habitat.—Dr Howden has recorded *Pagurus* (*Spiropagurus*) *Forbesii* from the Forth estuary; but Stebbing, in his *History of Crustacea*, p. 161, regards this as synonymous with *Eupagurus sculptimanus*, Lucas, the occurrence of which in the Forth is somewhat doubtful.[1]]

Genus (3) **Anapagurus**, Henderson, 1886.

6. *Anapagurus Hyndmanni* (Thompson).

1843. *Pagurus Hyndmanni*, Thomp., Brit. Assoc. Report (1843), p. 267.
1886. *Anapagurus Hyndmanni*, Henderson, Decap. and Schiz. Crust. of the Clyde, p. 27.

Habitat.—Off Musselburgh and Prestonpans (Howden). I have occasionally obtained this species amongst the trawl refuse of the Fishery steamer "Garland."

[1] It is probable that a critical study of the smaller hermit crabs of the Forth estuary might show that some that are regarded as forms of common species may turn out to be distinct.

7. *Anapagurus lævis* (Thompson).

1843. *Pagurus lævis*, Thomp., Brit. Assoc. Report (1843), p. 267.
1886. *Anapagurus lævis*, Henderson, *op. cit.*, p. 28.

Habitat.—Firth of Forth (Howden). This species is of more frequent occurrence than the last; I have taken it both with the dredge and amongst trawl refuse, in different parts of the estuary.

Family PORCELLANIDÆ.

Genus (4) **Porcellana**, Lamarck, 1801.

8. *Porcellana longicornis* (Linné).

1767. *Cancer longicornis*, Linn., Syst. Nat., ed. xii., vol. ii. p. 1040.

Habitat.—Moderately common, and generally distributed.

9. *Porcellana platycheles* (Pennant).

1777. *Cancer platycheles*, Penn., Brit. Zool., vol. iv. p. 9, pl. iv. fig. 2.

Habitat.—Taken at Crail and Fifeness at low-water (Howden). At Elie, and near North Berwick (Leslie and Herdman).

Family GALATHEIDÆ.

Genus (5) **Galathea**, Fabricius, 1793.

10. *Galathea squamifera*, Leach.

1815. *Galathea squamifera*, Leach, Edin. Encycl., vol. vii. p. 398.

Habitat.—Firth of Forth, moderately common (cf. Leslie and Herdman). In rock pools at North Berwick, January 1896 (W. Evans).

11. *Galathea nexa*, Embleton.

1834. *Galathea nexa*, Embl., Trans. Berw. Nat. Club, vol. i. p. 69.

Habitat.—Off Port Seton (Howden).

12. *Galathea dispersa*, Spence Bate.

1859. *Galathea dispersa*, Bate, Proc. Linn. Soc. (Zool.), vol. iii. p. 3.

Habitat.—Common "on the so-called oyster-banks" (Henderson).[1]

[1] Cf. "Decapod and Schizopod Crustacea of the Clyde," *Trans. Nat. Hist. Soc. Glasgow* (1886), p. 10.

13. *Galathea intermedia*, Lilljeborg.

1851. *Galathea intermedia*, Lillj., Ofvers Vet.-Akad. Forhandl., p. 21.
1857. ,, *Andrewsii* Kinah., Proc. Nat. Hist. Soc. Dublin, vol. ii. p. 58, pl. xvi. fig. 8.

Habitat.—Firth of Forth (Dr Anderson).[1]

14. *Galathea strigosa* (Linné).

1767. *Cancer strigosa*, Linn., Syst. Nat., ed. xii., vol. ii. p. 1052.

Habitat.—Off the Bass Rock (Howden). Taken near Dunbar (Robert Gray). I have obtained one or two specimens of this species while at work on the Fishery steamer "Garland," but it did not appear to be very common in the estuary. North Berwick 1895, one specimen (W. Evans).

Genus (6) **Munida**, Leach, 1820.

15. *Munida bamffia* (Pennant).

1777. *Astacus Bamffius*, Pennant, Brit. Zool., vol. iv. p. 17, pl. xiii. fig. 25.
1853. *Munida Rondelettii*, Bell, *op. cit.*, p. 208.

Habitat.—Not uncommon at Dunbar (Robert Gray). Mr Evans informs me that in January 1896, Mrs Rickards, North Berwick, showed him several specimens which had been obtained there.

Family THAUMASTOCHELIDÆ.

Genus (7) **Calocaris**, Bell, 1853.

16. *Calocaris Macandreæ*, Bell.

1853. *Calocaris Macandreæ*, Bell, *op. cit.*, p. 233.

Habitat.—Adam White, in his *Popular History of British Crustacea* (1857), p. 99, states that *Calocaris* was "found by Mr M'Andrew in Loch Fyne and the Mull of Galloway; and subsequently, when dredging in the Firth of Forth in 1851, he got a quantity of haddocks, the stomach and intestines of one of which were filled with it."

Calocaris does not appear to have again been observed in the Forth estuary till 1901, when it was obtained by Mr

[1] Cf. *Proc. Roy. Phys. Soc. Edin.*, vol. i. p. 415.

F. G. Pearcey, while engaged with some special work on board the Fishery steamer "Garland." On this occasion it was obtained by him among the refuse of the trawl-net, and in the stomachs of a Long Rough Dab and one or two Witch Soles. White's record of the occurrence of *Calocaris* in the Forth seems to have been overlooked by subsequent writers on the Crustacea of the estuary.

Family NEPHROPIDÆ.

Genus (8) **Nephrops**, Leach, 1819.

17. *Nephrops norvegicus* (Linné).

1767. *Cancer norvegicus*, Linn., Syst. Nat., ed. xii., vol. ii. p. 1053.

Habitat.—Common, especially in the seaward part of the estuary. Two fine specimens at water's edge, Gullane Point, 2nd May 1890; one cast up during storm at Prestonpans, October 1898 (W. Evans).

Genus (9) **Astacus**, Leach, 1814.

18. *Astacus gammarus* (Linné).

1761. *Cancer Gammarus*, Linn. Faun. Suec., 2nd ed., p. 2033.
1853. *Homarus vulgaris*, Bell, *op. cit.*, p. 242.

Habitat.—Frequent in Firth of Forth. Lobsters in considerable numbers are captured by fishermen where the coast-line is rocky, and especially about the seaward limits of the estuary.

Tribe CARIDEA.

Family CRANGONIDÆ.

Genus (10) **Crangon**, Fabricius, 1798.

19. *Crangon vulgaris*, Fabricius.

1798. *Crangon vulgaris*, Fabr., Ent. Syst., Suppl., p. 410.

Habitat.—Common in the littoral zone where the shore is sandy; taken occasionally with the dredge in moderately deep water.

20. *Crangon Allmani*, Kinahan.

1857. *Crangon Allmanni*, Kinahan, Proc. Nat. Hist. Soc. Dublin, vol. iv. p. 80.

Habitat.—Moderately common in the deeper parts of the estuary; it is also obtained occasionally in shallow water inshore. In 1862 Kinahan instituted a new genus (*Steiro-crangon*) for this species, but subsequent authors do not consider the characters on which the new genus is founded as sufficient to separate it from *Crangon.*

21. *Crangon nanus*, Kröyer.

1842. *Crangon nanus*, Kröyer, Naturh. Tidsskr. (ser. i.), vol. iv. p. 231.
1853. ,, *bispinosa*, Bell, *op. cit.*, p. 268.

Habitat.—Taken near the Bass Rock (Metzger, German Exploring Expedition, 1872). I have obtained it in mid-channel east of May Island, off Prestonpans, off the west side of Inchkeith, and in Largo Bay.

22. *Crangon trispinosus*, Hailstone.

1835. *Pontophilus trispinosus*, Hailstone, Mag. Nat. Hist., vol. viii. p. 261, fig. 25.
1853. *Crangon trispinosus*, Bell, *op. cit.*, p. 265.

Habitat.—Firth of Forth, not common (Mihi).

23. *Crangon neglectus* (G. O. Sars).

1882. *Cheraphilus neglectus*, G. O. Sars, Chr. Vidensk. Forhandl., p. 45, pl. i. fig. 7.

Habitat.—Dredged in Largo Bay, 1890, rare (cf. *Ninth F. B. Rept.*, pl. iii., p. 309).

24. *Crangon fasciatus*, Risso.

1816. *Crangon fasciatus*, Risso, Hist. Nat. Crust. de Nice, p. 82, pl. iii. fig. 5.

Habitat.—Off Musselburgh, September 1891, rare (cf. *Ann. Scot. Nat. Hist.*, 1902, p. 228).

Family Nikidæ.

Genus (11) **Nika**, Risso, 1816.

25. *Nika edulis*, Risso.

1816. *Nika edulis*, Risso, Crust. de Nice, p. 85, pl. iii. fig. 3.

Habitat.—Taken at the mouth of the estuary by tow-net, rare.

Family HIPPOLYTIDÆ.

Genus (12) **Hippolyte**, Leach, 1813.

26. *Hippolyte varians*, Leach.

1813. *Hippolyte varians*, Leach, Edin. Encycl., vol. vii. p. 432.

Habitat.—In shore pools (Howden). Frequent in tidal pools west from Granton. Off the west side of May Island. *H. fascigera*, Gosse, which is now considered to be only a form of *H. varians*, has been taken at Cramond Island at the edge of low-tide.

Genus (13) **Spirontocaris**, Spence Bate, 1888.

27. *Spirontocaris spinus* (Sowerby).

1805. *Cancer spinus*, Sowerby, Brit. Miscellany, p. 47, pl. xxiii.
1853. *Hippolyte spinus*, Bell, *op. cit.*, p. 284.

Habitat.—Common in the littoral and laminarian zones (Leslie and Herdman). I have occasionally obtained specimens in different parts of the estuary. *S. securifrons* (Norman), which differs chiefly in having the dorsal aspect of the abdomen even instead of the third segment terminating in a strong posterior dorsal tooth, is also occasionally obtained, but is regarded as a variety of the other.

28. *Spirontocaris pusiolus* (Kröyer).

1842. *Hippolyte pusiola*, Kröyer, Monogr. Fremst. of Hippol. Nord. Arter, Vid. Sel. naturvid. og mathem. Afh., ix Deel., p. 319, tab. iii. figs. 69-73.

Habitat.—Newhaven, from the fishermen's lines (Henderson). I have dredged *S. pusiolus* west of Queensferry, in the neighbourhood of Inchkeith, off Musselburgh, and off St Monans. This is probably the species referred to by Dr Howden as being common off Crail.[1]

29. *Spirontocaris Cranchii* (Leach).

1815. *Hippolyte Cranchii*, Leach, Malacol. Brit., p. 38, figs. 17-21.

Habitat.—Rocks off Broxmouth, near Dunbar (F. M. Balfour; in Leslie and Herdman's, *Invert. Fauna of Firth of Forth*, p. 106).

[1] Cf. A. White, *Hist. of Brit. Crust.*, p. 122.

30. *Spirontocaris Gaimardi* (M.-Edwards).

1837. *Hippolyte Gaimardi*, M.-Edw., Hist. Nat. des Crust., vol. ii. p. 378.
1853. ,, *pandaliformis*, Bell, *op. cit.*, p. 294.

Habitat.—Above Queensferry, and at one or two other parts of the estuary; not common.

Family PANDALIDÆ.

Genus (14) **Pandalus**, Leach, 1814.

31. *Pandalus Montagui*, Leach.

1815. *Pandalus Montagui*, Leach, Malacol. Brit., pl. xl.
1853. ,, *annalicornis*, Bell, *op. cit.*, p. 297.

Habitat.—Firth of Forth, common, and generally distributed.

Genus (15) **Pandalina**, Calman, 1899.

32. *Pandalina brevirostris* (Rathke).

1837. *Pandalus brevirostris*, Rathke, Mem. présenté a l'Acad. de Petersb., t. iii.
1853. *Hippolyte Thompsoni*, Bell, *op. cit.*, p. 290.

Habitat.—Firth of Forth (F. M. Balfour). I have obtained this species off the west side of Inchkeith, off Musselburgh, between Fidra and the Bass Rock, and in mid-channel west of May Island, but always sparingly.

Family PALÆMONIDÆ.

Genus (16) **Leander**, Desmarest, 1849.

33. *Leander squilla* (Linné).

1767. *Cancer squilla*, Linn., Syst. Nat., ed. xii., vol. ii. p. 1051.
1853. *Palæmon squilla*, Bell, *op. cit.*, p. 305.

Habitat.—In rock pools near the mouth of the estuary, frequent (Leslie and Herdman). In rock pools, North Berwick, rather common, August 1897 (W. Evans).

Suborder **Schizopoda.**

For this group I have followed the arrangement and nomenclature of the Rev. Canon Norman's "Revision of the British Species of Schizopoda," published in *Ann. and Mag.*

Nat. Hist., Ser. 6, vol. ix. pp. 454-464, and Ser. 6, vol. x. pp. 143-166, and 241-263, 1892.

Family EUPHAUSIIDÆ.

Genus (1) **Nyctiphanus**, G. O. Sars, 1883.

1. *Nyctiphanus norvegica* (M. Sars).

1856. *Thysanopoda norvegica*, M. Sars, Forhandl. Scand. Naturf. Möde i Chr., p. 169.

Habitat.—Firth of Forth, young specimens not uncommon (Henderson).[1] Nyctiphanes was usually scarce in our tow-net collections, but it appears to be scarcer some years than others.

Genus (2) **Rhoda**, G. Sim, 1872.

2. *Rhoda Raschi* (M. Sars).

1863. *Thysanopoda Raschi*, M. Sars, *op. cit.*, p. 7.
1872. *Rhoda Jardineana*, G. Sim, Scottish Naturalist, vol. i. p. 187, pl. iv. fig. A.
1883. *Boreophausia Raschi*, G. O. Sars, Chr. Vid.-Selsk. Forhandl., No. 7, p. 11.

Habitat.—Firth of Forth, moderately frequent, and generally distributed.

3. *Rhoda inermis* (Kröyer).

1849. *Thysanopoda inermis*, Kröyer, Voyage in Scand., Crust., pl. vii. fig. 2, *a-t*.

Habitat.—Firth of Forth, captured in 1892 and 1894.

Genus (3) **Thysanoessa**, F. Brandt, 1851.

4. *Thysanoessa neglecta* (Kröyer).

1849. *Thysanopoda neglecta*, Kröyer, *op. cit.*, pl. vii. fig. 3, *a-d*.
1872. *Thysanoessa aberdonensis*, G. Sim, Scottish Naturalist, vol. i. p. 188, pl. v. figs. 1-8.

Habitat.—Firth of Forth, frequent.

5. *Thysanoessa longicaudata* (Kröyer).

1849. *Thysanopoda longicaudata*, Kröyer, *op. cit.*, pl. viii. fig. 1, *a-f*.

Habitat.—Firth of Forth, off St Monans, 1891; a few

[1] "Decapod and Schizopod Crustacea of the Clyde," *Trans. Nat. Hist. Soc. Glasgow* (1886), p. 38.

specimens were obtained mixed up with *T. neglecta. T. longicaudata* is very similar in general appearance to the more common *T. neglecta,* and therefore it may have occasionally been overlooked.

Genus (4) **Nematoscelis**, G. O. Sars, 1883.

6. *Nematoscelis megalops*, G. O. Sars.

1872. *Thysanoessa borealis*, Norman, M. S., in Sim, Stalk-eyed Crust. N.E. Coast of Scotland; Scottish Naturalist, vol. i. p. 188.

1883. *Nematoscelis megalops*, G. O. Sars, Chr. Vid.-Selsk. Forhandl., p. 27.

Habitat.—Firth of Forth, 1892 [see Norman in *Ann. and Mag. Nat. Hist.* (June 1892), p. 464]. Off St Monans, one specimen, 28th May 1904.

Family Mysidæ.

Genus (5) **Siriella**, Dana, 1850.

7. *Siriella norvegica*, G. O. Sars.

1869. *Siriella norvegica*, G. O. Sars, Undersögelser over Christiania-fjorden, Dybvandsfauna, p. 40.

Habitat.—Firth of Forth, near May Island, 1889, rare.

8. *Siriella jaltensis* (Czerniavsky).

1868. *Siriella jaltensis*, Czern., Materialia ad Zoographiam Ponticam comparatam, p. 66, pl. iv. figs. 12 and 13.

Habitat.—Taken at Joppa, September 1887, and subsequently at various other places, but always sparingly. The latest record I have is for Station V., where one or two specimens were captured on 24th April 1901.

9. *Siriella armata* (M.-Edwards).

1837. *Cynthia armata*, M.-Edwards, Hist. Nat. des Crust., vol. ii. p. 436.

Habitat.—Taken off St Monans in February 1889, and at Station III. in March 1892. It also occurred sparingly in the same gathering with *S. jaltensis* from Station V. collected in April 1901. This *Siriella* has been observed in the Forth estuary more frequently than any of the other members of the genus.

Genus (6) **Gastrosaccus**, Norman, 1869.

10. *Gastrosaccus spinifer* (Goës).

1863. *Mysis spinifer*, Goës, Öfvers K. Vet.-Akad. Handl., vol. xx. p. 14.
1872. *Acanthocaris Livingstoniana*, G. Sim, Scottish Naturalist, vol. i. p. 185, pl. iv. fig. B, 1-7.

Habitat.—Obtained frequently in surface tow-net gatherings collected off Bo'ness in 1887-88, and subsequently at various places throughout the estuary.

Genus (7) **Heteromysis**, S. I. Smith, 1873.

11. *Heteromysis formosa*, S. I. Smith.

1873. *Heteromysis formosa*, Smith, U.S.A., Fish and Fisheries Comm. Rept., 1871-72, p. 553.

Habitat.—One or two specimens were captured off the east side of Inchkeith in October 1888. Taken also at Station I. in August 1894, and at Station IV. on 27th February 1895.

Genus (8) **Erythrops**, G. O. Sars, 1870.

12. *Erythrops erythrophthalmus* (Goës).

1863. *Mysis erythrophthalmus*, Goës, Crust. Decap. Marina Suecicæ, p. 18.
1870. *Erythrops Goësii*, G. O. Sars, Carcin. Bidrag til Norges Fauna, I. Monogr. Mysider, p. 24, pl. i.

Habitat.—Frequent in all parts of the estuary between Inchkeith and May Island, especially during the winter and spring.

13. *Erythrops elegans*, G. O. Sars.

1863. *Nematopus elegans*, G. O. Sars, Beret. om en i Somm. 1862 foret. zool. Reise i Chr. oy Throndhjems Stifter, p. 42.

Habitat.—Firth of Forth, 1901, taken very sparingly on one or two occasions.

14. *Erythrops serratus*, G. O. Sars.

1870. *Erythrops serratus*, G. O. Sars, Monogr. Mysider (I.), p. 27, pl. ii. figs. 1-12.

Habitat.—Obtained in 1889 in the neighbourhood of the Bass Rock, rare.

Genus (9) **Mysidopsis**, G. O. Sars, 1864.

15. *Mysidopsis didelphys* (Norman).

1863. *Mysis didelphys*, Norman, Trans. Tyneside Nat. Field Club, vol. 5, p. 270, pl. xii. figs. 9-11.

1872. *Mysidopsis didelphys*, G. O. Sars, Monogr. Mysider (II.), p. 20, pl. vii.

Habitat.—Taken in the Firth of Forth in November 1888, and subsequently on various occasions, and in different parts of the estuary, but always sparingly.

16. *Mysidopsis gibbosa*, G. O. Sars.

1864. *Mysidopsis gibbosa*, G. O. Sars, Zool. Reise 1863, i Christiania Stifter, p. 28.

Habitat.—Firth of Forth, frequent. It has been taken in Granton Harbour, as well as at several of the Experimental Stations (cf. *Sixteenth F. B. Rept.*, pt. iii. p. 209, 1898).

17. *Mysidopsis angusta*, G. O. Sars.

1864. *Mysidopsis angusta*, G. O. Sars, Zool. Reise 1863, i Chr. Stifter, p. 30.

Habitat.—Captured very sparingly at Stations I., III., and V., not more than one or two specimens being obtained in any single gathering.

Genus (10) **Leptomysis**, G. O. Sars, 1869.

18. *Leptomysis gracilis*, G. O. Sars.

1864. *Mysis gracilis*, G. O. Sars, Zool. Reise 1863, i Chr. Stifter, p. 23.

1869. *Leptomysis gracilis*, idem, Undersögelser over Christiania-fjordens, Dybvandsfauna, p. 29.

Habitat.—Captured off the east side of Inchkeith, off St Monans, and in the vicinity of Fidra, in October and November 1888, and subsequently at nearly all the Experimental Stations.

19. *Leptomysis lingvura*, G. O. Sars.

? 1842. *Cynthia Flemingii*, Goodsir, Edin. New Phil. Jour., vol. xxxiii. p. 175, pl. ii. fig. 1.

1866. *Leptomysis lingvura*, G. O. Sars, Zool. Reise 1865, i Chr. Stifter, p. 21.

Habitat.—Obtained in a tow-net gathering collected off

Joppa in September 1887; off the east side of Inchkeith in March 1892, and also in other parts of the estuary, but always very sparingly.

Genus (11) **Hemimysis**, G. O. Sars, 1869.

20. *Hemimysis Lamornæ* (Couch).

1856. *Mysis Lamornæ*, Couch, The Zoologist, p. 5286.

Habitat.—Collected off Bo'ness in November 1887; Largo Bay, December 1888; and afterwards at nearly all the Experimental Stations. This species, when living, is readily observed by its brilliant red colour.

Genus (12) **Macropsis**, G. O. Sars, 1876.

21. *Macropsis Slabberi* (Van Beneden).

1860. *Podopsis Slabberi*, Van Ben., Rech. sur la faune litt. de Belgique, Crust., p. 18, pl. vi.

1876. *Macropsis Slabberi*, G. O. Sars, Middelhavets Mysider, p. 28, pls. xi.-xiii.

Habitat.—Firth of Forth below Grangemouth, 1884, and subsequently near Granton Quarry, Inchmickery, and Inchkeith (Henderson). Common off Bo'ness and off Musselburgh, but becoming gradually scarcer seaward, and rarely taken at the mouth of the estuary.

Genus (13) **Macromysis**, White, 1847.[1]

22. *Macromysis flexuosus* (O. F. Müller).

1788. *Cancer flexuosus*, Müll., Zoologia Danica,—Discript. et Hist., vol. ii. p. 34, pl. lxiv. figs. 1-9.

1853. *Macromysis chamæleon*, Bell, Brit. Stalk-eyed Crust., p. 336.

Habitat.—Common, especially inshore, off Musselburgh and in the upper parts of the estuary. (See Norman, *op. cit.*, for a list of synonyms.)

23. *Macromysis inermis* (Rathke).

1843. *Mysis inermis*, Rathke, Beitr. zur Fauna Norw., p. 20.

Habitat.—Off Bo'ness in November 1887, and in February

[1] Cf. Stebbing on the name of the genus in *A History of Crustacea*, p. 267 (1893).

1895. I have also observed it at Stations V., VIII., and IX., though somewhat sparingly.

Genus (14) **Schistomysis**, Norman, 1892.

24. *Schistomysis spiritus*, Norman.

1860. *Mysis spiritus,* Norman, Ann. and Mag. Nat. Hist. (3), vol. vi. p. 431, pl. viii. fig. 1.

Habitat.—Off Bo'ness in November 1887, and subsequently at nearly all the Experimental Stations. Moderately frequent.

25. *Schistomysis ornata* (G. O. Sars).

1864. *Mysis ornata,* G. O. Sars, Zool. Reise 1863, i Chr. Stifter, p. 18.

Habitat.—Off Bo'ness in November 1887, with the others recorded above, and at nearly all the Experimental Stations.

Genus (15) **Neomysis**, Czerniavsky, 1882.

26. *Neomysis vulgaris* (J. V. Thompson).

1828. *Mysis vulgaris,* J. V. Thompson, Zoolog. Researches, vol. i. p. 30.

Habitat.—Moderately common in some parts of the estuary, as west of Queensferry and off Musselburgh. I have also captured it in Granton Harbour. In shoals at the mouth of Belhaven Burn, September 1905 (Evans).

Order 2. EDRIOPHTHALMA.

Suborder Sympoda.[1]

In the preparation of this part of the Catalogue, I have adhered more or less closely to the arrangement and nomenclature of Sars *Crustacea of Norway*, vol. iii., published 1899-1900. See also a paper by myself in the *Annals of Scottish Natural History* for October 1900.

[1] See remarks on this group by Rev. T. R. R. Stebbing, in his account of the *Crustacea brought by Dr Welley from the South Seas*, published by the Cambridge University Press, December 1900.

Family BODOTRIIDÆ.

Genus (1) **Bodotria**, Goodsir, 1843.

1. *Bodotria arenosa*, Goodsir.

1843. *Bodotria arenosa*, Goodsir, Edin. New Phil. Jour., vol. xxxiv. p. 120, pl. iii. (See also Proc. Roy. Phys. Soc., vol. ii. p. 10.)

Habitat.—Firth of Forth, 1841-42 (Goodsir).

2. *Bodotria scorpioides* (Montagu).

1808. *Cancer scorpioides*, Mont., Trans. Linn. Soc., vol. ix. p. 70, pl. vi. fig. 5.

1843. *Cuma Edwardsii*, Goodsir, *op. cit.*, p. 123, pl. ii. figs. 1-13.

Habitat.—Firth of Forth (Goodsir). Largo Bay (Leslie and Herdman). Dredged off Musselburgh and a few other places.

3. *Bodotria pulchella* (G. O. Sars).

1879. *Cuma pulchella*, G. O. Sars, Middlehavets Invertebratfauna (II. Cumaceer), p. 24, pl. vi.

Habitat.—Off St Monans, Largo Bay, and in the neighbourhood of Fidra; moderately common.

Genus (2) **Cumopsis**, G. O. Sars, 1879.

4. *Cumopsis Edwardsii* (Spence Bate).

1856. *Cuma Edwardsii*, Bate, Ann. and Mag. Nat. Hist. (2), vol. xvii. p. 457, pl. xiv.

1860. *Bodotria Goodsiri*, Van Beneden, Rech. sur la faune litt. de Belgique (Crust.), p. 76, pl. xiii.

Habitat.—Taken at Joppa, in pools between tide-marks, in 1888. Captured with bottom tow-net at Station III., in September 1891, and subsequently in various other parts of the estuary.

Genus (3) **Iphinoë**, Spence Bate, 1856.

5. *Iphinoë trispinosa* (Goodsir).

1843. *Cuma trispinosa*, Goodsir, Edin. New Phil. Jour., vol. xxxiv. p 126, pl. iii.

1856. *Venilia gracilis*, Bate, Ann. and Mag. Nat. Hist. (2), vol. xvii. p. 460, pl. xv. fig. 7 (♂).

Habitat.—Firth of Forth (Goodsir). Bass Rock, 24 fathoms (Metzger). This species is not rare in the Forth estuary, especially inshore, where the bottom consists of muddy sand.

Family VAUNTHOMPSONIIDÆ.

Genus (4) **Vaunthompsonia**, Spence Bate, 1858.

6. *Vaunthompsonia cristata*, Bate.

1858. *Vaunthompsonia cristata*, Bate, Nat. Hist. Review, vol. v. p. 203.

Habitat.—Off the west side of May Island on 11th March 1896. This appears to be a rare species in the Forth estuary.

Family LAMPROPIDÆ.

Genus (5) **Lamprops**, G. O. Sars, 1862.

7. *Lamprops fasciata*, G. O. Sars.

1862. *Lamprops fasciata*, G. O. Sars, Zool. Reise i Sömmeren, 1862, p. 44.

Habitat.—Near Joppa, frequent between tide-marks; also taken in Granton Harbour. It is not uncommon in shallow inshore water, where the bottom is muddy sand.

Family LEUCONIDÆ.

Genus (6) **Leucon**, Kröyer, 1846.

8. *Leucon nasicus*, Kröyer.

1841. *Cuma nasica*, Kröyer, Naturh. Tidsskrift, 1 R., B. iii. p. 524, pl. vi. figs. 31-33.

Habitat.—More or less frequent all over the estuary; its distribution appears to be somewhat irregular, due in part, perhaps, to seasonal variation. My latest record of the species is for Station V., where it was captured on 26th April 1901.

Genus (7) **Eudorella**, Spence Bate, 1867.

9. *Eudorella emarginata* (Kröyer).

1846. *Leucon emarginatus*, Kröyer, Naturh. Tidssk. Ny R., B. ii. pp. 181 and 209, pl. ii. fig. 3, *a-h*.

Habitat.—Taken in deep water near the seaward limits of the estuary; not common.

10. *Eudorella truncatula,* Spence Bate.

1856. *Eudora truncatula,* Bate, Ann. and Mag. Nat. Hist. (2), vol. xvii. p. 457, pl. xiv. fig. 3.

1900. *Eudorella truncatula,* G. O. Sars, *op. cit.*, p. xxxvii, pl. xxix.

Habitat.—Firth of Forth, sparingly distributed; my latest record is for Station III., where it was collected on 23rd May 1901. Immature specimens are not uncommon, but adults of either sex are rare.

Genus (8) **Eudorellopsis,** G. O. Sars, 1882.

11. *Eudorellopsis deformis* (Kröyer).

1846. *Leucon deformis,* Kröyer, *op. cit.*, p. 194, pl. ii. fig. 4.

Habitat.—Taken off St Monans and in Aberlady Bay, 1890; not common. This species, though somewhat rare, is widely distributed.

Family Diastylidæ.

Genus (9) **Diastylis,** Say, 1818.

12. *Diastylis Rathkei* (Kröyer).

1841. *Cuma Rathkei,* Kröyer, Naturh. Tidssk., vol. iii. p. 513, pls. v. and vi. figs. 17-30.

Habitat.—Not very rare in the Firth of Forth. A considerable number of specimens were captured by the dredge off the west side of Inchkeith in 1888: both females and adult males were present in this gathering. Prof. G. O. Sars mentions (*Crustacea of Norway,* p. 108) that the drawings of the male on plate lxxii. of his fine work on this group were prepared from a Forth specimen. Adam White, in his *Popular History of British Crustacea,* considered the *Alauna rostrata* of Goodsir to be synonymous with *D. Rathkei* (Kröyer),—an opinion which is also shared by Canon Norman.

13. *Diastylis rugosa,* G. O. Sars.

1864. *Diastylis rugosa,* G. O. Sars, Chr. Vid.-Selsk. Forhandl. (1864), p. 41.

Habitat.—Generally distributed, but not common. It has been taken in Largo Bay, off St Monans, off North Berwick, and in the deep water west of May Island.

14. *Diastylis lucifera* (Kröyer).

1841. *Cuma lucifera*, Kröyer, Naturh. Tidsskr., 1 R., B. iii. p. 527.

Habitat.—It has been taken very sparingly off the west side of Inchkeith, and at Stations V. and VII.; not common.

15. *Diastylis rostratus* (Goodsir).

1843. *Alauna rostrata*, Goodsir, Edin. New Phil. Jour., vol. xxxiv. p. 130, pl. iv. figs. 1-10. (See also Proc. Roy. Phys. Soc., vol. ii. p. 10.)
1869. *Diastylis lævis*, Norman,[1] Brit. Assoc. Rept. (1868), p. 27.
1900. ,, *rostratus*, G. O. Sars, Crustacea of Norway, p. 51, pl. 39.

Habitat.—Firth of Forth (Goodsir). Off Fidra, in 12 fathoms (Henderson). I have obtained *Diastylis lævis*, Norman, at Experimental Stations III., V., VI., and VII., but always very sparingly.

16. *Diastylis spinosa*, Norman.

1869. *Diastylis spinosa*, Norman, Brit. Assoc. Rept. for 1868, p. 271.

Habitat.—Off North Berwick, in 10 to 15 fathoms; captured in March 1891, but not identified till 1900. The species was described from specimens taken by Norman in Shetland in 1863. It was subsequently discovered in the Moray Firth by Thomas Edward of Banff, and in the Firth of Clyde by Dr Robertson of Millport, Cumbrae.

Family PSEUDOCUMIDÆ.

Genus (10) **Pseudocuma**, G. O. Sars, 1864.

17. *Pseudocuma cercaria* (Van Beneden).

1861. *Leucon cercaria*, Van Beneden, Rech. sur la Faune litt. de Belgique (Crust.), p. 85, pl. iv.

Habitat.—Common, and generally distributed in the Firth.

18. *Pseudocuma similis*, G. O. Sars.

1900. *Pseudocuma similis*, G. O. Sars, Crustacea of Norway, vol. iii. p. 76, pl. liii.

Habitat.—Firth of Forth, apparently rare, but it resembles

[1] Canon Norman considers that the *Alauna rostrata* of Goodsir is not the same as his *Diastylis lævis*, but is rather synonymous with Kröyer's *D. Rathkei* as stated above. If that is so, *D. lævis* will have to be restored for this species.

the common *Pseudocuma cercaria* so closely that it is easily overlooked. The specimens I have were dredged at Station V., on 24th April 1901.

Genus (11) **Petalosarsia**, Stebbing, 1893.

19. *Petalosarsia declivis* (G. O. Sars).

1864. *Petalopus declivis*, G. O. Sars, Chr. Vid. Selsk. Forhandl. (1864), p. 72.

Habitat.—Dredged in Largo Bay in March 1891; in the neighbourhood of May Island on 14th April 1893, and very sparingly in other parts of the estuary.

Family Nannastacidæ.

Genus (12) **Cumella**, G. O. Sars, 1864.

20. *Cumella pygmæa*, G. O. Sars.

1864. *Cumella pygmæa*, G. O. Sars, Chr. Vid. Selsk. Forhandl. (1864), p. 74.
1869. ,, *agilis*, Norman, Brit. Assoc. Rept. (1868), p. 272.

Habitat.—Taken at Station VI. (off St Monans), in May and again in July 1901; rare. This is a minute species, and easily missed; it may therefore be more frequent in the Forth estuary than at present it appears to be.

Family Campylaspidæ.

Genus (13) **Campylaspis**, G. O. Sars, 1864.

21. *Campylaspis rubicunda* (Lilljeborg).

1855. *Cuma rubicunda*, Lillj., Öfvers af Vet.-Akad. Forhandl., p. 121.

Habitat.—Taken in the neighbourhood of the Bass Rock in 1889, and at Station V. on 30th August 1894. It has also been taken off the east side of May Island, but always very sparingly. This appears to be a deep-water species, and is usually found on a muddy bottom.

Suborder Isopoda.

The work I have followed in the arrangement and nomenclature of the Isopoda is Prof. G. O. Sars' *Crustacea of Norway*, vol. ii. (1896-1899).

The Rev. Canon Norman's papers on "British Land Isopoda" and "British Isopoda Chelifera" [in *Ann. and Mag. Nat. Hist.* (7), vol. iii. (January and April 1899)] have been useful to me in the preparation of this section of the Catalogue, and to shorten the synonymy the reader is referred to these works; also to a paper by myself in the *Annals of Scottish Natural History* for October 1898.

CHELIFERA.

Family TANAIDÆ.

Genus (1) **Tanais**, M.-Edwards, 1828.

1. *Tanais Cavolinii*, H. Milne-Edwards.

1828. *Tanais Cavolinii*, M.-Edw. in Préces d'Entom., by Audouin, and M.-Edw., vol. i., pl. xxix. fig. 1.
1842. ,, *tomentosus*, Kröyer, Naturh. Tidsskr., R. 1, vol. iv. (1842-43), p. 167.

Habitat.—Taken at May Island and Dunbar, about half tide, living chiefly among mussels (Henderson).

Genus (2) **Paratanais**, Dana, 1852.

2. *Paratanais Batei*, G. O. Sars.

1866. *Paratanais forcipatus*, Bate and Westw., Brit. Sessile-eyed Crust., vol. ii. p. 138.

Habitat.—Off North Berwick, December 1892; dredged off North Craig, near Inchkeith, in 10 to 12 fathoms on 4th July 1901, apparently rare.

Genus (3) **Typhlotanais**, G. O. Sars, 1880.

3. *Typhlotanais brevicornis*, Lilljeborg.

1865. *Tanais brevicornis*, Lillj., Bidrag til Känned. Sver. och Norr. Crust. af Isopod. und.-ord. och Tanaidernes fam., p. 15.

Habitat.—Firth of Forth, 1894; rare. This specimen, though collected in 1894, has only recently been identified.

Genus (4) **Leptognathia**, G. O. Sars, 1880.

4. *Leptognathia brevimana* (Lilljeborg).

1865. *Tanais brevimana*, Lillj., *op. cit.*, p. 22.

Habitat.—Taken in 1891 and 1892. Station VII., in 17 fathoms, 9th July 1901. This, like the species already recorded, was obtained in the deeper parts of the estuary.

5. *Leptognathia breviremes* (Lilljeborg).

1865. *Tanais breviremis*, Lillj., *op. cit.*, p. 21.

Habitat.—Firth of Forth, 1891 and 1892; moderately rare.

6. *Leptognathia Lilljeborgia*, Stebbing.

1891. *Leptognathia Lilljeborgia*, Stebbing, Ann. and Mag. Nat. Hist. (6), vol. viii. p. 328, pl. 16.

Habitat.—Largo Bay, and off Musselburgh, in 1891. Off North Berwick in December 1892. Off Aberdour, November 1893; apparently rare.

7. *Leptognathia longiremis* (Lilljeborg), var.

1865. *Tanais longiremis*, Lilljeb., *op. cit.*, p. 19.
1901. *Leptognathia longiremis*, var., T. Scott, Nineteenth F. B. Rept., pt. iii. p. 269, pl. xviii. figs. 30-38.

Habitat.—Off North Berwick, December 1892 and January 1894. Off Musselburgh, 30th May 1891, and in the neighbourhood of the Bass Rock on 9th July 1901. This form, as shown by the drawings in the *Fishery Board Report* referred to, differs from the typical *L. longiremis* by the apparent absence of the lateral denticles on the terminal segment of the metasome, and, moreover, the antennules in the female are sometimes composed of *five* instead of *four joints.* Perhaps variety *varia* might be a suitable name for this form.[1]

Genus (5) **Tanaopsis**, G. O. Sars, 1896.

8. *Tanaopsis laticaudata*, G. O. Sars.

1881. *Leptognathia laticaudata*, G. O. Sars, Archiv f. Math. og Naturvid., p. 43.

Habitat.—Firth of Forth, 1891. Dredged at Station III. on 23rd May, and at Station VII., in 17 fathoms, on 9th July 1901.

[1] As there are no specimens in my collection of the *Leptognathia rigida*, Spence Bate, mentioned in my *Notes on some Scottish Marine Isopods*, I am unable to verify the record, and prefer, therefore, to exclude it from the present Catalogue.

FLABELLIFERA.

Family GNATHIIDÆ.

Genus (6) **Gnathia**, Leach, 1814.

9. *Gnathia maxillaris* (Montagu).

1804. *Oniscus maxillaris*, Mont., Trans. Linn. Soc., vol. vii. p. 65, pl. vi. fig. 2.
1814. *Gnathia termitoides*, Leach, Edin. Encyclop., vol. vii. p. 402.
1818. *Anceus maxillaris*, Lamarck, Animaux Sans Vertèbres, vol. v. p. 168.

Habitat.—Near Inchkeith, 1888, and subsequently in various parts of the estuary; the female being more frequently met with than the male.

Family CIROLANIDÆ.

Genus (7) **Eurydice**, Leach, 1815.

10. *Eurydice pulchra*, Leach.

1815. *Eurydice pulchra*, Leach, Trans. Linn. Soc., vol. xi. p. 370.
1867. ,, ,, Bate and Westwood, Brit. Sess.-eyed Crust., vol. ii. p. 310.

Habitat.—Taken off Preston Island, west of Queensferry, 28th November 1887; and at Station III., November 1890. I have not met with this species very frequently in the Forth estuary.

Family LIMNORIDÆ.

Genus (8) **Limnoria**, Leach, 1814.

11. *Limnoria lignorum* (Rathke).

1799. *Cymothoa lignorum*, Rathke, Skrifter af Naturh. Selsk., p. 101, pl. iii. fig. 14.
1814. *Limnoria terebrans*, Leach, Edin. Encycl., vol. vii. (Crust.) p. 433.

Habitat.—Firth of Forth, at Elie (Leslie and Herdman). Common, burrowing in old wood of piers, wharves, etc., exposed between tide-marks on both sides of the estuary.

Family Sphæromidæ.

Genus (9) **Sphæroma**, Latreille, 1802.

12. *Sphæroma rugicauda*, Leach.

1814. *Sphæroma rugicauda*, Leach, Edin. Encycl., vol. vii. p. 405.

Habitat.—In brackish pools at Aberlady; common.

Genus (10) **Næsa**, Leach, 1818.

13. *Næsa bidentata* (Adams).

1798. *Oniscus bidentatus*, Adams, Trans. Linn. Soc., vol. v. p. 8, pl. ii. figs. 3 and 4.

Habitat.—Found alive amongst barnacles and weed scraped from a ship's hull at Granton Harbour in 1888 (cf. *Ann. Scot. Nat. Hist.* (April 1899), p. 116).

Valvifera.

Family Idotheidæ.

Genus (11) **Idothea**, Fabricius, 1798.

14. *Idothea baltica* (Pallas).

1774. *Oniscus balticus*, Pallas, Spicil Zool., fasc. ix. p. 66, pl. iv. fig. 6, A-D.

1825. *Idotea tricuspidata*, Desmarest, Consid. sur Crust., p. 289.

Habitat.—Firth of Forth, in shallow water at various places (Leslie and Herdman). Moderately common upon Laminaria and other sea-weeds in shallow water on both sides of the estuary.

15. *Idothea pelagica*, Leach.

1815. *Idothea pelagica*, Leach, Trans. Linn. Soc., vol. xi. p. 365.

1868. ,, ,, Bate and Westw., Brit. Sessile-eyed Crust., vol. ii. p. 384.

Habitat.—"Common on the Bell Rock in the Firth of Forth" (Bate and Westwood, *op. cit.*, p. 385). "Bell Rock" is doubtless, I think, a misprint for Bass Rock, for it is described as being "in the Firth of Forth," whereas the Bell Rock is 13 or 14 miles north by east of Fife Ness, the extreme limit of the Forth estuary on the north side.

16. *Idothea emarginata* (Fabricius).

1794. *Cymothoa emarginata*, Fabr., Entomon. Syst., vol. ii. p. 508.

Habitat.—Aberlady Bay, 1888. Station I., 23rd May 1891. Occasionally obtained with *I. baltica* amongst Laminaria at various places within the estuary.

17. *Idothea linearis* (Linné).

1767. *Oniscus linearis*, Linn., Syst. Nat., vol. ii. p. 1060.
1868. *Idotea linearis*, Bate and Westw., *op. cit.*, vol. ii. p. 388.

Habitat.—Occasionally at Newhaven (Henderson). Off Crail, 1888. Station X. (west of Queensferry), 31st August 1894, and 26th April 1901. Station IV., 22nd April 1901. Several of the specimens are adorned with longitudinal light and dark lines (cf. form *I. sexlineata*, Kröyer).

Family ARCTURIDÆ.[1]

Genus (12) **Astacilla**, Cordiner, 1795.

18. *Astacilla longicornis* (Sowerby).

1806. *Oniscus longicornis*, Sow., British Miscellany, Taf. 19.[2]
1841. *Leachia gracilis*, Goodsir, Edin. New Phil. Jour., vol. xxxi. p. 310, pl. vi. fig. 4 (♂).
1868. *Arcturus longicornis*, Bate and Westw., Brit. Sessile eyed Crust., vol. ii. p. 365.

Habitat.—Firth of Forth (Goodsir). Off Dysart, T. W. Simmons (cf. Bate and Westwood, *op. cit.*, vol. ii. p. 369). Moderately frequent in the estuary, and generally distributed. G. O. Sars considers the *A. gracilis* of Goodsir to be the male of *A. longicornis*.

19. *Astacilla intermedia* (Goodsir).

1841. *Leachia intermedia*, Goodsir, *op. cit.*, p. 309, pl. vi. fig. 1.
1868. *Arcturus intermedius*, Bate and Westw., Brit. Sessile-eyed Crust., p 371.

Habitat.—Taken off Anstruther (Goodsir). This is the

[1] As *Astacilla*, Cordiner, was instituted in 1795, and *Arcturus*, Latreille, in 1804, the family name should perhaps be ASTACILLIDÆ, from the older genus.

[2] James Sowerby, "*British Miscellany;* or, Coloured Figures of New, Rare, or Little-Known Animal Subjects, many not before ascertained to be Natives of the British Isles." London, 1806, 8vo.

Astacilla affinis, G. O. Sars (*Crustacea of Norway*, vol. ii. p. 90).

Genus (13) **Arcturella**, G. O. Sars, 1897.

20. *Arcturella dilatata*, G. O. Sars.

1882. *Astacilla dilatata*, G. O. Sars, Overs. af Norges Crust., vol. i. p. 63, pl. ii. fig. 3.

Habitat.—Dredged off St Monans, 22nd May 1901; only a single male specimen was obtained.

ASELLOTA.

Family ASELLIDÆ.

Genus (14) **Asellus**, G. St Hillaire, 1764.

21. *Asellus aquaticus* (Linné).

1761. *Oniscus aquaticus*, Linn., Fauna Suecica, 2nd ed., p. 500.
1868. *Asellus aquaticus*, Bate and Westw., Brit. Sessile-eyed Crust., vol. ii. p. 343.

Habitat.—Pond at Redbraes, near Edinburgh, "in remarkable profusion" (Sir J. Dalyell). Very common in Union Canal, near Gilmore Place, Edinburgh (1889-90); Duddingston Loch (1897). Marchfield Pond, very common (Dr and Miss Sprague, July 1900). Braid Burn; Peffer Burn, near Aberlady, etc. (W. Evans). Upper Elf Loch, Braid Hills, common in 1905 (W. Evans).

Family JANIRIDÆ.

Genus (15) **Janira**, Leach, 1813

22. *Janira maculosa*, Leach.

1813. *Janira maculosa*, Leach, Edin. Encycl., vol. vii. p. 434.

Habitat.—Firth of Forth, off Bo'ness, 1887. Taken at Station IX. in April 1870, and subsequently at other stations, but always very sparingly.

Genus (16) **Jæra**, Leach, 1813.

23. *Jæra marina* (O. Fabricius).

1780. *Oniscus marinus*, Fabr., Fauna Grönlandica, p. 252.
1813. *Jæra albifrons*, Leach, Edin. Encycl., vol. vii. p. 434.

Habitat.—Common at May Island and Granton Quarry under stones, near high-water mark (Henderson). Dredged off Inchkeith; taken between tide-marks at Joppa and other places; frequent. South Queensferry (Evans). Sars is somewhat doubtful whether the form figured by Bate and Westwood under the name of *Jæra Nordmanni*, Rathke, is the true Rathkian species, or more probably the male of *Jæra marina.*

Family MUNNIDÆ.

Genus (17) **Munna**, Boeck, 1839.

24. *Munna Kröyeri*, Goodsir.

1842. *Munna Kröyeri*, Goodsir, Edin. New Phil. Jour., vol. xxxiii. p. 365, pl. vi. fig. 6.

Habitat.—Firth of Forth (Goodsir). Off the west side of Inchkeith (1887). Dredged at Station III., and at the north-west end of Inchkeith, in May 1901; not very common.

Genus (18) **Paramunna**, G. O. Sars, 1866.

25. *Paramunna bilobata*, G. O. Sars.

1866. *Paramunna bilobata*, G. O. Sars, Beretning om en i Somm., 1865, foretag. Zool. Reise ved Kyst. af Christiania og Christiansands Stift., p. 31.

Habitat.—Firth of Forth, 1894. Moderately rare in dredged material from Stations VI. and III., and from the north-west end of Inchkeith, collected by F. G. Pearcey in May 1901.

Genus (19) **Pleurogonium**, G. O. Sars, 1871.[1]

26. *Pleurogonium rubicundum*, G. O. Sars.

1863. *Pleuracantha rubicunda*, G. O. Sars, Chr. Vidensk. Selsk. Forhandl., p. 16.

Habitat.—Firth of Forth, 1894 and 1895; rare.

[1] The Rev. Canon Norman, in a paper entitled "A Month on the Trondbjem Fiord" (*Ann. and Mag. Nat. Hist.* (6), vol. xiii. p. 281), remarks, "The genus *Leptaspidia*, Bate and Westwood, is, I think, unquestionably a synonym of *Pleurogonium*." Moreover, it seems to me that Bate and Westwood's text-figure of *Leptospidia* resembles *Pleurogonium inerme* more closely than any other species of the genus.

27. *Pleurogonium inerme*, G. O. Sars.

1882. *Pleurogonium inerme*, G. O. Sars, Oversigt af Norges Crust., vol. i. p. 67, pl. ii. fig. 5.

1891. *Leptaspidia brevipes*, T. Scott, Ninth F. B. Rept., pt. iii. p. 308.

Habitat.—Taken off Musselburgh, April 1891.

28. *Pleurogonium spinosissimum*, G. O. Sars.

1866. *Pleuracantha spinosissima*, G. O. Sars, Beretning om en i Somm., 1865, foretag. Zool. Reise ved Kyst. af Christiania og Christiansands Stift., p. 30.

Habitat.—Taken at the north-west end of Inchkeith, 23rd May 1901; rare.

Genus (20) **Eurycope**, G. O. Sars, 1863.

29. (?) *Eurycope mutica*, G. O. Sars.

1863. *Eurycope mutica*, G. O. Sars, Chr. Vid. Selsk.-Forhandl. (1863), p. 6.

Habitat.—Firth of Forth, near the Bass Rock, in 20 fathoms, 28th June 1904; two specimens that appear to belong to this species—one of them an ovigerous female—were obtained.

Oniscoida.

"This tribe comprises the air-breathing or terrestrial Isopoda" (G. O. Sars).

Family Ligiidæ.

Genus (21) **Ligia**, Fabricius, 1798.

30. *Ligia oceanica* (Linné).

1767. *Oniscus oceanicus*, Linn., Syst. Nat., ed. xii., vol. ii. p. 1061.

Habitat.—Cramond, 1888 (Mihi). Aberlady, November 1891; North Berwick, August 1897; and shore at Dalmeny, March 1901 (W. Evans). Also at Granton and other places, under stones on the shore.

Family TRICHONISCIDÆ.

Genus (22) **Trichoniscus**, Brandt, 1833.

31. *Trichoniscus pusillus*, Brandt.

1833. *Trichoniscus pusillus*, Brandt, Conspect. Monogr. Crust. Oniscodorum, p. 12, pl. iv. fig. 9.
1891. *Philougria riparia*, T. Scott., Proc. Roy. Phys. Soc. Edin., vol. xi. p. 76.

Habitat.—Under stones at St Margaret's Hope, Cramond Island, Arthur's Seat, Largo, and other places; moderately frequent. Generally distributed (W. Evans).

32. *Trichoniscus roseus* (C. L. Koch).

1838. *Itea rosea*, Koch, Deutschlands Crustaceen, p. 22, fig. 16.
1887. *Philougria rosea*, T. Scott, Trans. Nat. Hist. Soc. Glasg., vol. i. (N.S.) p. 373.

Habitat.—Under stones at South Queensferry, 23rd March 1901 (W. Evans, in *Ann. Scot. Nat. Hist.*, April 1901); in garden, Morningside, September 1905 (Evans). Salisbury Crags, Edinburgh, July 1887; and Cramond Island, 18th April 1888.[1] These last two records were overlooked in the preparation of my paper on "The Land and Fresh-Water Crustacea of the District around Edinburgh," part i., published in *Proc. Roy. Phys. Soc. Edin.*, vol. xi. p. 73 *et seq.*

Family ONISCIDÆ.

Genus (23) **Oniscus**, Linné, 1761.

33. *Oniscus asellus*, Linné.

1761. *Oniscus asellus*, Linn., Fauna Suecica, vol. iv. p. 183, No. 2058; and Syst. Nat., ed. xii., vol. ii. p. 1061.

Habitat.—Common everywhere, usually hiding under stones, old wood, etc. *O. fossor*, Bate and Westw., is now regarded as a form of *O. asellus.*

[1] On the occasion of this visit to Cramond Island in April 1888, a friend and I crossed over to it about 1 A.M.—just before the track was covered by the rising tide—and we remained on the island till the tide ebbed and began to flow again. The interval from the time that daylight made things visible till we recrossed to the mainland, was spent in searching for natural history objects, and especially for the smaller Crustacea, and with fairly satisfactory results.

Genus (24) **Philoscia**, Latreille, 1804.

34. *Philoscia muscorum* (Scopoli).

1763. *Oniscus muscorum*, Scopoli, Entomologia Carniolica, p. 415.

Habitat.—Under stones, among dead leaves, etc; common, and generally distributed.

Genus (25) **Platyarthrus**, Brandt, 1833.

35. *Platyarthrus Hoffmannseggi*, Brandt.

1833. *Platyarthrus Hoffmannseggi*, Brandt, Consp. Monogr. Crust. Onisc., p. 12, pl. iv. fig. 10.
1900. ,, ,, W. Evans, Ann. Scot. Nat. Hist. (July 1900), p. 186.

Habitat.—Near Inverkeithing, Fifeshire, "in nests of the common ashy-black ant, *Formica fusca*" (W. Evans, Edinburgh). The only other Scottish record for this curious species is that by Thomas Edward, of Banff, in the list of Crustacea in Smiles' *Life of Edward.*

Genus (26) **Porcellio**, Latreille, 1804.

36. *Porcellio scaber*, Latreille.

1804. *Porcellio scaber*, Latr., Hist. Nat. Générale et particulière des Crust. et des Insectes, vol. vii. p. 45.

Habitat.—Under stones, old wood, etc., everywhere.

37. *Porcellio pictus*, Brandt.

1830. *Porcellio pictus*, Brandt and Ratzeburg, Medicin. zoologie, vol. ii. p. 78, pl. xii. fig. 5.
1891. ,, ,, T. Scott, Proc. Roy. Phys. Soc. Edin., vol. xi. p. 78.

Habitat.—At the foot of a wall near Seafield, Leith, April 1888; apparently rare. Taken under a stone near Dunbar in 1904 (W. Evans).

Genus (27) **Cylisticus**, Schnitzler, 1853.

38. *Cylisticus convexus* (De Geer).

1778. *Oniscus convexus*, De Geer, Mem. pour Servir a l'hist. des Ins., vol. vii. p. 563, pl. xxxv. fig. 11.
1891. *Porcellio armadilloides*, T. Scott, Proc. Roy. Phys. Soc. Edin., vol. xi. p. 79.

Habitat.—Under stones at the foot of Salisbury Crags, 14th April 1888, and subsequently; not common. Foot of Salisbury Crags (W. Evans).

Family ARMADILLIDIIDÆ.

Genus (28) **Armadillidium**, Brandt, 1830.

39. *Armadillidium vulgare* (Latreille).

1804. *Armadillo vulgaris*, Latr., Hist. Nat. Crust. et Insectes, vol. vii. p. 48.
1891. ,, ,, T. Scott, Proc. Roy. Phys. Soc. Edin., vol. xi. p. 79.

Habitat.—Under stones at Salisbury Crags. Salisbury Crags, Blackford Hill, Pettycur, St David's (Fife), etc. (W. Evans).

EPICARIDA.

The Epicarida are but poorly represented in this "Catalogue of Forth Crustacea," and further careful research should add considerably to this group.

Family BOPYRIDÆ.

Genus (29) **Athelges**, Hesse, 1861.

40. *Athelges paguri* (Rathke).

1843. *Phryxus paguri*, Rathke, Nova Acta Acad. Nat. Curios., vol. xx. p. 57, pl. i. figs. 13-15; pl. ii. figs. 11 and 12.

Habitat.—Firth of Forth, parasitic on *Eupagurus bernhardus* (Dr J. Anderson).

Genus (30) **Phryxus**, Rathke, 1843.

41. *Phryxus abdominalis* (Kröyer).

1840. *Bopyrus abdominalis*, Kröyer, Nat. Tidsskr., vol. iii. p. 102, pls. i. and ii.

Habitat.—Firth of Forth, off St Abb's Head, 40 fathoms (Metzger). Station III., parasitic on *Pandalus Montagui*, Leach, 9th May 1901.

Family CRYPTONISCIDÆ.

Genus (31) **Cryptothir**, Dana, 1852.

42. *Cryptothir balani*, Spence Bate.

1860. *Liriope balani*, Bate, Brit. Assoc. Rept. (1860), p. 225.
1869. *Cryptothiria balani*, Bate and Westw., Brit. Sessile-eyed Crust., vol. ii. p 267.

Habitat.—Firth of Forth, parasitic on *Balanus balanoides* (inside the shell). This is one of the interesting additions to the fauna of the Firth of Forth by H. D. S. Goodsir. I obtained a single specimen of this curious parasite at East Tarbert, Loch Fyne, on the same kind of barnacle.

Suborder Amphipoda.

The classification (and arrangement) generally followed is that of G. O. Sars' *Crustacea of Norway*, vol. i. (Amphipoda), 1890-95. See also papers on "British Amphipoda," by Rev. A. M. Norman, in *Ann. and Mag. Nat. Hist.* for January, February, April, and July 1900.

HYPERIIDEA.

Family HYPERIIDÆ.

Genus (1) **Hyperia**, Latreille, 1825.

1. *Hyperia galba* (Montagu).

1815. *Cancer gammarus galba*, Mont., Trans. Linn. Soc., vol. xi. p. 4, pl. ii. fig. 2.

Habitat.—Frequent and generally distributed; often found associated with *Aurelia cyanea* and other large Medusæ.

Genus (2) **Hyperoche**, Bovalius, 1887.

2. *Hyperoche tauriformis* (Bate and Westwood).

1868. *Hyperia tauriformis*, Bate and Westw., Brit. Sessile-eyed Crustacea, vol. ii. p. 519.
1890. *Hyperoche Kröyeri*, G. O. Sars, Crustacea of Norway, vol. i. p. 9, pl. iv.

Habitat.—Generally, though sparingly, distributed throughout the estuary.

Genus (3) **Parathemisto**, Boeck, 1870.

3. *Parathemisto oblivia* (Kröyer).

1838. *Hyperia oblivia*, Kröyer, Grœnlands Amphipoder, p. 70, pl. iv. fig. 19.

Habitat.—Generally distributed, usually more or less frequent, and at times abundant, especially in the seaward part of the estuary, and particularly in winter and spring.

Genus (4) **Euthemisto**, Bovalius, 1887.

4. *Euthemisto compressa* (Goës).

1865. *Themisto compressa*, Goës, Öfvers k Vet.-Akad. Forhandl., p. 533, pl. xli. fig. 34.

Habitat.—Taken sparingly off the west side of May Island in February 1892 and November 1893; and at Station VII. (off North Berwick) in November 1892. These were probably stragglers from the great shoal of *Euthemisto* reported off the Yorkshire coast in February 1892.[1]

Gammaridea.

Family Orchestiidæ.

Genus (5) **Talitrus**, Latreille, 1802.

5. *Talitrus locusta* (Pallas).

1772. *Oniscus locusta*, Pallas, Spicilegia Zoologica, fasc. 9, pl. iv. fig. 7.

Habitat.—"Very abundant about high-tide mark among stones, seaweed, etc." (L. and H.). I have taken *T. locusta* near Dunbar. At high-water mark sandy beaches, Gullane and North Berwick (Evans).

Genus (6) **Orchestia**, Leach, 1814.

6. *Orchestia littorea* (Montagu).

1804. *Cancer gammarus littoreus*, Mont., Trans. Linn. Soc., vol. ix. p. 96, pl. iv. fig. 4.

Habitat.—Common on the shore west from Granton amongst decaying seaweed at about high-tide mark. Taken also on the shore near Dunbar. Aberdour and Prestonpans (Evans).

[1] Cf. T. H. Nelson in *Naturalist* for May 1892.

Genus (7) **Hyale**, Rathke, 1837.

7. *Hyale Nilssoni* (Rathke).

1843. *Amphitoe Nilssoni,* Rathke, Acta Akad. Leopold, vol. xx. p. 264.

Habitat.—"Granton Quarry, common; May Island, near high-water" (Henderson). West of Queensferry, rare.

[8. *Hyale* (*Nicea*) *Lubbockiana* (Spence Bate).

This species is recorded among my notes of Amphipoda dredged off St Monans in 1889, but no specimens are in my collection, and I am unable to verify the record.]

Family LYSIANASSIDÆ.

Genus (8) **Acidostoma**, Lilljeborg, 1865.

9. *Acidostoma obesum* (Spence Bate).

1862. *Anonyx obesus,* Bate, Cat. Amphip. Crust. Brit. Museum, p. 74, pl. xii. fig. 1.

Habitat.—Dredged between Fidra and the Bass Rock in 1893, and on 9th July 1901; it has also been dredged off St Monans, but always very sparingly.

Genus (9) **Socarnes**, Boeck, 1870.

10. *Socarnes Vahli* (Kröyer).

1838. *Lysianssa vahlii,* Kröyer, Grönlands Amfipoder, p. 5.
1896. *Socarnes Vahli,* T. Scott, Fourteenth F. B. Rept., part iii. p. 158.

Habitat.—Firth of Forth; very rare.

Genus (10) **Calisoma**, A. Costa.

11. *Calisoma Hopei,* A. Costa.

1851. *Calisoma Hopei,* A. Costa, Hope Cat. Crost. Ital., p. 44, and plate, fig. 2.
1863. ,, *crenata,* Bate and Westw., Brit. Sessile-eyed Crust., vol. i. p. 120.

Habitat.—Moderately common in the Firth of Forth; it occurs sometimes in abundance inside the dead tests of *Amphidotus* and *Spatangus,* feeding on the decaying animal matter; also on dead fishes.

Genus (11) **Hippomedon**, Boeck, 1870.

12. *Hippomedon denticulatus* (Spence Bate).

1862. *Anonyx denticulatus*, Bate, Cat. Amphip. Crust. Brit. Mus., p. 75, pl. xii. fig. 4.

Habitat.—Taken in the vicinity of May Island in 1888, and subsequently in various parts of the estuary between May Island and Inchkeith, but seldom more than a few specimens taken in any single gathering.

Genus (12) **Orchomene**, Boeck, 1870.

13. *Orchomene humilis* (A. Costa).

1857. *Lysianassa humilis*, A. Costa, Mem. del Accad. del Sc. de Napoli, vol. i. p. 187, pl. i. fig. 6.

1863. *Anonyx Edwardsi*, Bate and Westw., Brit. Sessile-eyed Crust., vol. i. p. 94.

1890. *Orchomene Batei*, G. O. Sars, Crustacea of Norway, vol. i. p. 6, pl. xxii.

Habitat.—In the neighbourhood of the Bass Rock; rare.

Genus (13) **Tryphosa**, Boeck, 1870.

14. *Tryphosa nana* (Kröyer).

1846. *Anonyx nanus*, Kröyer, Naturh. Tidsskr., 2 R., Bd. ii. p. 30.

1891. *Orchomenella ciliata*, G. O. Sars, *op. cit.*, p. 69, pl. xxv. fig. 2.

Habitat.—Taken near Joppa in 1888; subsequently in other parts of the estuary, but always sparingly.

Genus (14) **Tryphosella**, J. Bonnier, 1893.

15. *Tryphosella Sarsi*, Bonnier.

1891. *Tryphosa nana*, G. O. Sars, *op. cit.*, p. 76, pl. xxvii. fig. 1.

1893. *Tryphosella Sarsi*, Bonnier, Bull. Sci. France et Belgique, vol. xxiv. p. 170 (footnote).

Habitat.—Firth of Forth; not common.

16. *Tryphosella Höringii* (Boeck).

1870. *Tryphosa Höringii*, Boeck, Crust. Amphip. bor. et arct., p. 38.

Habitat.—Firth of Forth, 1896; off the east side of Inchkeith, in 5 fathoms, 23rd May 1901; not common.

17. *Tryphosella nanoides* (Lilljeborg).

1865. *Anonyx nanoides*, Lillj., On the Lysianassa magellanica, etc., p. 25, pl. iii. figs. 32-34.
1891. *Tryphosa nanoides*, G. O. Sars, Crustacea of Norway, vol. i. p. 79, pl. xxviii. fig. 2.
1893. *Tryphosella nanoides*, Bonnier, *op. cit.*, vol. xxiv. p. 171 (footnote).

Habitat.—Off St Monans, captured with a tow-net at a depth of about 13 fathoms, in November 1904. In this species, the palm of the first gnathopods does not slope away from the base of the claw (dactylus), but forms nearly a right angle with the sides of the propodos.

Genus (15) **Tryphosites**, G. O. Sars, 1891.

18. *Tryphosites longipes* (Spence Bate).

1863. *Anonyx longipes* and *ampula*, Bate and Westw., Brit. Sessile-eyed Crust., vol. i. pp. 113, 116.

Habitat.—Off St Monans, several specimens, 1889; and subsequently, but sparingly, in other parts of the estuary.

Genus (16) **Anonyx**, Kröyer, 1838.

19. *Anonyx nugax* (Phipps).

1774. *Cancer nugax*, Phipps, Voyage towards the North Pole, p. 192, pl. xii. fig. 2.
1893. *Anonyx nugax*, T. Scott, Eleventh F. B. Rept., pt. iii. p. 212, pl. v. figs. 18-21.

Habitat.—Near May Island, February 1889. North end of Inchkeith, 23rd January 1896; rare.

Genus (17) **Hoplonyx**, G. O. Sars, 1891.

20. *Hoplonyx leucophthalma*, G. O. Sars.

1891. *Hoplonyx leucophthalma*, G. O. Sars, *op. cit.*, p. 97, pl. xxxiv. fig. 1.

Habitat.—This somewhat critical species was taken off St Monans with a tow-net, close to the bottom, in November 1904. In this species the eyes are of a light cream colour or almost white; the dactylus of the first gnathopods has also a row of very minute spines extending along its dorsal aspect a little below the upper margin, which appears to be a character peculiar to this species.

Genus (18) **Lepidepecreum**, Spence Bate, 1868.

21. *Lepidepecreum longicorne* (Bate).

1861. *Anonyx longicornis*, Bate and Westw., *op. cit.*, vol. i. p. 91 (♂).

Habitat.—Off St Monans; off the north end of Inchkeith, January 1896; and off the east side of the same island, May 1901.

Family PONTOPOREIIDÆ.

Genus (19) **Bathyporeia**, Lindström, 1855.

22. *Bathyporeia Guilliamsoniana* (Bate).

1856. *Thersites Guilliamsoniana*, Bate, Brit. Assoc. Rept. (1856), p. 59; and Ann. Nat. Hist. (2), vol. xix. (1857) p. 146.

1891. *Bathyporeia norvegica*, G. O. Sars, Crust. of Norway, vol. i. p. 128, pl. xliii.

Habitat.—Firth of Forth; taken sparingly in various parts of the estuary.

23. *Bathyporeia pelagica*, Spence Bate.

1862. *Bathyporeia pelagica*, Bate, Cat. Amphip. Brit. Museum, p. 174, pl. xxxi. fig. 6.

Habitat.—Firth of Forth; taken occasionally with the other species of the genus.

24. *Bathyporeia Robertsoni*, Spence Bate.

1892. *Bathyporeia Robertsoni*, Bate, *op. cit.*, p. 173, pl. xxxi. fig. 5.

Habitat.—Firth of Forth, frequent near low-water on the sandy shore east of Burntisland; obtained by passing the wet sand through a wire-sieve.

Genus (20) **Haustorius**, Statius Müller, 1775.

25. *Haustorius arenarius* (Slabber).

1769. *Oniscus arenarius*, Slabber, Naturkund. Verlustig., etc., p. 92, pl. 11, figs. 3, 4.

Habitat.—Firth of Forth, sandy shore east of Burntisland, near low-water; not common.

Genus (21) **Urothoë**, Dana, 1852.

26. *Urothoë marinus*, Spence Bate.

1862. *Urothoë marinus*, Bate and Westw., Brit. Sessile-eyed Crust., vol. i. p. 195.

Habitat.—Firth of Forth; not very common.

27. *Urothoë brevicornis*, Spence Bate.

1862. *Urothoë brevicornis*, Bate and Westw., *op. cit.*, vol. i. p. 198.

Habitat.—Largo Bay; not common.

Family PHOXOCEPHALIDÆ.

Genus (22) **Phoxocephalus**, Stebbing, 1888.

28. *Phoxocephalus Holbölli* (Kröyer).

1842. *Phoxus Holbölli*, Kröyer, Naturh. Tidsskr., 1 R. p. 157.

Habitat.—Taken off the west side of May Island in 1888. Taken in Largo Bay in 1892 and 1894, and at Station III. on 23rd May 1901.

29. *Phoxocephalus Fultoni*, T. Scott.

1890. *Phoxocephalus Fultoni*, T. Scott, Eighth F. B. Rept., pt. iii. p. 327, pl. xii. figs. x.-xii.; pl. xiii. figs. xiii.-xix.

Habitat.—Off St Monans; not rare.

Genus (23) **Harpinia**, Boeck, 1870.

30. *Harpinia neglecta*, G. O. Sars.

1891. *Harpinia neglecta*, G. O. Sars, Crustacea of Norway, vol. i. p. 153, pl. liii. fig. 1.

Habitat.—Generally though sparingly distributed. First recorded for the Firth of Forth in 1888. This is the *Phoxus plumosus* of Bate and Westwood's *British Sessile-eyed Crustacea*, but not of Kröyer.

31. *Harpinia crenulata*, Boeck.

1870. *Harpinia crenulata*, Boeck, Crust. Amphip. bor. et arctica, p. 56.

Habitat.—Near Inchkeith, and other parts of the estuary; not common. Station III., in 5 fathoms, 23rd May 1901.

Family Ampeliscidæ.

Genus (24) **Ampelisca**, Kröyer, 1842.

32. *Ampelisca typica* (Spence Bate).

1857. *Tetromatus typicus*, Bate, Ann. and Mag. Nat. Hist. (2), vol. xix. p. 139.
1863. *Ampelisca Gaimardi*, Bate and Westw., Sessile-eyed Crust., vol. i. p. 127.

Habitat.—Between Fidra and the Bass Rock; not common.

33. *Ampelisca tenuicornis*, Lilljeborg.

1855. *Ampelisca tenuicornis*, Lillj., Öfvers af Vet.-Akad. Forhandl., p. 123.

Habitat.—Near the Bass Rock, 24 fathoms; off St Abb's Head, 40 fathoms (Metzger). Off Prestonpans, 1888, not common; off the North Craig, 4th July 1901.

34. *Ampelisca assimilis*, Boeck.

1870. *Ampelisca assimilis*, Boeck, Crust. Amphip. borealia et arctica, p. 144.

Habitat.—Taken near May Island, 1893. Off St Monans, in 13 fathoms, and at Station III., in 7 fathoms, May 1901. Several specimens of *Ampelisca*, including *A. assimilis*, were obtained in the stomachs of Long Rough Dabs captured in the Forth estuary in May 1901.

35. *Ampelisca brevicornis* (A. Costa).

1853. *Araneops brevicornis*, Costa, Rend. Acc. Napoli, p. 171.
1855. *Ampelisca lævigata*, Lillj., Öfvers K. Vet.-Akad. Forhandl., 1855, p. 123.

Habitat.—Largo Bay and one or two other places, 1893. Taken also at Station III., in 7 fathoms, on 23rd May 1901.

36. *Ampelisca macrocephala*, Lilljeborg.

1852. *Ampelisca macrocephala*, Lillj., *op. cit.* (1852), p. 7.

Habitat.—Firth of Forth, 24 fathoms (Metzger). I have obtained this species in the stomachs of Long Rough Dabs and Whitings captured in the Firth of Forth in May 1901, as well as in tow-net gatherings collected about the same time.

37. *Ampelisca spinipes*, Boeck.

1870. *Ampelisca spinipes*, Boeck, Crust. Amphip. borealia et arctica, p. 143.

Habitat.—Taken near May Island, not common, 1893. At Station III., in 5 fathoms, 23rd May 1901. Also in the stomachs of Long Rough Dabs and small Whitings captured in the estuary in May 1901.

38. *Ampelisca æquicornis*, Bruzelius.

1859. *Ampelisca æquicornis*, Bruz., K. Vet.-Akad. Handl., vol. iii. p. 82, pl. iv. fig. 15.

Habitat.—West of May Island, 20 fathoms (Henderson). This appears to be the only record of *A. æquicornis* for the Forth estuary.

Genus (25) **Byblis**, Boeck, 1870.

39. *Byblis Gaimardi* (Kröyer).

1848. *Ampelisca Gaimardi*, Kröyer, Gaimard's Voyaces en Scand., pl. xxiii. fig. 1.

Habitat.—Taken off St Abb's Head, 40 fathoms (Metzger, 1875). Near May Island, 1890 (Mihi).

Genus (26) **Haploops**, Lilljeborg, 1855.

40. *Haploops tubicola*, Lilljeborg.

1855. *Haploops tubicola*, Lillj., Öfvers K. Vet.-Akad. Forhandl. (1855), p. 134.

Habitat.—Taken near the Bass Rock, 1892, and in other parts of the estuary. Dredged in 5 fathoms at Station III., 23rd May 1901; found also in the stomachs of Long Rough Dabs (*Drepanopsetta platessoides*) captured in the Forth during the same month.

Family AMPHILOCHIDÆ.

Genus (27) **Amphilochus**, Spence Bate, 1862.

41. *Amphilochus manudens*, Spence Bate.

1862. *Amphilochus manudens*, Bate, Cat. Amphip. Brit. Mus., p. 107, pl. xvii. fig. 6.

Habitat.—Taken in South Bay in 1888, not common.

Dredged at Station III., and also at the north-west end of Inchkeith, on 23rd May 1901.

42. *Amphilochus tenuimanus*, Boeck.

1870. *Amphilochus tenuimanus*, Boeck, Crust. Amphip. borealia et arctica, p. 51.

Habitat.—Taken in the stomach of a small Whiting captured in the estuary in April, and in the stomach of a Long Rough Dab captured in May 1901; obtained also in a small gathering of dredged material at Station IX., collected 5th June 1903.

Genus (28) **Amphilochoides**, G. O. Sars.

43. *Amphilochoides serratipes* (Norman).

1869. *Probolium serratipes*, Norman, Brit. Assoc. Rept. (1868), p. 273.

1892. *Amphilochoides odontonyx*, G. O. Sars, Crust. of Norw., vol. i. p. 221, pl. lxxv. fig. 2.

1893. ,, ,, T. Scott, Eleventh F. B. Rept., pt. iii. p. 215, pl. v. figs. 41, 42.

Habitat.—Firth of Forth, near Fidra Island; rare.[1]

44. *Amphilochoides odontonyx* (Boeck).

1870. *Amphilochus odontonyx*, Boeck, Crust. Amphip. bor. et arct., p. 51.

1896. *Amphilochoides odontonyx*, T. Scott, Fourteenth F. B. Rept., pt. iii. p. 159, pl. iv. figs. 4-6.

Habitat.—At various places in the Firth of Forth, but always very sparingly. This species was described by Professor G. O. Sars under the name of *Amphilochoides pusillus*, but was afterwards identified as the true *A. odontonyx* of Boeck; see footnote below.

[1] At p. 159 of Part III. of the *Fourteenth Annual Report of the Fishery Board for Scotland* (1896), in my remarks on *Amphilochoides intermedius*, I state incidentally that the typical *A. odontonyx*, G. O. Sars (*A. serratipes*, Norman), had not hitherto been observed in the Firth of Forth; this was a mistake, due to my forgetting that that species had been recorded in Part III. of the *Eleventh Annual Report*, with drawings showing two of the most characteristic parts of the animal. Further, as pointed out by Professor G. O. Sars (*op. cit.*, p. 690), the form mentioned here is not the *A. odontonyx* of Boeck, but a different species, for which Sars proposed to substitute the name *A. Boecki*, being unaware that Norman had already described it.

45. *Amphilochoides intermedius*, T. Scott.

1896. *Amphilochoides intermedius*, T. Scott, Fourteenth F. B. Rept., pt. iii. p. 159, pl. iv. figs. 1-3.

Habitat.—Taken in various parts of the estuary, but usually very sparingly. The latest records I possess of the occurrence of *A. intermedius* in the Forth are for Station III., where it was obtained on the 23rd and 25th of May 1901.

Genus (29) **Gitana**, Boeck, 1870.

46. *Gitana Sarsi*, Boeck.

1870. *Gitana Sarsi*, Boeck, Crust. Amphip. borealia et arctica, p. 52.

Habitat.—Taken very sparingly in various parts of the estuary. My most recent record of this species is for Station III., where it was dredged on 23rd and 25th May 1901.

47. *Gitana abyssicola*, G. O. Sars.

1892. *Gitana abyssicola*, G. O. Sars, Crustacea of Norway, vol. i. p. 229, pl. lxxviii. fig. 2.

Habitat.—Dredged at Station VI. (off St Monans), 25th May 1901. One of the characters which serves to distinguish this small species from *G. Sarsi* is that the second pair of coxal plates are rather narrow, and they exhibit only two small serrations on the obtusely-pointed tips of these plates, instead of three, as in *G. Sarsi.*

Family Stenothoidæ.

Genus (30) **Stenothoe**, Dana, 1852.

48. *Stenothoe marina* (Spence Bate).

1862. *Montagua marina*, Bate, Catal. Amphip. Brit. Mus., p. 56, pl. viii. fig. 5.

Habitat.—Various parts in the Firth of Forth from Inchkeith to May Island, but not very common, 1889. Station V., 24th April, and off the north-west end of Inchkeith, 23rd May 1901.

49. *Stenothoe monoculoides* (Montagu).

1804. *Cancer (Gammarus) monoculoides*, Mont., Trans. Linn. Soc., vol. xi. p. 4, pl. ii. fig. 3.

Habitat.—Not very common; the specimens in my collection were taken in Granton Harbour with a surface tow-net.

Family METOPIDÆ, T. R. R. Stebbing, 1899.[1]

Genus (31) **Metopa**, Boeck, 1870.

50. *Metopa Alderi* (Spence Bate).

1862. *Montagua Alderi*, Bate, Catal. Amphip. Brit. Mus., p. 57, pl. viii. fig. 6.

Habitat.—Firth of Forth, 1889; and taken subsequently at nearly all the Experimental Stations within the limits of the estuary. It has been also observed in the stomachs of Whitings captured in 1901.

51. *Metopa borealis*, G. O. Sars.

1882. *Metopa borealis*, G. O. Sars, Oversigt Norges Crust., i. p. 91, pl. iv. fig. 4.

Habitat.—Dredged in South Bay, off Musselburgh, in 1888.

52. *Metopa rubrovittata*, G. O. Sars.

1882. *Metopa rubrovittata*, G. O. Sars, Oversigt Norges Crust., i. p. 90, pl. iv. figs. 2, 2*a*.

Habitat.—Obtained in a bottom tow-net gathering collected at Station II. on 30th August 1894.

53. *Metopa pusilla*, G. O. Sars.

1892. *Metopa pusilla*, G. O. Sars, Crustacea of Norway, vol. i. p. 206, pl. xc. fig. 1.

Habitat.—Firth of Forth, at the following places in 1901, viz.:—At Stations III. and VII. in April, at Station III. in May, and off North Craig in July; but not more than one or two specimens were obtained in any single gathering.[2]

[1] Cf. "Revision of Amphipoda," *Ann. and Mag. Nat. Hist.* for March, April, and September 1899.

[2] Cf. *Twentieth F. B. Rept.*, pt. iii. p. 478 (1902).

54. *Metopa Bruzelii* (Göes).

1865. *Montagua Bruzelii*, Göes, Crust. Amphip. maris Spitzberg., Öfv. K. svenska Vet.-Akad. förhandl. (1865), p. 522, pl. xxxviii. fig. 10.

Habitat.—Firth of Forth, 1896; not common.

55. *Metopa propinqua*, G. O. Sars.

1892. *Metopa propinqua*, G. O. Sars, Crustacea of Norway, vol. i. p. 264, pl. xciii. fig. 1.

Habitat.—Dredged off Crail in 1892; rare.

56. *Metopa norvegica* (Lilljeborg).

1851. *Leucothoë norvegica*, Lillj., Bidr. til Norra Rysslands og Nor. Fauna (1848); K. Vet.-Akad. Forhandl. (1851), vol. ii. p. 335, pl. xx. fig. 4.

1855. *Montagua pollexiana*, Spence Bate, Brit. Assoc. Report (1855), p. 57.

Habitat.—Newhaven (Henderson). Off the west side of Inchkeith, 1888. Dredged at the west end of Station III. in May, and off the North Craig in July, 1901. I find this species generally though sparingly distributed throughout the estuary.

Genus (32) **Sthenometopa**, Norman.[1]

57. *Sthenometopa robusta* (G. O. Sars).

1893. *Metopa robusta*, G. O. Sars, Crustacea of Norway, vol. i. p. 271, pl. xcvi. fig. 1.

1894. ,, ,, T. and A. Scott, Ann. and Mag. Nat. Hist. (6), vol. xiii. p. 184 (Feb. 1894).

Habitat.—Dredged at the west end of Station III. in May, and off the North Craig in July, 1901. The Rev. Canon Norman remarks (*op. cit.*, p. 45) that Dr J. R. Henderson obtained this species in the Firth of Forth in 1884, but that T. and A. Scott were the first to record it as British.[2]

Genus (33) **Metopella**, G. O. Sars, 1892.

58. *Metopella nasuta* (Boeck).

1870. *Metopa nasuta*, Boeck, Crust. Amphip. borealia et arctica, p. 64.

Habitat.—Taken in moderately deep water west of May

[1] Cf. Norman, *Natural History of E. Finmark* (pt. 2); *Ann. and Mag. Nat. Hist.*, Dec. 1902, p. 481.

[2] It would thus appear that when Henderson found his specimens the species was still undescribed. Sars did not describe it till 1893.

Island, in 1892. The generic name *Metopella* was proposed by G. O. Sars in his remarks on a closely allied species, *M. longimana*, Boeck.[1]

Family Cressidæ, Stebbing, 1899.

Genus (34) **Cressa**, Boeck, 1870.

59. *Cressa dubia* (Spence Bate).

1862. *Danaia dubia*, Bate, Catal. Amphip. Brit. Mus., p. 59, pl. x. fig. 1.

1870. *Cressa Schiödter*, Boeck, Crust. Amphip. borealia et arctica, p. 65.

Habitat.—Taken at Station V. in February 1892. Dredged at Station III. on 23rd May 1901; apparently not very common.

Family Leucothoidæ.

Genus (35) **Leucothoë**, Leach, 1814.

60. *Leucothoë Lilljeborgii*, Boeck.

1860. *Leucothoë Lilljeborgii*, Boeck, Forhandl. Skand. Natur. 8de Möde, p. 653.

Habitat.—Obtained in the neighbourhood of the Bass Rock, rare (1894). Dredged off the north-west end of Inchkeith on 23rd May 1901. Found also in the stomach of a Sharp-tailed *Lumpenus*, *Lumpenus lampretiformis*, captured in the estuary during the same month.

Family Œdiceridæ.

Genus (36) **Monoculodes**, Stimpson, 1853.

61. *Monoculodes carinatus*, Spence Bate.

1862. *Monoculodes carinatus*, Bate, Catal. Amphip. Brit. Mus., p. 104, pl. xvii. fig. 2.

Habitat.—Dredged in Largo Bay, off St Monans, and near Fidra Island; not common.

[1] Cf. *Crustacea of Norway*, vol. i. p. 274.

Genus (37) **Perioculodes**, G. O. Sars, 1892.

62. *Perioculodes longimanus* (Bate and Westwood).

1869. *Monoculodes longimanus*, B. and W., Brit. Sessile-eyed Crustacea, p. 507.

Habitat.—Dredged off Bo'ness, 1888; Largo Bay, 1890, frequent. Station V., 24th April, and in the neighbourhood of the Bass Rock in 20 fathoms, 28th June 1901. Also found in the stomachs of small Whiting captured in the estuary in May 1901.

Genus (38) **Pontocrates**, Boeck, 1870.

63. *Pontocrates arenarius* (Spence Bate).

1858. *Kröyera arenaria*, Bate, Trans. Tyneside Field Club, vol. iv., pt. i. (1858) p. 15, pl. ii. fig. 1.
1862. ,, ,, Bate and Westw., Brit. Sessile-eyed Crust., vol. i. p. 173.

Habitat.—Shore east of Burntisland, frequent, burrowing in the wet sand, near low-water, 1889. Dredged in shallow water, off Musselburgh, in May 1901.

64. *Pontocrates altamarinus* (Bate and Westwood).

1862. *Kröyera altamarina*, B. and W., Brit. Sessile-eyed Crustacea, vol. i. p. 177.
1895. *Pontocrates altamarinus*, G. O. Sars, Crust. of Norw., vol. i. p. 695 (Suppl.), pl. vii. fig. 2.

Habitat.—Dredged off Bo'ness; not common.

Genus (39) **Synchelidium**, G. O. Sars, 1892.

65. *Synchelidium brevicarpum* (Bate and Westwood).

1868. *Kröyera brevicarpa*, B. and W., Brit. Sessile-eyed Crustacea, vol. ii. (Appendix), p. 508.

Habitat.—Dredged in Largo Bay in 1889; at Station VI. (off St Monans) in April 1901; and at other places and dates; not common.

Genus (40) **Halimedon**, Boeck, 1870.

66. *Halimedon parvimanus* (Bate and Westwood).

1863. *Œdicerus parvimanus*, B. and W., *op. cit.*, vol. i. p. 161.
1870. *Halimedon Mülleri*, Boeck, Crust. Amphip. bor. et arct., p. 89.

Habitat.—Dredged at Station V. in February 1892, and subsequently in other parts of the estuary. It was again dredged at Station V. in April 1901, and was also found in the stomachs of Sharp-tailed *Lumpenus* captured in the neighbourhood of that station in May of the same year.

Family PLEUSTIDÆ.

Genus (41) **Paramphithoë**, Bruzelius, 1859.

67. *Paramphithoë bicuspis* (Kröyer).

1838. *Amphithoë bicuspis*, Kröyer, Grönlands Amphipoder, p. 45, pl. i. fig. 1.

Habitat.—Newhaven, from fishermen's lines (Henderson). Dredged off the east side of Inchkeith on 23rd May 1901. The species appears to be generally though sparingly distributed throughout the seaward part of the estuary.

68. *Paramphithoë monocuspis*, G. O. Sars.

1892. *Paramphithoë monocuspis*, G. O. Sars, *op. cit.*, vol. i. p. 351, pl. cxxiii. fig. 2.

Habitat.—Firth of Forth (Henderson, 1884; cf. *Twelfth F. B. Rept.*, pt. iii. p. 264, 1894). Dredged off the east side of Inchkeith, and at the north-west end of the island, in May 1901.

69. *Paramphithoë assimilis*, G. O. Sars.

1882. *Paramphithoë assimilis*, G. O. Sars, Oversigt af Norges Crust., vol. i. p. 99, pl. v. fig. 1.

Habitat.—Dredged between Inchkeith and May Island, found adhering to zoophytes brought up in the dredge, 1894. Dredged at Station VI. (off St Monans), 22nd May 1901; rare.

Genus (42) **Sympleustes**, Stebbing, 1899.[1]

70. *Sympleustes latipes* (M. Sars).

1858. *Amphithoë latipes*, M. Sars, Forhandl. Vid. Selsk. Chr. (1858), p. 139.

1890. *Amphithopsis latipes*, T. Scott, Eighth F. B. Rept., pt. iii. p. 328.

1893. *Parapleustes latipes*, G. O. Sars, Crustacea of Norway, vol. i. p. 360, pl. cxxvii.

Habitat.—Several specimens, prettily coloured, were

[1] Cf. Stebbing, "Revision of Amphipoda," *Ann. and Mag. Nat. Hist.*, Sept. 1899, p. 209.

obtained adhering to a tuft of *Antennularia antennina* dredged off the east side of Inchkeith in August 1889, and at Station V. in September 1890.

Family EPIMERIDÆ.

Genus (43) **Epimeria**, A. Costa, 1851.

71. *Epimeria cornigera* (Fabricius).

1779. *Gammarus corniger*, Fabr., Reise nach Norwegen, p. 83.
1863. *Acanthonotus Owenii*, Bate and Westw., Brit. Sessile-eyed Crust., vol. i. p. 232.

Habitat.—Dredged at Station III. in 1890, and off the North Craig on 4th July 1901; not common.

Family IPHIMEDIDÆ.

Genus (44) **Iphimedia**, Rathke, 1843.

72. *Iphimedia obesa*, Rathke.

1843. *Iphimedia obesa*, Rathke, Nova Acta Acad. Leopold., t. xx. p. 85.

Habitat.—Newhaven, many specimens, dredged to the east of Inchkeith (Henderson). Granton Harbour, 1888; Station V., January 1892. Generally distributed throughout the estuary, but usually not very common.

73. *Iphimedia minuta*, G. O. Sars.

1882. *Iphimedia minuta*, G. O. Sars, Oversigt af Norges Crust., vol. i. p. 100, pl. v. fig. 2.

Habitat.—Dredged at the north end of Inchkeith and other parts of the estuary; not common. Dredged at Station III. on 23rd May 1901.

Family SYRRHOIDÆ.

Genus (45) **Argissa**, Boeck, 1870.

74. *Argissa hamatipes* (Norman).

1869. *Syrrhoë hamatipes*, Norman, Brit. Assoc. Rept. (1868), p. 279.
1870. *Argissa typica*, Boeck, Crust. Amphip. bor. et arctic., p. 45.

Habitat.—Taken at various places during the autumn and winter of 1892. Taken at Station V. in April, and at Station VI. in May, 1901.

Family LAPHYSTIIDÆ.

Genus (46) **Laphystius**, Kröyer, 1842.

75. *Laphystius sturionis*, Kröyer.

1842. *Laphystius sturionis*, Kröyer, Naturh. Tidsskr., 1 R., Bd. iv. p. 157.

1855. *Darwinia compressa*, Spence Bate, Brit. Assoc. Rept. (1855), p. 58.

Habitat.—Parasitic on various fishes; a considerable number of specimens have at different times been observed adhering to Angler-fishes, *Lophius piscatorius*, Linn., captured in the estuary.

Family CALLIOPIIDÆ.

Genus (47) **Apherusa**, A. O. Walker, 1891.

76. *Apherusa bispinosa* (Spence Bate).

1857. *Dexamine bispinosa*, Bate, Ann. and Mag. Nat. Hist. (2), vol. xx. p. 142.

1863. *Atylus bispinosus*, Bate and Westw., Brit. Sessile-eyed Crust., vol. i. p. 250.

1893. *Apherusa bispinosa*, G. O. Sars, Crustacea of Norway, vol. i. p. 439, pl. cliii. fig. 1.

Habitat.—South Bay, 1888, and subsequently in other parts of the estuary. Taken in 20 fathoms in the neighbourhood of the Bass Rock, 28th June 1904.

77. *Apherusa cirrus* (Bate).

1862. *Pherusa cirrus*, Bate, Cat. Amphip. Brit. Mus., p. 143, pl. xxvii. fig. 6.

1870. *Halirages borealis*, Boeck, Crust. Amphip. borealia et arctica, p. 116.

1893. *Apherusa borealis*, G. O. Sars, *op. cit.*, vol. i. p. 441, pl. clv. fig. 2.

Habitat.—Generally distributed in the Forth; recent records include Station V., where it was taken on 24th April 1901, and near the Bass Rock on 28th June 1904.

78. *Apherusa Jurinii* (M.-Edwards).

1830. *Amphithoë Jurinii*, M.-Edwards, Ann. Sci. Nat., vol. xx. p. 376.
1862. ? *Pherusa fucicola*, Leach (Bate, Catal. Amphip. Brit. Museum, p. 145, pl. xxvii. fig. 10, not fig. 9).
1893. *Apherusa Jurinii*, G. O. Sars, *op. cit.*, vol. i. p. 445, pl. clvii. fig. 1.

Habitat.—? Newhaven, on fishermen's lines (Henderson, 1884, as *Pherusa fucicola*). Several specimens were dredged in the estuary in 1887 (Mihi). I am doubtful if Henderson's record really refers to *A. Jurinii*, but do not know what else to refer it to.

Genus (48) **Calliopius**, Lilljeborg, 1865.

79. *Calliopius Rathkei* (Zaddach).

1844. *Amphithoë Rathkei*, Zaddach, Synops. Crust. Pruss. Prodrom., p. 6.
1862. *Calliope grandoculus*, Bate, Catal. Amphip. Brit. Mus., p. 149, pl. xxviii. fig. 4.

Habitat.—Firth of Forth, near Dunbar, at the mouth of the estuary, 1894. This is probably only a smaller form of the next species.

80. *Calliopius læviusculus* (Kröyer).

1838. *Amphithoë læviusculus*, Kröyer, Grönlands Amphipoder, p. 6.
1863. *Calliope læviscula*, Bate and Westw., Brit. Sessile-eyed Crust., vol. i. p. 259.

Habitat.—Not uncommon in various parts of the estuary from above Queensferry to North Berwick, especially inshore amongst Algæ.

Family ATYLIDÆ.

Genus (49) **Paratylus**, G. O. Sars, 1893.

81. *Paratylus Swammerdami* (M.-Edwards).

1830. *Amphithoë Swammerdami*, M.-Edw., Ann. des Sci. Nat. (1), vol. xx. p. 378.
1863. *Atylus Swammerdami*, Bate and Westw., *op. cit.*, vol. i. p. 247.

Habitat.—Firth of Forth; moderately common and generally distributed.

82. *Paratylus falcatus* (Metzger).

1871. *Atylus falcatus*, Metzger, Wirbelosen Meeresthiere der ostfriesischen Kuste, Beitr. II. p. 9.

Habitat.—Firth of Forth, 1896; several specimens in my collection.

83. *Paratylus uncinatus*, G. O. Sars.

1882. *Atylus uncinatus*, G. O. Sars, Oversigt af Norges Crust., p. 102.

Habitat.—Off Aberlady, 12th December 1892, and again in the spring of 1893. This form does not appear to be very rare, but it may be easily passed over as a more common species.

84. *Paratylus vedlomensis* (Bate and Westwood).

1863. *Dexamine Vedlomensis*, Bate and Westw., Brit. Sessile-eyed Crust., vol. i. p. 242.

Habitat.—Taken sparingly in several localities between Inchkeith and May Island. Dredged off St Monans, 22nd May 1901.

Family Dexaminidæ.

Genus (50) **Dexamine**, Leach, 1814.

85. *Dexamine spinosa* (Montagu).

1813. *Cancer gammarus spinosus*, Mont., Trans. Linn. Soc., vol. xi. p. 3, pl. ii. fig. 1.

1863. *Dexamine spinosa*, Bate and Westw., *op. cit.*, vol. i. p. 237.

Habitat.—Obtained at low-water at Prestonpans (Cunningham; Leslie and Herdman). Off Musselburgh, 1888. This appears to be a rare species in the Forth estuary.

86. *Dexamine Thea*, Boeck.

1870. *Dexamine Thea*, Boeck, Crust. Amphip. bor. et arct., p. 107.

Habitat.—Firth of Forth, 1896; scarce.

Genus (51) **Tritæta**, Boeck, 1876.

87. *Tritæta gibbosa* (Spence Bate).

1862. *Atylus gibbosus*, Bate, Catal. Amphip. Brit. Mus., p. 137, pl. xxvi. fig. 3.

Habitat.—Firth of Forth, 1896; not common.

Genus (52) **Guernea,** Chevreux, 1887.

88. *Guernea coalita* (Norman).

1868. *Helleria coalita,* Norman, Ann. and Mag. Nat. Hist. (4), vol. ii. p. 418, pl. xxii. fig. 8; pl. xxiii. figs. 1-6.

1887. *Guernea coalita,* Chevreux, Bull. Soc. Zool. de France, vol. xii. p. 16 (separate copy).

Habitat.—Dredged off St Monans, 12 to 14 fathoms, 1889-90. In a gathering of dredged material from the same place, collected on 22nd May 1901; not uncommon.

Family Melphidippidæ.

Genus (53) **Melphidippella,** G. O. Sars, 1893.

89. *Melphidippella macera* (Norman).

1869. *Atylus macer,* Norman, Brit. Assoc. Report (1868), p. 280.

Habitat.—Taken with bottom tow-net at Station V., 16th April 1892. At the same Station on 24th April, and at Station VI. on 22nd May 1901; not common.

Family Gammaridæ.

Genus (54) **Amathilla,** Spence Bate, 1863.

90. *Amathilla homari* (J. C. Fabricius).

1798. *Gammarus homari,* Fabr., Entom. Syst. Suppl., p. 418.

1863. *Amathilla Sabini,* Bate and Westw., Brit. Sessile-eyed Crust., vol. i. p. 361.

Habitat.—Dredged near May Island, 1889. Also at Station IV., 23rd December 1892, and Station VII., 23rd February 1894; rare in the adult stage.

Genus (55) **Gammarus,** Fabricius, 1776.

91. *Gammarus marinus,* Leach.

1815. *Gammarus marinus,* Leach, Trans. Linn. Soc., vol. xi. p. 359.

1863. ,, ,, Bate and Westw., *op. cit.*, vol. i. p. 370.

Habitat.—Taken near Culross, west of Queensferry, 1892. Between tide-marks, Dalmeny shore, November 1904 (Evans). Generally but sparingly distributed throughout the estuary.

92. *Gammarus Duebeni,* Lilljeborg.

1851. *Gammarus Duebeni,* Lillj., Öfvers af K. Svenska Vet.-Acad. Forhandl., p. 22.

Habitat.—Taken in the brackish water lagoon at the mouth of the Cocklemill Burn, near Largo, 1896; also in brackish water pools on May Island, 13th June 1893.

93. *Gammarus locusta* (Linné).

1767. *Cancer locusta,* Linn., Syst. Nat., ed. xii., vol. ii. p. 1055.
1863. *Gammarus locusta,* Bate and Westw., Brit. Sessile-eyed Crust., vol. i. p. 378.

Habitat.—Common, especially in the littoral zone.

94. *Gammarus pulex* (De Geer).

1752. *Squilla ponce,* De Geer, Mem. pour Servir a l'Hist. des Insects, vol. vii. p. 525, pl. 33.
1777. *Astacus pulex,* Pennant, British Zoology, vol. iv. p. 17.

Habitat.—Common in shallow fresh-water lakes, slow streams, ditches, etc., throughout the district.

Genus (56) **Melita,** Leach.

[1] 95. *Melita obtusata* (Montagu).

1804. *Cancer gammarus obtusatus,* Mont., Trans. Linn. Soc., vol. ix. p. 5, pl. ii. fig. 7.
1863. *Melita obtusata,* Bate and Westw., vol. i. p. 407.

Habitat.—Moderately frequent throughout the estuary.

96. *Melita dentata* (Kröyer).

1842. *Gammarus dentatus,* Kröyer, Naturh. Tidsskr. 1 R., vol. iv. p. 159.
1862. *Megamœra dentata,* Bate, Catal. Amphip. Brit. Mus., p. 225, pl. xxxix. fig. 4.

Habitat.—Taken in moderately deep water (28 fathoms) at the mouth of the estuary in January 1890; rare. Only two specimens, one partly dissected, are in my collection.

[1] Two specimens of *Melita gladiosa,* Bate, were in 1888 recorded by me from Largo Bay (cf. *Sixth F. B. Rept.,* part iii. p. 247), but they were probably merely well-developed males of *M. obtusata.*

Genus (57) **Mæra**, Leach, 1813.

97. *Mæra Othonis* (M.-Edwards).

1830. *Gammarus Othonis*, M.-Edw., Ann. des Sci. Nat., vol. xx. p. 373, pl. x. fig. 11 (♀).

1863. *Megamæra Othonis*, Bate and Westw., *op. cit.*, vol. i. p. 405 (♀).

1863. ,, (?) *longimana*, idem, *ibidem*, p. 403 (♂).

Habitat.—Dredged in South Bay in 1888, and off the east side of Inchkeith in 1891; rare.

98. *Mæra Loveni* (Bruzelius).

1869. *Gammarus Loveni*, Bruz., Skand. Amphip. Gamm., p. 59, fig. 9.

1868. *Mæra Loveni*, Norman, Ann. and Mag. Nat. Hist. (4), vol. ii. p. 416, pl. xxi. figs. 11, 12.

1889. ,, ,, idem, *ibidem* (6), vol. iv. p. 127 (Aug. 1889).

Habitat.—A single specimen of this large species was dredged a short distance west of Inchkeith on 11th November 1887. Another specimen was obtained in the stomach of a Lemon Sole (*Pleuronectes microcephalus*) captured at Station IX. on 5th August 1890, and a third in the stomach of a Witch Sole (*Pleuronectes cynoglossus*) captured at Station V. on 28th June 1901.

[1] 99. *Mæra tenuimana* (Bate).

1862. *Gammarus tenuimanus*, Bate, Catal. Amphip. Brit. Mus., p. 214, pl. xxxviii. fig. 2.

1868. *Mæra Batei*, Norman, Ann. and Mag. Nat. Hist. (4), vol. ii. p. 416, pl. xxii. figs. 1-3 (♀).

1869. *Megamæra multidentata*, Bate and Westw., *op. cit.*, vol. ii. p. 515 (♂).

Habitat.—Firth of Forth, captured in 1895; rare. (Cf. *Fourteenth F. B. Rept.*, pt. iii. p. 160, 1896.)

Genus (58) **Megaluropus**, Norman, 1889.

100. *Megaluropus agilis*, Norman.

1889. *Megaluropus agilis*, Norman, Ann. and Mag. Nat. Hist. (6), vol. iii. p. 446, pl. xviii. figs. 1-10 (June 1889); *op. cit.*, vol. iv. p. 122, pl. x. figs. 15-17 (Aug. 1889).

Habitat.—Taken in Largo Bay, 1888-90; frequent. Dredged off Musselburgh in May 1891, and at Stations V. and VI. in April 1901.

[1] See A. O. Walker's remarks on this and other species, *Ann. and Mag. Nat. Hist.* for June 1895 (Ser. 6, vol. xv. pp. 464-476).

Genus (59) **Cheirocratus**, Norman, 1865.

101. *Cheirocratus Sundewalli* (Rathke).

1843. *Gammarus Sundewalli*, Rathke, Nova Acta Acad. Leopold, vol. xx. p. 65, pl. iii. fig. 2.

Habitat.—Taken at Station II., 14th November 1888; and subsequently, but sparingly, at other parts of the estuary. Dredged off the east side and at the north-west end of Inchkeith in May 1901; also found in the stomach of a Long Rough Dab (*Platessoides limandoides*) captured in the Forth during the same month.

102. *Cheirocrates intermedius*, G. O. Sars.

1894. *Cheirocrates intermedius*, G. O. Sars, *op. cit.*, vol. i. p. 527, pl. clxxxvi. fig. 1.
1896. ,, ,, T. Scott, Fourteenth F. B. Rept., pt. iii. p. 160, pl. iv. fig. 7.

Habitat.—Firth of Forth, taken in 1889 and 1893 (but not recorded till 1896); rare.

103. *Cheirocrates assimilis* (Lilljeborg).

1851. *Gammarus assimilis*, Lillj., Öfvers af K. Svenska Vet.-Acad. Forhandl. (1851), p. 23.
1865. *Cheirocrates mantis*, Norman, Nat. Hist. Trans. Northumb. and Durham, vol. i. p. 13, pl. vii. figs. 14, 15.

Habitat.—Dredged off the west side of Inchkeith in February 1894; at the north end of the same island on 23rd January 1896; and at Station III. on 23rd May 1901; moderately rare.

Family Lilljeborgiidæ.

Genus (60) **Lilljeborgia**, Spence Bate, 1862.

104. *Lilljeborgia Kinahani* (Spence Bate).

1862. *Phædra Kinahani*, Bate, Catal. Amphip. Brit. Mus., p. 119, pl. xxi. fig. 1.

Habitat.—Dredged at Station VI. and Station III., and also at the north-west end of Inchkeith, in May 1901, but only a few specimens were obtained altogether.

Family Aoridæ.

Genus (61) **Microdeutopus**, A. Costa, 1853.

105. *Microdeutopus anomalus* (Rathke).

1843. *Gammarus anomalus*, Rathke, Nova Acta Acad. Leopold, vol. xx. p. 63, pl. vi. fig. 7.

Habitat.—Firth of Forth, 1893; rare.

Genus (62) **Aora**, Kröyer, 1844.

106. *Aora gracilis*, Spence Bate.

1855. *Lonchomerus gracilis*, Bate, Brit. Assoc. Rept. (1855), p. 58.
1862. *Aora gracilis*, idem, Catal. Amphip. Brit. Mus., p. 160, pl. xxix. fig. 7.

Habitat.—Newhaven; many specimens. Both sexes taken off Fidra (Henderson, 1884). I have dredged it off Elie, and one or two other places, but usually in small numbers.

Genus (63) **Lembos**, Spence Bate, 1856.[1]

107. *Lembos Websteri*, Spence Bate.

1857. *Lembos Websteri*, Bate, Ann. and Mag. Nat. Hist. (2), vol. xix. p. 142.

Habitat.—Dredged at Station V., 24th April 1901; rare.

108. *Lembos longipes* (Lilljeborg).

1852. *Gammarus longipes*, Lillj., Öfvers af K. Svenska Vet.-Acad. Forhandl. (1852), p. 10.

Habitat.—Dredged off St Monans, 19th June 1893 and 22nd May 1901; rare.

Family Photidæ.

Genus (64) **Protomedeia**, Kröyer, 1842.

109. *Protomedeia fasciata*, Kröyer.

1842. *Protomedeia fasciata*, Kröyer, Naturh. Tidsskr., vol. iv. p. 154.

Habitat.—Captured near May Island, October 1894.

[1] Cf. Rev. T. R. R. Stebbing, "Notes on Amphipoda, Old and New," in *Ann. and Mag. Nat. Hist.* for September 1895.

Found in the stomachs of Gurnards (*Trigla gurnardus*), as well as in the stomachs of sharp-tailed *Lumpenus*, small Whitings, and Long Rough Dabs, captured in the estuary in April and May 1901.

Genus (65) **Leptocheirus**, Zaddach, 1844.

[1] 110. *Leptocheirus hirsutimanus* (Spence Bate).

1862. *Protomedeia hirsutimanus*, Bate, Catal. Amphip. Brit. Mus., p. 168, pl. xxx. fig. 6.

1894. *Leptocheirus pilosus*, G. O. Sars, *op. cit.*, vol. i. p. 556, pl. cxcvii. (not *L. pilosus*, Zaddach).

Habitat.—Dredged off Elie Ness in 17 fathoms in 1888. Dredged off Inchkeith in 1890, and again in 1894; and at Station III. and Station VI. in May 1901. In this species the accessory appendage of the superior antennæ is composed of about six joints.

111. *Leptocheirus pilosus*, Zaddach.

1844. *Leptocheirus pilosus*, Zadd., Synopsis Crustaceorum Prussicorum Prodr., p. 8.

?1869. *Protomedeia pectinata*, Norman, Brit. Assoc. Rept. (1868), p. 283.

1895. *Leptocheirus pilosus*, A. O. Walker, Trans. Liverpool Biol. Soc., vol. ix. p. 310.

Habitat.—Dredged in the Firth of Forth in 1893 and 1894. Over a dozen specimens of this species were obtained in some material dredged off St Monans on 22nd May 1901. In this species the accessory appendage of the superior antennæ is two-jointed. A female specimen, with ova, measured a little over three millimetres.

Genus (66) **Gammaropsis**, Lilljeborg, 1854.

112. *Gammaropsis maculata* (Johnston).

1828. *Gammarus maculatus*, Johnston, Contrib. to Brit. Fauna, Zool. Jour., vol. iii. p. 176.

1894. *Gammaropsis erythrophthalma*, G. O. Sars, Crustacea of Norway, vol. i. p. 558, pl. cxcviii.

1900. ,, *maculata*, Chevreux, Albert I^er^ Prince de Monaco, Camp. Scient. (Amphipoda), p. 92.

Habitat.—Dredged off the west side of Inchkeith in 1888.

[1] Cf. A. O. Walker, "Revis. of the Amphip. of the L. M. B. C. District," *Trans. Liverpool Biol. Soc.*, vol. ix. p. 310 (1895).

Taken at Station V. in December 1890; and subsequently, but always sparingly, in various other parts of the estuary.

113. *Gammaropsis nana,* G. O. Sars.

1894. *Gammaropsis nana,* G. O. Sars, *op. cit.*, vol. i. p. 561, pl. cxcix. fig. 2.

Habitat.—Taken at one or two places in the estuary in 1890. Dredged at Station IV. in April, and at Station III. in May, 1901.

Genus (67) **Megamphopus**, Norman, 1869.

114. *Megamphopus cornutus,* Norman.

1869. *Megamphopus cornutus,* Norman, Brit. Assoc. Rept. (1868), p. 282.

Habitat.—Firth of Forth, 1896; dredged at Station III. in May 1901.

Genus (68) **Microprotopus**, Norman, 1866.

115. *Microprotopus maculatus,* Norman.

1866. *Microprotopus maculatus,* Norman, Brit. Assoc. Rept. (1866), p. 203.

Habitat.—Dredged in Largo Bay in 1891, and subsequently in other parts of the estuary, but not very common.

Genus (69) **Photis**, Kröyer, 1842.

116. *Photis longicaudatus* (Bate and Westwood).

1863. *Eiscladus longicaudatus,* B. and W., Brit. Sessile-eyed Crust., vol. i. p. 412.

Habitat.—Firth of Forth, dredged off St Monans in 1892; also west of Queensferry in April, and at Stations III. and VI. in May, 1901.

Genus (70) **Podoceropsis**, Boeck, 1860.

117. *Podoceropsis Sophiæ,* Boeck.

1860. *Podoceropsis Sophiæ,* Boeck, Forh. Ved. de Skand. Naturf. 8 de Möde, p. 666.

1862. *Nænia tuberculosa,* Bate, Catal. Amphip. Brit. Mus., p. 271, pl. xlvi. fig. 2.

Habitat.—"Dredged to the east of Inch Mickery, also south-west of Inchkeith" (Henderson, 1884). This species I have not met with in the Firth of Forth.

118. *Podoceropsis excavata* (Spence Bate).

1862. *Nænia excavata*, Bate, *op. cit.*, p. 272, pl. xlvi. fig. 4 (♀).
1862. ,, *rimapalma*, idem, *ibidem*, p. 272, pl. xlvi. fig. 3 (♂).

Habitat.—"With the last in both localities" (Henderson). Dredged in Largo Bay, Kirkcaldy Bay, at Station III., and elsewhere; generally though sparingly distributed.

Family AMPHITHOIDÆ.

Genus (71) **Amphithoë**, Leach, 1813.

119. *Amphithoë rubricata* (Montagu).

1804. *Cancer (Gammarus) rubricatus*, Mont., Trans. Linn. Soc., vol. ix. p. 99, pl. v. fig. 1.
1856. *Amphithoë littorina*, Bate, Brit. Assoc. Rept. (1855), p. 59.

Habitat.—Dredged off Musselburgh and off the west side of May Island in 1887-88. Subsequently in other parts of the estuary, especially in shallow water amongst Algæ.

Genus (72) **Pleonexes**, Spence Bate, 1857.

120. *Pleonexes gammaroides*, Spence Bate.

1857. *Pleonexes gammaroides*, Bate, Ann. and Mag. Nat. Hist. (2), vol. xix. p. 147 (♂).
1857. *Sunamphithoë hamulus*, idem, *ibidem*, p. 148 (♀).

Habitat.—Obtained off Pittenweem amongst trawl refuse, and between tide-marks near Portobello, 1887-88.

Family ISCHYROCERIDÆ.

Genus (73) **Ischyrocerus**, Kröyer, 1838.

121. *Ischyrocerus minutus*, Lilljeborg.

1850. *Ischyrocerus minutus*, Lillj., Kgl. Svenska Vet.-Acad. Handl. (1850), p. 335.

Habitat.—Taken in various parts of the estuary. The specimens in my collection were obtained in 1892.

[1] Genus (74) **Jassa**, Leach, 1813.

122. *Jassa falcata* (Montagu).

1804. *Cancer* (*Gammarus*) *falcatus*, Mont., Trans. Linn. Soc., vol. ix. p. 100, pl. v. figs. 1, 2.

Habitat.—Dredged off Musselburgh in 1888 and 1891; and subsequently, though sparingly, in other parts of the estuary.

123. *Jassa pusilla* (G. O. Sars).

1894. *Podocerus pusillus*, G. O. Sars, Crustacea of Norway, vol. i. p. 596, pl. ccxiii. fig. 1.

Habitat.—Firth of Forth, 1887, and also in 1889, when the specimens in my collection were obtained. More recently it has been dredged at Station III., and at the north-west end of Inchkeith on 23rd May 1901.

[2] 124. *Jassa Herdmani* (A. O. Walker).

1893. *Podocerus Herdmani*, A. O. Walker, Sixth Rept. L. M. B. C., p. 37, fig. 13.
1894. ,, *odontonyx*, G. O. Sars, *op. cit.*, vol. i. p. 597, pl. ccxiii. fig. 2.

Habitat.—Off St Monans, 19th June 1893. This form, which I have observed on several occasions, resembles in some respects the *Jassa pusilla* (G. O. Sars); and, as A. O. Walker suggests, may be only a form of it. (It is probable that the species of *Jassa* mentioned above may have to be removed to another genus.)

125. *Jassa pelagica*, Leach.

1814. *Jassa pelagica*, Leach, Edin. Encyclop., vol. vii. p. 433.
1843. *Podocerus capillatus*, Rathke, Nova Acta Cæsar. Leop. Carol. Nat. Cur., vol. xx. p. 89, pl. iv. fig. 8.

Habitat.—Firth of Forth, off Musselburgh, in April 1891, and very sparingly on one or two other occasions.

[1] Cf. Rev. T. R. R. Stebbing, "On the true *Podocerus*, and some New Genera of Amphipoda," *Ann. and Mag. Nat. Hist.* (7), vol. iii p. 237 *et seq.* (March 1899). Cf. also Chevreux, "Result. Camp. Scient. Albert Ier Prince de Monaco," Amphipoda, Addenda, p. 165 (1900).

[2] Cf. Rev. T. R. R. Stebbing, *op. cit.*, p. 240.

Genus (75) **Erichthonius**, M.-Edwards, 1830.

126. *Erichthonius abditus* (Templeton).

1836. *Cerapus abditus*, Templ., Trans. Ent. Soc., vol. i. p. 188, pl. xx. fig. 5.

1862. *Dercothoë punctata*, Bate, Catal. Amphip. Brit. Mus., p. 260, pl. xliv. fig. 10.

Habitat.—South Bay, 1888; Kirkcaldy Bay, 27th March 1891; Station III., 25th May 1901.

127. *Erichthonius deformis*, M.-Edwards.

1830. *Erichthonius deformis*, M.-Edw., Ann. Sci. Nat., vol. xx. p. 382.

1863. *Cerapus deformis*, Bate and Westw., Brit. Sessile-eyed Crust., vol. i. p. 457.

Habitat.—Dredged near the Bass Rock (Metzger). Dredged in South Bay in 1887. Obtained in the stomachs of small Whitings and Butter-fishes captured in the estuary in May 1901.

128. *Erichthonius Hunteri* (Spence Bate).

1862. *Cerapus Hunteri*, Bate, Catal. Amphip. Brit. Mus., p. 264, pl. xlv. fig. 3.

1896. *Erichthonius Hunteri*, T. Scott, Fourteenth F. B. Rept., pt. iii. p. 161, pl. iv. fig. 8.

Habitat.—Firth of Forth, generally though sparingly distributed. The specimens in my collection were obtained in 1887 and 1894. Specimens of *E. Hunteri* were dredged at Station VII. in April, and at Station III. in May, 1901.

Family Corophiidæ.

Genus (76) **Cerapus**, Say, 1817.

129. *Cerapus crassicornis* (Spence Bate).

1855. *Siphonoecetes crassicornis*, Bate, Brit. Assoc. Rept. (1855), p. 59.

1863. ,, ,, Bate and Westw., Brit. Sessile-eyed Crust., vol. i. p. 496.

Habitat.—Firth of Forth; a single specimen (still in my collection) was obtained in a bottom tow-net gathering on 30th May 1892. This specimen, in its tube of hardened mud, with which it was able to move freely about, had a close resemblance to a small insect larva.

Genus (77) **Siphonoëcetes**, Kröyer.

130. *Siphonoëcetes Whitei* (Gosse).

1853. *Cerapus Whitei*, Gosse, Naturalist's Rambles on Devonshire Coast, p. 282, pl. xxii. figs. 12-14.
1870. *Siphonoëcetes Colletti*, Boeck, Crust. Amphip. bor. et arct., p. 258.

Habitat.—Frequent in material dredged in Largo Bay in 1890, and occasionally in other parts of the estuary.

Genus (78) **Corophium**, Latreille, 1807.

131. *Corophium grossipes* (Linné).

1767. *Cancer grossipes*, Linn., Syst. Nat., ed. xii., vol. ii. p. 1050.
1775. *Gammarus longicornis*, Fabr., System. Entom., vol. ii. p. 515.
1863. *Corophium longicorne*, Bate and Westw., *op. cit.*, vol. i. p. 493.

Habitat.—Dunbar (Robertson). "Very abundant on the mud flat at Morrison's Haven" (Cunningham).[1] Brackish water pools at Aberlady in 1895.

132. *Corophium crassicorne*, Bruzelius.

1859. *Corophium crassicorne*, Bruz., Skand. Amphip. Gamm., p. 15, pl. i. fig. 2.

Habitat.—Taken off Musselburgh in 1888. Aberdour Bay, November 1893. (Cf. also *Fourteenth F. B. Rept.*, pt. iii. p. 161, 1896.)

133. *Corophium Bonelli*, M.-Edwards.

1830. *Corophium Bonelli*, M.-Edw., Ann. Sci. Nat., vol. xx. p. 385.

Habitat.—Taken near Dunbar in 1894. Dredged at Station III. in May 1901.

134. *Corophium affine*, Bruzelius.

1859. *Corophium affine*, Bruz., *op. cit.*, p. 16.
1869. ,, *tenuicorne*, Norman, Brit. Assoc. Rept. (1868), p. 286.

Habitat.—A single specimen dredged off Fidra, October

[1] Cf. *Invertebrate Fauna*, by Leslie and Herdman, pp. 44-106 (1881).

1884 (Henderson). Dredged off Inchkeith; in Kirkcaldy Bay, and other places, but seldom more than one or two specimens in any single gathering.

Genus (79) **Unciola**, Say, 1818.

135. *Unciola planipes*, Norman.

1865. *Unciola planipes*, Norman, Nat. Hist. Trans. Northumb. and Durham, vol. i. p. 14, pl. vii. figs. 9-13.

Habitat.—Firth of Forth, dredged 22nd November 1889, and on one or two subsequent occasions; rare.

Family DULICHIIDÆ.

Genus (80) **Dulichia**, Kröyer, 1845.

136. *Dulichia porrecta*, Spence Bate.

1862. *Dulichia porrecta*, Bate, Catal. Amphip. Brit. Mus., p. 348, pl. liv. fig. 9.

Habitat.—Taken off Musselburgh in April 1891. Dredged at Station III., and at the north-west end of Inchkeith, on 23rd May 1901. It was also obtained in the stomachs of small Whitings captured in the Forth during the same month.

137. *Dulichia monacantha*, Metzger.

1873. *Dulichia monacantha*, Metz., Nordseef. der Pommerania, Crust., p. 226, pl. vi. fig. 6.
1898. ,, ,, T. Scott, Ann. Scot. Nat. Hist. (Jan. 1898), p. 55.

Habitat.—Dredged at Station V. on 24th April, and on the 29th at Station VII., 1901. It was also obtained in the stomachs of a few of the fishes captured in Forth in April and May 1901, and which were sent for examination to the laboratory at Bay of Nigg, Aberdeen.

138. *Dulichia falcata*, Spence Bate.

1857. *Dulichia falcata*, Bate, Ann. and Mag. Nat. Hist., vol. xx. p. 526.

Habitat.—Taken with surface tow-net in Granton Harbour, 26th November 1887. Dredged near Inchkeith on 11th April 1892; and at Station V. on 24th April 1901. Obtained also in the stomachs of fishes.

Caprellidea.

Family Caprellidæ.

Genus (81) **Phtisica**, Slabber, 1749.

139. *Phtisica marina*, Slabber.

1749. *Phtisica marina*, Slabber, Natuurkundige verslustigingen, etc., p. 79.
1814. *Proto pedata*, Leach, Edin. Encyclop., vol. vii. p. 433.

Habitat.—Newhaven, on fishermen's lines, not uncommon (Henderson). Dredged in South Bay in 1888; and subsequently at other parts of the estuary; and also obtained in the stomachs of small fishes captured in the Forth.

Genus (82) **Protella**, Dana, 1852.

140. *Protella phasma* (Montagu).

1804. *Cancer phasma*, Mont., Trans. Linn. Soc., vol. vii. p. 66, pl. vi. fig. 3.
1868. *Protella phasma*, Bate and Westw., Sessile-eyed Crust., vol. ii. p. 45.

Habitat.—Firth of Forth (Goodsir). Dredged in South Bay in 1888, and again in 1892; and at Station III. on 23rd May 1901.

Genus (83) **Pariambus**, Stebbing, 1888.

141. *Pariambus typicus* (Kröyer).

1844. *Podalirius typicus*, Kröyer, Naturh. Tidsskr. 2 R., 1 B. p. 283.
1868. *Caprella typica*, Bate and Westw., *op. cit.*, vol. ii. p. 75.

Habitat.—Firth of Forth, frequent on the common starfish *Asterias rubens*, with which it appears to be associated.

Genus (84) **Caprella**, Lamarck, 1818.

142. *Caprella linearis* (Linné).

1767. *Cancer linearis*, Linn., Syst. Nat., ed. xii., vol. ii. p. 1056.
1842. *Caprella lævis*, Goodsir, Edin. New Phil. Jour., vol. xxxiii. p. 189, pl. iii. fig. 4.

Habitat.—" Plentiful in the laminarian zone " (Henderson).

South Bay, frequent, 1888. Dredged at Station III. on 23rd May 1901.

143. *Caprella acanthifera*, Leach.

1814. *Caprella acanthifera*, Leach, Edin. Encyclop., vol. vii. p. 404.

Habitat.—Firth of Forth, taken by the Rev. J. Gordon (cf. Bate and Westwood, *Brit. Sessile-eyed Crust.*, vol. ii. p. 67). A single specimen in my collection has on the label, "Firth of Forth, 1888," but I don't remember what part of the estuary it was taken in.

144. *Caprella tuberculata*, Guerin.

1829. *Caprella tuberculata*, Guerin, Iconograph. Crust., pl. xxviii. fig. 1.
1842. ,, ,, Goodsir, *op. cit.*, vol. xxxiii. p. 188, pl. iii. fig. 6.
1869. ,, ,, Bate and Westw., Brit. Sessile-eyed Crust., vol. ii. p. 68.

Habitat.—Firth of Forth (Goodsir; specimen in Brit. Mus. Coll. Cf. Bate and Westw., *op. cit.*, p. 70).

145. *Caprella æquilibra*, Say.

1818. *Caprella æquilibra*, Say, Jour. Acad. Nat. Sci. Philadelphia, vol. i. p. 391.
1899. ,, ,, T. Scott, Ann. Scot. Nat. Hist. (April 1899), p. 116.

Habitat.—A considerable number of specimens were obtained amongst Algæ and barnacles scraped from a ship's bottom at Granton Harbour; most of the specimens were either females or immature, but a few adult males were found, by means of which the species to which they belonged was satisfactorily identified.

Sub-Class II. ENTOMOSTRACA

Order 3. BRANCHIOPODA.

Suborder Cladocera.

The arrangement followed for this suborder is that of Professor Lilljeborg's monograph, *Cladocera-Sueciæ,* published in 1900 (700 pp., and 87 plates). See also the Rev. T. R. R. Stebbing, F.R.S., on "Lynceus and the Lynceidæ," in *The Zoologist*, March 1902, pp. 101-106.

Suborder Cladocera.

Division CALYPTOMERA, G. O. Sars.

Tribe CTENOPODA, G. O. Sars, 1865.

Family SIDIDÆ, Baird, 1850.

Genus (1) **Sida**, Strauss, 1820.

1. *Sida crystallina* (O. F. Müller).

1776. *Daphne crystallina*, Müller, Zool. Dan. Prod., p. 200, No. 2405.

[1] 1820. *Sida crystallina*, Strauss, Mém. Mus. Hist. Nat., vol. vi. p. 157.

Habitat.—Raith Lake, Kirkcaldy, Fifeshire, common, 1890; Loch Leven, Kinross; Loch Vennachar and Loch Katrine, Perthshire.

Genus (2) **Diaphanosoma**, Fischer, 1890.

2. *Diaphanosoma brachyurum* (Liéven).

1848. *Sida brachyura*, Liéven, Neueste Schrift. d. Naturf. Gesellschaft in Danzig, 4: ten Bds. 2: tes Heft. p. 20, pl. iv. figs. 3-9.

Habitat.—Loch Leven, 1890; Raith Lake, 1890, common; Loch Katrine, Loch Achray, Loch Vennachar; Marfield Loch, Midlothian, September 1901 (Dr and Miss Sprague).

Genus (3) **Latona**, Strauss, 1820.

3. *Latona setifera* (O. F. Müller).

1785. *Daphnia setifera*, Müll., Entomostraca, p. 98, pl. xiv. figs. 5-7.

Habitat.—Loch Lubnaig, 29th September 1894.

[1] For other synonyms see Professor Lilljeborg's work mentioned above.

Family HOLOPEDIDÆ.

Genus (4) **Holopedium**, Zaddach, 1855.

4. *Holopedium gibberum*, Zaddach.

1855. *Holopedium gibberum*, Zaddach, Wiegmann, Archiv. fur Naturges., Bd. 21, p. 159, pl. viii. fig. 9.

Habitat.—Loch Achray, Loch Voil. Common in Loch Achray in September 1897 and June 1898, but entirely absent during the intervening winter months.

Tribe ANOMOPODA, G. O. Sars.

Family DAPHNIADÆ, Strauss.

Genus (5) **Daphnia**, O. F. Müller, 1785.

The study of the various forms comprised in the genus *Daphnia* is extremely interesting, but very perplexing. The variations, especially in form, and also to some extent in structural details, are so great that the student of sanguine temperament could easily describe a dozen species where the severely critical could only make out two or three. As I cannot lay claim to a very expert knowledge of the relationships of this difficult genus, it is necessary for me to rely, to some extent, on the discrimination of writers more familiar with it.

5. *Daphnia pulex* (De Geer).

1778. *Monoculus pulex*, De Geer, Mem. pour. servir a l'hist. nat. des Insectes, T. vii. p. 442, pl. 27, figs. 1-8.

Habitat.—Generally distributed, and occurring sometimes in considerable abundance. Very plentiful in an artificial pond in the vicinity of Edinburgh in July 1898.[1] The variety *hamata* (Brady) has been taken by Dr and Miss Sprague in Granton Quarry, near Edinburgh, and I have found it, as well as the variety *obtusata*, in the "marl-pit" near Davidson's Mains, Midlothian. This species possesses a comb-like fringe of minute hairs at the base of the post-abdominal claw.

[1] *Seventeenth Fishery Board Report*, part iii. (1899) p. 199.

6. *Daphnia longispina*, O. F. Müller.

1785. *Daphnia longispina*, O. F. Müller, Entomostraca, p. 88, tab. 12, figs. 8-10.
1850. *Daphnia pulex*, var. *longispina*, Baird, Brit. Entom., p. 91, pl. vii. figs. 3, 4.

Habitat.—Duddingston Loch (?). A form very common in Duddingston Loch appears to belong to this species. The same form is also common in Loch Leven, and in several other small lakes and ponds. *D. longispina* differs from the last in the post-abdominal claw being without a pectinate fringe of small hairs at the base. The shell is also usually furnished with a moderately long and slender posterior spine. There appear to be several varieties of *D. longispina*. A variety with a curious sloping head (var. *nasuta*, G. O. Sars) was found in Loch Doon in Ayrshire. Immature individuals are sometimes furnished with a "vertex tooth" (cf. var. *hamata*).

7. *Daphnia hyalina*, Leydig, var. *pellucida*, P. E. Müller.

Habitat.—Duddingston Loch (G. S. Brady). This may turn out to be only another form of *D. longispina*, O. F. Müller.

8. *Daphnia lacustris*, G. O. Sars.

1862. *Daphnia lacustris*, G. O. Sars, Om de i Omegnen af Christiania forekommen de Cladocerer, Forhandl. Vidensk. Selsk. Christ. (1861), p. 19.
1899. ,, ,, T. Scott, Seventeenth F. B. Rept., pt. iii. pp. 192-194, pl. vii. figs. 29-33, 34 and 34*a*.

Habitat.—Loch Leven (G. S. Brady). Probably frequent. Hurley Cove, Penicuik, 31st December 1900, common (Dr and Miss Sprague). This species possesses when young, and sometimes also in the adult stage, a "vertex tooth," which may be single or double. *D. lacustris* is, by some writers, considered to be a variety of the last species (*D. hyalina*), to which it bears a close resemblance.

9. *Daphnia galeata*, G. O. Sars.

1863. *Daphnia galeata*, G. O. Sars, Om en i Somm. 1862 fortagen Zool. Reise i Christ. og Throndh. stifter, p. 21.
1899. *Daphnia galeata*, T. Scott, Seventeenth F. B. Rept., pt. iii. p. 193, pl. vii. figs. 22, 53, see also fig. 16.

Habitat.—Loch Katrine, Loch Achray, and Loch Vennachar.

Granton Quarry, 1st September 1900 (Dr and Miss Sprague). I find this species exceedingly variable, especially in the form of the head, which in the more typical specimens is strongly crested, but passing by minute gradations to others that have no crest at all, but having the head evenly rounded. I am inclined to agree with those who regard this *Daphnia* and the two immediately preceding as forms of one and the same species, to which *Daphnia jardinii*, Baird, must also be ascribed. In that case, Baird's name, being the older, would take precedence of the others.

Genus (6) **Scapholeberis**, Schoedler, 1858.

10. *Scapholeberis mucronata* (O. F. Müller).

1785. *Daphne mucronata*, O. F. Müller, Entomostraca, p. 94, pl. xiii. figs. 6, 7.

Habitat.—Raith Lake, Kirkcaldy, frequent, 1890; Ravelston Cottage Quarry, Midlothian, July 1900 (Dr and Miss Sprague).

Genus (7) **Simosa**, Norman, 1903.

(Syn.—*Simocephalus*, Schoedler, 1858, preoccupied.)

11. *Simosa vetula* (O. F. Müller).

1776. *Daphne vetula*, O. F. Müller, Zool. Dan. Prod., p. 199, No. 2399.

1858. *Simocephalus vetulus*, E. Schoedler, Jahresber. über die Louisenstädtische Realschule, p. 18.

Habitat.—Duddingston Loch; Loch Leven; Lochgelly and Kilconquhar Lochs, Fifeshire; Loch Coulter, Stirlingshire, etc.; frequent and generally distributed.

Genus (8) **Ceriodaphnia**, Dana, 1853.

12. *Ceriodaphnia reticulata* (Jurine).

1820. *Monoculus reticulatus*, Jurine, Nat. Hist. des Monoc., p. 139, taf. 14, figs. 3, 4.

Habitat.—Raith Lake, Kirkcaldy, frequent, 1890. Upper Elf Loch, Edinburgh, 1896 and 1897. In the same loch in September 1900 by Dr and Miss Sprague.

13. *Ceriodaphnia quadrangula* (O. F. Müller).

1785. *Daphnia quadrangula*, O. F. Müller, Entomostraca, p. 90, tab. 13, fig. 4.

Habitat.—Duddingston Loch, September 1897 and 1898. Taken in the same loch in June 1901 by Dr and Miss Sprague.

14. *Ceriodaphnia affinis*, Lilljeborg.

1900. *Ceriodaphnia affinis*, Lillj., Cladocera-Sueciæ, p. 202, tab. 28, figs. 19-28.
1901. ,, *scitula*, Herrick? (Sprague), Trans. Edin. Field Nat. and Micros. Soc., vol. iv. pt. iii. p. 258.
1902. ,, *affinis*, Sprague, *op. cit.*, pt. iv. pl. xxxa. figs. 1-4.

Habitat.—High Pond, Penicuik, 7th September 1901 (Dr and Miss Sprague).

This rare species is one of the additions made to the Entomostracan fauna of the inland waters of Scotland by Dr and Miss Beatrice Sprague.

15. *Ceriodaphnia laticaudata*, P. E. Müller.

1867. *Ceriodaphnia laticaudata*, P. E. Müller, Danmarks Cladocera, p. 130, pl. i. fig. 19.

Habitat.—Duddingston Loch, September 1897, frequent; not observed in 1898.

Family Bosminadæ.

Genus (9) **Bosmina**, Baird, 1850.

16. *Bosmina longirostris* (O. F. Müller).

1776. *Lynceus longirostris*, O. F. Müller, Zool. Dan. Prod., No. 2394.
1846. *Bosmina longirostris*, Baird, Ann. and Mag. Nat. Hist., vol. xvii. p. 412.

Habitat.—Common and generally distributed in small lakes and ponds throughout the lowland parts of the district.

17. *Bosmina longispina*, Leydig.

1860. *Bosmina longispina*, Leydig, Naturgesch. d. Daphniden, p. 207, pl. viii. fig. 62.

Habitat.—Loch Katrine, Loch Achray, Loch Leven, etc.;

not rare in the larger lakes, where both species are sometimes found living together. They are both variable species, and a number of varieties have been described.

Family Lyncodaphnidæ, G. O. Sars.

Genus (10) **Ilyocryptus**, G. O. Sars, 1861.

18. *Ilyocryptus sordidus* (Liévin).

1848. *Acanthocercus sordidus*, Liévin, Die Branchiopoden d. Danziger Gegend; Neueste Schrift. d. Naturf. Gesell. in Danzig, 4 : ten Bds. 2 : tes Heft. p. 34, pl. viii. figs. 7-12.

Habitat.—Lochend Loch, Edinburgh, Loch Leven; Linlithgow Loch, and Loch Achray; not uncommon. Úpper Elf Loch, Edinburgh (Dr and Miss Sprague).

Genus (11) **Macrothrix**, Baird.

19. *Macrothrix laticornis* (Jurine).

1820. *Monoculus laticornis*, Jurine, Hist. des Monocles, p. 151, pl. xv. figs. 6, 7.

1901. *Macrothrix laticornis*, Dr and Miss Sprague, Trans. Edin. Field Nat. and Micros. Soc., vol. iv. p. 258, pl. xxxa. figs. 13-15.

Habitat.—Pond in Queen's Park, Edinburgh, 16th June 1900; rare (Dr and Miss Sprague).

Genus (12) **Lathonura**, Lilljeborg, 1853.

20. *Lathonura rectirostris*, O. F. Müller.

1785. *Daphnia rectirostris*, O. F. Müller, Entomostraca, etc., p. 92, pl. xii. figs. 1-3.

Habitat.—Loch Achray, Trossachs, November 1897; rare.

Genus (13) **Drepanothrix**, G. O. Sars, 1861.

21. *Drepanothrix dentata* (H. A. Eurén).

1861. *Acantholeberis dentata*, Eurén, Öfvers af K. Wet.-Akad. Forh. (1861), No. 3, p. 118, pl. iii. fig. 2.

Habitat.—Loch Lubnaig, Loch Katrine, and Loch Achray.

Genus (14) **Acantholeberis**, Lilljeborg, 1853.

22. *Acantholeberis curvirostris* (O. F. Müller).

1776. *Daphne curvirostris*, O. F. Müller, Zool. Dan. Prod., p. 200, No. 2403.

Habitat.—Marfield Loch, Midlothian, 21st September 1901; rare (Dr and Miss Sprague).

Family Chydoridæ, T. R. R. Stebbing, 1902.

Genus (15) **Eurycercus**, Baird, 1843.

23. *Eurycercus lamellatus* (O. F. Müller).

1785. *Lynceus lamellatus*, O. F. Müller, Entomostraca, p. 73, pl. ix. figs. 4-6.

Habitat.—Common and generally distributed throughout the district.

Genus (16) **Camptocercus**, Baird, 1843.

24. *Camptocercus rectirostris*, Schoedler.

1862. *Camptocercus rectirostris*, Schoedler, idem, Die Lynceiden u. Polyphemiden der Umgegend v. Berlin, Ichresb. ü. d. Dorothunstäd Realschule, p. 25, pl. ii. fig. 43.

Habitat.—Loch Achray, November 1897; rare. The form described in Baird's classical work on *British Entomostraca* is probably this species. Typical specimens of *C. macrurus* (O. F. Müller) have been observed in none of the Scottish lakes or ponds examined by me.

Genus (17) **Acroperus**, Baird, 1843.

25. *Acroperus harpae*, Baird.

1835. *Lynceus harpae*, Baird, Trans. Berw. Nat. Club, vol. i. p. 100, pl. ii. fig. 17.

1850. *Acroperus harpae*, idem, Brit. Entom., p. 129, pl. xvi. fig. 5.

Habitat.—Generally distributed and moderately common throughout the district.

Genus (18) **Alonopsis**, G. O. Sars, 1862.

26. *Alonopsis elongata*, G. O. Sars.

1862. *Alonopsis elongata*, G. O. Sars, Forh. i Vidensk. Selsk. i Christiania, 1861 (Aftr.), p. 53.

Habitat.—Moderately common in several of the larger lakes throughout the district. I have no record of it from the loch at Duddingston or from any locality in the vicinity of Edinburgh except Marfield Loch, where it was obtained by Dr and Miss Sprague, and in the Union Canal by myself.

Genus (19) **Alona**, Baird, 1843.

27. *Alona quadrangularis* (O. F. Müller).

1776. *Lynceus quadrangularis*, O. F. Müller, Zool. Dan. Prodr., p. 199, No. 2393.
1895. *Alona costata*, T. Scott, Thirteenth F. B. Rept., pt. iii. p. 189, pl. v. figs. 2 and 12.

Habitat.—Loch Achray, Loch Leven, Duddingston Loch, etc. This species appears to be generally distributed and moderately frequent throughout the district.

28. *Alona affinis*, Leydig.

1860. *Alona affinis*, Leydig, Naturgesch. d. Daphniden, p. 223, pl. ix. figs. 68, 69.
1895. ,, *quadrangularis*, T. Scott, *loc. cit.*, p. 1895, pl. v. figs. 2, 11, 13, 15, and 25.

Habitat.—Distribution somewhat similar to that of *A. quadrangularis.*

29. *Alona tenuicaudis*, G. O. Sars.

1862. *Alona tenuicaudis*, G. O. Sars, *loc. cit.*, p. 37.

Habitat.—Camilla Loch, Fifeshire, 1894, not uncommon; Duddingston Loch, frequent, 1st September 1897, but when this loch was visited three months later the species was not so common. No specimens were observed on 2nd March, but it was again of frequent occurrence in a shore-gathering collected on 15th June 1898. Dr and Miss Sprague found *A. tenuicaudis* rare in Duddingston Loch on 18th August 1900.

30. *Alona costata*, G. O. Sars.

1862. *Alona costata*, G. O. Sars, *loc. cit.*, p. 38.

Habitat.—Upper Elf Loch, and ditch near Harelaw Dam, in the vicinity of Edinburgh; Lochgelly Loch; not uncommon.

31. *Alona guttata*, G. O. Sars.

1862. *Alona guttata*, G. O. Sars, *loc. cit.*, p. 39.
1895. ,, ,, T. Scott, Thirteenth F. B. Rept., pt. iii. p. 190, pl. v. figs. 6 and 16.

Habitat.—Camilla Loch, Loch Leven, Loch Achray, and Upper Elf Loch. Duddingston Loch (Dr and Miss Sprague).

32. *Alona intermedia*, G. O. Sars.

1862. *Alona intermedia*, G. O. Sars, *loc. cit.*, p. 38.
[1] 1895. ,, *neglecta*, T. Scott, Thirteenth F. B. Rept., pt. iii. p. 189, pl. v. figs. 4 and 18.

Habitat.—Loch Katrine and Loch Achray. This species, which does not appear to be very rare, was described in 1895 from specimens found in some Shetland lochs. It has not yet been recorded from England or Ireland.

33. *Alona rustica*, T. Scott.

1895. *Alona rustica*, T. Scott, Thirteenth F. B. Rept., pt. iii. p. 189, pl. v. figs. 5 and 17.

Habitat.—Loch Achray. This appears to be a widely distributed though somewhat local species. It was first observed in samples of Entomostraca sent to me from Shetland by Robert Duthie, Fishery Officer.

34. *Alona rostrata* (Koch).

1841. *Lynceus rostratus*, Koch, Deutschlands Crustacean, Heft. 36, pl. 12.
1901-1902. *Alonella rostrata*, Dr and Miss Sprague, Trans. Edin. Field Nat. and Micros. Soc., vol. iv. pp. 259 and 321.

Habitat.—Cobbinshaw Reservoir, 13th August 1900; rare (Dr and Miss Sprague).

[1] The *Alona intermedia* recorded from Shetland in the Thirteenth F. B. Report is not Sars' species of that name, but the *Alona rectangula* of G. O. Sars. I have no record for this species from the Forth basin, but as it is not rare, especially in ponds and marshy places near the sea, it may yet be found in the district.

Genus (20) **Rhynchotalona**, Norman, 1903.

(Syn.—*Leptorhynchus*, Herrick, and *Harporhynchus*, G. O. Sars, both of which names are preoccupied.)

35. *Rhynchotalona falcata* (G. O. Sars).

1861. *Alona falcata*, G. O. Sars, Forhandl. i Vidensk. i Christiania, 1861 (Aftr.), p. 20.

Habitat.—Loch Katrine and Loch Achray; not common.

Genus (21) **Ledigia**, Kurz.

36. *Ledigia quadrangularis* (Leydig).

1860. *Lynceus quadrangularis*, Leydig, Naturges. der Daphnid., p. 221, pl. viii. fig. 59.
1891. *Ledigia quadrangularis*, T. Scott, Ninth F. B. Rept., pt. iii. p. 292, pl. vi. figs. 5, 5*a* and *b*.

Habitat.—Lochgelly Loch, Fifeshire. It may be of interest to recall the fact that the record of this species in the Fishery Board's Report mentioned above was the first for Britain.

Genus (22) **Graptoleberis**, G. O. Sars, 1862.

37. *Graptoleberis testudinarius* (Fischer).

1851. *Lynceus testudinarius*, Fischer, Mem. des Sar étrangers, St Petersburg, vol. vi. p. 191, pl. ix. fig. 12.

Habitat.—Lochend Loch, 1894; Upper Elf Loch, Braid Hills, 1896 and 1897, where it was also obtained in August 1901 by Dr and Miss Sprague.

Genus (23) **Alonella**, G. O. Sars, 1862.

38. *Alonella excisa* (Fischer).

1854. *Lynceus excisus*, Fischer, Bull. Soc. Impér. d. Nat. d. Moscow (1854), p. 428, pl. iii. figs. 11-14.

Habitat.—Loch Leven, frequent. Loch Katrine, Loch Achray, Loch Vennachar, and Loch Lubnaig. Marfield Loch, 9th April 1901 (Dr and Miss Sprague). As *Alonella excisa* (Fischer) and *A. exigua* (Lilljeborg) are retained by Lilljeborg as distinct species, and as the Scottish specimens I have examined belong to Fischer's *L. excisus*, that name is used here (see remarks in *Seventeenth F. B. Rept.*, pt. iii. p. 201).

39. *Alonella nana* (Baird).

1843. *Acroperus nanus*, Baird, Ann. and Mag. Nat. Hist., vol. ii. p. 92, pl. iii. fig. 8.

Habitat.—Upper Elf Loch, Raith Lake, Loch Leven, Loch Katrine, Loch Achray. Marfield Loch (Dr and Miss Sprague).

Genus (24) **Peratacantha**, Baird, 1843.

40. *Peratacantha truncata*, O. F. Müller.

1785. *Lynceus truncatus*, Müller, Entomostraca, p. 75, pl. xi. figs. 4-8.

Habitat.—Lochgelly Loch, Loch Katrine, Loch Achray, Loch Vennachar, and Loch Lubnaig. High Pond, Penicuik, 7th September 1901; rare (Dr and Miss Sprague).

Genus (25) **Pleuroxus**, Baird, 1843.

41. *Pleuroxus lævis*, G. O. Sars.

1861. *Pleuroxus lævis*, G. O. Sars, Forh. i Vid. Selsk. i Christiania, 1861 (Aftr.), p. 22.

Habitat.—Camilla Loch, Fifeshire; not common.

42. *Pleuroxus trigonellus* (O. F. Müller).

1785. *Lynceus trigonellus*, Müll., Entomostraca, p. 74, pl. x. figs. 5, 6.

Habitat.—Duddingston Loch, Loch Leven, Raith Lake, Loch Katrine, Loch Achray. Marfield Loch (Dr and Miss Sprague).

43. *Pleuroxus uncinatus*, Baird.

1850. *Pleuroxus uncinatus*, Baird, Brit. Entomostraca, p. 135, pl. xvii. fig. 4.

Habitat.—Raith Lake and Loch Leven.

Genus (26) **Chydorus**, Leach, 1816.

44. *Chydorus globosus*, Baird.

1850. *Chydorus globosus*, Baird, Brit. Entomostraca, p. 127, pl. xvi. fig. 7.

Habitat.—Loch Achray. Dr and Miss Sprague collected this fine species in an old quarry in Dalmeny grounds, close to the river Almond, on 6th September 1901.

45. *Chydorus ovalis*, Kurz.

1874. *Chydorus ovalis*, Kurz, Dodekas neuer Cladoc., p. 73, pl. iii. fig. 11.

Habitat.—A few specimens of a *Chydorus*, which agree with the description of *C. ovalis* given by Professor Lilljeborg in his important work on the Swedish Cladocera, were obtained in Linlithgow Loch in October 1896 and in Loch Leven in June 1898.

46. *Chydorus latus*, G. O. Sars.

1862. *Chydorus latus*, G. O. Sars, Vid. Selsk. i Christiania Forh., 1861 (Aftr.), p. 41.

Habitat.—Loch Achray, frequent in March 1898, but this was the only time it was observed during my four visits to this loch.

47. *Chydorus barbatus* (G. S. Brady).

1868. *Lynceus barbatus*, Brady, Intellectual Observer, 1868.

Habitat.—This *Chydorus* appears to be moderately frequent in some of the lochs and ponds within the district under consideration, as Loch Leven, Loch Lubnaig, Loch Katrine, Loch Achray, etc. As remarked by Mr Scourfield, "the ventral shell margin is in this species densely fringed with long plumose setæ, hence the name *C. barbatus*."

48. *Chydorus sphæricus* (O. F. Müller).

1785. *Lynceus sphæricus*, O. F. Müller, Entomostraca, p. 71, No. 2932.

Habitat.—Common and generally distributed. *C. cœlatus*, Schoedler, is, according to Professor Lilljeborg, a variety of *C. sphæricus*.

Genus (27) **Monospilus**, G. O. Sars, 1861.

49. *Monospilus dispar*, G. O. Sars.

1861. *Monospilus dispar*, G. O. Sars, Vid. Selsk. i Christiania Forhandl., 1861, p. 23.
1891. ,, *tenuirostris* (Fischer), T. Scott, Ninth F. B. Rept., pt. iii. pp. 272 and 295, pl. v. fig. 1.

Habitat.—Loch Leven, 1890; Loch Achray, November 1897; rare.

Division GYMNOMERA.

Tribe ONYCHOPODA, G. O. Sars.

Family POLYPHEMIDÆ.

Genus (28) **Polyphemus**, O. F. Müller, 1776.

50. *Polyphemus pediculus*, Linné.

1761. *Monoculus pediculus*, Linn., Fauna Suecica, p. 498, No. 2048.

Habitat.—Loch Leven, 1890; Loch Lubnaig, 1894; Loch Vennachar, Raith Lake.

Genus (29) **Bythotrephes**, Leydig, 1860.

51. *Bythotrephes longimanus*, Leydig.

1860. *Bythotrephes longimanus*, Leydig, Naturges. der Daphniden, p. 244, pl. x. figs. 73-75.

Habitat.—Loch Leven, 1890; Loch Vennachar (1895), Loch Katrine, and Loch Achray. Not uncommon in the larger lochs.

Genus (30) **Podon**, Lilljeborg, 1853.

(The members of this genus and the next are marine.)

52. *Podon Leuckarti*, G. O. Sars.

1862. *Pleopis leuckarti*, G. O. Sars, Forhandl. i Vidensk. Selsk. i Christiania, 1861, p. 45.
1902. ,, ,, T. Scott, Twentieth F. B. Rept., pt. iii. p. 476, pl. xxv. figs. 23 and 24.

Habitat.—Firth of Forth, occasionally frequent, especially in the seaward part of the estuary. The *Podon polyphemoides* recorded in Part III. of the *Ninth Annual Report of the Fishery Board for Scotland,* p. 308 (1891), is probably this species, as no Forth specimens of *P. polyphemoides* are now in my collection.

Genus (31) **Evadne,** S. Loven, 1836.

53. *Evadne Nordmanni,* Loven.

1836. *Evadne nordmanni,* Loven, K. Wetensk.-Akad. Handl., 1835, p. 1, pls. i. and ii. figs. 1-16.

Habitat.—Firth of Forth, usually moderately common.

Tribe HAPLOPODA, G. O. Sars.

Family LEPTODORIDÆ, Lilljeborg.

Genus (32) **Leptodora,** Lilljeborg, 1861.

54. *Leptodora Kindtii* (Focke).

1844. *Polyphemus kindtii,* Focke, Sonntagshlatt. der Weser-Zeitung, No. 34, p. 6.
1861. *Leptodora hyalina,* Lillj., Öfversigt af K. Vet.-Akad. Förhandl., 1860, No. 5, p. 265, taf. vii. figs. 1-22.

Habitat.—Loch Leven, June 1890, frequent in the open water; common on 3rd September 1897, but no specimens were obtained in December of the same year, nor in the months of March and June of 1898. A few specimens were captured in September 1897 in Loch Katrine, but none in November; in 1898 none were taken in March, while in June, though none were observed at the upper end of the loch, the species was moderately frequent at the lower end. The only other lake within the limits of the district from which I have notes of *Leptodora* is Loch Achray; it was found sparingly here on 10th September 1897, but no specimens were observed when the loch was visited in November; neither were any specimens observed when the loch was examined on the 17th of March and the 28th of June 1898.

In Professor Lilljeborg's work on the *Cladocera of Sweden*, 38 genera are described; 32 of them are represented in the preceding list. The 6 not represented are as follows:—

1. *Limnosida*, G. O. Sars.
2. *Moina*, W. Baird.
3. *Ophryoxus*, G. O. Sars.
4. *Bunops*, E. A. Birge.
5. *Streblocerus*, G. O. Sars.
6. *Anchistropus*, G. O. Sars.

Three of these—*Ophryoxus gracilis*, G. O. Sars, *Streblocerus serricaudatus* (Fischer), and *Anchistropus emarginatus*, G. O. Sars, have been obtained in Scotland. The first was discovered by Mr D. J. Scourfield in Loch Ness, and in a backwater of the Caledonian Canal at Coiltry Lock. The second I found in the Dhu Lochan—a small loch close to Loch Lomond, and about two miles south of Rowardennan. The third was taken by the late Dr Robertson, of Millport, in 1863, in the Paisley Canal (since filled up), and has occurred more recently in Ireland, and at one or two places in England.

Moina—all three species—has been recorded from England, but not from Scotland, and there does not appear to be any British record for the other two. But though the genera are so well represented, our list comes far short in the matter of species. Lilljeborg describes about 100 species from Sweden, besides numerous varieties, whereas our record amounts only to 54. It is thus apparent that further research is necessary, and will doubtless be rewarded.

Suborder **Branchiura.**

Family ARGULIDÆ, Leach, 1819.

Genus (1) **Argulus**, O. F. Müller, 1781.

1. *Argulus foliaceus* (Linn.).

1785. *Monoculus foliaceus*, Linn., Syst. Nat., ed. x., p. 634, No. 2.
1850. *Argulus foliaceus*, Baird, Brit. Entom., p. 255, pl. xxxi. figs. 1, 2.

Habitat.—Found attached to a specimen of the Three-spined Stickleback (*Gasterosteus aculeatus*), and also free amongst *Anacharis* in the Union Canal, near Edinburgh, by Mrs Janet Carphin, on 26th August 1895.[1]

[1] *Ann. Scot. Nat. Hist.*, No. 16, October 1895, p. 255.

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PROCEEDINGS

OF THE

ROYAL PHYSICAL SOCIETY

FOR THE

PROMOTION OF ZOOLOGY AND OTHER BRANCHES OF NATURAL HISTORY.

SESSION 1905-1906.

No. 5. VOL. XVI. PAGES 191-230.

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EDINBURGH: M'FARLANE & ERSKINE.
MARCH 1906.

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XV. *The Embryology of certain of the Lower Fishes, and its Bearing upon Vertebrate Morphology.* By J. Graham Kerr.

(Read 27th February 1905.)

Introduction.

The worker who takes up seriously the study of Vertebrate Morphology cannot, as it seems to me, avoid being much impressed by certain limitations to which one important side of his subject—the embryological side—is subjected. These limitations are due to the fact that the foundations of the science of embryology have been laid, not on the comparison with one another of the developmental phenomena shown by the more lowly organised vertebrates, but on the features of development as they occur in a few easily accessible and easily investigated forms—the chick, the rabbit, the selachian, and, to a much less extent, the frog. The first three of these—and they have played by far the greater part in building up the science of embryology—are all of them forms in which there is present, or appears to have been present in the ancestral forms, an enormous mass of food-yolk, which cannot have been without a marked distorting influence on the course of development.

Considerations of this kind led the author some years ago to devote himself to a study of the development of certain of the lower forms of vertebrates; and, in the present communication, it is proposed to draw the attention of the Society to some of the embryological features of these forms, which may be regarded as having a bearing upon the general morphology of the Vertebrata.

The work has been carried out upon the Dipnoans, *Lepidosiren* and *Protopterus*, with *Ceratodus* and various *Urodeles* for comparison, and more recently on the Crossopterygian ganoid *Polypterus*.[1]

[1] Owing to the lamented death of my friend Budgett. A detailed account of the development of *Polypterus* will be found in the forthcoming Budgett Memorial Volume.

Gastrulation.

The process of gastrulation in the forms under consideration is of interest, as affording links between the types of gastrulation familiar in other Anamnia. In *Polypterus* the process, so far as is possible to judge from the meagre material available, shows characters which, while resembling those found in Amphibians, have not advanced quite so far along the path of specialisation from the primitive mode of gastrulation found at the present time in *Amphioxus* alone amongst vertebrates. In *Lepidosirén,* on the other hand, the mode of gastrulation, while again resembling the process as met with in the Amphibia, shows a decided advance towards the type of gastrulation found in the Elasmobranch.

Polypterus.

The earliest stage known in the process of invagination is one where a sharply-marked groove extends about half-way round the equator of the egg. In a later stage, the groove forms a complete circle about 50 degrees from the lower pole. The diminution in radius of curvature, and the still circular form of the curve, probably indicate that the line of invagination has been advancing downwards towards the lower pole at an equal rate at all parts of its extent. The specially characteristic feature at this stage is the enormous unpigmented yolk-plug, sharply marked off by the deep and wide groove from the remaining pigmented part of the egg surface. In this stage we see a transitional condition between that found in *Amphioxus,* where the line of invagination forms a complete closed curve while still nearly equatorial in position, and that characteristic of the Amphibian, where it is completed only at a much later stage, when it has advanced much farther over the egg surface, and had its radius of curvature greatly reduced. In these modifications of the gastrulation process we probably have to do with a postponement of the process caused directly by the increased quantity of yolk. In *Amphioxus,* the main part (A) of the gastrulation process consists of the tucking in of the hypoblastic part of the blastula wall; it is only in its latest stages (B) that it consists in an onward movement of the blastopore lip. In *Polypterus* and Amphibians, owing to the enormous thickening of the hypoblast due to its storage of yolk, the process A is rendered mechanically impossible until in the latest stage of gastrulation, when the blastopore lip has already been carried almost completely over the mass of yolk. In the stage in *Polypterus* of which I have been speaking, we see in the deep groove round the huge yolk-plug the attempt on the part of the egg to carry out the gastrulation process in the ancestral way.

Lepidosiren.

The method of gastrulation is shown in my previous papers.[1] The process begins with the appearance of a shallow latitudinal groove running round about one-third of the circumference of the egg at its latitude. This groove gradually shortens up, its terminal parts flattening out. It is only in its central portion that the groove deepens and gives rise to the archenteron of the gastrula. In *Polypterus* we have seen that the invagination groove still becomes a closed curve at an early stage in gastrulation, and in the Amphibian usually only at a much later stage. In *Lepidosiren* the curve never becomes closed at all, its terminal parts disappearing. Finally, in the Elasmobranch, the only part of the invagination curve which ever appears is the central part, which gives rise to the archenteron.

Primitive Arrangement of the Cell Layers.

There do not appear to exist in the data of vertebrate embryology, as known to us at present, any distinct traces of the descent of this phylum from any other phylum of triploblastic Metazoa, though there are various morphological considerations which make it seem probable that vertebrates,

[1] *Phil. Trans. Roy. Soc.*, vol. 192, B; and *Quart. Jour. Micros. Sci.*, vol. 45.

annelids, arthropods, and molluscs are offshoots of a common triploblastic stem. On the other hand, there are various points in the ontogeny of various vertebrates which, so far, seem explicable only on the hypothesis of a coelenterate-like ancestor, possessing some of the main features of existing Actinozoa. Most important amongst these are the apparent traces of a once present slit-like protostoma or primitive mouth, forming a continuation of the blastopore forwards along the mid line of the medullary plate. Associated with this is the fact that in various vertebrates the blastopore persists as the definitive anus, and that in some, *e.g.*, *Lepidosiren*, the primitive nerve rudiment is continued posteriorly behind the anus. The only working hypothesis which fits in with these facts is that we are dealing with the vestiges of a condition of things resembling what we find in the modern Actinian, with its slit-like mouth dilated at either end into an inhalent and an exhalent opening, and surrounded by a specially condensed part of the general nerve plexus.

I have shown elsewhere [1] how, in my opinion, the method of mesoderm formation in the higher vertebrates can be connected up by a series of links with the method of formation in *Amphioxus*, where the mesoderm arises in the form of archenteric or coelenteric diverticula, which are, of course, directly comparable with those of the Actinian.

Considerable confusion of thought has been introduced into vertebrate morphology by the loose way in which the word "outgrowth" is used; the optic rudiment is frequently described as an "outgrowth" from the thalamencephalon, the mesodermal rudiments as "outgrowths" from the gut-wall. As a matter of fact, it would be more accurate to describe these structures as being formed rather by being tucked off from the neighbouring parts of the brain or gut-wall. This is important in connection with the question of the existence from the beginning of the nervous connection between central nervous rudiment and myotome, for we see that the nervous bridge in the earliest stage at which I was able to determine its existence in *Lepidosiren*, connects two points

[1] *Quart. Jour. Micros. Sci.*, vol. 45, p. 34.

which are primitively in close proximity. The motor nerve trunks, in fact, are merely the much enlarged portions of an originally diffuse nervous network which connect up two once adjoining regions of the original epithelial wall—continuous from ectoderm through protostoma to endoderm—which have become specialised to form central nervous and muscular systems.

External Gills.

A set of organs which have proved to be of much interest in the development of those forms with which I have concerned myself are the external or dermal gills.

The importance of these structures has been, in my opinion, by no means properly appreciated by morphologists. This is not surprising when we consider that among the more accessible vertebrates they occur in only one group—that of the Amphibia. The researches of recent years have shown that they are also highly conspicuous features in the development of both existing Crossopterygians and of two out of the three surviving Dipnoans; and a study of their development in the three groups in which they occur leads me to believe that they are by no means to be lightly dismissed as mere recent adaptations to a larval existence, evolved independently in the three groups, but that, on the contrary, we have in them truly homologous structures, and consequently structures of great antiquity in the evolution of the vertebrate phylum.

Typically, an external gill forms a conspicuous projection—carrying lateral branches, often arranged in a pinnate manner—from the side of the body in the region of the visceral arches. The lateral branches have a rich development of superficial capillaries, whose blood supply is carried by a conspicuous afferent and an efferent vessel running along the interior of the organ. The external gill is provided with voluntary muscles. By means of these muscles the external gills can be twitched actively at the will of the animal, so as to renew the water which bathes their surface.

Each external gill originally forms a projection from a visceral arch, in the broad sense, *i.e.*, from the mass of tissue lying between two visceral clefts, and in existing vertebrates the distribution of external gills is as follows:—

Visceral Arch.

Group	I.	II.	III.	IV.	V.	VI.
Crossopterygii		×				
Dipnoi			×	×	×	×
Urodela	× Modified or Vestigial.[1]	Vestige.[1]	×	×	×	

Ontogenetic Development.

In ontogeny the development of the external gills follows the same lines in all three groups—Crossopterygii, Dipnoi, and Urodela. The external gill makes its first appearance as a rounded elevation of the surface of the body, consisting of mesoderm covered by ectoderm, and situated *between* the positions where two visceral clefts will appear later. The external gill rudiment appears long before the clefts are perforated. The hypoblastic walls of the gill outgrowths of the pharyngeal wall are sharply distinguishable from the ectoderm by their cells being packed with large yolk granules. There can be no possibility of hypoblast entering in any way into the formation of the external gills, which are purely dermal outgrowths covered with ectoderm.

The external gill rudiment comes to project more and more freely above the general surface, and presently it develops its characteristic relation to the vascular system, as described long ago by Boas. The main aortic arch passes right out into the external gill, looping back at its tip. The aortic

[1] Cf. Drüner, *Zool. Jahrb. Anat.*, Bd. 19, s. 434.

arch in its early stages is, in fact, the vessel of the external gill. This relation of aortic arch to external gill constitutes, to my mind, a weighty piece of morphological evidence of the archaic nature of these organs.

PHYLOGENETIC DEVELOPMENT.

Palaeontology so far has afforded next to no evidence regarding external gills in the more ancient vertebrates. This is not surprising when we bear in mind (1) that until their morphological importance is appreciated, palaeontologists are not likely to direct any special attention to the search for traces of them, and (2) that external gills, composed almost or quite entirely of soft tissue, would not be likely to leave any conspicuous traces behind them.

In this connection it is of interest to note, however, that there is already some evidence to indicate that external gills have in at least certain cases possessed a supporting skeleton, *e.g.*, in *Dolichosoma*, Fritsch[1] found remains of an extensive skeleton projecting from the branchial region, and which can only be explained on the supposition that it served as a support for large external gills. Along with this evidence of palaeontology, we have the fact discovered by Budgett,[2] that in the young larval *Polypterus* there is a segmented rod of cartilage projecting from the hyoid arch, and serving to support the base of the external gill.

EVOLUTION OF ORGANS OF RESPIRATION.

It is one of the fundamental characters of living substance, that it needs to carry on respiratory exchanges with the surrounding medium. The process of life is to a certain extent a process of slow combustion, and, like any other combustion, it needs a supply of oxygen to enable it to go on. As in other forms of combustion, carbon dioxide is produced, a substance unfavourable to the combustion process, and which actually stops that process if it is allowed to accumulate. In any piece of living substance then, these respiratory exchanges take place between it and the fluid medium in contact with it—for living protoplasm

[1] *Fauna Gaskohl.*, Bd. II. s. 114.

[2] *Trans. Zool. Soc. Lond.*, vol. xvi. p. 32 .

must always be in contact with fluid. In the lower forms of animal life the habitat is aquatic, and the medium with which the respiratory exchange takes place is the water. The more complex animals, on the other hand, are characterised by increase in bulk, so that their inner portions are far away from the outer medium. In these we find that watery fluid is formed in the interior of the creature, filling chinks or more or less regular cavities. It is with this internal fluid—this internal medium, as it has been aptly termed—that respiratory change now takes place. There will obviously be a tendency for the internal medium soon to be robbed of all its available oxygen, and to become loaded with carbon dioxide, so as to be useless for respiration. To avoid this, we find (1) that a mechanism arises by which the internal fluid is pumped along so as to circulate through its series of chinks, in other words, a blood vascular system arises; and (2) in one or more regions a highly vascular surface is formed, which comes into intimate relation with the external medium, the respiratory organ in the ordinary sense. There is now a definite blood vascular system, and one, or more than one, definite organ of respiration.

It is clear that the actual process of respiration is of a double nature. There is, firstly, what we may call tissue respiration, consisting of the respiratory exchanges between the living substance of the tissues and the blood; and secondly, the respiratory exchanges, that take place between the blood and the external medium. It is with the latter of these two that what we ordinarily understand by respiratory organs have to do, and it is my purpose in this section to trace what we may consider the most probable course of the evolution of such organs amongst the Vertebrata.

It may be assumed, to commence with, that the primitive potential respiratory organs in vertebrates, or any other of the more complicated Metazoa, are two in number—(1) the skin, and (2) that part of the original outer surface which has been tucked into the interior of the body to form the alimentary canal. In each we have a more or less richly vascular surface, which is brought into intimate relations with the external medium as a whole, or with isolated portions of it taken into the gut. From these two primitive breathing organs are developed the specialised breathing organs which are so characteristic of the subgroups of the Vertebrata.

The general surface of the skin is the great original organ of respiration. In groups where it still carries on this function, we find very usually that the function becomes accentuated locally. Special portions of the skin become specially vascular, and then they tend to increase in area so as to increase the respiratory surface. In this way we find involutions of skin into interior of body, as, *e.g.*, in tracheæ of insects, or we find projections developed from the surface forming dermal gills, *e.g.*, molluscs, chætopods.

In the lower vertebrate, probably in correlation with increase in thickness, and more especially with the development of a placoid dermal skeleton, the skin generally seems to have lost its great respiratory significance, but there exist in some of the most primitive vertebrates structures which appear to represent ancient dermal gills. These structures are the external gills mentioned already as occurring in the young of Crossopterygians, Dipnoans, and Amphibians.

The more usual view that these external gills are secondarily developed structures of no phylogenetic importance seems to be negatived—(1) by their very early appearance in ontogeny; (2) by the importance of their blood supply—the main aortic arch passing into them; (3) and by the remarkable constancy of their position in relation to the upper end of the visceral arch.

There is one obvious and strong argument against the archaic nature of the external gills, and that is the fact of their absence in certain of the admittedly primitive groups, *e.g.*, the Elasmobranchii. There are two considerations which seem to me to diminish the weight of this objection. We know that external gills are remarkably liable to injury through disease or enemies. Apart from this being known from observation, it is implied in the remarkable powers of regeneration shown by these organs. They would therefore tend to disappear in evolution if their function were taken on by other organs.

Further, as I have pointed out elsewhere,[1] many of the groups without external gills are those which possess a yolk-sac with highly vascular surface, which *must* itself act as a highly efficient respiratory organ, in addition to its nutritive function. It is quite to be expected in such a case that external gills, with their purely respiratory function, should disappear.

We see, then, that there is nothing improbable in the disappearance of external gills. On the other hand, it appears to me most unlikely that they should have developed independently in the three groups in which they occur. They show a remarkable similarity—not a superficial resemblance, but a deep-seated resemblance—in their fundamental characters. They are situated in the same relation to their visceral arches: the aortic arch passes out into them in exactly the same way.

Enteric Organs of Respiration.

In a few cases, the general enteric lining plays an important part in respiration, *e.g.*, in some of the loaches this is the case. The gut lining is very highly vascular, and the living fish is seen at intervals to *swallow* bubbles of air; if not allowed to do this, the fish dies. Again, in the Siluroid *Callichthys*, water is taken in periodically to the posterior part of the intestine, which acts as an organ of respiration.

It is, however, normally in the region of the pharynx that we find respiratory activity specially concentrated. We find in this region the series of gill-clefts with their respiratory walls, their surface increased by the development of the highly vascular lamellæ. We are still in complete obscurity regarding the phylogeny of the gill-clefts. In ontogeny they arise as a series of pockets or pouches of the pharyngeal wall, which secondarily fuse at their tips with the ectoderm, and open to the exterior. Now the great question to be answered regarding their phylogeny, and one to which we cannot as yet find any certain answer, is, Were the gill-clefts in their early functional stages *pouches* or *clefts?*

[1] *Proc. Camb. Phil. Soc.*, vol. x. p. 233.

If the former, we should probably conclude that their function was from the beginning a simple respiratory one; they would be looked on simply as local enlargements and outgrowths of the primitively respiratory gut surface, which finally developed an opening to the exterior, connected with the causing a more perfect flow of water over the respiratory surface. If, on the other hand, they first acquired their directly respiratory surface as *clefts*, then we must assume that in their first beginnings they had some other function. Now, I think it is not impossible that such a significance may be found in connection with the external gills. For the functioning of the external gills, it is essential that the water over their surface should undergo frequent renewal. It seems perfectly possible that the clefts should have developed in relation to this need; supplies of fresh water being pumped through them over the external gills. Were this view shown to be correct, we should regard the direct respiratory activity of the walls of the clefts as secondarily acquired—most probably by the spreading inwards of respiratory ectodermal epithelium along the walls of the clefts. What looks very like such a spreading inwards of ectoderm to form the respiratory lining of the gill-cleft, may be seen in the ontogeny of various water-breathing vertebrates.

Then finally, in connection with the pharynx, we have the swim-bladder and lungs. In development, each of these arises as an outgrowth of the pharyngeal wall: in the case of the lungs, a medioventral outgrowth; in the case of the swim-bladder, of a Teleost, mediodorsal. The question of the homology of the swim-bladder and lungs has been much discussed. The knowledge which we now possess appears to render quite untenable the position of those who dispute the homology of the two organs in at least certain groups. In the case of Crossopterygians and Dipnoans, the swim-bladder arises exactly as do typical lungs, and in the adult condition the blood supply is identical. In this case it would seem impossible to doubt the homology. Wiedersheim recently found in *Lepidosiren* a mediodorsal groove on the pharyngeal wall, which he interpreted as a last vestige of a true dorsal swim-bladder: the fact, however, that this groove appears only late in development is against its morphological significance.

The problem is more difficult as regards the swim-bladder of Actinopterygians. This is throughout dorsal in relation to gut: its blood supply is derived from the dorsal aorta. It is, however, important to notice that in a considerable number of Teleosts—*e.g.*, *Erythrinus*—and other Characinids, the opening of the swim-bladder is lateral, and that in many Teleosts the first rudiment is not exactly median. These are indications of transitional conditions, and suggest that a wandering round the gut has taken place. Important evidence bearing on this question is afforded by the manner in which the organ is supplied with blood. In the typical lung, and also in the "swim-bladder" in Dipnoans and Crossopterygians, the blood is supplied by means of a pulmonary artery on each side, arising from the sixth aortic arch. In the case of the typical Actinopterygian, on the other hand, the blood supply of the swim-bladder is derived from branches of the coeliac artery and branches of the dorsal aorta situated posterior to this, an apparently fundamentally different arrangement. Now, as we know that the swim-bladder arises as a small localised rudiment from the pharyngeal wall, and grows back secondarily, any blood supply derived from farther back branches of the dorsal aorta, and particularly any blood supply whose vessels arise over a considerable antero-posterior extent of the dorsal aorta, *must* be looked on as secondary. That this is so, and that the blood supply of the swim-bladder was primitively the same as that of the typical lung, is indicated further by the fact that in at least one Actinopterygian, *Amia*, such a blood supply is still retained.

Upon the whole, the view that seems most tenable regarding the phylogeny of lung and swim-bladder is this:—

1. It arose as a median ventral diverticulum.

We must conclude this from its always arising in this position in ontogeny, except in the specialised Actinopterygians.

2. Its ventral position renders it probable that the structure functioned at first as a lung rather than as a hydrostatic organ, and this is supported by the fact that in

the lowest fishes where it exists (Crossopterygians, Dipnoans) it does act as a lung.

3. With the adoption of a deep-water habitat, the lung began to function mainly as a hydrostatic organ, and, associated with this, its connection with the pharynx migrated to the mid-dorsal line. An important clue to how this migration may have taken place is given by the Dipnoi. In them the glottis is ventral, but the pneumatic duct passes up round the right side of the pharynx, the lung being situated dorsally. This dorsal position of a lung which has not yet lost its original undivided character is rendered practically necessary by the aquatic existence in which the lung, besides its primary respiratory function, necessarily exerts a secondary hydrostatic function. When once the lung itself had become dorsal in position, it would seem only natural that the glottis should then gradually migrate dorsad so as to make the communication between lung and pharynx as direct and uncomplicated as possible.

The Origin of the Limbs of Vertebrates.

Before leaving the subject of external gills, a few words may be said in regard to their possible connection with the origin of the limbs of vertebrates. I may say that with more extensive knowledge of the development of external gills and of limbs, I see no reason to give up or to modify my opinion that the only feasible working hypothesis of the origin of limbs is that which derives them from external gills. The guiding principle in all speculations as to the origin of new organs must be that a pre-existing organ, with a different dominant function, must be found, out of which, by modification in structure and function, the new organ may have been evolved. In the case of the limb, the pre-existing organ *must* have possessed two qualifications—(1) it must have projected beyond the general surface, and (2) it must have been movable by means of voluntary muscles. The only paired organs of the more lowly organised vertebrates which fulfil these conditions, and are not limbs, are the external gills.

It has been suggested that a forerunner of the paired limbs once existed as a lateral fold running along each side of the body. The embryological basis upon which this view rested has long ago been shown to be unreliable, the traces of such a fold in ontogeny being now known to be absent in the less highly specialised Elasmobranchs, though present in such forms as *Torpedo.* Certain morphologists attach great weight to the evidence of the paired fins in *Cladoselache,* but it is only necessary to look at the remarkably highly specialised tail of this creature to see that its motor arrangements were of a highly efficient kind, and to feel the gravest doubts as to any interpretation of its paired fins which makes them out to be of a primitive, less specialised, and therefore comparatively slightly efficient character. If, in addition, one turns to the structure of the paired fins in *Cladodus Neilsoni,* described by Traquair (as intermediate between the biserial archipterygium of Pleuracanthids and the condition found in sharks), it is difficult to avoid the belief that we have still much to learn as to the structure of the paired fins in *Cladoselache.*

On the whole it must, it seems to me, be admitted that, in the present state of our knowledge, the former existence in vertebrates of a lateral fin-fold is absolutely hypothetical, and we must therefore incline towards the other view, which derives the limb from a forerunner whose existence is rendered probable on independent morphological grounds.

I may recapitulate here, in a few words, the view which I hold as to the derivation of the paired fins:—

1. There were present in primitive vertebrates a series of paired external or dermal gills. These existed on each of the visceral arches, as is rendered probable by their vestigial occurrence on arches I.–VI. in existing vertebrates. The same evidence which renders it probable that the series of branchial clefts once was more extensive than it is in existing forms points to the probability of the series of external gills once also having extended back beyond arch VI.

2. These external gills, while primarily respiratory, were highly muscular, and therefore *potentially* motor organs.

3. Two pairs of these organs lost their respiratory and developed their supporting (as in "balancer" of *Urodeles*—the external gill of arch I.) and motor functions, and became

rod-like "stylopterygia," used for clambering about amongst the vegetation in the primitive shallow-water habitat.

4. As the struggle for existence became more intense in the shallow marginal zone, certain forms spread into deep water, and their stylopterygia became paddle-like archipterygia, while others took to a more terrestrial existence; and in them the stylopterygium becoming flattened at the tip, and taking on an S-shaped curve, became developed into a cheiropterygium.

It will be seen that the view implies the acceptance of the belief that the biserial archipterygium is really the primitive type of existing *fin*. That this is so is rendered probable by the fact of the predominance of this type of fin in the earlier periods of the history of the main groups of fishes, and, further, by the anatomical structure of the fin, which is clearly less highly differentiated as an organ of swimming than the other forms of paired fin. It will be noted further, that the view involves the acceptance of Gegenbaur's view that the limb *girdle* has been evolved from a branchial arch.

Development of the Nervous System.

In regard to the central nervous system, there appear to emerge from the facts of development, as shown by the forms under consideration, two points of cardinal importance. The first of these relates to the general topography of the brain region. In *Polypterus*, and in *Lepidosiren* and *Protopterus*, the brain shows at an early stage a division into two regions, the posterior one of which will give rise to the hind brain region of the adult, the other to the whole of the brain lying anterior to this.

In none of these cases do we find the division into three primitive brain vesicles—the familiar fore, mid, and hind brain. And when we look into the matter we find that the view that this division is a primitive one rests upon the developmental phenomena as seen in the bird, and selachian, and mammal. Apart from the relatively high systematic position of two out of the three groups mentioned, which would in itself suggest caution in basing general ideas upon the phenomena observed in them—we have a further disturbing factor in the differential growth seen in the brain region. This is correlated with two facts—(1) that associated with the high complexity of the adult brain, there occurs precocious increase in the size of the brain, and (2) that owing to the enormous mass of yolk, the ventral side of the embryo is kept back in its increase in length, while the dorsal side, going on with its development, causes the axis of the brain to become greatly curved.

Personally, I am inclined to conclude that the correct view as to the primitive division of the vertebrate brain is that which divides it into two (rhombencephalon and cerebrum), a view now accepted by many anatomists on the grounds of adult structure.

The second point is in regard to the morphology of the fore-brain region. The evidence of all three of the forms under consideration agrees in supporting the old view—supported in these days especially by Studnička—that the hemisphere region is primitively paired, and absolutely against the more generally accepted view that the hemispheres are to be looked on as the terminal region of the brain, as a "telencephalon" in the sense of His.

From the evidence of the more primitive vertebrates, where the brain region is not distorted by the presence of the yolk-sac hindering the growth in length of the ventral side, it must, I think, be believed that the hemispheres are to be regarded simply as localised developments of the lateral walls of the primitive fore-brain, developments of a similar kind to those which are developod in connection with the special sense of sight, and form the optic "outgrowths."

Motor Nerves.

In my description of the development of the motor nerves,[1] the chief point brought out is that in *Lepidosiren* it is possible to demonstrate the fact that the motor nerve which passes from the central nervous system to the peripheral muscles can be traced back to an extremely early stage of

[1] *Trans. Roy. Soc. Edin.*, vol. xli. p. 119.

development, when it is found in the form of a soft protoplasmic bridge connecting spinal cord and myotome, the latter structures being still in contact with one another. As development proceeds, the myotome becomes pushed outwards by the development of mesenchyme, and the nerve-trunk becomes correspondingly lengthened. As the myotome increases in size, the peripheral end of the nerve becomes expanded, and this expansion breaks up into conically arranged branches. Later on the myotome breaks up into various muscles, which become pushed about into their adult positions, each one dragging with it its bit of the original nerve-trunk to form its nerve in the adult state. The nerve-trunk is, as I have shown, originally naked; its sheath is derived from mesenchymatous elements, which apply themselves to it. This spreads itself out along the nerve, and forms the continuous protoplasmic sheath. The conducting elements of the nerve, the primitive fibrils, gradually appear in the originally simple granular protoplasm of the nerve-trunk.

The special interest of these phenomena of nerve development lies in their bearing on the general problem. It will be seen that they render quite unnecessary the remarkable view, which is still taught by many in authority, that nerve-trunks grow out towards the periphery. Evidence to support this view is, of course, plentiful enough: it may be found in almost every slide of sections. It would have been easy to furnish numerous accurate figures of sections showing freely ending nerves; while it needed much laborious searching through long series of sections of carefully fixed and prepared embryos before it was possible to get together a set of specimens like those which I have figured, showing the whole course of the nerve-trunk. It requires very little consideration to realise that one must frequently find what seem to be free ending nerves, not because they really are so, but because the nerve passes out of the plane of section. It is often very difficult indeed to pick up such nerves in the neighbouring sections of the series. There is also the further possibility that the delicate and inconspicuous nerve-trunk may not be towards its peripheral end still naked, and the abrupt end of its sheath produce the impression that it is the end of the whole nerve.

On the other hand, there is no conceivable source of error which could produce the appearance shown in my figures, with their continuous nerve-trunk stretching right from spinal-cord to myotome, and showing peripherally absolute protoplasmic continuity between nerve-trunk and myoblast.

Nerve Fibrils.

The development of the primitive nerve fibrillæ affords a problem of surpassing interest. The view which I take of the general problem is this. I take it that in the simplest mass of living matter there is a constant playing backwards and forwards of vital impulses. It is by this that the bit of living matter exhibits individuality. The nucleus of say a protozoon sends out impulses regulating, *e.g.*, its secretory activity; similarly it receives impulses coming from the outer surface which play a part in starting the efferent impulses. So also impulses pass hither and thither through the cytoplasm. The instant the microgamete penetrates the surface of the Echinid egg, the vitelline membrane is seen to spread out over the surface all round: the membrane is everywhere formed in response to the stimulus which spreads through the egg substance from the point of entrance.

Similarly in the metazoon there are in all probability impulses constantly passing hither and thither through the living substance so long as life lasts. But in the metazoon, composed of large numbers of cells, modified some as muscular, some as secretory, some as sensory, and all in more or less fixed topographical relations to one another, there would naturally be more or less definite tracks along which special and frequently recurring impulses would flow, —for example, between a definite centre and a definite peripheral end organ. In the primitive nerve fibrillæ I believe we have these tracks—visible because the protoplasm along them is modified in correlation with its active physiological condition. If this physiological activity ceases, the fibril will soon revert back to its original simple protoplasmic condition; if activity is again set up, the fibril will soon again form in response. The impulse can, of course, pass through the simple, undifferentiated protoplasm, but it can only do so with difficulty and in a relatively imperfect fashion. For the transmission of intense impulses, probably the completely developed nerve track or primitive nerve fibril is an absolute necessity.

On this view, what takes place when a nerve is cut and regenerates is as follows:—The passage ceasing in the peripheral part, the neurofibrillæ revert to their simple protoplasmic condition. Feeble impulses will still pass however, even in the simple protoplasm. There may be simple stray impulses affecting the peripheral portion, in which case this may show a certain amount of regeneration. Or if the end organ remains active with more or less of the nerve undegenerated, faint attempts at the normal stimuli will be able to pass across the degenerated bridge of protoplasm between such peripheral part of the nerve and the central stump. This will cause a re-formation of primitive fibrils, which, being a mere expression of impulse tracks, must necessarily form in continuity with the central and peripheral parts of the track, in other words, the newly-formed part of the fibril will be in absolute continuity with the undegenerated part.

Such a view of the origin of nerve fibrils is not without interest from the psychological point of view, for we see how if it be true new association paths may be readily laid down in the brain, impulses passing at first with difficulty through the undifferentiated cell substance, but their repetition causing the tracks to be marked out as definite nerve fibrils by which the transmission of impulse would be far more perfectly carried out, but these paths tending in time, if not used, to lapse back into the original protoplasmic condition.

Genetic Affinities of Lower Gnathostomata.

In working through sections of embryos of the various groups of vertebrates, one is impressed by the remarkable resemblances which appear on every hand between the Dipnoi and the Amphibia urodela. This resemblance is one affecting not merely the general features of development, but extending to histological detail in a way that makes it quite impossible to put it down to mere convergence.

The really important morphological differences between the two groups are very few. The most striking, perhaps, is the pentadactyle character of the limb in the urodele. This difference becomes of less importance on the view of evolution of the limb which I hold—involving the independent development of cheiropterygium and ichthyopterygium from a stylopterygial form. In the Dipnoi the limb has evolved a less distance from the stylopterygium than in any of the other groups. In *Ceratodus* it is a typical archipterygium; in *Protopterus* and in *Lepidosiren* it shows less or more complete reversion to the stylopterygial condition. In other words, the Dipnoans are nearer the form which possessed the type of limb ancestral to both cheiropterygium and icthyopterygium than is any other group.

Another important difference, that of the character of the intestine, is also shown by embryology to be less fundamental than it seems, for it appears that in the short gut with spiral valve we have a type produced by the fusion together of the turns of an elongated spirally coiled gut. From the occurrence of the spiral valve in Elasmobranchs, Crossopterygians, Ganoid Actinopterygians, and Dipnoans, it is fairly clear that at one period it must have been characteristic of the ancient Gnathostomata generally. In the Pentadactyle vertebrates we see a reversion to the still earlier condition where the turns of the gut had not yet become fused.

In the earlier stages of my work upon *Lepidosiren,* I was much interested by the paper which Dollo[1] had just produced upon the phylogeny of the group, and special search was made for any features which might support his plausible arguments. Dollo's main thesis is that the present-day type of Dipnoan, with its diphycercal tail and continuous median fin, is really a degenerate descendant of forms with a heterocercal tail and discontinuous median fins. Such questions, dealing with the possibly degenerate character of forms which are apparently primitive, are, in my opinion, of much

[1] *Bull. Soc. Belg. Géol. Paléont.*, T. ix.

less importance than they appear to be at first sight; for we must believe that in degenerative evolution the characters which disappear most easily are those which have been most recently acquired, and those which tend to persist longest are those which are most ancient and most deeply engrained into the constitution of the creature. Degeneration will therefore tend to be a process of reversion, and it is hardly profitable to inquire whether the apparently primitive features of, say, such forms as Cyclostomes or Cephalochordata are there because they have been retained throughout, or because they have been reverted to after passing through a more highly specialised condition.

It is, however, of interest to inquire whether there are really strong grounds for believing that the protocercal Dipnoans of to-day have ever had heterocercal ancestors. In considering any such phylogenetic question, it is essential to consider it from the three points of view of comparative anatomy, embryology, and palaeontology,[1] or at least as

[1] The worker in comparative anatomy or embryology is accustomed to bear constantly in mind the danger of mistaking features which are adaptations, or correlated with adaptive features, for features which are archaic and of phylogenetic importance. In palaeontological work, the risk is perhaps greater of accepting results without due criticism, of imagining that allied forms found in successive formations necessarily form an ancestral series. The expert palaeontologist will doubtless be one of the first to admit how extraordinarily imperfect our knowledge really is of the fauna of any geological age except the present, and how unreliable are such phylogenetic series, unless supported by comparative anatomy or embryology, or preferably by both. The special risks of error in embryological research are keenly realised, particularly by embryologists, who consequently endeavour to take every precaution against falling into them. One type of error to which embryology appears not to be liable, is that which has to do with the *order* in which evolutionary stages occur. If an organism or an organ recapitulates certain phylogenetic stages, say A, B, C, D, they are found to occur in their true phylogenetic order. In palaeontology, however, so imperfect is our knowledge of the geological record, that it may easily happen that in a series of successive deposits we find the same stages in the order D, C, B, A. This may be due either to mere chance, all four stages being equally abundant during each period under consideration, or, on the other hand, it may have been that the group reached its maximum in the earlier period, and evolved into highly specialised forms, intimately adapted to the environmental conditions of the time, which died out as these conditions changed, sooner or later, according as they were more or less specialised.

many of these as are available, in order to reach a reliable conclusion.

Comparative Anatomy teaches us that of the two types of tail, diphycercal and heterocercal, the former is unquestionably the more archaic. As a piece of mechanism, it is very much simpler and less perfect. In its muscular and skeletal arrangements it shows far less divergence from the ordinary arrangements seen in the regions lying anterior to it, and of which it must be looked on merely as a modification. Further, it is the type of tail which is alone found amongst the Cephalochordata and the Cyclostomata.

Embryology fails to afford a shred of evidence for the former existence of a heterocercal tail. The tail is typically protocercal throughout ontogenetic development.

Palaeontology—or rather such knowledge of palaeontology as we happen to possess at the present time—affords the evidence upon which the view is based, which sees in the diphycercal tail and continuous median fin of present-day Dipnoans, characters which are not primitive, but developed secondarily, the ancestral forms having possessed heterocercal tails and divided-up median fins. The evidence upon which this view, so opposed to morphological probabilities, is based, consists of the fact that amongst palaeozoic Dipnoi many forms are known with the last-mentioned set of characters, while none are known with the first mentioned; and further, upon the fact that it is possible to select out from such known palaeozoic forms a series, the members of which, from successive geological formations, show a series of steps from the heterocercal type, with segmented median fin, towards, though not reaching, the diphycercal type, with continuous median fin. Of these two pieces of evidence, I personally, for the reasons already given—particularly on account of the necessarily extraordinarily incomplete state of our knowledge of extinct faunas — should attach little weight to the last mentioned. The weight of the first also is lessened fatally, so it seems to me, by the following considerations. The palaeozoic times, from which the evidence has been obtained, were times when fishes allied to what we should to-day call Dipnoans, and Crossopterygians and Elasmobranchs flourished exceedingly. The waters were thickly peopled with these vertebrates, which sought refuge by developing a purely aquatic habitat—as others of their contemporaries doubtless did by adopting purely terrestrial habits—from the intense struggle for existence in the shallow marginal zone, where, amidst a more favourable environment, the early forms of life probably arose. In any case, apart from such speculations, the waters certainly had a crowded population of such purely aquatic fishes. But this being so, we must believe that such fishes were intimately adapted to their aquatic mode of life. Now, I have no hesitation in asserting that any one who has spent any considerable time in the study of living specimens of the various types of fishes, will admit that the type such as is seen in the Dipnoan of to-day, as well as in various Teleosts—the type with diphycercal tail and undivided median fin—although well enough adapted to what may be called a bentheic existence, to wriggling about amidst aquatic vegetation, is hopelessly unadapted to an active nectonic or free-swimming existence, and quite unfit to compete with the active type with heterocercal tail and highly specialised segmented median fins. This being so, it would excite no surprise that remains of the protocercal type should be rare or absent in deposits where the nectonic type of fish is abundant; nor could the rarity or absence of such remains be allowed any weight whatever as evidence that the protocercal type did not exist at the time the deposits were laid down.

Taking an all-round view of the evidence at present available, it is difficult to see how it is in any way sufficient to serve as foundation for such a view as that of Dollo, that the ancestors of the present-day Dipnoans were at any time of the specialised nectonic type.

Cellular Constitution of the Vertebrate Body.

One of the Dipnoans which I have dealt with—*Lepidosiren*—is characterised by the large size of its cell elements, and on this account, taken along with the comparatively lowly organised character of the creature, one is impelled to look whether or not data afforded by it are such as to affect in any way our notions of the general constitution of the vertebrate body.

In recent years, owing in great part to the efforts of Sedgwick, our ideas on the "cell theory" have become somewhat modified. Sedgwick emphasised the fact that the study of vertebrate embryos shows that the cells forming the body are, as a rule, not isolated, but joined together by bridges of protoplasm. The study of such a form as *Lepidosiren,* with its enormous cell elements, brings out very clearly the truth of Sedgwick's statements as regards, *e.g.*, the mesenchymatous network. We still have a cell theory. We still look upon a vertebrate as consisting of vast numbers of cells. It is not, however, to be looked on as an *aggregation* of cells in the literal sense, but rather as a mass of living matter subdivided into cells. It does not grow because its cells multiply, but rather its cells become more numerous because it increases in size. The division of a developing metazoon into cells is to be looked on as a necessary consequence of the increase in volume of its living matter, very much as Sachs long ago taught was the case with the growing point of one of the Metaphyta.

I was greatly struck by observing in the ectoderm of young Lepidosirens beautiful tailed cells, recalling exactly the tailed cells familiar to us in the neuroepithelial and myoepithelial cells of the Coelenterata. So far as I can judge, these tail-like processes pass into a kind of plexus lying beneath the ectoderm, and more or less mixed up with the basement membrane. Processes from the underlying mesenchyme cells also pass up into the plexus. I am inclined to the belief that subsequent research will show that the subepidermic plexus is of high importance in the development of nerves such as, *e.g.*, the lateral nerve, which appear to arise by a process of splitting off from the lower surface of the ectoderm. Tailed epithelial cells, such as I have mentioned, are not found in the ectoderm only. They are beautifully seen in *Lepidosiren* in the developing myotome. Here, as I have shown elsewhere, the muscle cell exists for a time as a typical tailed epithelial cell, within the protoplasm of whose body the contractile fibrillæ are developed, while the tail-like process is prolonged into the motor nerve fibres.

The facts which I have mentioned appear to indicate that as regards the Vertebrata the germ layer theory should be stated in some such fashion as this. The vertebrate body consists fundamentally of the two cell-layers—ectoderm and endoderm—each consisting primarily of an epithelial layer of tailed cells. Parts of the primitive endoderm become nipped off to form coelomic lining, including in this, of course, the myocoelic wall, which becomes partially converted into muscle, while individual cells of both primary layers migrate into the cavity between them, and give rise to the mesenchyme and its derivatives. In the nipped off parts of primitive endoderm which line the enterocoelic outgrowths, we may see, with Sedgwick, Gardiner, and others, persisting representatives of the coelenteric pouches of the Scyphozoan Coelenterate and in the immigration of mesenchyme cells a continuation of the similar process so beautifully seen in the immigration of the skeletogenous cells of the Alcyonaria.

XVI. *The Bdelloid Rotifera of the Forth Area.* By James Murray. [Plate VII.]

(Read 27th November 1905.)

This list of Bdelloid Rotifers from the Forth Area is based entirely on the work of Mr Wm. Evans, who sent to me, in the course of the present year (1905), numerous samples of moss, specially selected for this purpose, gathered on hill-top and in peat-bog, on trees, walls, and rocks, by roadsides and in streams. A few samples of *Lemna* and other pond weeds, also some seaweed, were likewise sent. This moss, etc., was found to be very rich in microscopic life. A short list of Tardigrada obtained from it has already been published (*Ann. Scot. Nat. Hist.*, 1905, p. 160). Bdelloids were much more numerous; indeed, among the moss-dwellers no order is so prominent as the Bdelloida. Though they live in other situations, such as the mud of ponds and lakes, and as ecto-parasites on other animals, it is in moss, using the term in the wider sense to include also the hepatics, that they are most at home. Where we have moss we have bdelloids, and usually in great numbers. Rarely does a handful of moss, properly treated, fail to yield at least a dozen species. It must not be supposed, however, that all kinds of moss are equally productive. The pleurocarpous section is very much better than the acrocarpous. *Sphagnum*, as a rule, is populous, but *Thuidium*, *Fontinalis*, and certain *Hypna*, among the true mosses, and *Frullania* among the hepatics, usually give more variety. And as regards season, autumn, winter, and spring are better than summer.

The method of obtaining the bdelloids which I have found most successful is a very simple one. The moss is washed vigorously in a vessel of water; then the water is strained through a coarse silk net, and finally passed through a silk net fine enough to retain all the rotifers. The coarse net, for which I find a No. 6 bolting cloth suitable, retains all moss stems, leaves, and the larger debris, but allows all but the largest rotifers, such as *Stephanoceros*, to pass through. In practice it is found most convenient to place the coarse net inside the fine one, and to use them as the vessel in which the moss is washed. When the coarse net is removed the rotifers pass through into the fine one, and can then be bottled and examined at leisure. They should be examined as soon as possible, as many species invariably die within twenty-four hours when kept in bottles, although others will live for a long time.

It is not definitely known whether any bdelloids, except *Discopus*, have their ordinary habitat in the sea. Gosse found *Philodina microps* in salt-water, but it has not been again found. At Lochinver I found two species, which I was unable to name, in the washings of seaweeds, and again at Aberdeen a single example. These may have been casually introduced, or they may be, like some rotifers of the other orders (*i.e.*, *Furcularia reinhardti*), able to live indifferently in salt or fresh water.

On the 17th of November 1905, Mr Evans obtained some fine moss-like seaweed at Morrison's Haven, on the south side of the Firth of Forth. On washing it I found one known species (*Philodina flaviceps*, Bryce, MS.) in abundance, and two others which I could not name.

The list of species here recorded numbers 53.

Other five species previously discovered by Mr Bryce, but not yet named, were also found.

Messrs Scott and Lindsay, in their list of Rotifera from the Upper Elf Loch (14), enumerate 11 bdelloids, 4 of which were not found in any of Mr Evans's collections. Adding those, we have a total of 62 species, the largest local list of Bdelloid Rotifers I know of.

The four species given in Scott and Lindsay's list which have not been found in any of Mr Evans's collections are—

Rotifer actinurus, Ehr.
R. hapticus, Gosse.
Philodina megalotrocha, Ehr.
Callidina bidens, Gosse.

Rotifer hapticus I regard as identical with *R. macroceros*, Gosse, which, however, is not otherwise recorded for the Forth area. *Callidina bidens* is so insufficiently described that I find it impossible to guess what animal was identified as this species. As Mr Evans also collected in the Elf Loch, the same animal is probably included in this list under another name.

Several common species do not occur in either of the lists, although they must surely be found in the district sooner or later. Such are *Rotifer macroceros, R. neptunius, Adineta tuberculosa.* A number of others, though less common, are also quite likely to occur.

The list of literature contains only the works referred to in the text. When species have been discovered subsequent to the completion of Hudson and Gosse's Monograph (5) (1889), the work in which the original description occurs is cited. The works of Zelinka (19, 20), Janson (6), and Jennings (7) are valuable for the extensive bibliography which they contain. The works are referred to in the text by their numbers (enclosed in brackets) in the list on page 228.

LIST OF SPECIES.

Family Microdinadæ.

Microdina paradoxa, Murray (12).

The family and species were originally discovered in the higher part of the Forth Valley, at the outflow of Loch Vennachar. Mr Evans found it, in wet moss at Torduff, in the Pentlands, March 1905.

Family Philodinadæ.

In anticipation of Mr Bryce's revised classification of this family, I have included all the species in the three old-established genera, *Philodina, Callidina, Rotifer.* In order to avoid the anomaly of placing species, the close relationship of which is not denied, in different genera, merely because one possesses eyes while the other does not, I have provisionally redefined these genera in accordance with our present conception of the affinities of the species.

Genus *Philodina.*

Animals having four toes, and the corona consisting mainly of a pair of wheel-like ciliated discs. The only other animal known, in the order Bdelloida, having four toes, is *Microdina,* which is separated by the absence of discs, etc.

A. *Eyes present; oviparous.*

P. roseola, Ehr.

On *Potamogeton,* Malleny Dam, near Balerno, February.

P. citrina, Ehr.

On *Potamogeton,* Malleny Dam; Upper Elf Loch, Braid Hills, November; on *Lemna,* from Duntarvie Pond, near Winchburgh, December.

P. erythrophthalma, Ehr.

Duddingston Loch, March; Nether Habbie's Howe, Pentland Hills, March.

P. rugosa, Bryce (4).

Among *Sphagnum*, Bavelaw Moss, near Balerno, February.

P. flaviceps (Bryce, MS.).

This species, which will be described by Mr Bryce at an early date, was first discovered in the Forth Valley. Mr Bryce found it in some *Lemanea* sent to him from Loch Vennachar, on the occasion when *Microdina* was discovered. It is now known to be extremely common, especially in pure streams and lake margins in Scotland, but, so far as I am aware, has not been reported elsewhere.

In moss from stream, Torduff; Lothian Burn, March; Nether Habbie's Howe; Upper Elf Pond; Dundas Castle, June; Winchburgh and Aberfoyle, December; abundant on seaweed, Morrison's Haven, November.

P. nemoralis, Bryce (4).

Roslin Glen, March; Duddingston Loch; Torduff; Lothian Burn; Ochils, behind Dollar, June.

P. brevipes, Murray (11).

The type of this somewhat variable species has only been observed in the district at the Upper Elf Loch, Braid Hills, but a curious variety was found at Midcalder, which I include provisionally under *P. brevipes*, though in some respects it is intermediate between that and *P. citrina*. (Plate VII. Fig. 1, *a* to *c*.)

The general form is that of *P. brevipes*, which is a much less massive animal than *P. citrina*, and the upper lip is exactly similar. It differs in having a distinctly four-jointed foot, and in lacking the very long setæ on the rostrum. Resembling *P. citrina* in the four-jointed foot, the pointed egg, and the spurs, it differs in the form of the upper lip, less massive trunk, lack of yellow colour, etc.

From both species it differs in some important particulars. The eyes are very minute dots. Both species have large eyes, *P. citrina* very large. The trunk is covered by a coating of dirt, as is normally the case with *Callidina* (*Rotifer*) *longirostris* and some other species. This indicates that there is a viscous secretion on the skin, and in fact the mucus-pores can be seen as a close stippling, as in *P. macrostyla.* I have never seen any sign of viscosity about either *P. brevipes* or *P. citrina.* The occurrence of a single individual with a dirt-coated trunk could not be considered of much importance, but in this instance the animal was abundant, and every one was alike "sordid," although other bdelloids in the same water were clean.

As the peculiarity was correlated with much smaller eyes than in either of the species with which it could be compared, the differences may be regarded as of some importance. Considering that it has some points of close resemblance to each of those species, and that it thus occupies the unenviable intermediate position, I do not feel justified in bestowing even a varietal name upon it, till it has been more fully investigated.

Type.—Upper Elf Loch, November.

Var.—In moss, Kirknewton, near Midcalder, 28th March 1905 (Evans).

P. acuticornis, Murray (11).

Bavelaw Moss, February; near Penicuik, March; near Winchburgh, December.

B. *Eyes absent; oviparous.*

P. laticeps, Murray (12).

A parasite on insect larvæ living in streams. The examples found were not on insects, but had no doubt been washed off their hosts.

Nether Habbie's Howe, March.

P. plena (Bryce), (3).

Nether Habbie's Howe, March; Fullarton, November.

P. vorax (Janson), (6), (3).

Thornton, Fife, April 1905. This is, so far as I can ascertain, the first notice of the species in Scotland. Mr Bryce has before found it several times in England.

P. brycei (Weber), (17).

Two principal varieties are distinguished. The commoner has only a single series of dorsal spines, crossing the central segments. The other has an additional shorter row farther back.

Both occurred together in wet moss from Torduff; the first at Gullane Links, November, very abundant; also at Winchburgh in December, and on the Ochils in June.

P. alpium, Ehr. (3).

On *Elodea* from ditch at Winchburgh, December.

A very common animal all over Scotland. Its occurrence only on one occasion in the course of a year's work in the Forth area is therefore somewhat surprising.

C. *Viviparous; eyes present or absent.*

The only two species belonging to this section of the genus, which have been found in the district, normally possess eye-spots. Blind forms of both are occasionally found, and a third species, not yet found in the area (*P. spinosa*), is normally blind.

P. macrostyla, Ehr.

Generally distributed and very common.

Duddingston; Nether Habbie's Howe; East Cairn Hill, Pentlands, September; Loch Leven, April; Winchburgh, etc. Var. *tuberculata* in the same localities, and also from Aberfoyle, December.

P. aculeata, Ehr.?

It is somewhat doubtful if the spiny *Philodina,* so common in Scotland, is Ehrenberg's species. That is figured as having about twenty-seven spines, but the greatest number which I have seen is twelve. If it is the same it is extremely variable, and has puzzled authors accordingly, almost every naturalist who has noticed it giving a different account of it. In my experience, the spines have always been in pairs, and vary from four to twelve in number. Mr Bryce has seen a form with only two knobs, but he is disposed to regard this as belonging to *P. macrostyla.*

In the Forth area few of the forms have yet been seen—one example found near Penicuik had ten spines, all directed backward; another had eight spines.

Genus *Callidina.*

Animals with three toes, or a perforate disc formed by a union of the toes, oviparous, eyes present or absent. The very few viviparous species formerly included in this genus have been transferred to *Rotifer* or *Philodina,* with which their real affinities lay.

Animals belonging truly to *Callidina* have been found exceptionally to contain living young. I believe, however, that in those instances what has happened is that the egg has hatched within the parent, and that the mode of reproduction is really invariable in each species. I believe, further, that the mode of reproduction is generic—related animals have the same mode. The exceptions are so few as to prove the rule.

As in *Philodina,* several natural groups can be recognised.

A. *Food moulded into pellets.*

This is by far the largest and most important natural group found within the order. It is possibly of more than generic value, as is suggested by the occurrence within its limits of every condition in relation to eye-spots found in the whole order, viz., eyes in rostrum, eyes on brain, and no eyes.

C. hexodonta (Bergendal), (1), (11).

Otterston, near Aberdour, March; Bavelaw Moss; top of East Cairn Hill, Pentlands, September.

C. ræperi (Milne), (10).

A parasite or commensal on *Sphagnum,* Bavelaw Moss, February.

C. elegans, Ehr. (6).

Blair Drummond, near Doune, April.

C. lata, Bryce (2).

Common and general. Lothian Burn; Leadburn, March; Bavelaw Moss; East Cairn Hill; Loch Leven, April; Ochils, June; Markinch, May; Bridge of Allan, December; etc.

C pulchra, Murray (12).

Roslin Glen, Leadburn, Nether Habbie's Howe; Hopetoun Woods, very abundant, December; Wemyss Woods, near Thornton, December.

C. aspera, Bryce (2).

Kirknewton, near Midcalder, March; Boltonmoor, near Gifford, April; Hopetoun and Thornton, December.

C. augusticollis, Murray (12).

Near Midcalder, a single empty case, March; Ochils, June; Hopetoun Woods; Thornton; numerous in *Sphagnum* from Aberfoyle, December.

C. annulata, Murray (12).

Nether Habbie's Howe.

C. leitgebii, Zel. (19).

Several characters, notably the loop of the gullet, lead me to suppose that the species, which Zelinka does not figure, belongs to this section rather than to the symbiotic group.

Leadburn; Wemyss Woods, near Thornton.

Callidina microcephala, n. sp. (Plate VII. Fig. 2, *a* to *e*).

Specific Characters.—Trunk very broad, longitudinally plicate, neck of moderate length, tapering to very small head; corona very narrow, angled (in dorsal view, see Fig. 2, *b*); rostrum very broad; teeth $\frac{7}{6}$; antenna very short; foot short, of three joints; spurs small, divergent, meeting at base, convex on outer border, sigmoid on inner; toes, three; food moulded into pellets.

Length, when feeding, 312μ; width of trunk, 96μ; of corona, 29μ; pellets about 9μ in diameter.

The skin is hyaline, stippled; the longitudinal folds few, broad, deeper at the sides. The head and neck are very narrow, relatively to the trunk, and when partially drawn in look disproportionately small.

In comparing this bdelloid with the earlier descriptions of allied species, our greatest difficulty arises from the insufficiency of these descriptions.

From all species having less than six teeth, it is sufficiently separated by that character alone. Most of those having six or more teeth (*e.g.*, *C. russeola*, *C. magna*, *C. scarlatina*, *C. annulata*, *C. crenata*) possess other good distinctive characters. There are only three species known to me which the new form resembles closely enough to call for detailed comparison. Those are *C. elegans*, Ehr, *C. constricta*, Duj., and *C. leitgebii*. *C. elegans*, which has usually more numerous teeth, has also a much larger corona, and larger, longer-pointed spurs. *C. leitgebii*, according to Janson, may have as many as seven teeth. I identify as this species an animal common among mosses from trees, which has a longer and narrower neck, a very small narrow rostrum, and softer, less distinctly plicate trunk. There remains only *C. constricta*. The most important characters given by Janson (6, p. 56), the very small corona, the number of teeth, and the small spurs, fit our animal very well. Not having seen *C. constricta*, a carefully measured drawing from the living animal was sent to Mr Bryce, who knows that species. He was good enough to send me examples of *C. constricta*, and to point out an important difference. In *C. constricta* the corona is as broad as the collar, or very nearly so, in *C. microcephala* it is very decidedly less. The discs of *C. constricta* have not the angled appearance of those of *C. microcephala*.

Among moss from the foot of a wall at Polton, near Roslin, 2nd March 1905 (Evans). It has since been seen among ground moss from Fort Augustus.

C. constricta, Duj.

Since writing the above, *C. constricta* has been found in moss from Hopetoun Woods, December.

C. crenata, Murray (12).

In moss from wall at Dalkeith, April.

C. tridens, Milne (9).

On *Lemna*, in pond, near Winchburgh, December.

B. *Toes bearing a number of cup-like suckers, or united to form a broad disc.*

C. symbiotica, Zel. (19).

Usually symbiotic with various hepatics, but also very frequently symbiotic with *Sphagnum*.

Rosebery, in moss off tree, February; Leadburn; East Cairn Hill, September, very abundant in *Sphagnum;* Thornton Moss and Aberfoyle.

C. russeola, Zel. (20).

Among *Leucodon*, Rosebery; near Gifford, April; Gullane Links, November.

C. scarlatina, Ehr. (6).

Rosebery, Midlothian; Boltonmoor, near Gifford.

C. tetraodon, Ehr. (6), (3).

Nether Habbie's Howe; Fullarton; Boltonmoor; Hopetoun; Wharry Glen, Bridge of Allan.

C. incrassata, Murray (12).

Top of East Cairn Hill, in *Sphagnum*, September. The second station known for the species, the other being at Fort Augustus.

C. magna, Plate (13).

This species has a large central process on each disc similar to that of *P. laticeps* (12).

Gullane Links, November.

C. *Toes three, distinct; food not moulded into pellets.*

C. plicata, Bryce (2).

The commonest bdelloid in Scotland, and extremely variable. The characteristic processes on the anal segment may be reduced or entirely absent, or they may be produced into long tails suggestive of those of the swallow-tailed butterfly, and which may equal the foot in length.

Very generally distributed.

The type at Duddingston, Upper Elf Loch, Torduff, Bavelaw Moss, East Cairn Hill, Fullarton, Hopetoun, Aberdour, Markinch, Loch Leven, Ochils, Bridge of Allan, Aberfoyle, etc. The swallow-tailed variety at Nether Habbie's Howe and Boltonmoor.

C. ehrenbergi, Janson (6).

Hopetoun Woods, December.

C. habita, Bryce (3).

Very common and general.

Duddingston Loch, Lothian Burn, and Nether Habbie's Howe, March; Lochgelly and Doune, April; Upper Elf Loch, November; Winchburgh and Hopetoun, December; etc.

C. quadricornifera, Milne (9).

Almost as common as *C. plicata*.

Duddingston, Upper Elf Loch, Dalkeith, Lothian Burn, Leadburn, Bavelaw Moss, Winchburgh, Otterston, Lochgelly, Ochils, Aberfoyle.

C. papillosa, Thompson (15).

Common and general.

Duddingston, Upper Elf Loch, Lothian Burn, Fullarton, Midcalder, near Aberdour, Lochgelly, Loch Leven, Gifford, Gullane Links, Winchburgh, Doune, Bridge of Allan, Aberfoyle.

C. multispinosa, Thompson (15).

Midcalder, Gifford, Hopetoun, Lochgelly, Wemyss Woods.

C. aculeata, Milne (9).

Gullane Links, in moss, November.

Genus *Rotifer*.

A more compact genus than either of the others. All viviparous; toes, three. The eyeless species do not form a natural section. *R. longirostris* is related to *R. tardus*, *R. socialis* to *R. macrurus.*

R. vulgaris, Schrank.

Near Roslin, March; Upper Elf Loch, November; Winchburgh; Bridge of Allan, December.

R. macrurus, Schrank.

In *Sphagnum*, Bavelaw Moss, February; Aberfoyle, December.

R. tardus, Ehr.

Duddingston, Nether Habbie's Howe, Doune.

R. longirostris (Janson), (6).

I think there can be no doubt as to the close affinity of this species with *R. tardus.* Beyond the lack of eyes, and the presence of the series of processes on the neck of this species, they are almost identical.

Duddingston, Fullarton, Hopetoun, Aberdour, Loch Leven, Bridge of Allan, Doune.

R. citrinus, Ehr. (6), (18).

This species appears to have been generally overlooked. I find it quite common in ponds in various parts of Scotland.

Lochgelly, Upper Elf Loch, Winchburgh.

R. trisecatus, Weber (16).

On *Elodea* from ditch, near Winchburgh, December.

R. socialis (Kell.), (8).

I find this to be the commonest of the species parasitic on *Asellus* in Scotland.

Ditch near Winchburgh, on *Asellus*, December.

Genus *Adineta.*

Adineta vaga, Davis.

Roslin, Duddingston, Bavelaw Moss, Nether Habbie's Howe, Thornton, Ochils near Dollar.

A. gracilis, Janson (6).

Near Lothian Burn, Bavelaw Moss, Hopetoun, Markinch, Ochils, Doune.

A. barbata, Janson (6).

Bavelaw Moss, Roslin, Fullarton, Hopetoun, Aberdour, Markinch, Aberfoyle.

A. oculata, Milne (9).

Among *Lemna*, Upper Elf Pond, Braid Hills, November.

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Explanation of Plate.

Fig. 1. *Philodina brevipes*, variety.

a. Dorsal view, showing the "sordid" trunk, small eyes, and pointed egg.
b. Jaw.
c. Spurs.

Fig. 2. *Callidina microcephala*, n. sp.

a. Dorsal view.
b. Head, on larger scale.
c. Jaw.
d. Rostrum.
e. Spurs.

XVII. *The Higher Crustacea of the Scottish Carboniferous Rocks.*

On Monday, 23rd October 1905, B. N. Peach, Esq., LL.D., F.R.S., delivered an Address on the above subject, of which the following is an abstract:—

The Scottish Carboniferous rocks yield abundant remains of the higher Crustacea. Some of them belong to forms like the recent Nebalia, the unspecialised structure of which shows that it lies at the base of the genealogical tree of the higher Crustacea. Most of the forms, however, belong to the more advanced order of the Schizopoda, generally known as the Opossum-Shrimps, three of the families being well represented. Other forms, intermediate between these and the modern squillas, sand-hoppers, and wood-lice, are also comparatively numerous. None of the highest Crustacea, such as shrimps, prawns, crayfish, lobsters, and crabs, have been met with, nor have they been recorded from Carboniferous strata in any part of the globe. It is, therefore, only natural to infer that they had not come into existence in Carboniferous times, but that they were subsequently evolved from the Euphausiidæ, a family of Opossum-Shrimps well represented in the Carboniferous rocks. The nature of the deposit in which the above occurs, as well as that of their associated fossils, shows that they lived along the ancient shores. Their modern immediate congeners, on the contrary, inhabit the open ocean, either swimming near its surface or crawling at the bottom of its abysses, where they had evidently been driven by the severe struggle for existence which goes on inshore. One very anomalous creature, *Anaspides*, the only surviving genus of a family common enough in Carboniferous time, turned up a few years ago in a fresh-water pool on Mount Wellington, in Tasmania, and added another old-world form to the Archaic fauna and flora which is known to exist on that island and in Australia.

PROCEEDINGS

OF THE

ROYAL PHYSICAL SOCIETY

FOR THE

PROMOTION OF ZOOLOGY AND OTHER BRANCHES OF NATURAL HISTORY.

SESSION 1905-1906.

No. 6. VOL. XVI. PAGES 231-266.

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EDINBURGH: M'FARLANE & ERSKINE.
SEPTEMBER 1906.

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XVIII. *Note on a Rare Sponge from the "Scotia" Collection.* By Professor J. ARTHUR THOMSON, M.A., and Mr J. D. FIDDES, M.A.

(Read 18th December 1905.)

In the collection of Alcyonarians made by Mr W. S. Bruce on the "Scotia" Expedition, there was an interesting and rare sponge, which is deserving of record. It was dredged from deep water between Gough Island and Cape Town. The specimen consists of two separate parts of a straight upright axis, giving off numerous irregular branches, most of which are short. The axis is 26 centimetres in length, rigid in its thicker lower part, becoming slightly flexible as it tapers upwards. One of the branches is long, and bifurcates at a distance of 7 cms. from the stem, being continued in two slender divisions (one with a secondary twig) for about 4 cms.

The siliceous spicules composing the stem show at once that it is the core of a Monaxonial sponge, from which, unfortunately, almost every trace of the soft tissue has been weathered or rubbed off. On two or three areas there was a thin coating of soft, white, friable material, which revealed nothing. The texture of the stem is tough and stringy; the surface is rough, with minute monticular eminences, which give it a somewhat file-like appearance.

Closer examination shows that the axis is composed of densely-packed style-like spicules, imbedded in a spongin framework, and a transverse section shows that the spicules have an annular arrangement like the lines of growth in a tree-trunk. The branches are formed by bundles of spicules, which diverge from those of the main stem.

The majority of the spicules are needle-like, with a rounded and a pointed end, growth evidently occurring towards the point. In more technical language, they are monactine monaxons, growth proceeding along the axis in one direction only, and they are rounded or strongylote at one end. In a word, they are "styles." They have a great tendency to split along the axis when boiled in caustic potash, so that many of the separated spicules appeared bifid. That this was artificial was evident from an examination of a thin longitudinal slice, which showed no split spicules. There was no trace of minute flesh-spicules or microscleres.

The nature of the skeleton—spongin-fibres, with imbedded styles forming a firm axis—points to the family Axinellidæ. In this family the genus *Axinella*, O. Schmidt, is characterised by having a firm-branched axis, composed of a spongin-network, with included siliceous styles. To this genus, therefore, we refer the "Scotia" specimen, but although the species is probably new, it is impossible to determine this with certainty, as only the axial skeleton is preserved.

XIX. *Notes on certain Blood-Inhabiting Protozoa.* By MURIEL ROBERTSON, Carnegie Research Scholar in the University of Glasgow. [Plates VIII. and IX.]

(Read 26th March 1906.)

During the last six months I have had the opportunity of examining a number of different hæmosporidial forms. These notes embody some of the points of interest that have appeared during the course of the work.

I am glad to have this opportunity of acknowledging how much I owe to the guidance and encouragement of Professor Graham Kerr, under whose supervision the work was conducted.

The forms dealt with in this communication are—(1) *Trypanosoma brucei*; (2) *Trypanosoma pythonis*, n.sp., an endocorpuscular form from the blood of an African python; (3) a Trypanosome found in the blood of *Pleuronectes platessa* and *Pleuronectes flesus*; (4) a Hæmogregarine, also found in the blood of the two last-mentioned hosts; (5) *T. raiæ* (Laveran and Mesnil); and (6) a Hæmogregarine found in the erythrocytes of *Raia microcellata*.

1. Trypanosoma brucei.

Prowazek, in his work upon *Trypanosoma brucei*, gives an account of the more important processes in the life-history of this parasite in the blood of the vertebrate host. I have been able to corroborate a number of the results arrived at by the above-mentioned observer. My material, however, showed certain points of interest which are worthy of description.

The infection with which I was working was one of long standing. Two out of the three cases which came under my observation were very severe, an enormous number of parasites being present in the blood. The host was in each case a guinea-pig.

Division. This process agrees essentially with that described by Prowazek (*Studien über Säugetiertrypanosomen, Arb. aus dem kaiserh. Gesund.*, Bd. xxii. Heft 2), but there appears to be a certain amount of variation in detail. Prowazek describes a division of eight chromosomes in the somatic nucleus, which become grouped finally at either end of the dividing karyosome, without forming an equatorial plate. The division of the nucleus is preceded by the division of the blepharoplast. Division, as I observed it, agrees broadly with this description, but both the karyosome and the chromatin show some points of difference. Thus the karyosome, which is on the whole a larger and more prominent structure than is indicated by Prowazek's figures, shows a very strong tendency to precocious division. Quite a common nuclear condition is shown in Fig. 1, where the karyosome is already divided, and where the chromatic network has broken up into separate chromosomes, which lie arranged in a comparatively regular oval. More often the chromatin becomes closely grouped in irregular masses round each karyosome (Figs. 1, 2).

Forms strongly suggesting autosynthesis of the nucleus were not infrequently met with (Fig. 4); this process involves one or more, usually two, divisions of the karyosome. Of the four karyosomes thus produced, two apparently fuse together, while the other two degenerate.

Parthenogenesis was not observed, although the nucleus was not infrequently found with a divided karyosome, and the chromatin arranged in four or more bars running across at right angles to the main axis of the nucleus. This, according to Prowazek, is the early stage of parthenogenesis, but further stages were not met with, and the cross bar arrangement of chromatin has probably, as will be seen later, another explanation. The process very probably occurs, but must be very obscure. From Prowazek's account these appearances are much clearer in *Trypanosoma lewisi*. *Trypanosoma brucei*, by itself, does not give sufficient evidence to enable one to form a definite conclusion as to the nature of this phenomenon.

The feature of greatest interest in this material is the presence of a well-marked line, which passes from the blepharoplast anteriorly to the tip of the body, taking the flagellum-bearing extremity as the anterior end of the creature (Figs. 5-10). This line is not a chromatic structure, though it may on occasions apparently carry chromatin. It stains a deep violet-blue, with the modification of the Romanowski method which I used; it stains also deeply with gentian-violet and methyl-green; moreover, safranin, and Heidenhain's iron hæmatoxylin, which were in every other respect perfectly useless stains, showed this line in several specimens. The course of the central line is often marked at the posterior end by a rather irregular and indefinite violet-blue granule, more especially where there is a vacuole in front of the blepharoplast; in these cases the granule and terminal portion of the line lie immediately in front of the vacuole (Figs. 5, 6, 8). Anteriorly, there is another granule which is much smaller and very inconstant; in favourable specimens a small vacuole may be seen just posterior to the granule (Fig. 8). The central line is present with greater or less distinctness in a very large number of individuals. In many cases it is connected with the karyosome; this is particularly clear in individuals where the karyosome is divided into two. A very common condition for trypanosomes in this material is to be seen in Figs. 5, 6. Here there is no sign of division in either blepharoplast or plasma, but the karyosome, which is often very large, is divided into two parts, which lie one at each end of the nucleus. The central line in these cases runs uninterruptedly from the blepharoplast, or vacuole, right through both the karyosomes and through the strand which at this stage joins them. Some specimens suggest that the red strand between the two daughter karyosomes has disappeared, and left the blue staining central line. The remaining chromatin at this stage may be arranged in various ways (Figs. 5, 6, 7, 8). It may either be scattered over an irregular fine reticulum (*i.e.*, the chromatic part of the nucleus is still in the resting condition), or may form separate, more or less rod-shaped chromosomes. It may form cross bars running from one side of the nucleus to the other, or bars attached to the central line, and passing from it to the periphery, or the chromatin may already be arranged in the irregularly shaped caps at either end round the karyosomes.

A later stage of this process shows the two karyosomes completely separated: the line is now interrupted in the middle, and passes from the blepharoplast to one karyosome, and from the other, *i.e.*, the anterior karyosome, to the tip of the body (Figs. 1, 2). At division of the plasma the line apparently divides, but the process is obscure. This much, however, is certain, that specimens are found in a late stage of division when blepharoplast, nucleus, and membrane are already divided (or sometimes a little earlier), which show two central lines passing forwards, one in each daughter individual.

In many specimens that part of the line which lies anterior to the nucleus bears a number of thickenings, staining from violet to reddish-violet or even red; sometimes bars can be seen to pass out from these either on one side or on both (Figs. 9, 7, 8, 5).

These appearances were for a time incomprehensible, until a number of forms were met with which offered an explanation. Trypanosomes were found (Figs. 11, 6, 3) which showed a spiral band of chromatin-staining substance (giving a clear red reaction with the modified Romanowski) in the pre-nuclear part of the animal. When this band is present the central line is often only to be seen in the post-nuclear part, but specimens are found which show both the spiral band and the line. The line and the band are really two separate structures, although they seem to have a certain amount of connection with one another. The spiral is continued sometimes right into the nucleus proper, in which the chromatin may show traces of a spiral arrangement (Fig. 11). Nuclei, with chromatin forming a quite definite spiral band, are also found in individuals which do not show the band in the pre-nuclear part of the body (Fig. 12). Cross bars (Fig. 7) are often found instead of the spiral band; these strongly suggest that they have been formed by the nipping across of the spiral. The bars (Figs. 5, 8, 9) now apparently become connected with the central line, and presently it is found that the red staining reaction begins to be lost—the time at which this happens seems to vary. They are soon reduced to little concentrations along the central line, with faint bars going out at right angles; the bars may then disappear, leaving only the violet-blue thickenings. The spiral band, though not by any means rare, is still not a very frequent appearance, and the same may be said of the red staining cross bars, but the two last stages are quite commonly seen; the central line, as I have before mentioned, occurs in a very large proportion of individuals. I am unable to suggest what is the functional importance of the spiral band. Appearances such as those just described are usually quite absent from the post-nuclear part, but indistinct thickenings of the central line and stray red staining bars are occasionally seen: these are, however, rare exceptions, and may be regarded possibly as vestigial in character.

The band, in my opinion, is to be interpreted as the remnant of a primitive spiral running the whole length of the animal, and representing the chromatic part of the primitive nuclear apparatus, the central line representing the primitive karyosome. The nucleus, as now found in the majority of the trypanosomes, would be, on this view, a concentration of the central portion of the primary elongated apparatus. This view is the more probable, as the primitive condition of a spiral breaking up into cross bars is not infrequently found in the somatic nucleus of the trypanosomes I examined (Figs. 10, 12). It is an interesting question as to whether there may not be a possible phylogenetic connection between this primitive spiral and the spireme of much higher forms.

Mr W. S. Perrin has lately published (*Archiv für Protistenkunde,* Bd. vii. Heft 1, 1906) an account of a primitive trypanosome, *Trypanosoma balbianii,* where he has described a spiral band of chromatin which contains a thread-like karyosome. The stage illustrated in Perrin's fig. 10 shows a spiral of chromatin and a separate longitudinal thread, the karyosome. In the ordinary condition of *Trypanosoma balbianii,* the karyosome is not so clearly differentiated. The stage shown in fig. 10 of Perrin's paper resembles the state of affairs in the *Trypanosoma brucei* with the spiral and the line, though in this last-named form there is, of course, the well-developed blepharoplast, and usually the central somatic nucleus. It is interesting to note that these forms replace one of the hypothetical figures in the series of diagrams which Perrin published in the above-mentioned paper to illustrate the connection between *Trypanosoma balbianii* and *Trypanosoma noctuæ.*

I have no suggestion to offer as to how these forms appeared in my material; they were evidently absent from the infections studied by Prowazek, as he makes no mention of them, and they are far too striking to have escaped the notice of this observer had they been present. Possibly these specimens may be reversions to a more primitive condition, due to the fact that the trypanosome has been propagated by artificial transference from host to host for a considerable time without passing any period in the alimentary tract of *Glossina,* which is the natural method of infection. The forms I have here described may perhaps be a reversion to the one host type from which the ordinary trypanosome developed.

2. **Trypanosoma pythonis**, n.sp.

This hæmosporidian is parasitic in the blood of an African python from the Gambia. I have, through the courtesy of Dr Logan Taylor, had the opportunity of looking through some films made from the blood of an infected animal, and I am indebted to him for the permission to publish the results.

The parasite in question is a fairly large organism, measuring 12 μ to 15 μ or 16 μ; it is slightly pointed at one end, and there is a tendency to curl up at this end, but the condition found here does not approach the bent-up double-shanked appearance of Hæmogregarines. The protoplasm is finely alveolar, and no conspicuous granules, food particles, or pigment are present: vacuoles are also absent. As in many parasites, there is no obvious differentiation into ectoplasm and endoplasm. Quite the most conspicuous feature

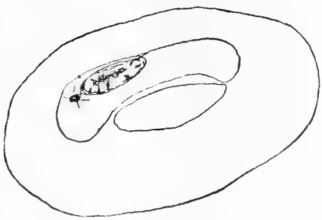


Fig. 1.

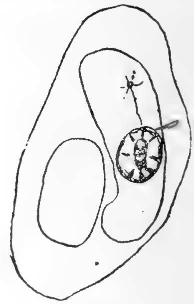


Fig. 2.

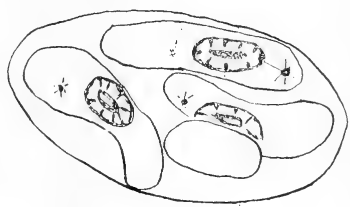


Fig. 3.

Text-Figs. 1, 2, and 3.—*Trypanosoma pythonis.*

Fig. 1. The blepharoplast is in close proximity to the nucleus.

Fig. 2. The blepharoplast is connected with the nucleus by a fibril.

Fig. 3. Multiple infection of a single erythrocyte.

of the organism is the nucleus, which is large for a protozoon of this size. At first sight it strongly suggests the complex reticulate character of a metazoan nucleus, more especially as it is often rather elongated. In favourable specimens, however, it appears to be of that type so often found in blood parasites. In fact, it closely resembles the nucleus described by Schaudinn in *Trypanosoma noctuæ*, that is to say, it is composed of a hollow sphere, showing eight masses of chromatin, while within this sphere is the karyosome, which is also certainly at times a hollow structure, showing a number of thickenings. I have on several occasions made out eight of these, but the different masses of chromatin are only rarely clearly defined in the karyosome. The whole nucleus is bounded at this stage by that—for the Protozoa at least—rather doubtful organ the nuclear membrane. Next to be described is the centrosome, or as it may here, I think, be called, the blepharoplast. This appears as a small but still well-defined granule, and is to be seen in the vast majority, though not in all, of the parasites—indeed, it is a very constant feature. The position of the blepharoplast in relation to the nucleus varies in an interesting and suggestive way. Thus, in what I take to be one of the earlier stages, it is lying closely apposed to the large nucleus (Text-Fig. 1). In a later stage the blepharoplast is more remote, but is bound to the big nucleus by a quite definite thread (Text-Fig. 2): this thread seems ultimately to disappear. The centrosome body is not an altogether simple granule. When once it has left the near neighbourhood of the large nucleus, it becomes clear that rays pass from it into the cytoplasm. The centrosome or blepharoplast seems capable of increasing slightly in size and of dividing, the products showing a strong tendency to remain connected together by a staining fibril. This process of division may be repeated, and somewhat complex appearances are found; but owing to the limitations of the material, I am not in a position to give a definite interpretation of the facts observed. The blepharoplast is undoubtedly a product of the large nucleus, but I cannot definitely say that it arises from it by heteropolar mitosis. The evidence, however, is in favour of this supposition, in which case the thread joining the blepharoplast to the large nucleus would correspond to the spindle formed by the central granule, which, according to Schaudinn's description, lies within the karyosome. So far as I can see at present, the small nucleus or blepharoplast does divide by mitosis, but the details are very obscure. The phenomena just described strongly recall Schaudinn's account of the development of the flagellar apparatus in *Trypanosoma noctuæ*. This account is now too well known to require recapitulation here.

It is true that I have not yet found any actual flagellate forms. This, however, is not surprising, as their absence may be explained in a number of ways. The material, to begin with, is very limited, and composed, so far as I am aware, only of peripheral blood; the flagellate forms may possibly be found in the deep-seated organs, such as the liver or the spleen, or may only finally be developed in another host.

In the light of Schaudinn's researches into the life-history of *Trypanosoma noctuæ*, and particularly in view of the presence of a well-marked blepharoplast, it is pretty clear that the parasite in question is really the intracorpuscular stage of a trypanosome, and I propose to call it provisionally *Trypanosoma pythonis.*

This description is naturally of an incomplete nature, as blood taken on a single occasion from an infected animal rarely gives a sufficient number of different stages to form anything like a complete series of the changes undergone by the parasite during its sojourn in the blood. This criticism is more particularly applicable to the parasite here discussed, which very probably completes its life-cycle in another host.

The two next forms to be considered were found in the blood of specimens of *Pleuronectes platessa* and *Pleuronectes flesus,* which were in the tanks of the Millport Biological Station in January 1906.

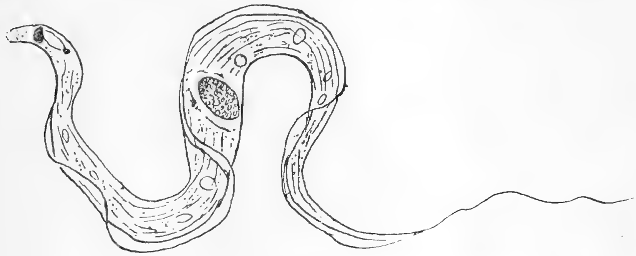
The first of these is a typical trypanosome, with blepharoplast, flagellum, and undulating membrane. The second is a Hæmogregarine inhabiting the red blood-corpuscles, a point of interest being that they were found associated in the same host.

3. **Trypanosoma** from blood of *P. flesus* and *P. platessa.*

The trypanosome[1] is a large creature, measuring from 50 μ to

[1] Since this paper was read, I have found that M. Lebailly has, in a short note contributed to the *C. R. Ac. Sci. Paris,* T. 139, 1904, drawn attention to parasites in the blood of *Pleuronectes flesus* and *P. platessa,* and has named them respectively *Trypanosoma flesi, T. platessæ, Hæmogregarina flesi,* and *H. platessæ.* While both the Trypanosome and Hæmogregarine described by M. Lebailly appear to correspond with those found by myself, there seems to me to be only one species of Trypanosome and one species of Hæmogregarine. That is to say, the Trypanosome I found in *Pleuronectes platessa* appeared to me to be identical with the one present in the specimens of *Pleuronectes flesus* which I examined, and similarly with the Hæmogregarine.

60 μ in length (Text-Fig. 4). It has a narrow, undulating membrane, produced at one end into a flagellum. The movement of this creature is particularly beautiful; it sometimes proceeds forwards with a graceful eel-like motion, at other times rolling itself up into a wheel and whirling round in a circle.



Text-Fig. 4.—*Trypanosoma* from *Pleuronectes.*

I would like here to emphasise the uncertainty of a negative diagnosis in the case of the blood flagellates of fishes; the flagellates are usually so scarce in positive cases that it is impossible to conclude that they are absent merely because a careful search has failed to reveal their presence. Thus in one case where two live specimens were observed, no specimens at all were found in the prepared films. The most severe of the three infections showed only four or five specimens in a 2 by 1 inch dry film. The endocorpuscular forms are usually present in greater numbers, and a negative result is apparently more trustworthy.

I am not yet in a position to describe the details of the nuclear apparatus of this creature, on account of technical difficulties in staining. There is, however, a large nucleus lying at the centre of the creature, or slightly anterior to it, and there is a complicated blepharoplast present which takes on a brilliant red colour when stained with polychrome methylene blue or with Giemsa. This blepharoplast varies in position, but is always near the vacuole, which lies a little in front of the slightly truncated posterior end of the animal; the blepharoplast may form a single compact body, or may be composed of several separate elements. A number of well-marked striations are to be seen passing longitudinally along the body; these striations are very conspicuous in individuals stained with polychrome methylene blue or thionin, but are less clear in Giemsa preparations. Division and further stages of the life-history have not as yet been observed.

I hope in a future publication to describe in fuller detail both this and the following forms.

4. **Hæmogregarine** from blood of *P. flesus* and *P. platessa.*

This parasite is a small creature, measuring 7 μ to 12 μ in length. There is a large nucleus, of much the same type as that described for the form in the python, only the karyosome is a more compact body, and does not appear ring-shaped in the ordinary resting stage: it is a more variable organ, and the appearance it presents in the different specimens suggests that it is an important element in the nuclear apparatus (Fig. 14). The number of chromosomes is not quite easy to make out, but there appear to be eight. The nuclear membrane is not at all a constant structure. It is present in some stages, but very frequently the chromatin lies arranged in definite little masses without the faintest sign of a surrounding membrane (Fig. 16). A very constant feature in this form is the presence of an eosinophile body, lying towards the slightly more pointed end of the creature. This body was at first taken to be a vacuole, as it is absolutely unstained by methylene blue. In all Giemsa preparations it stains a clear rose-pink, and appears to correspond to a similar body found by Dr Rogers in the *Herpetomonas*,[1] which causes the disease known as kala-azar. A centrosome is not present as a constant structure in the majority of specimens, but a well-marked granule, whose appearance and staining reaction strongly suggest a centrosome, is to be seen in a number of cases (Figs. 13, 14). This granule appears to divide, and in certain cases marked

[1] The author uses the word *Hepatomonas*, but no doubt intends *Herpetomonas*.

radiations can be seen to pass out from it. I am not yet clear as to the origin of this structure (Figs. 17, 21). As to its position—it usually lies in close contact with the eosinophile body. This is an interesting point of resemblance to the already cited *Herpetomonas* of kala-azar, where the blepharoplast and eosinophile body are in the same close topographical relation to one another. Occasionally the centrosome lies behind the eosinophile body near to the nucleus. In one case it appeared to be inside the eosinophile body (Fig. 21). The size and appearance of the parasite shows considerable variation. The usual form (Figs. 13, 14, 16, 17) is rather slim, with very finely alveolar protoplasm, and few, if any granules, but forms are to be met with which are of markedly larger dimensions, both broader and longer, and with a more granular protoplasm. The alveolar structure of the protoplasm is often exquisitely clear in these latter forms (Figs. 18 to 22). The nucleus of this form is very large, and has a more scattered irregular appearance: the eosinophile body is occasionally missing. This is very possibly a macrogamete. Forms intermediate as to size are found between these and the ordinary individual. I take them to be probably young female forms; they are distinguished by the abnormal size of the nucleus, which may occupy two-thirds of the whole animal. The characteristic configuration of the chromatin is not to be made out in these specimens, the whole nucleus having a deeply staining, almost reticulate appearance. Large forms with two nuclei are found, and of these, two types, as far as I can see at present, are to be distinguished: (1) those where (Fig. 22) the two nuclei show the ordinary number of chromosomes; and (2) those which show (Fig. 23) only four chromatin masses. This last suggests a reduction division, but I have not got sufficient information to make a definite statement, more especially as this is a point which requires very careful investigation in forms such as the one at present under discussion.

The details of division are still very obscure, owing to lack of material, but there appears to be, as in many trypanosomes (and other Protozoa, *e.g.*, *Euglena* and *Coccidium schubergi*), a division of the chromosomes, or, in less specialised cases, of the chromatin, without the formation of an equatorial plate (Fig. 15).

There is, it appears to me, strong presumptive evidence that this form has a flagellate stage, very probably in some invertebrate host. The features which suggest this are the eosinophile body and the centrosome, and the absence apparently of schizogonous stages, which form so conspicuous a feature in Hæmogregarines and Halteridia proper.

The occurrence of the parasites here mentioned is as follows:—Out of ten plaice (four of which were large, freshly caught specimens) four were infected with the endocorpuscular form; two of these infected animals showed the large trypanosome. Out of eight flounders examined, one showed infection with the endocorpuscular form and one with the trypanosome. Unfortunately the films made from this last specimen were very badly fixed, and I cannot make certain as to the presence of the endocorpuscular parasite.

I do not wish, at the present time, to assert that the endocorpuscular form has anything to do with the trypanosome; the discrepancy in size is an *à priori* argument against the probability of such a relation. It may very possibly be a case of double infection. However, it is interesting to find the two forms in the same host.

5. Trypanosoma raiæ.

MM. Laveran and Mesnil (*Trypanosomes et Trypanosomiases.* Paris, 1904) described a trypanosome which they had observed in the blood of various rays. Three specimens of *Raia microcellata* which I examined in the end of March 1906 at the Millport Marine Station were found to be infected with a trypanosome, which agrees with that described by the above observers, with the exception of two points, namely, the length of the body behind the blepharoplast and the construction of the nucleus. In the individuals which I observed, the part behind the blepharoplast is regularly much longer than in MM. Laveran and Mesnil's figure. The divergence between the two forms as regards the nucleus is, however, a more serious point of difference. (Text-Fig. 5.)

Text-Fig. 5.—*Trypanosama raiæ.*

The nucleus lies towards the flagellar end of the animal. It consists of a large central karyosome, staining blue mottled with red (Laveran's modification of Romanowski's stain): this body is surrounded by a clear space, staining pink, which is traversed by numerous fine red rays extending to the limit of the nucleus. I think this nucleus is to be interpreted as consisting of a large plastin karyosome carrying little chromatin, and of a fine regular reticulum (*i.e.*, the rays). This nucleus is exceedingly constant, which is a feature rare in trypanosomes, where the most bewildering differences in nuclear appearance are the rule rather than the exception.

In spite of the discrepancy between the above account of the nucleus and that indicated by Laveran and Mesnil, I do not think it very probable that I am here dealing with a distinct species.

6. **Hæmogregarine** from blood of *Raia microcellata.*

A Halteridium-like parasite was also found in the red blood-corpuscles of *Raia microcellata.* This parasite appears to correspond with *Hæmogregarina delagei,* described by MM. Laveran and Mesnil as parasitic in the erythrocytes of *Raia punctata* and *R. mosaica* (*C. R. Ac. Sci. Paris*, T. 135, 1902).

The parasite was, on the whole, rare and difficult to see. It is found lying at the ends or sides of the erythrocytes. The creature is about 10 μ to 16 μ in length, and is usually shaped like a rather thin sausage, though fusiform individuals are also met with. There is no obvious blepharoplast. Vacuoles are occasionally present, as also granules, which stain almost black with methylene blue: in Giemsa preparations the latter do not show up anything like so clearly.

The nucleus, which is large in size, is either somewhat reticulate in character or shows an irregular arrangement of chromatin round what appears to be a karyosome. At times the boundary of the nucleus is sharp and membrane-like, at others the collection of chromatin granules shows an irregular external boundary.

Division or schizogonous stages have not been met with.

I do not at present see any connection between this form and the trypanosome cycle. It is, however, interesting and possibly significant to note that in all the three cases observed the Trypanosome was accompanied by the Halteridium. This recalls the similar juxtaposition of parasites found in the plaice and flounder.

In conclusion, I may call attention to two points in the above description on which I desire to lay stress: firstly, the occurrence of a typical blepharoplast within the endocorpuscular parasite of the python—indicating that it has a free trypanosome stage; and secondly, the occurrence of a spiral arrangement of chromatin in *T. brucei*—recalling the condition found in *T. balbianii,* and confirming the near relationship of *T. balbianii* to the typical trypanosomes, and so indirectly supporting the view that the genera *Trypanosoma* and *Spirochæta* are closely allied forms.

Explanation of Figures.

All the figures are from preparations stained with modifications of the Romanowski method, with the exception of Fig. 14, which is stained with polychrome methylene blue. The figures are all Camera lucida drawings, made under the two millimetre apochromatic oil immersion lens, by Zeiss, and the eighteen compensating eye-piece. The drawing was made at the level of the table.

Figs. 1 to 12 represent *Trypanosoma brucei.*

Fig. 1. The karyosome is divided into two parts: the chromatin is represented by rods arranged in an oval.
Fig. 2. Division stage showing central line.
Fig. 3. Spiral in pre-nuclear part, and central line in post-nuclear part.
Fig. 4. Autosynthesis (?) of the nucleus.
Fig. 5. Central line passing through the nucleus; it shows thickening in pre-nuclear part. The karyosome has divided.
Fig. 6. Central line and spiral in pre-nuclear part.
Fig. 7. Chromatin arranged in cross bars; central line present.
Fig. 8. Chromatin of the nucleus arranged in cross bars. This shows the vacuole and granule at the anterior extremity of the central line.
Fig. 9. The central line shows thickenings and cross bars in pre-nuclear part.
Fig. 10. Nucleus, with chromatin in bars.
Fig. 11. The pre-nuclear spiral band is continued into the nucleus.
Fig. 12. Spiral arrangement of the chromatin in the nucleus.

Figs. 13 to 23 represent the endocorpuscular parasite found in *Pleuronectes platessa* and *Pleuronectes flesus.*

Fig. 13. This shows the eosinophile body and the centrosome: the arrangement of the chromatin in this specimen is obscure.
Fig. 14. Specimen stained with polychrome methylene blue, eosinophile body unstained, centrosome present: nucleus shows the karyosome and eight somewhat irregularly-shaped chromosomes.
Fig. 15. Karyosome elongated: the chromosomes appear to be dividing.
Fig. 16. Eight chromosomes, karyosome: the nuclear membrane is absent.
Fig. 17. This shows the centrosome with radiations passing from it; it is lying in the protoplasm, and not adjacent to the eosinophile body.
Fig. 18. Large granular form, with compact nucleus; the separate chromosomes are not clearly defined.
Fig. 19. Smaller form, with large nucleus; probably intermediate stage.
Fig. 20. Division of nucleus: nucleus nearest eosinophile body shows eight chromosomes.
Fig. 21. Much the same stage as Fig. 18, but here centrosome apparently inside the eosinophile body.
Fig. 22. Form with a large and less compact nucleus; the protoplasm shows the eosinophile body and a vacuole.
Fig. 23. Division of nucleus suggesting reduction of chromatin: there are apparently only four chromosomes in each nucleus.

XX. *Notes on Fossils from the Falkland Islands brought home by the Scottish National Antarctic Expedition in* 1904. By E. T. Newton, F.R.S. [Plate X.]

(Read 26th February 1906.)

Mr W. S. Bruce, the leader of the Scottish National Antarctic Expedition, has sent me for examination several blocks and smaller specimens of a buff-coloured sandstone containing numerous casts of fossils, which were obtained from Port Louis South, in the Falkland Islands. These fossils were presented to Mr W. S. Bruce by the Governor of the Islands, Mr (now Sir) Wm. Grey-Wilson, when the Expedition visited that place in 1904.

The largest of these specimens is a block of buff-coloured micaceous sandstone, measuring about 20 inches in length by about 18 inches in width and 9 or 10 inches thick: one surface of this is covered by many casts of Brachiopod shells, most of which are referable to the genus *Spirifera.* Numerous smaller examples of a similar rock exhibit casts of other Brachiopods and Crinoid stems. The matrix of all the specimens is so similar that, without opposing evidence, they may be regarded as from one horizon.

On two previous occasions fossils have been brought to this country from the Falkland Islands, namely, by Charles Darwin on the return of the "Beagle" in the year 1844, and by the "Challenger" when she returned from her expedition in the year 1876.

The earliest account of the geology of the Falkland Islands was by Charles Darwin about sixty years ago,[1] and on 25th March 1846 he read a paper on the subject before the Geological Society[2]; and this was followed by descriptions and figures of the fossils by John Morris and Daniel Sharpe[3]. The fossils illustrating these papers were deposited in the Museum of Practical Geology, and many years afterwards

[1] *Voyage of the Beagle,* 1844.

[2] *Quart. Jour. Geol. Soc.*, vol. ii. p. 267.

[3] *Ibid.*, vol. ii. p. 274, pls. x., xi.

were transferred to the British Museum, Cromwell Road, South Kensington, where, by the courtesy of the officers, I have had the opportunity of examining them.

Although satisfied as to the Palæozoic age of these fossils, Morris and Sharpe would not refer them to any definite formation. They say: "Thus we cannot attempt to place the beds in the Falkland Islands, which have supplied these specimens, on the level of any particular portion of the European scale of formations, but must be contented with saying that they belong to a part of the Palæozoic series of which the position is still undetermined."

It is interesting to find that a few years after the publication of Darwin's discovery, Andrew Geddes Bain[1] read a paper (1852) before the Geological Society "On the Geology of South Africa," which was followed by descriptions of Palæozoic fossils by Daniel Sharpe and J. W. Salter,[2] among them being many Brachiopods, which were referred to species previously described from the Falkland Islands. These Brachiopods, together with the Trilobites and other fossils accompanying them, were referred without doubt to the Devonian period.

The Falkland Islands were visited by H.M.S. "Challenger" during her memorable voyage, and Sir Wyville Thomson,[3] in his book, says that while they were at Port Stanley Mr Moseley went across to Port Sussex to examine a supposed deposit of coal, and "brought back a fine lot of fossils from the sandstone, the beds and their contents having very much the appearance of the ferruginous sandstones of May Hill or Girvan. The species of *Orthis*, *Atrypa*, and *Spirifer* are different; and as there are no graptolites in the schists, it is probable that the whole series belongs to a somewhat later period—possibly the base of the Devonians."

The fossils from the Falkland Islands brought home by the "Challenger" were submitted to Mr R. Etheridge, jun., and an account of them is given in the narrative of the cruise.[4]

[1] *Trans. Geol. Soc.*, vol. vii., 1856, p. 175.

[2] *Loc. cit.*, p. 203.

[3] *The Atlantic*, vol. ii. p. 208, 1877.

[4] *Narrative of the Cruise of the Challenger*, 1885, vol. i. part ii. p. 892.

Mr Etheridge says the individuals of the genus *Spirifera* were few in number, while *Orthis, Chonetes,* and *Atrypa* were abundant. This is the reverse of what we find among the specimens brought home by Mr Bruce, where the *Spiriferæ* are the most abundant fossils.

Mr Etheridge recognised definitely three of the species described by Morris and Sharpe, namely, *Orthis Sulivani, Atrypa palmata,* and *Spirifera antarctica*; but there were four other forms which he referred with doubt to *Chonetes falklandica* (?), *Orthis tenuis* (?), *O. concinna* (?) and *Spirifera Orbignii* (?).

These fossils, as we have seen, were thought by Sir Wyville Thomson to indicate a horizon near the base of the Devonian.

The "Challenger" fossils were obtained from Port Louis, and were for the most part in a fine liver-coloured, micaceous sandstone; but there were also pieces of buff-coloured sandstone, apparently quite a different deposit, containing fragments of Trilobites.

A further account of the Brachiopoda from the Bokkeveld beds, South Africa, was published by Mr F. R. C. Reed in 1893.[1] In this paper twenty-eight forms are recognised and described, some six or seven being identical with species recorded by Morris and Sharpe from the Falkland Islands. Mr Reed thinks these Bokkeveld Brachiopods show an undoubted Devonian facies, but he hesitates to assign them to any particular part of that formation.

Quite recently Mr Ivor Thomas[2] has described a series of fossils from strata regarded as of Devonian age, which were collected by Professor Bodenbender at Cordoba, Argentina. Among the forty-one forms described by Mr Ivor Thomas there are six Brachiopods which he refers to species described by Morris and Sharpe as Falkland Island fossils; two of these, and perhaps the most distinctive, *Spirifera antarctica* and *Leptocœlia flabellites,* being among the fossils which form the subject of the present communication.

[1] *Annals of the South African Museum*, vol. iv. p. 165.

[2] "Neue Beiträge zur Kenntnis der devonischen Fauna Argentiniens," *Zeitsch. d. Deutsch. Geol. Gesells.*, Band 57, 1905, p. 233.

LIST OF BRACHIOPODA, ETC., FROM FALKLAND ISLANDS.

FALKLAND ISLAND FOSSILS, described by Morris and Sharpe, 1846.	Falkland Islands "Challenger" fossils, recognised by R. Etheridge, jun., 1885.	South African fossils, described by Morris and Sharpe, 1852.	South African, recognised by Cowper Reed, 1903.	Argentina fossils identified by Mr Ivor Thomas, 1905.	Mr Bruce's specimens.
Chonetes falklandica,	?	...	×	×	×
Orthis Sulivani,	×	×	×	×	?
,, *tenuis,*	?	...	...	×	...
,, *concinna,*	?	...	?	×	...
Atrypa palmata [now *Leptocœlia flabellites*],	×	×	×	×	×
Spirifera Hawkinsi,	...	...	...	...	...
,, *antarctica,*	×	×	...	×	×
,, *Orbignii,*	?	×	×	...	...
Orbicula sp. [now *Orbiculoidea Baini*],	...	×	×	...	×
Avicula sp.,	...	...	...	...	...
Crinoid stems,	...	×	...	...	×
Tribolite fragments,	×	...	...	...	×
From South Africa, described by Sharpe in 1852.					
Cryptonella (Terebratula) Baini,	...	×	×	...	×

An account of the fossils brought home by Mr Bruce will now be given; and as they are in the form of hollow casts, the descriptions are from impressions taken in wax, which thus reproduce the forms of the original shells.

The matrix of these fossils corresponds with the description "yellowish, sometimes micaceous, sandstone" given by Darwin of the rocks in which most of his fossils were found; in both cases, also, the fossils are in the condition of casts, and the species appear to be identical. It seems probable, therefore, that both series of fossils are from the same bed. On the other hand, the "Challenger" specimens, although so similar as regards species, are said to be in a liver-coloured sandstone, and are therefore from a different bed, but probably not far removed from the sandstone which yielded the other two series.

The specimens brought home by Mr Bruce, as well as those previously recorded from the Falkland Islands, are so similar to the Brachiopods obtained from the Bokkeveld beds of South Africa, that there can be little doubt as to their being from beds of approximately the same age; and Mr Reed's statement that the Bokkeveld fossils exhibit a Devonian facies is therefore strong confirmation of the opinion expressed by the earlier writers as to the Devonian age of these Falkland Island fossils.

1. *Spirifera antarctica*, M. and S. (Pl. X. Figs. 1-10).

By far the greater number of the fossils brought home by Mr Bruce are referable to the genus *Spirifera*, and most of them, as I think, to the species *S. antarctica.* At first sight there seems to be a considerable difference in the forms, some of the valves being much coarser than others; but when examined more closely it will be found that the dorsal valves have eight or nine ribs on each side of the median fold, and the ventral valves nine or ten ribs on each side. The width of the ribs varies somewhat in different specimens, and the lines of growth are sometimes very strongly marked and irregular; besides this, the ventral or grooved valves have the ribs more or less angular, while in the dorsal or ridged valve the ribs are more rounded. The hinge-area is wide, concave, and marked by distinct longitudinal lines. The deltidial opening seems to have occupied about half the height of the area, which is marked on each side of the opening by a distinct groove forming an inverted Λ (Fig. 5).

Among these Spirifers I do not find so much variation in the number of the ribs as is figured and described by Morris and Sharpe. The largest specimen (Fig. 3) is a ventral valve, it is about 80 mm. wide and about 35 mm. high; while the smallest specimen, which seems to belong to the same species, is a dorsal valve, 16 mm. wide and 10 mm. high. The best preserved example (Fig. 10) is a dorsal valve, 53 mm. wide and 19 mm. high; the greatest width of the convex median fold is 9 mm. There are eight rounded ribs on each side of the fold, the outer ones being rather smaller than the inner ones. These ribs are wider than the grooves between them. The whole surface of the valve is marked by distinct thread-like lines of growth, which, at irregular intervals, are more strongly developed. The extremities of the hinge-line are not so clearly seen in this specimen as in some others; but it is evident that they were never so sharp in the dorsal as in the ventral valve.

Having examined the type specimens now in the British Museum, which were figured and described by Morris and Sharpe, I have no hesitation in referring the specimens above described to their *Spirifera antarctica.* It is true that in their description this species is said to have twenty to twenty-four ribs; but the specimens do not bear this out. The example with the most numerous ribs is the one figured on their plate xi. fig. 2*a*, and on this I can only count nine ribs on one side of the median ridge, and then towards the angle of the shell there is a space devoid of ribs, as in Mr Bruce's specimens.

I am strongly of opinion that the specimens called *Spirifera Orbignii* by Morris and Sharpe are only younger examples of *S. antarctica.* Mr R. Etheridge, jun., could only certainly recognise the one species of *Spirifera, S. antarctica,* among the fossils which the "Challenger" brought from the Falkland Islands.

Daniel Sharpe, in his description of the South African fossils in 1856, retained the two species *Spirifera antarctica* and *S. Orbignii*; but Mr F. R. C. Reed, in 1893,[1] thought that the South African forms should all be referred to *S. Orbignii,* and that the true *S. antarcticus* of the Falkland Islands was not present among the South African specimens. Mr Reed says: "After a careful examination of the original specimens of *S. antarcticus* and *S. Orbignii* from Cape Colony described and figured by Sharpe in 1856, I am convinced that they all belong to one species (with perhaps the exception of the one figured, *op. cit.*, pl. xxvi. fig. 6)." Mr Reed shows further that, except for the greater number of ribs

[1] *Annals of the South African Museum*, vol. iv. p. 165.

(20-24) in the Falkland Island *S. antarcticus*, there is very little difference between this species and *S. Orbignii.* But seeing (as I have stated above) that the type specimen of *S. antarcticus* has only eighteen ribs, or at most twenty ribs, the chief if not the only grounds for retaining the two names fails. Under these circumstances it is the name *S. antarctica* which must be used, as was pointed out by Mr Reed, who also called attention to Professor Kayser's[1] opinion, that *S. antarctica* and *S. Orbignii* are one and the same species. Mr Ivor Thomas[2] has likewise united these two forms under the one name.

2. *Leptocœlia flabellites* (Conrad), (Pl. X. Figs. 11-14).

The Brachiopod shell figured and described by Morris and Sharpe from the Falkland Islands as a new species under the name of *Atrypa palmata*, is represented in Mr Bruce's collection by several examples similar to those figured by Morris and Sharpe (*loc. cit.*, pl. x. fig. 3), as well as the broader forms from South Africa figured by the last-named author (*loc. cit.*, pl. xxvi. figs. 8, 9). Besides these, there are a few examples of a smaller shell resembling the broad form in shape, but with only three or four ribs on each side of the median fold, which, I think, must be referred to the same species.

The *Atrypa palmata*, M. and S., is now regarded as specifically identical with that called *Atrypa flabellites* by Conrad,[3] and is referred to the genus *Leptocœlia.*

L. flabellites was abundantly represented in the "Challenger" collection, and has been recognised in South Africa. Mr F. R. C. Reed has given a full description and synonymy of this species in his account of the Brachiopoda from the Bokkeveld beds, and has alluded to the occurrence of the same species on the continent of South America, in Devonian rocks in Bolivia, Argentina, and Brazil. Mr Ivor Thomas includes this among his Argentina forms.

[1] *Zeitsch. Deutsch. Geol. Gesells.*, vol. xlix., 1897, p. 297, t. ix. figs. 1-4.

[2] *Loc. cit.*, 1905, p. 261.

[3] *Fifth Ann. Rep. N.Y. Geol. Surv.*, p. 55, 1841.

3. *Chonetes falklandica*, M. and S.

Numerous impressions of *Chonetes* are to be seen upon the slabs of stone, but none of them in a very perfect state of preservation; and in no instance have hinge-spines been detected. Some of the specimens may be referred to *C. falklandica* without much doubt; but others, which are larger, may perhaps belong to another species.

Chonetes falklandica has been found in South Africa, but Mr F. R. C. Reed questions the identification of specimens so named from Argentina; and Mr Ivor Thomas is unable to identify it among his fossils from that country.

4. *Orthotetes.*

There are a few impressions of Orthis-like Brachiopod valves which resemble some of the forms figured by Morris and Sharpe. Three of these represent valves externally concave, and marked by numerous radiating lines; and they seem most nearly to resemble *O. Sulivani*, but cannot be definitely determined.

5. *Cryptonella Baini*, Sharpe (Pl. X. Figs. 15, 16).

This Brachiopod, under the name of *Terebratula Baini*, was first described by Sharpe from South Africa, and has been further described by Mr F. R. C. Reed from the same country, but it seems not to have been hitherto recognised among fossils from the Falkland Islands. There are among Mr Bruce's specimens two casts representing the exteriors of two shells, long and broad forms, like those represented by Sharpe's two figures, plate xxvi. figs. 11 and 12, and these I refer to the same species. The internal structure is not seen; but feeling sure that they are the same species as that described by the above-named authors, I follow Mr Reed in placing it in the genus *Cryptonella.*

6. *Orbiculoidea Baini*, M. and S.

Several pieces of this Brachiopod have been detected among Mr Bruce's specimens, but all of them are mere fragments.

7. *Crinoidal Stems.*

Some of the rock fragments contain many pieces of Crinoidal stems, and are doubtless such as were alluded to by Morris and Sharpe in their early description. These stems are peculiar and characteristic, the ossicles being marked by fine rings of fimbriated fringes. Similar stems occur in the Bokkeveld beds, and are figured by Sharpe on his plate xxv. fig. 24.

8. *Trilobites.*

There are two fragments of Trilobite pleuræ, characterised by exceedingly coarse pitting, but their generic position remains doubtful.

Slab of Rock from near Hope Point, West Falkland, containing numerous impressions of Crinoid Stems.

Besides the fossils from Port Louis South, Mr Bruce sent me another specimen from near Hope Point, West Falkland, which was presented by Mr W. Felton. This is a quadrate slab of hard, sandy rock, containing very many impressions of Crinoid stems, the fossils themselves having been entirely dissolved, and leaving only their casts. The slab is about 15 inches long and wide, and about 1½ inch thick. The Crinoid stems had been broken into small pieces before being fossilised, the largest pieces being not more than 2 inches long, with a diameter of perhaps one-third of an inch. The number of ossicles in the longest pieces being eight or nine, the length of each ossicle is rather less than its diameter. The exterior of the stem is cylindrical in most cases, but some of the impressions show numerous pittings, which may represent ornamentation, but are more probably the bases of cirri. The casts of the ends of the ossicles show very indistinct radial markings, and in no case is the central tube well seen. The geological age of this slab cannot be inferred from the fossils, for Crinoid stems similar to these might occur in beds of almost any age.

Explanation of Plate X.

The original specimens are from Port Louis South, Falkland Islands, and being in the condition of casts only, impressions in wax have been made, from which photographs have been taken, and these reproduced by collotype process.

All the figures are natural size.

Spirifera antarctica, Morris and Sharpe.

Fig. 1. Dorsal valve, hollow cast of exterior, coarse form.
,, 2. ,, exterior of coarse form.
,, 3. Ventral valve, large specimen.
,, 4. ,, narrow sulcus.
,, 5. Hinge-area of large specimen.
,, 6. Associated examples of dorsal and ventral valves, and a large hinge-area.
,, 7. Ventral valve, interior and hinge-area.
,, 8. ,, exterior.
,, 9. ,, ,,
,, 10. Dorsal valve of very perfect specimen, showing external ornamentation.

Leptocœlia flabellites, Conrad.

Fig. 11. Rounded form, flattened valve and hinge-area.
,, 12. ,, inflated valve.
,, 13. Wide form.
,, 14. ,,

Cryptonella Baini, Sharpe.

Fig. 15. Long oval form.
,, 16. Broad form.

XXI. *A Note on the Geology of Gough Island.* By J. H. Harvey Pirie, B.Sc., M.B., Geologist to the Scottish National Antarctic Expedition.

(Read 26th March 1906.)

Gough Island lies in the South Atlantic in about 40° 20′ S., 9° 56′ W., some 1500 miles W. by S. of the Cape of Good Hope, which is the nearest land except the Island of Tristan da Cunha, distant about 280 miles N. by W. The island has a height of over 4000 feet, and is about 8 miles long by 4 broad.

It is one of the peaks of the mid-Atlantic rise, a ridge which is covered by water less than 2000 fathoms deep, and from which rise above water St Paul's Rocks, Ascension, and Tristan da Cunha. No soundings have been taken between this latter island and Gough Island, but the rise is now known to extend southwards as far as the parallel of 55° S., and possibly Bouvet Island is situated on a spur extending somewhat to the eastward.

The island was visited on the voyage homeward of the "Scotia" from the Antarctic seas to Cape Town in April 1904, and three days were spent in its vicinity, but only on one of these was landing possible. Even then the time ashore was limited to several hours, so that nothing like a complete survey of the island was possible; in fact, the exploration ashore was restricted to the seaward end of a narrow glen, and the difficulty of landing made it necessary to limit the collection of rocks to a small number of hand specimens, all of which were obtained within an area of some few hundred yards.

The island, as seen from the sea, is very precipitous, and in most places rises in sheer cliffs some 200 feet high, increasing to nearer 1000 feet at the northern end of the island. At the south-west end is a more or less level plateau at an elevation of about 300 feet, but everywhere else the island appears to consist of steep ridges separated by narrow glens. In general appearance it reminds one rather of

Madeira, with its bold jagged outlines and steep slopes deeply trenched by ravines, but its high, sheer cliffs are more like those of St Helena, only differing in being much more clothed with vegetation. The steep slope of the land appears to be even greater under water, for at a distance of 3 miles from the coast (to the S.-E.) a depth of 1322 fathoms was obtained.

These cliffs bear witness to the rapidity with which the coast-line is being eaten back by the waves, at a rate seemingly much greater than that of the sub-ærial denudation, for most of the stream valleys have their courses sharply truncated by the sea-cliffs, the streams ending in cascades which pour out from the hanging valleys and tumble down the precipices into the sea, forming very prominent features of the landscape. Only very few of the streams—notably that one at the mouth of which a landing was effected—have a deeper, mature course, by which the water reaches the sea without any terminal waterfall. These have excavated valleys which apparently penetrate to the very heart of the island, and should afford fairly easy access to the interior.

The highest part of the island appears to be of the nature of a ridge, cut into two slightly separated summits. Nothing indicative of a crater was observed. On the contrary, through a telescope conspicuous horizontal terracing was visible very near the summit. If these terraces are due to successive sheets of lava, as seems probable, one must be prepared to admit a former considerably greater extension of the island. It may possibly even have been in continuity with Tristan da Cunha: the fact that the latter has almost certainly been continuous at one time with Nightingale Island (one of its outliers), although now separated by water over 1000 fathoms deep, makes this hypothesis at least worthy of mention.

Some of the shore cliffs also show, though less distinctly, a succession of lava flows, and in some of the beds a transverse columnar structure is visible, but neither of these features was seen in the rocks near the landing-place.

The stream at the mouth of which we landed might be well compared with a typical small Highland burn,—there were even the familiar pot-holes worn out in its bed,—and to judge by the number and size of the boulders, in time of spate it must be of considerable volume.

It forks some distance inland and from the ridge between the two tributaries, but some way below the summit of the island, there rises up a large rounded column of rock, which has been named by some of the sealers, who have from time to time lived on the island, "The Apostle." This appeared, from a distance, to be the stump of the plug of a volcanic vent, but without closer inspection it was impossible to be sure of its nature. It may be either a "Tower of Pèlée" or one of those phonolite bosses so common in the volcanic islands of the South Atlantic, *e.g.*, "Lot" and "Lot's Wife" at St Helena, the "Peak" of Fernando Noronha, and the "Nine-pin Rock" on South Trinidad. Its appearance was not at all unlike the pictures of the latter.

Dykes do not form very prominent scenic features, so far as was seen, save in one of the hanging valleys near the north-east corner of the island, where large detached wall-like pieces stand out prominently on both sides of the valley. Smaller vertical dykes can, however, be traced up the face of the cliffs in various places.

Around a considerable part of the island there is a rough bouldery beach at the foot of the cliffs, with here and there small screes resting on it. Numerous sea-caves occur on the south and east coasts at a height of 10 to 15 feet above sea-level, and the ground on which stand the ruined huts at the landing-place is a small raised beach of coarse pebbles, through which the stream has cut a bed. There has evidently been, therefore, a slight alteration of sea-level in favour of the land, and it is interesting to note that in the South Orkneys there has also been a recent elevation of about the same extent.

The first thing that attracted one's attention on landing was the lower part of the cliff on the left bank of the stream, where a bright yellow semicircular patch of rock, some 30 to 40 feet in radius, formed a prominent contrast to the darker rock surrounding it. This was found to be a fine grained tuff or peperino, containing abundant black crystals of augite

(No. 3). It was evidently water-laid, containing small rounded lapilli and scoriæ arranged along horizontal lines of stratification.

Specimens of the lava which had overflown this tuff were taken from various points (Nos. 2, 4, 7, and (?) 6). In their naked eye appearances these varied considerably, but I was unable to make out any definite succession of flow. All appeared, however, to be lavas, not intrusive sheets.

Another fragmental rock of very localised occurrence was found on the right bank of the stream, between two dykes, each about 2 feet thick, and running parallel to the shore, 6 to 8 feet apart. This was of a bright red colour, containing numerous crystals of felspar, and was seen only in the narrow outcrop on the bank of the stream between the two dykes. It was friable, and gave one the impression of being a volcanic ash (No. 10) which had accumulated in the hollow between the dykes subsequent to their formation. Its strictly limited occurrence between the dykes made one wonder whether it was not a decomposition product due to their influence, but there were no signs of it along the lines of contact with the dykes on either side. It may, however, have been the slaggy surface of one of the lava flows through which the dyke ran.

On the rising slope on the right bank of the stream there was a coarse agglomerate composed of boulders firmly cemented together by scoriæ, so as to form a compact mass as hard as the solid lava. Many of the boulders were rather rounded, and I am inclined to think it had been formed under water, although I could not fully satisfy myself on this point. Some of the rocks in this agglomerate had a very white weathered crust (No. 8), and were at first mistaken for a quartzite, but on exposing a fresh surface they were found to be volcanic in nature. As numerous white patches of rock had been noted from the ship at various parts of the coast, it is possible that this agglomerate has a fairly wide distribution throughout the island.

In addition to the double dyke already mentioned, a large dyke, about 6 feet wide, cropped out on the shore to the north of the peperino (No. 9). This dyke ran at about right angles to the coast-line. Between it and the peperino there was a small knob of rock, seemingly also intrusive, which contained many large augite crystals; in fact, these formed by far the larger part of the rock mass.

Besides these rocks found *in situ*, some specimens were taken from boulders in the stream as giving some indication of the rocks occurring farther inland. The samples were picked from rocks evidently different from those seen *in situ*. A grey, almost homogeneous rock (No. 14) was particularly common. Others were red and brown trachyte-like rocks, and a sample of grey compact tuff was also obtained. All were volcanic with the exception of one small piece of limestone, picked up at the mouth of the stream. Had this been found *in situ*, its occurrence would be a very strong argument in favour of the former existence of a great land area between South Africa and South America. But as there is the double possibility of its having been carried there by an iceberg or by some of the sealers who have visited the island, no positive conclusions can be drawn from it. Mr Schwarz has already stated [1] pretty strongly, on the evidence of a piece of gneiss picked up on Tristan da Cunha, the petrographical evidence in favour of a "Flabellites Land," occupying the greater part of what is now the basin of the South Atlantic.

[1] Schwarz, "Rocks of Tristan d'Acunha," *Trans. South African Phil. Soc.*, 1905, vol. xvi. part i. See also Rudmose-Brown, "Diego Alvarez or Gough Island," *Scot. Geog. Mag.*, 1905, p. 430. L. V. Pirsson, "Notes on some Volcanic Rocks from Gough's Island," *Am. Jour. of Science*, 1893, p. 380.

XXII. *Notes on the Petrology of Gough Island.*

By R. Campbell, M.A., B.Sc.

(Read 26th March 1906.)

The material collected by Dr Pirie includes volcanic rocks, tuffs, and a boulder of limestone. The volcanic rocks, which are all remarkably fresh, comprise several varieties of trachyte, trachy-dolerite, and basalt.

I. Trachytes.

Trachytes are represented by two types. One of these is a rock which varies in colour from very pale brown to reddish brown (G. 5, 12, 19).[1] Small phenocrysts of felspar, biotite, and green augite are embedded in a compact, felspathic ground-mass. Examined microscopically, the felspar phenocrysts, which occur in tabular sections, often showing a marginal zone of inclusions with a narrow band of later felspar substance, appear to be typical sanidines. Some of them, however, exhibit the characteristic fine striation of anorthoclase. They enclose fairly large idiomorphic crystals of biotite and augite. Next in abundance to the felspar comes biotite, showing the usual evidences of magmatic resorption. The augite occurs rather sparingly, and is pale green in thin section. The ground-mass is holocrystalline, and consists mainly of alkali felspar. Augite occurs sparingly in a second generation. Zircon, apatite, and magnetite are also present. The structure is typically trachytic.

The specimens examined were obtained *in situ*.

The second type (G. 14) is of a pale grey colour, compact in texture, and non-porphyritic. In thin section the rock is seen to be holocrystalline, consisting of lath-shaped crystals of orthoclase, with scattered, irregular granules and ophitic patches of bright green, dichroic, soda-augite, and particles of magnetite. Small zircons and apatite needles also occur.

[1] Specimens of the various rocks may be seen in the Geological Museum, University of Edinburgh.

Parallel arrangement of the felspar laths gives the rock in parts a well-marked fluidal structure.

The specimens sliced were stream boulders. A rock of similar appearance, forming a flow or series of flows which overlie the brown trachytes, is probably the source of these boulders. The agglomerate mentioned above is composed largely of angular fragments of a pale grey rock, which is identical in microscopic character with that just described (G. 8).

II. Basalts (including Trachy-dolerites).

Specimens were obtained from four lava flows and from two dykes.

(G. 2.) Microscopically this is a rock of ashy grey colour, with scattered phenocrysts of felspar, augite, and olivine. In thin section the phenocrysts are seen to be plagioclase felspar, green augite, and olivine. From the extinction angles in sections cut at right angles to the albite lamellæ the felspar is seen to be basic labradorite. The olivine is very fresh. None of the phenocrysts are abundant. The bulk of the rock consists of a fine grained ground-mass, which is largely felspathic. Laths of oligoclase, pale green augite (prismatic in habit, and often occurring in cross twins), minute needles of apatite, along with particles of iron ore, are embedded in poecilitic fashion in a felspathic base. The felspathic base has a refractive index well under that of Canada balsam, and is probably orthoclase.

(G. 6.) In this specimen the porphyritic constituents are much more abundant and the ground-mass is much lighter in colour. The phenocrysts of plagioclase frequently occur in clusters, and have a glassy appearance in hand specimens. Examined microscopically they exhibit albite, pericline, and Carlsbad twinning, and well-marked zonary banding. Since this banding disappears simultaneously with the albite lamellæ, it is probably due to ultra-microscopic twinning. The inclusions consist of large plates of magnetite, small rounded olivines, and needles of apatite. Many of the crystals show also a marginal zone of inclusions of magnetite, augite, etc., which have been enclosed by a later growth of the felspar substance. As in G. 2, the plagioclase is a basic labradorite. Olivine is abundant in rounded, often much corroded, phenocrysts. These show a marginal decomposition zone of brown limonite. An aggregation of olivine, apatite, and magnetite in one part of the slide is rather suggestive of an "olivine nodule." Augite phenocrysts, pale green in section, occur sparingly.

The ground-mass is andesitic in habit. It consists largely of a network of interwoven laths of oligoclase, through which are scattered small augites, magnetite, and many thin needles of apatite. The felspathic base, which is so abundant in G. 2, here plays a very subordinate part in the composition of the rock.

(G. 4.) Macroscopically this is a grey, slaggy, vesicular lava, with phenocrysts of olivine and felspar. Examined microscopically it is seen to be exceedingly rich in olivine. The felspar phenocrysts are again basic labradorite. The ground-mass consists mainly of laths of labradorite, with green augite, apatite, and magnetite in relatively small proportions.

(G. 7.) In hand specimen this rock shows large phenocrysts of felspar, augite, and olivine in a pale grey ground-mass. It weathers to a brown crust. The felspar phenocrysts are labradorite, and usually occur in groups. Most of the crystals are surrounded by a narrow zone of more acid plagioclase. Microscopic examination reveals the presence of numerous idiomorphic prisms of a rhombic pyroxene, which shows the characteristic pleochroism of hypersthene. The rock is also rich in olivine. Along with these are phenocrysts of a pale green monoclinic pyroxene.

The ground-mass resembles that of G. 4, but contains a fair amount of the felspathic base which is so abundant in G. 2.

The most interesting feature in this rock is the occurrence together of hypersthene and olivine.

(G. 11.) This a dark grey rock, mottled all over with small phenocrysts of felspar. Microscopic examination reveals the presence of scattered phenocrysts of olivine and brown augite. One of the latter encloses ophitically a large lath-shaped plagioclase. The felspar phenocrysts are basic labradorite. The rock is very porous, and the nature of the ground-mass is rather obscured by products of decomposition. It consists mainly of laths of labradorite, prismatic crystals of brown augite, and magnetite.

The specimens were taken from two narrow dykes, cutting the brown trachyte and parallel to the coast-line.

(G. 9.) The specimen is from the margin of a dyke running at right angles to the coast-line. It shows a beautiful chilled edge. In thin section it is seen to be a very fine grained basaltic rock, with small phenocrysts of basic labradorite in a ground-mass which is made up chiefly of microlites of augite and plagioclase, with a considerable amount of residual glass. One section shows a large phenocryst of brown hornblende.

Some of the lavas, which we have termed basalts, appear to be types intermediate in character between trachytes and normal basalts. While their exact systematic position cannot be stated with certainty until chemical analyses have been made, the mineral composition seems to indicate that they belong to the trachy-dolerites of Abich (intermediate rocks rich in potassium). Similar transition types occur in the Azores, Teneriffe, and Ascension,[1] and also in the Tristan d'Acunha group.[2] Thus it would appear that the trachy-dolerites are a constant feature in that line of volcanic islands which sweeps across the South Atlantic.

Tuffs.—The tuffs are greyish to brown in colour, with rounded lapilli of volcanic rocks and broken crystals of augite and felspar. In thin section they are seen to consist mainly of fragments of glass.

Limestone.—Specimen from a boulder. Microscopic examination shows that this rock consists of irregular grains of granitic quartz, flakes of muscovite, and much fragmentary organic material, conspicuous among which are spines and plates of echinoderms: these various constituents are embedded in a calcareous cementing material. The rock is undoubtedly of terrigenous origin.

[1] *Jour. of Geol.*, v. p. 362.

[2] *Trans. South African Phil. Soc.*, xvi.

PROCEEDINGS

OF THE

ROYAL PHYSICAL SOCIETY

FOR THE

PROMOTION OF ZOOLOGY AND OTHER BRANCHES OF NATURAL HISTORY.

SESSION 1905-1906.

No. 7. Vol. XVI. Pages 267-386.

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XXIII. *A Catalogue of Land, Fresh-Water, and Marine Crustacea found in the Basin of the River Forth and its Estuary.* By THOMAS SCOTT, LL.D., F.L.S., Mem. Soc. Zool. de France, etc.

(Read 26th March 1906.)

PART II.—THE OSTRACODA, COPEPODA, AND CIRRIPEDIA.

(Part I., published in the *Proceedings*, Vol. XVI. pp. 97-190, contained the MALACOSTRACA, CLADOCERA, and BRANCHIURA.)

Order OSTRACODA.

The work that has been mainly followed in the arrangement and nomenclature of the Ostracoda is that by Professor G. S. Brady and the Rev. Canon A. M. Norman, entitled "A Monograph of the Marine and Fresh-Water Ostracoda of the North Atlantic and North-Western Europe." The work was published in two separate portions in the scientific *Transactions of the Royal Dublin Society.* The first portion, which formed Part II. of Vol. IV. (Series 2), appeared in 1889, and the second, which formed Part II. of Vol. V. of the same series, in 1896.

In this work the Ostracoda are divided into four sections, viz.—(1st) the Podocopa, which comprises all the fresh-water and most of the marine species; (2nd) the Myodocopa, which is represented in this Catalogue by only two species, *Asterope Mariæ* and *Philomedes interpuncta;* (3rd) the Cladocopa, which is represented by *Polycope orbicularis* and *Polycopsis compressa*; and (4th) the Platycopa—a section not represented in this Catalogue.

As this work has been, with few exceptions, followed throughout, I have not considered it necessary to mention it under every species, and where it is mentioned it is referred to as the Monograph (or *l. c.*), Part I. or Part II., as the case may be.

Various other works have been consulted, two of which may be mentioned here, viz., one by Dr G. W. Müller on "The Fresh-Water Ostracoda of Germany," and the other by Dr A. Kaufmann on "The Fresh-Water Ostracoda of Switzerland."

Section I. PODOCOPA.

Family CYPRIDIDÆ.

Genus (1) **Cypria**, Zenker, 1854.

1. *Cypria exculpta* (S. Fischer).

1855. *Cypris exculpta*, Fischer, Beitrag zur Kenntniss der Ostracoden, Abhdlg. der math.-phys. Klasse der k. bayr. Akad. d. Wiss., Bd. vii. p. 652, taf. xix. figs. 36-38.

This species, though widely distributed, is not very common in the district under consideration. It has been obtained in Loch Leven,[1] Lochgelly Loch, Lochs Lurg and Dow, Kinross; Loch Achray, Perthshire; and Goldenhoof Dam, near Howietoun, Stirlingshire. Loch Ard, July 1906 (W. Evans).

2. *Cypria ophthalmica* (Jurine).

1820. *Monoculus ophthalmicus*, Jurine, Hist. des Monocles, p. 178, taf. xix. figs. 16, 17.

This is one of the most common and widely distributed species of our fresh-water Ostracoda.

Genus (2) **Cyclocypris**, G. S. Brady and A. M. Norman, 1889.

3. *Cyclocypris globosa* (G. O. Sars).

1863. *Cypris globosa*, G. O. Sars, Om en i Somm., 1862, foretagen Zool. Reise i Christianias og Trondhjems Stifter, p. 27.

Has been obtained in a pond near Musselburgh in August 1894; Loch Leven, Loch Fitty, Black Loch, Loch Dow, Loch Katrine, Loch Achray, Loch Vennachar, and Loch Coulter. Teith at Callander (Evans).

[1] It will be understood that the Loch Leven mentioned in this Catalogue is Loch Leven, Kinross.

4. *Cyclocypris serena* (Koch).

1838. *Cypris serena*, Koch, Deutschlands Crustaceen, Heft xxi. p. 22.
1896. *Cyclocypris serena*, B. and N., *l. c.*, Part II. (Appendix) p. 718.

A common and widely distributed species. It has been found in Loch a Chroin, at an altitude of 2500 feet, by Mr Evans.

5. *Cyclocypris lævis* (O. F. Müller).

1896. *Cyclocypris lævis*, Brady and Norman, *l. c.*, Part II. (Appendix) p. 718.

This, which is not such a common species as the last, has an elliptical instead of an ovate form when looked at from above. It has been observed in Duddingston Loch, Lochgelly Loch, pools on Luffness Links, etc.

Dr G. W. Müller appears to think that the species referred by G. S. Brady and Norman to *Cyclocypris serena*, Koch, is the true *C. lævis* of O. F. Müller, and that their *C. lævis* is probably identical with a form described by Croneberg under the name of *Cyclocypris pygmæa.*[1]

Genus (3) **Cypris**, O. F. Müller, 1785.

6. *Cypris fuscata*, Jurine.

1820. *Cypris fuscata*, Jurine, Hist. des Monocles de Geneva, p. 174, pl. xix. figs. 1-16.

Hab.—Duddingston Loch; Upper Elf Loch, Braid Hills; Linlithgow Loch; Loch Leven. Roslin Curling Pond, March 1906 (W. Evans).

7. *Cypris incongruens*, Ramdohr.

1806. *Cypris incongruens*, Ramdohr, Mag. der Gesells. naturf. Freunde in Berlin, Bd. ii. p. 86, taf. iii. figs. 1-12 *et seq.*

Hab.—Abundant in pools in the brickfield at Portobello in the autumn of 1888. In pools on May Island in September 1890. Common in pools on the side of the Union Canal at

[1] *Scottia Browniana* (Jones), which up till 1887, when living specimens were obtained near Rothesay, was only known as a fossil, was collected in a post-Tertiary deposit at Elie, Fifeshire, by the late James Bennie of the Geological Survey (cf. *Proc. Roy. Phys. Soc. Edin.*, vol. x. pp. 339-341, 1890-91). This form, which is placed between *Cyclocypris* and *Cypris*, has not yet been found *living* on the east side of Scotland.

Kingsknowe in May 1888. Pond at House-o'-Hill Farm, Midlothian, common, July 1900 (Dr and Miss Sprague).

8. *Cypris virens*, Jurine.

1820. *Cypris virens*, Jurine, Hist. des Monocles, p. 174, taf. xviii. figs. 15, 16.

Hab.—Duddingston Loch; pools on Luffness Links; pools at Slateford; Kilconquhar Loch; Loch Leven. Marchfield Pond, July 1900, very common (Dr and Miss Sprague). Roslin Curling Pond, March 1906 (Evans).

9. *Cypris affinis*, Fischer.

1851. *Cypris affinis*, Fischer, Ueber das genus *Cypris*, p. 32, pl. x. figs. 9-11.
1889. ,, *reticulata*, Brady and Norman, *l. c.*, Part I. p. 76, pl. viii. figs. 1, 2; pl. xi. figs. 5-7.
1900 ,, *affinis*, Kaufmann, Cypriden u. Darwinuliden der Schweiz, Revue Suisse de Zool., T. 8, p. 272, taf. xv. figs. 17-20 *et seq.*

Hab.—Camilla Loch, Fifeshire, and Duddingston Loch. This species does not appear to be very common. (I have recorded *C. affinis* from Linlithgow Loch, but the dissections show that the specimens belong to *C. fuscata*.)

10. *Cypris obliqua*, G. S. Brady.

1868. *Cypris obliqua*, Brady, Mon. rec. Brit. Ostrac., p. 364, pl. xxiii. figs. 33-38.

Hab.—Lurg Loch (near L. Glow), Kinross-shire; Lochgelly Loch and Loch Achray. Craigleith Quarry, near Edinburgh, February 1901, one specimen (Dr and Miss Sprague).

Genus (4) **Eurycypris**, G. W. Müller, 1898.

11. *Eurycypris pubera* (O. F. Müller).

1785. *Cypris pubera*, O. F. Müller, Entomostraca, p. 56, taf. v. figs. 1-5.
1900. *Eurycypris pubera*, G. W. Müller, Deutschl. Süssw.-Ostrac., p. 54, taf. xiii. figs. 1-11.

Hab.—Duddingston Loch (Baird, Norman, and myself); Kilconquhar Loch; Kinghorn Loch (common); Lochgelly

Loch. Townhill Loch, Dunfermline (D. Robertson). Otterston Loch, Fife, October 1905 (W. Evans).

Genus (5) **Cyprinotus**, G. S. Brady, 1886.

12. *Cyprinotus prasina* (Fischer).

1889. *Cypris prasina*, Brady and Norman, Monograph, Part I. p. 78.
1896. *Cyprinotus prasina*, id., Part II. (Appendix) p. 772.

Hab.—Pools in an old brickfield at Seafield, near Dunbar, August 1890; in pools at the mouth of the Peffer Burn, near Aberlady, August 1893. *Cyprinotus prasinus* was obtained by the late James Bennie, of the Geological Survey, in material excavated from the bed of the Old "Nor Loch," Edinburgh (cf. *Proc. Roy. Phys. Soc. Edin.*, vol. x. p. 139, 1889).

Genus (6) **Herpetocypris**, G. S. Brady and A. M. Norman, 1896.

Erpetocypris, idem, 1889.

13. *Herpetocypris reptans* (Baird).

1835. *Candona reptans*, Baird, Trans. Berw. Nat. Club, vol. i. p. 99, pl. iii. fig. 11.

Hab.—Duddingston Loch, Loch Leven, Linlithgow Loch, Loch Lubnaig, pools on Gullane Links, and various other places throughout the district. Loch Ard (Evans).

14. *Herpetocypris strigata* (O. F. Müller).

1785. *Cypris strigata*, O. F. Müller, Entomostraca, p. 54, pl. iv. figs. 4-6.

Hab.—Duddingston Loch, Loch Leven, Black Loch near L. Glow; pools at Kingsknowe near Edinburgh, May 1888; Loch Coulter; and about Howietoun, Stirlingshire, 1889.

15. *Herpetocypris tumefacta*, G. S. Brady and D. Robertson.

1870. *Cypris tumefacta*, B. and R., Ann. and Mag. Nat. Hist. (4), vol. vi. p. 13, pl. iv. figs. 4-16.

Hab.—Duddingston Loch, Loch Leven, pools on Luffness Links, Loch Achray, Loch Vennachar, Loch Coulter, and pools near Howietoun, etc. Ben Ledi, at 2500 feet (Evans).

Genus (7) **Ilyodromus**, G. O. Sars, 1894.

16. *Ilyodromus olivacea* (G. S. Brady and A. M. Norman).

1889. *Erpetocypris olivacea*, B. and N., *l. c.*, Part I. p. 89, pl. viii. figs. 3, 4.
1896. *Ilyodromus olivacea*, *l. c.*, Part II. (Appendix) p. 724.

Hab.—Duddingston Loch, Kinghorn Loch, Black Loch near L. Glow.

17. *Ilyodromus Robertsoni*, G. S. Brady and A. M. Norman.

1889. *Erpetocypris Robertsoni*, B. and N., *l. c.*, Part I. p. 88 (with two text figures).
1896. *Ilyodromus Robertsoni*, *l. c.*, Part II. (Appendix) p. 724.

Hab.—Linlithgow Loch; Black Loch near L. Glow, 14th September 1889.

Genus (8) **Cypridopsis**, G. S. Brady, 1867.

18. *Cypridopsis villosa* (Jurine).

1820. *Monoculus villosus*, Jurine, Hist. des Monocles, p. 178, pl. xix. figs. 14, 15.
1868. *Cypridopsis villosa*, Brady, Mon. rec. Brit. Ostrac., p. 377, pl. xxiv. figs. 11-15; pl. xxxvi. fig. 9.

Hab.—Duddingston Loch, Loch Leven, and in various other lochs and ponds throughout the district

19. *Cypridopsis aculeata* (Lilljeborg).

1853. *Cypris aculeata*, Lillj., De Crust. ex Ord. trib., p. 117, taf. xi. figs. 15, 16.
1868. *Cypridopsis aculeata*, Brady, *l. c.*, p. 376, pl. xxiv. figs. 16-20; pl. xxxvi. fig. 10.

Hab.—Pools in an old brickfield at Seafield, near Dunbar; Gullane, near Aberlady, August 1893. Cramond Island, July 1901 (Dr and Miss Sprague).

Genus (9) **Pionocypris**, G. S. Brady and A. M. Norman, 1896.

20. *Pionocypris vidua* (O. F. Müller).

1785. *Cypris vidua*, O. F. Müller, Entomostraca, p. 55, taf. iv. figs. 7-9.
1889. *Cypridopsis vidua*, B. and N., *l. c.*, Part I. p. 89.
1896. *Pionocypris vidua*, id., *ibid.*, Part II. (Appendix) p. 726.

Hab.—Duddingston Loch, Loch Leven, Loch Coulter, Loch

Achray; Loch Rusky (Evans); and generally throughout the district, especially in the smaller bodies of water.

Objection is taken to the separation of this species from the genus *Cypridopsis*, to which it was ascribed by Dr G. S. Brady in 1867, but, as pointed out by Brady and Norman in the Appendix to their valuable *Monograph*, pp. 725 and 726, its removal became necessary when it was found to differ materially in the principal character on which the genus was founded, viz., the caudal rami. These were described as "being quite rudimentary, consisting of two slender setiform processes springing from a common base." Careful examination has shown that while *C. villosa*, *C. aculeata*, and one or two others agree so far with this definition, the caudal rami in *C. vidua* consists of four setiform processes, and also that the basal part of each pair of processes differs to some extent. Dr Kaufmann does not appear to attach much value to this difference, and therefore replaces *C. vidua* under *Cypridopsis*, but he at the same time removes *the others* to a new genus—*Cypridopsella*—the chief distinguishing character of which is that while the first has five the other has only two hairs on the branchial plate of the first maxilla.[1] Though *C. vidua* was made the type of the genus *Cypridopsis* by Dr Brady, it was doubtless because he considered its furca to be similar to that of the two species associated with it, and as these two species agree with the definition of *Cypridopsis*, I think *they* ought to be retained in that genus, and *C. vidua* removed, as has been done by Brady and Norman.

Genus (10) **Potamocypris**, G. S. Brady, 1870.

21. *Potamocypris fulva*, G. S. Brady.

1868. *Bairdia fulva*, Brady, Mon. rec. Brit. Ostrac., p. 474, pl. xxviii. fig. 21.

Hab.—Duddingston Loch, Loch Leven, Raith Lake, Loch Gelly, and several other places. Ben Ledi, at 2500 feet (Evans).

[1] *Cypridopsis*—Branchial platte des Kiefer fusses mit fünf Borsten. Furka verkümmert mit geisselförmiger Borste.
Cypridopsella—Branchial platte des Kiefer fusses mit zwei Borsten. Furke verkümmert mit geisselförmiger Borste.

Genus (11) **Aglaia**, G. S. Brady.

22. *Aglaia complanata*, G. S. Brady and D. Robertson.

1869. *Aglaia complanata*, B. and R., Ann. and Mag. Nat. Hist. (4), vol. iii. p. 66, pl. xx. figs. 4, 5.

Hab.—Forth at Bo'ness (David Robertson). The late Dr Robertson, who obtained this rare form among some material collected by himself at Bo'ness, informed me *in lit.* of its occurrence there, but I have not met with it myself.

Genus (12) **Notodromas**, Lilljeborg, 1853.

23. *Notodromas monacha* (O. F. Müller).

1785. *Cypris monacha*, Müller, Entomostraca, p. 60, taf. v. figs. 6-8.

Hab.—Pools on Luffness Links; in a pond near Musselburgh; Lochgelly Loch and Camilla Loch, Fifeshire. Burntisland Reservoir and Loch Rusky, 1906 (Evans).

Genus (13) **Cyprois**, Zenker, 1854.

24. *Cyprois marginata* (H. E. Straus).

1821. *Cypris marginata*, Straus, Mémoire sur les Cypris, Mém. du Mus., vol. vii. p. 59, pl. i. figs. 20-22.
1889. *Cyprois flava*, B. and N., *l. c.*, Part I. p. 97, pl. viii. figs. 18, 19; pl. xii. figs. 13-21, 28.

Hab.—Duddingston Loch (A. M. Norman). In 1889 I found this species in moderate abundance at the upper end of the Loch—not in the Loch itself, but in little pools on the marshy ground behind the fringe of tall reeds. I observed it again in September 1898 on the same marshy ground, but not so plentiful as in 1889. I do not remember ever having found it in the loch itself. This species was collected by the late Mr James Bennie, of the Geological Survey, in a post-Tertiary fresh-water deposit at Kirkland of Leven, Fifeshire (cf. *Proc. Roy. Phys. Soc.*, vol. x. pp. 335-337, 1890-91).

Genus (14) **Candona**, Baird, 1845.

25. *Candona candida* (O. F. Müller).

1785. *Cypris candida*, Müller, Entomostraca, p. 62, taf. vi. figs. 7-9.

Hab.—This appears to be a moderately common species throughout the whole district.

26. *Candona neglecta*, G. O. Sars.

1887. *Candona neglecta*, G. O. Sars, Mittelh. Invert.—fauna IV., Ostrac. Mediterranea, p. 279, taf. xv. figs. 5-7; taf. xix. figs. 1-21.
1889. ,, *candida* (Part), B. and N., *l. c.*, Part I. p. 99, pl. x. figs. 20, 21.

Hab.—I find this species generally distributed but not very plentiful, and the males appear to be more frequent and larger than the females. The following are some of the places where it has been obtained:—Duddingston Loch (♂); Loch Leven (♂); Linlithgow Loch (♀); Cocklemill Burn, near Largo (♂ and ♀); Lochgelly Loch (♂); Camilla Loch (♂ and ? ♀); Kinghorn Loch (♂).

27. *Candona lactea*, Baird.

1850. *Candona lactea*, Baird, Proc. Zool. Soc. Lond. (1850), p. 255, pl. xviii. figs. 25-27.

Hab.—Duddingston Loch, Loch Leven, Camilla Loch, Linlithgow Loch, Loch Coulter, and other places within the area.

28. *Candona compressa* (S. Fischer).

1851. *Cypris compressa*, Fischer, Abhandl. über das genus Cypris, Mém. des Sav. étrang. des Sci. de St. Pétersb., t. 7, p. 144, taf. ii. figs. 7-12; taf. iii. figs. 1-5.
1889. *Candona pubescens*, B. and N., *l. c.*, Part I. p. 101, pl. xii. figs. 32-37.
1900. ,, *compressa*, Kaufmann, Cyprid. u. Darwinul., p. 371, taf. xxvii. figs. 4-6 *et seq.*

Hab.—Duddingston Loch (Brady and Norman), Lochgelly Loch, Loch Leven, and several other places within the district.

29. *Candona stagnalis*, G. O. Sars.

1890. *Candona stagnalis*, G. O. Sars, Christ. Videns-Selsk. Forhandl., p. 69.
1891. ,, *ambigua*, T. Scott, Ninth Rept. F. B. S., pt. iii. p. 277, pl. iv. fig. 7 *a-c*.

Hab.—Lochgelly Loch and Loch Fitty, Fifeshire; not common.

30. *Candona rostrata*, Brady and Norman.

1889. *Candona rostrata*, B. and N., *l. c.*, Part I. p. 101, pl. ix. figs. 11, 12, 12*a*, *b*; pl. xii. figs. 22-31.

Hab.—Duddingston Loch, Lurg Loch, Raith Lake, pond at Howietoun; not common. The larva of the tapeworm, *Tænia gracilis*, has been found encysted in a specimen of this species collected in Duddingston Loch.[1]

31. *Candona fabæformis* (Fischer).

1851. *Cypris fabæformis*, Fischer, Über das genus Cypris, p. 146, pl. iii. figs. 6-16.

Hab.—Duddingston Loch; marl-pit, near Davidson's Mains, Edinburgh; pools on Luffness Links; Loch Fitty, and other places in Fifeshire; Linlithgow Loch; and in a pool near Howietoun.

32. *Candona acuminata* (Fischer).

1851. *Cypris acuminata*, Fischer, Über das genus Cypris, p. 148, taf. iv. figs. 12-16.

Hab.—Ditch beside Harelaw Dam, Balerno; Threipmuir Reservoir; Loch Fitty; ponds at Howietoun; and Loch Coulter.

The specimens recorded here agree closely with the female of *Candona caudata*, figured by Kaufmann in *Cypriden u. Darwinuliden der Schweiz*, p. 365, taf. xxiv. figs. 16-20; taf. xxvi. figs. 17-23.

[1] *Proc. Roy. Phys. Soc.*, vol. x. p. 314 (with text-figure), 1890-91.

33. *Candona hyalina*, G. S. Brady and D. Robertson.

1870. *Candona hyalina*, B. and R., Ann. and Mag. Nat. Hist. (4), vol. vi. p. 18, pl. ix. figs. 5-8; pl. v. figs. 4-11.
1889. ,, ,, B. and N., *l. c.*, Part I. p. 247, with text-figures 1-5.

Hab.—Threipmuir Reservoir, near Balerno (♂); Loch Fitty and Loch Gelly, Fifeshire; Loch Dow, Kinross-shire (♀); Loch Katrine. The shell is much compressed, and of a white colour in living specimens. The dorsal edge is obtusely angular.

Genus (15) **Candonopsis**, Vavra, 1891.

34. *Candonopsis Kingsleii* (Brady and Robertson).

1870. *Candona Kingsleii*, B. and R., Ann. and Mag. Nat. Hist. (4), vol. vi. p. 17, pl. ix. figs. 9-12.
1891. *Candonopsis kingsleii*, Vavra, Mon. der Ostrac. Bohmens, p. 54, fig. 16.

Hab.—Duddingston Loch, pools on Luffness Links, Loch Leven, Camilla Loch, Loch Coulter, Loch Katrine, and others. This is a well-marked and widely distributed species. The shell in living specimens is white and much compressed.

Genus (16) **Paracandona**, Hartwig, 1899.

35. *Paracandona euplectella* (Robertson).

1880. *Candona euplectella*, Robertson, Fresh and Brackish-Water Ostrac. of Clydesdale, p. 23. (See also Proc. Nat. Hist. Soc. Glasgow, vol. iv. pt. i., 1880, p. 77.)
1900. *Paracandona euplectella*, G. W. Müller, Deutschl. Süssw.-Ostrac., p. 37, taf. ix. figs. 1-9, 14.

Hab.—Loch Dow, near Loch Glow, Kinross-shire, 14th September 1889. This is still the only record I have of *P. euplectella* from the district under consideration. It is the most beautiful of the species belonging to the British *Candonæ*. The shell is cylindrical and very tumid, and its structure is suggestive of the glass-sponge *Euplectella*, as implied by the specific name.

Genus (17) **Ilyocypris**, Brady and Norman, 1889.

36. *Ilyocypris gibba* (Ramdohr).

1808. *Cypris gibba*, Ramdohr, Mag. der Gesells. naturf. Freunde in Berlin, ii. p. 91, taf. iii. figs. 13-17.

Hab.—Union Canal, near Edinburgh, 4th September 1889. I obtained a number of specimens here—the only place where I have observed it within the district. The shell of this species is ornamented with prominent tubercles.

37. *Ilyocypris bistrigata* (Jurine).

1820. *Monoculus bistrigatus*, Jurine, Hist. Nat. des Monocles, p. 177, pl. xix. figs. 12, 13.

1838. *Cypris biplicata*, Koch, Deutschlands Crustaceen, H. 21 (161), fig. xvi.

Hab.—Duddingston Loch, Loch Leven, etc. This species is generally distributed throughout the district. I have occasionally observed specimens distinctly larger than some of the others, but could find no other difference sufficient to permit of their separation even as a variety.

Genus (18) **Pontocypris**, G. O. Sars, 1865.

38. *Pontocypris mytiloides* (Norman).

1862. *Cythere mytiloides*, Norman, Ann. and Mag. Nat. Hist. (3), vol. ix. p. 50, pl. iii. figs. 1-3.

Hab.—Off Aberlady, off Musselburgh, and various other parts of the Forth estuary. Living specimens are usually moderately dark in colour.

39. *Pontocypris acupunctata*, G. S. Brady.

1866. *Pontocypris acupunctata*, Brady, Brit. Assoc. Report (1866), p. 209.

1868. ,, ,, Brady, Mon. rec. Brit. Ostrac., p. 386, pl. xxiv. figs. 53-56.

Hab.—Off St Monans and one or two other places in the estuary, 1890; rare. Living specimens are brownish in colour, and the surface is minutely punctate.

40. *Pontocypris trigonella*, G. O. Sars.

1865. *Pontocypris trigonella*, G. O. Sars, Oversigt af Norges mar. Ostrac., p. 16.

Hab.—Largo Bay and other parts of the estuary, but not very common.

Genus (19) **Argillœcia**, G. O. Sars, 1865.

41. *Argillœcia cylindrica*, G. O. Sars.

1865. *Argillœcia cylindrica*, G. O. Sars, *l. c.*, p. 18.

Hab.—Firth of Forth (Brady and Robertson). Off St Monans, rare.

Family Bairdiidæ.

Genus (20) **Bairdia**, M'Coy (? 1849).

42. *Bairdia inflata* (Norman).

1862. *Cythere inflata*, Norman, Ann. and Mag. Nat. Hist. (3), vol. ix. p. 49, pl. iii. figs. 6-8.

1868. *Bairdia inflata*, Brady, Mon. rec. Brit. Ostrac., p. 388, pl. xxvii. figs. 9-17; pl. xxxviii. fig. 5.

Hab.—Dredged off St Monans, 1889; rare. The specimens were of a brownish colour, and tumid, as indicated by the name.

Family Darwinulidæ.

Genus (21) **Darwinula**, Brady and Robertson, 1885.

43. *Darwinula Stevensoni*, Brady and Robertson.

1870. *Polycheles Stevensoni*, B. and R., Ann. and Mag. Nat. Hist. (4), vol. vi. p. 25, pl. vii. figs. 1-7; pl. ii. figs. 4-14.

Hab.—Loch Lubnaig, Perthshire, rare; obtained near the east shore by hand-net on 29th September 1894. This somewhat rare species was obtained by the late James Bennie in a lacustrine deposit in the Meadows, Edinburgh. (Cf. "The Ancient Lakes of Edinburgh," by James Bennie and T. Scott, *Proc. Roy. Phys. Soc. Edin.*, vol. x. p. 131.)

Family Cytheridæ.

Genus (22) **Cythere**, O. F. Müller, 1785.

44. *Cythere lutea*, O. F. Müller.

1785. *Cythere lutea*, Müller, Entomostraca, p. 65, taf. vii. figs. 3, 4.

Hab.—Forth estuary, especially inshore—a common British species.

45. *Cythere pellucida*, Baird.

1850. *Cythere pellucida*, Baird, Brit. Entom., p. 173, pl. xxi. fig. 7.

Hab.—Cramond Island, taken with hand-net at low water in 1889, and subsequently in other parts of the estuary, chiefly in brackish water.

46. *Cythere confusa*, Brady and Norman.

1865. *Cythere pellucida*, G. O. Sars (not Baird), Oversigt af Norges mar. Ostrac., p. 31

1889. ,, *confusa*, B. and N., *l. c.*, Pt. I. p. 127, pl. xiv. figs. 16-18.

Hab.—Largo Bay, off Musselburgh, and other places; moderately frequent.

47. *Cythere porcellanea*, G. S. Brady.

1889. *Cythere porcellanea*, B. and N., *l. c.*, Pt. I. p. 127, pl. xiv. figs. 22-24.

Hab.—South Bay, off Musselburgh, and other places, but for the most part in shallow water that is slightly brackish.

48. *Cythere tenera*, G. S. Brady.

1868. *Cythere tenera*, Brady, Mon. rec. Brit. Ostrac., p. 599, pl. xxviii. figs. 29-32.

Hab.—South Bay, and deep water west of May Island; not common.

49. *Cythere semipunctata*, G. S. Brady.

1868. *Cythere* (?) *semipunctata*, Brady, Mon. rec. Brit. Ostrac., p. 411, pl. xxix. figs. 33-37.

Hab.—Aberlady Bay and Largo Bay; not common.

50. *Cythere crispata*, G. S. Brady.

1889. *Cythere crispata*, B. and N., *l. c.*, Pt. I. p. 131, pl. xv. figs. 1, 2.

Hab.—Off the west side of Inchkeith; scarce.

51. *Cythere gibbosa*, Brady and Robertson.

1869. *Cythere gibbosa*, B. and R., Ann. and Mag. Nat. Hist. (4), vol. iii. p. 368, pl. xxi. figs. 1-3.

Hab.—Brackish pools at the mouth of the Cocklemill Burn, Largo Bay, 1890.

52. *Cythere semiovata*, T. Scott.

1890. *Cythere semiovata*, T. Scott, Eighth Rept. F. B. S., pt. iii. p. 321, pl. xii. figs. 1, 2.
1896. ,, ,, B. and N., *l. c.*, Pt. II. (Appendix) p. 732, pl. lxiii. figs. 14, 15.

Hab.—Off St Monans, frequent. I had at first some doubt concerning the validity of this species, but having as yet seen no described form with which it could agree, either as adult or young, it is retained in this Catalogue. In the original description of the species, "anterior" end should read "posterior" end, and *vice versa*.

53. *Cythere albomaculata*, Baird.

1850. *Cythere albomaculata*, Baird, Brit. Entomostraca, p. 169, pl. xx. fig. 7.

Hab.—Off Bo'ness and throughout the estuary, but apparently not very plentiful.

54. *Cythere Robertsoni*, G. S. Brady.

1868. *Cythere Robertsoni*, Brady, Ann. and Mag. Nat. Hist. (4), vol. ii. p. 33, pl. iv. figs. 5, 8-10.

Hab.—Dredged in the neighbourhood of Inchkeith, as well as in other parts of the estuary, but not very common.

55. *Cythere convexa*, Baird.

1850. *Cythere convexa*, Baird, Brit. Entomostraca, p. 174, pl. xxi. fig. 3.

Hab.—Firth of Forth; distribution similar to that of *C. Robertsoni*, but it appears to be even scarcer. I have observed it only sparingly.

56. *Cythere limicola*, A. M. Norman.

1865. *Cythere limicola*, Norman, Nat. and Mag. Hist. Trans. Northumb. and Durham, vol. i. p. 20, pl. vi.

Hab.—South Bay, and in deep water west of May Island (1888). I find this to be a moderately rare species in the Firth of Forth.

57. *Cythere cuneiformis*, G. S. Brady.

1868. *Cythere cuneiformis*, Brady, Mon. rec. Brit. Ostrac., p. 404, pl. xxxi. figs. 47-54.

Hab.—Aberlady Bay in 3 fathoms, bottom muddy sand; rare.

58. *Cythere navicula* (A. M. Norman).

1869. *Cytherura navicula*, Norman, Brit. Assoc. Rept. for 1868, p. 292.

Hab.—Off St Monans; not common.

59. *Cythere villosa*, G. O. Sars.

1865. *Cythere villosa*, G. O. Sars, Oversigt af Norges mårine Ostracoder, p. 42.

Hab.—South Bay, off Inchkeith, and at various other places; frequent.

60. *Cythere pulchella*, G. S. Brady.

1868. *Cythere pulchella*, Brady, Mon. rec. Brit. Ostrac., p. 404.

Hab.—Firth of Forth (Brady and Norman). Off St Monans; not common. Without careful examination this species might be mistaken for the more common *C. villosa.*

61. *Cythere quadridentata*, Baird.

1850. *Cythere quadridentata*, Baird, Brit. Entom., p. 173, pl. xxi. fig. 2.

Hab.—Off the west side of Inchkeith (1888), and subsequently, but very sparingly, in other parts of the estuary.

62. *Cythere emaciata*, G. S. Brady.

1867. *Cythere emaciata*, Brady, Brit. Assoc. Rept. for 1866, p. 210.

Hab.—Firth of Forth, taken from the stomach of a Sharp-tailed *Lumpenus, L. lampretiformis*, captured at Station III. (east of Inchkeith), 13th July 1901. This is the only record I have of *C. emaciata* for the Forth estuary.

63. *Cythere tuberculata*, G. O. Sars.

1865. *Cytheris tuberculata*, G. O. Sars, Oversigt af Norges marine Ostracoder, p. 37.

Hab.—South Bay; deep water west of May Island and other parts of the estuary; frequent.

64. *Cythere concinna*, Rupert Jones.

1856. *Cythere concinna*, Jones, Tert. Entom., p. 29, pl. iv. fig. 7 *a-f*.

Hab.—South Bay, Largo Bay, west of May Island; not very common. Firth of Forth (Brady and Norman).

65. *Cythere finmarchica* (G. O. Sars).

1865. *Cythereis finmarchica*, G. O. Sars, Oversigt af Norges marine Ostracoder, p. 41.

Hab.—Off St Monans, frequent (1890).

66. *Cythere angulata* (G. O. Sars).

1865. *Cythereis angulata*, G. O. Sars, *l. c.*, p. 40.

Hab.—Firth of Forth (Brady and Norman). Dredged in deep water west of May Island, not common; and subsequently in one or two other parts of the estuary.

67. *Cythere dunelmensis* (Norman).

1865. *Cythereis dunelmensis*, Norman, Nat. Hist. Trans. Northumb. and Durh., vol. i. p. 22, pl. vii. figs. 1-4.

Hab.—Firth of Forth (Brady and Norman). Dredged in deep water west of May Island, 1888.

68. *Cythere antiquata* (Baird).

1857. *Cythereis antiquata*, Baird, Brit. Entom., p. 176, pl. xx. fig. 2.

Hab.—Firth of Forth (Brady and Norman). Dredged near Inchkeith and in South Bay; not common.

69. *Cythere Whitei* (Baird).

1850. *Cythereis Whitei*, Baird, *l. c.*, p. 175, pl. xx. figs. 3, 3*a*.

Hab.—Largo Bay; not common.

70. *Cythere Jonesii* (Baird).

1850. *Cythereis Jonesii*, Baird, *l. c.*, p. 175, pl. xx. fig. 1.

Hab.—South Bay, deep water west of May Island, and other places in the estuary; not common.

Genus (23) **Limnicythere**, G. S. Brady, 1867.

71. *Limnicythere inopinata* (Baird).

1850. *Cythere inopinata*, Baird, *l. c.*, p. 172, pl. xxi. figs. 1, 1 *a-e*.

Hab.—Duddingston Loch, Loch Leven, Linlithgow Loch, Kilconquhar Loch, Lochgelly Loch, and other places. It is a small species that lives amongst the mud, and is easily missed.

72. *Limnicythere Sancti-Patricii*, G. S. Brady and D. Robertson.

1869. *Limnicythere Sancti-Patricii*, B. and R., Ann. and Mag. Nat. Hist. (4), vol. iii. p. 17, pl. xviii. figs. 8-11; pl. xxi. fig. 4.

Hab.—Loch Leven, moderately frequent. This is the only loch within the district where this species has been observed.

Genus (24) **Cytheridea**, Bosquet, 1852.

73. *Cytheridea elongata*, Brady.

1868. *Cytheridea elongata*, Brady, Mon. rec. Brit. Ostrac., p. 421, pl. xxviii. figs. 13-16; pl. xl. fig. 6.

Hab.—Firth of Forth (G. S. Brady). Off the west side of Inchkeith, and a few other parts of the estuary; not common.

74. *Cytheridea papillosa*, Bosquet.

1862. *Cytheridea papillosa*, Bosq., Entom. fossil des terrains de la France, p. 42, pl. ii. fig. 5 *a-d*.

Hab.—South Bay, off North Berwick, and some other places; not common.

75. *Cytheridea punctillata*, Brady.

1865. *Cytheridea punctillata*, Brady, Ann. and Mag. Nat. Hist. (3), vol. xvi. p. 189, pl. ix. figs. 9-11.

Hab.—Aberlady Bay, Largo Bay, and other places.

76. *Cytheridea torosa* (Jones).

1850. *Candona torosa*, Jones, Ann. and Mag. Nat. Hist. (2), vol. vi. p. 27, pl. iii. fig. 6.

Hab.—Granton Harbour (D. Robertson); brackish-water pools on the shore at Aberlady; pools in an old brickfield at Seafield, near Dunbar; mouth of the Cocklemill Burn, Largo Bay.

77. *Cytheridea lacustris* (G. O. Sars).

1862. *Cythere lacustris*, G. O. Sars, Zoolgisk Reise i. Sommeren, 1862, p. 30.

Hab.—Union Canal, near Edinburgh (D. Robertson); Loch Leven, moderately frequent.

Genus (25) **Eucythere**, G. S. Brady, 1868.

78. *Eucythere declivis* (Norman).

1864. *Cythere declivis*, Norman, Nat. Hist. Trans. Northumb. and Durh., vol. i. p. 16, pl. v. figs. 9-12.

Hab.—Off the west side of Inchkeith and various other places; frequent.

Genus (26) **Krithe**, G. S. Brady, Crosskey, and Robertson, 1874.

79. *Krithe bartonensis* (T. R. Jones).

1856. *Cytherideis bartonensis*, Jones, Mon. Ter. Entom., p. 50, pl. v. figs. 2 *a*, *b*; 3 *a*, *b*.

Hab.—Near the mouth of the Forth estuary; moderately common.

Genus (27) **Loxoconcha**, G. O. Sars, 1862.

80. *Loxoconcha impressa* (Baird).

1850. *Cythere impressa*, Baird, Brit. Entom., p. 173, pl. xxi. fig. 9.

Hab.—Aberlady Bay, Largo Bay, and other parts of the estuary; frequent.

81. *Loxoconcha guttata* (Norman).

1864. *Cythere guttata*, Norman, Nat. Hist. Trans. Northumb. and Durh., vol. i. p. 19, pl. vi. figs. 9-12.

Hab.—Firth of Forth (Brady and Norman), South Bay and off North Berwick; frequent.

82. *Loxoconcha viridis* (O. F. Müller).

1785. *Cythere viridis*, Müller, Entomostraca, p. 64, taf. vii. figs. 1, 2.

Hab.—Granton Harbour (D. Robertson); Largo Bay, rather rare.

83. *Loxoconcha multifora* (Norman).

1864. *Cythere multifora*, Norman, Nat. Hist. Trans. Northumb. and Durh., vol. i. p. 18, pl. vi. figs. 13-16.

Hab.—Granton Harbour (D. Robertson). This is the only record for the Forth known to me. The species is, however, widely distributed, and is likely to occur in other parts of the estuary.

84. *Loxoconcha pusilla*, Brady and Robertson.

1870. *Loxoconcha pusilla*, B. and R., Ann. and Mag. Nat. Hist. (4), vol. vi. p. 23, pl. viii. figs. 1-3.

Hab.—Taken in the vicinity of Cramond Island where the water is somewhat brackish; apparently rare. Firth of Forth (Brady and Norman).

85. *Loxoconcha tamarindus* (T. R. Jones).

1856. *Cytherideis tamarindus*, Jones, Tert. Entom., p. 49, pl. iii. figs. 4*a*, 4*b*.

Hab.—Near Inchkeith, South Bay, and off North Berwick; frequent.

86. *Loxoconcha fragilis*, G. O. Sars.

1865. *Loxoconcha fragilis*, G. O. Sars, Oversigt af Norges marine Ostracoder, p. 65.

Hab.—Firth of Forth (Brady and Norman). This appears to be a rare species in the estuary. I have not myself observed it.

Genus (28) **Xestoleberis**, G. O. Sars, 1865.

87. *Xestoleberis aurantia* (Baird).

1835. *Cythere aurantia*, Baird, Mag. Zool. and Bot., vol. ii. p. 143, pl. v. fig. 26.

Hab.—Off St Monans, Aberlady Bay, Largo Bay, etc., but not very plentiful.

88. *Xestoleberis depressa*, G. O. Sars.

1865. *Xestoleberis depressa*, G. O. Sars, Oversigt af Norges marine Ostracoder, p. 68.

Hab.—Off the west side of Inchkeith; rather rare.

Genus (29) **Cytherura**, G. O. Sars, 1865.

89. *Cytherura gibba* (O. F. Müller).

1785. *Cythere gibba*, Müller, Entomostraca, p. 66, pl. vii. figs. 7, 8.
1889. *Cytherura gibba*, B. and N., *l. c.*, Part I., p. 190, pl. xviii. figs. 13-16; pl. xxii. figs. 6-12; pl. xxiii. fig. 8.

Hab.—Granton Harbour (D. Robertson), Largo Bay, and off Aberlady.

90. *Cytherura cornuta*, G. S. Brady.

1838. *Cytherura cornuta*, Brady, Mon. rec. Brit. Ostrac., p. 445, pl. xxxii. figs. 12-15.

Hab.—Near Fidra Island; off Musselburgh, and Burntisland.

91. *Cytherura sella*, G. O. Sars.

1865. *Cytherura sella*, G. O. Sars, *l. c.*, p. 73.

Hab.—Largo Bay, South Bay, and other parts of the estuary; moderately frequent.

92. *Cytherura acuticostata*, G. O. Sars.

1865. *Cytherura acuticostata*, G. O. Sars, *l. c.*, p. 76.

Hab.—Dredged off the west side of Inchkeith. This is said to be one of the commonest species belonging to the *Cytheruræ*.

93. *Cytherura bodotria*, T. Scott.

1890. *Cytherura bodotria*, T. Scott, Eighth Rept. F. B. S., part iii. p. 232, pl. xii. figs. 6, 7.
1896. ,, ,, B. and N., *l. c.*, Part II. (Appendix) p. 736, pl. xiv. figs. 16, 17.

Hab.—Dredged off St Monans; rare. This species has also been obtained in the Firth of Clyde.

The authors of the Monograph referred to above are inclined to think that this form "must be regarded as the young of

Cytherura acuticostata," and in support of this view they state that though they do not have very young examples of *that* species to compare it with, a very fine series of the young of the *C. cornuta* shows that "the beak occupies a much larger proportion of shell, and is thus more prominently conspicuous" in the young of the *Cytheruræ*, and "that the lateral projections are also more acute than in the adult."[1] These remarks are supported by an indifferent outline side-view of young forms of *C. cornuta* and *C. nigrescens*, but I think for the purpose of comparison a dorsal view should also have been given. I am, however, not extremely anxious whether the "species" stands or not, and therefore will not discuss its merits here. There are one or two points, however, that may be referred to—(1st) If a careful comparison of the *original* figures of *C. bodotria* be made with those of *C. acuticostata* given on plate xxxii. (figs. 12-15) of Dr Brady's excellent "Monograph of recent British Ostracoda," published in the *Transactions of the Linnean Society*, 1868, it will be seen that *C. bodotria* is proportionally more elongated and more depressed, and that, when seen from above, the lateral angles are remarkably prominent and not like the species it is said to be the young of; but (2nd), and leaving *these* differences meanwhile out of account, and taking for granted that *Cytherura bodotria* is the young of *Cytherura acuticostata*, then from what happens with other species one might expect these young to be smaller than the adult, but they are not so. The length of the specimen of *C. bodotria* represented by our drawings in Part III. of the *Eighth Annual Report of the Fishery Board for Scotland* was ·5 mm., and the size of *C. acuticostata* as given in the Monograph already referred to at page 446, and which I suppose represents the adult size, is the $\frac{1}{50}$th of an inch, so that this supposed young form is as big as the one full grown.

But I had even a better and larger specimen of *C. bodotria* than the one figured, though it was similar in form and sculpture, and it would have been figured instead, but it was

[1] I have two smaller (younger) specimens of *C. bodotria*, and these have the lateral projections *less* developed than in the one figured, though otherwise similar to it.

unfortunately accidentally crushed by the object-glass of the microscope having been lowered down on it. I have examined a considerable number of *C. acuticostata* and allied forms, but have failed to observe any with which *C. bodotria* could be incorporated.

94. *Cytherura striata*, G. O. Sars.

1865. *Cytherura striata*, G. O. Sars, *l. c.*, p. 74.

Hab.—Off Musselburgh, Largo Bay, and other parts of the estuary; moderately frequent.

95. *Cytherura angulata*, G. S. Brady.

1868. *Cytherura angulata*, Brady, Monograph recent British Ostracoda, p. 440, pl. xxxii. figs. 22-25.

Hab.—Dredged off the west side of Inchkeith and other parts of the estuary, but not very plentiful.

96. *Cytherura undata*, G. O. Sars.

1865. *Cytherura undata*, G. O. Sars, *l. c.*, p. 75.

Hab.—Dredged off Musselburgh, and off the west side of Inchkeith and other places. It appears to be generally distributed, but being very small (about the $\frac{1}{65}$th of an inch in length) it is easily overlooked.

97. *Cytherura producta*, G. S. Brady.

1868. *Cytherura producta*, Brady, Mon. rec. Brit. Ostrac., p. 443, pl. xxxii. figs. 60, 61.
1890. ,, *mucronata*, T. Scott, Eighth Rept. F. B. S., pt. iii. p. 323, pl. xii. figs. 3-5 (? juv.).

Hab.—Dredged in Largo Bay and off St Monans, but not very common.

98. *Cytherura nigrescens* (Baird).

1850. *Cythere nigrescens*, Baird, Brit. Entom., p. 171, pl. xxi. figs. 4, 4*a*.

Hab.—South Bay, off Musselburgh, common. It has also been observed in other parts of the estuary.

99. *Cytherura simplex*, Brady and Norman.

1889. *Cytherura simplex*, B. and N., *l. c.*, Pt. I. p. 200, pl. xviii. figs. 1, 2.

Hab.—Off St Monans, frequent, in 12 to 15 fathoms, bottom partly clean sand and partly gravel.

100. *Cytherura similis*, G. O. Sars.

1865. *Cytherura similis*, G. O. Sars, Oversigt af Norges marine Ostracoder, p. 72.

Hab.—Dredged off Musselburgh and in Largo Bay; not very common.

101. *Cytherura clathrata*, G. O. Sars.

1865. *Cytherura clathrata*, G. O. Sars, *l. c.*, p. 77.

Hab.—Bo'ness, Firth of Forth (Brady and Robertson). Dredged off Bo'ness, off the west side of Inchkeith, and other parts of the Forth; not common.

102. *Cytherura cellulosa*, A. M. Norman.

1865. *Cytherura cellulosa*, Norman, Nat. Hist. Trans. Northumb. and Durh., vol. i. p. 22, pl. v. figs. 17-20; pl. vi. fig. 17.

Hab.—South Bay, and in other parts of the estuary, but apparently not common; but as it only measures $\frac{1}{70}$ of an inch (about ·36 mm.) it may have frequently been overlooked.

Genus (30) **Cytheropteron**, G. O. Sars, 1865.

103. *Cytheropteron latissimum* (Norman).

1865. *Cythere latissima*, Norman, *l. c.*, vol. i. p. 19, pl. vi. figs. 5-8.

Hab.—Dredged in South Bay, and in deep water west of May Island; frequent.

104. *Cytheropteron nodosum*, G. S. Brady.

1868. *Cytheropteron nodosum*, Brady, Mon. rec. Brit. Ostrac., p. 448, pl. xxxiv. figs. 31-34.

Hab.—Firth of Forth (Brady and Robertson). South Bay, off Musselburgh; not unfrequent.

105. *Cytheropteron punctatum*, G. S. Brady.

1868. *Cytheropteron punctatum*, Brady, *l. c.*, p. 449, pl. xxxiv. figs. 45-48.

Hab.—Dredged off St Monans; rather rare.

106. *Cytheropteron angulatum*, Brady and Robertson.

1872. *Cytheropteron angulatum*, B. and R., Ann. and Mag. Nat. Hist. (4), vol. ix. p. 62, pl. ii. figs. 7, 8.

Hab.—Largo Bay and off Aberlady; rare.

107. *Cytheropteron depressum*, Brady and Norman.

1889. *Cytheropteron depressum*, B. and N., *l. c.*, Pt. I. p. 218, pl. xx. figs. 22, 23.

Hab.—Largo Bay and off Aberlady; not common.

108. *Cytheropteron humile*, Brady and Norman.

1889. *Cytheropteron humile*, B. and N., *l. c.*, Pt. II. p. 220, pl. xx. figs. 4-7.

Hab.—Dredged off Limekilns and in Largo Bay. This small species, which measures only ·33 mm., has also been found fairly plentiful in the Clyde in the crevices of partly decayed pieces of wood brought up in the dredge, and usually associated with an interesting species of Copepoda, *Harrietella simulans*, T. Scott.

Genus (31) **Bythocythere**, G. O. Sars, 1865.

109. *Bythocythere turgida*, G. O. Sars.

1865. *Bythocythere turgida*, G. O. Sars, *l. c.*, p. 84.

Hab.—Dredged off Musselburgh and other places; not common. This moderately large species has sometimes been obtained in the stomachs of small fishes.

110. *Bythocythere constricta*, G. O. Sars.

1865. *Bythocythere constricta*, G. O. Sars, *l. c.* p. 85

Hab.—Largo Bay and off Aberlady; frequent. This is a moderately common species in the Forth.

111. *Bythocythere simplex* (Norman).

1865. *Cythere simplex,* Norman, Nat. Hist. Trans. Northumb. and Durh., vol. i. p. xvii, pl. v. figs. 1-4.

Hab.—South Bay, in deep water west of May Island, and other places, but not very common. This is a fine large species, conspicuous from its white colour; it forms part of the food of young Gadoids, Rocklings, *Lumpenus,* Long Rough Dabs, and other fishes.

112. *Bythocythere recta,* G. S. Brady.

1868. *Cytheropteron rectum,* Brady, Mon. rec. Brit. Ostrac., p. 476.

Hab.—Largo Bay; rare.

Genus (32) **Pseudocythere,** G. O. Sars, 1865.

113. *Pseudocythere caudata,* G. O. Sars.

1865. *Pseudocythere caudata,* G. O. Sars, Oversigt af Norges marine Ostracoder, p. 88.

Hab.—Firth of Forth (Brady and Robertson). Off St Monans; frequent.

Genus (33) **Sclerochilus,** G. O. Sars, 1865.

114. *Sclerochilus contortus* (Norman).

1862. *Cythere contorta,* Norman, Ann. and Mag. Nat. Hist. (3), vol. ix. p. 48, pl. ii. fig. 15.

Hab.—South Bay, and in deep water west of May Island; frequent.

Genus (34) **Cytherideis,** T. R. Jones, 1856.

115. *Cytherideis subulata,* G. S. Brady.

1868. *Cytherideis subulata,* Brady, Mon. rec. Brit. Ostrac., p. 454, pl. xxxv. figs. 43-46.

Hab.—Dredged off the west side of Inchkeith and other parts in the estuary; not very common.

Genus (35) **Cytherois,** W. Müller, 1884.

116. *Cytherois Fischeri* (G. O. Sars).

1865. *Paradoxostoma Fischeri,* G. O. Sars, *l. c.*, p. 96.

Hab.—Off Aberlady and St Monans; frequent.

Genus (36) **Paradoxostoma**, Fischer, 1851.

117. *Paradoxostoma variabile* (Baird).

1835. *Cythere variabilis*, Baird, Trans. Berw. Nat. Club, vol. i. p. 98, pl. iii. fig. 7 *a*, *b*.

Hab.—Largo Bay, and generally throughout the estuary, especially in the littoral and laminarian zones.

118. *Paradoxostoma ensiforme*, G. S. Brady.

1868. *Paradoxostoma ensiforme*, Brady, Mon. rec. Brit. Ostrac., p. 460, pl. xxxv. figs. 8-11.

Hab.—Dredged off the west side of Inchkeith; off Musselburgh and elsewhere.

119. *Paradoxostoma abbreviatum*, G. O. Sars.

1865. *Paradoxostoma abbreviatum*, G. O. Sars, Oversigt af Norges marine Ostracoder, p. 94.

Hab.—Off Musselburgh; not very common. Easily distinguished from its being remarkably short in comparison to the height; there is also a perceptible difference in the contour of the shell when seen from the side.

120. *Paradoxostoma obliquum*, G. O. Sars.

1865. *Paradoxostoma obliquum*, G. O. Sars, *l. c.*, p. 97.

Hab.—Off Fidra, Musselburgh, and Burntisland; moderately rare. This species is more tumid as viewed from above when compared with most of the other British species.

121. *Paradoxostoma pulchellum*, G. O. Sars.

1865. *Paradoxostoma pulchellum*, G. O. Sars, *l. c.*, p. 95.

Hab.—Dredged off Musselburgh; moderately rare.

122. *Paradoxostoma hibernicum*, G. S. Brady.

1868. *Paradoxostoma hibernicum*, Brady, *l. c.*, p. 460, pl. xxxv. figs. 35, 36; pl. xl. fig. 7.

Hab.—Largo Bay; rather rare.

123. *Paradoxostoma arcuatum*, G. S. Brady.

1868. *Paradoxostoma arcuatum*, Brady, *l. c.*, p. 461, pl. xxxv. fig. 37.

Hab.—Granton (Brady and Robertson). Off St Monans, Largo Bay, and vicinity of Inchkeith; rare.

124. *Paradoxostoma orcadense*, G. S. Brady and D. Robertson.

1872. *Paradoxostoma orcadense*, B. and R., Ann. and Mag. Nat. Hist. (4), vol. ix. p. 53, pl. i. figs. 5-7.

Hab.—Off St Monans; rare.

125. *Paradoxostoma Hodgei*, G. S. Brady.

1870. *Paradoxostoma Hodgei*, Brady, Nat. Hist. Trans. Northumb. and Durh., vol. iii. p. 371, pl. xii. figs. 12, 13.

Hab.—Off St Monans, frequent; also near Fidra.

126. *Paradoxostoma flexuosum*, G. S. Brady.

1868. *Bythocythere* (?) *flexuosa*, Brady, Brit. Assoc. Report (1866), p. 211.

1889. *Paradoxostoma flexuosum*, B. and N., *l. c.*, Part I. p. 236, pl. xxi. figs. 11, 12.

Hab.—Firth of Forth (Brady and Robertson). Off Bo'ness, South Bay, and other parts of the estuary; frequent.

127. *Paradoxostoma affine*, T. Scott.

1890. *Paradoxstoma affine*, T. Scott, Eighth Rept. F. B. S., pt. iii. p. 325, pl. xii. figs. 8, 9.

1896. ,, ,, B. and N., *l. c.*, Part II. (Appendix) p. 739, pl. lxiii. figs. 10, 11.

Hab.—Off St Monans; not common. The species which this form most closely resembles is the *Paradoxostoma arcuatum* of G. S. Brady, but it is not so narrow posteriorly, and its greatest breadth is nearer the posterior extremity. It has also been taken by Canon Norman near Inveraray, Loch Fyne.

Genus (37) **Machærina**, Brady and Norman, 1889.

128. *Machærina tenuissima* (Norman).

1869. *Bythocythere tenuissima*, Norman, Brit. Assoc. Rept. for 1868, p. 294.

Hab.—Dredged in deep water west of May Island; not common. Also observed in the stomach of a Five-bearded Rockling captured in the Forth on 13th May 1901. This species is remarkably compressed, and though moderately high in the middle, both ends taper gradually to a narrow point, imparting to the shell a very slender appearance.

Section II. Myodocopa.

Family Asteropidæ, Brady and Norman.

Genus (38) **Asterope,** Philippi, 1840.

129. *Asterope mariæ* (Baird).

1850. *Cypridina mariæ*, Baird, Proc. Zool. Soc. Lond., pt. xviii. p. 257, pl. xvii. figs. 5-7.

1896. *Asterope mariæ*, B. and N., *l. c.*, Part II. p. 630, pl. l. figs. 1-6 *et seq.*

Hab.—Dredged near the Bass Rock; not common.

Family Cyprinidæ, Baird, 1850.

Genus (39) **Philomedes,** Lilljeborg, 1853.

130. *Philomedes interpuncta* (Baird).

1850. *Cypridina interpuncta*, Baird, *l. c.*, p. 257, pl. xvii. figs. 8-10.

Hab.—South Bay, off west side of Inchkeith, and other parts of the estuary; sometimes taken with the tow-net, and often with the dredge.

Section III. Cladocopa, G. O. Sars, 1865.

Family Polycopidæ.

Genus (40) **Polycope,** G. O. Sars, 1868.

131. *Polycope orbicularis*, G. O. Sars.

1865. *Polycope orbicularis*, G. O. Sars, Oversigt af Norges marine Ostracoder, p. 122.

Hab.—Dredged near Fidra, Firth of Forth; rare.

Genus (41) **Polycopsis,** G. W. Müller, 1894.

132. *Polycopsis compressa* (Brady and Robertson).

1869. *Polycope compressa*, B. and R., Ann. and Mag. Nat. Hist. (4), vol. iii. p. 20, pl. xxi. figs. 5-11.

Hab.—Off St Monans; frequent.

It will be observed that the Ostracoda enumerated here amount to 132 species, and belong to 41 genera. There are some others which, judging from their distribution, may also occur within the Forth area, though hitherto they have escaped notice. I have already mentioned that *Scottia Browniana* has been observed in a lacustrine deposit at Elie, Fifeshire, and as it appears to be very local in its distribution, it may yet be found living somewhere within the district. *Cypridopsis Newtoni* is another that may be expected to occur in some of the inland waters, and there are also a few marine forms that are likely to be met with.

About 170 species have, I think, been recorded from Scotland (including the Orkney and Shetland Islands), and if those which have hitherto been only observed in the neighbourhood of Shetland be excepted, it will be found that fully 84 per cent. of the Scottish species are represented within the Forth area.

Order COPEPODA.

The Copepoda comprise a much larger number of species than any of the other Crustacean orders. The species enumerated here amount to 306, and include both free-swimming and parasitic forms.

Various methods have been adopted for the scientific arrangement of these organisms. In that used by Professor G. O. Sars in his great work on the *Crustacea of Norway*, now in course of publication, and which for the sake of uniformity I propose to follow generally, the Copepoda are separated into seven divisions, viz.:—1st, the Calanoida, most of which are free-living and pelagic; 2nd, the Harpacticoida, which for the most part are free-living but demersal; 3rd, the Cyclopoida, some of which are free-living fresh-water species, while others are "semi-parasites," and live as commensals or messmates with various other organisms; 4th, the Notodelphyoida, which, for the most part, are "semi-parasites," associated with various Ascidians; 5th, the Monstrilloida, a small but curious group, which appear to live a partly parasitic and partly free life; 6th, the Caligoida, chiefly parasitic on fishes, but some of which possess a certain freedom of movement; and 7th, the Lernæoida, fish parasites, which, in the adult stage, are more or less permanently fixed on some part of the fish.

This arrangement does not differ greatly from that of Professor G. S. Brady's excellent *Monograph of the Free and Semi-Parasitic Copepoda of the British Islands*, except that the Cyclopidæ and Notodelphydæ are in that work placed between the Calanoids and Harpacticoids.

The species recorded in the sequel are distributed among the seven divisions as follows:—

1st.	The Calanoida,	represented by	30	species.
2nd.	The Harpacticoida,	„ „	170	„
3rd.	The Cyclopoida,	„ „	59	„
4th.	The Notodelphyoida,	„ „	9	„
5th.	The Monstrilloida,	„ „	5	„
6th.	The Caligoida,	„ „	12	„
7th.	The Lernæoida,	„ „	21	„
		Total number,	306	„

Division Calanoida.

In the arrangement and nomenclature of the species under this division, Professor G. O. Sars' work—*An Account of the Crustacea of Norway*, vol. iv., Copepoda Calanoida—is generally followed. See also Professor G. S. Brady's *Monograph of the Free and Semi-Parasitic Copepoda of the British Islands*, vol. i.

Family Calanidæ.

Genus (1) **Calanus**, Leach, 1816.

1. *Calanus septentrionalis* (Goodsir).

1843. *Cetochilus septentrionalis*, Goodsir, Edin. New Phil. Jour., vol. xxxv. p. 339, pl. vi. figs. 1-11.

1863. *Calanus helgolandicus*, Claus, Die frei-lebenden Copepoden, p. 171, pl. xxvi. figs. 2-9.

Hab.—Common in the Firth. Previously recorded as *C. finmarchicus* (Gunn.), but, as indicated by G. O. Sars, that species is slightly larger, and differs in some structural details, and its distribution appears for the most part to be confined to the arctic or subarctic seas. There seems to be little doubt that *Cetochilus septentrionalis* is identical with *Calanus helgolandicus,* Claus, and having priority in publication, it should have preference over *C. helgolandicus.*

Family Paracalanidæ, G. O. Sars, 1902.

Genus (2) **Paracalanus,** Boeck, 1864.

2. *Paracalanus parvus* (Claus).

1863. *Calanus parvus,* Claus, Die frei-lebenden Copepoden, p. 173, pl. xxvi. figs. 10-14; pl. xxvii. figs. 1-4.

Hab.—Occasionally taken with the tow-net near the seaward limits of the Forth estuary, sometimes in moderate abundance, but usually it is a rather scarce species.

Family Pseudocalanidæ.

Genus (3) **Pseudocalanus,** Boeck, 1872.

3. *Pseudocalanus elongatus,* Boeck.

1864. *Clausia elongata,* Boeck, Forhandl. Videnskabs-Selskabet, Christiania (1864), p. 9.

Hab.—Common throughout the estuary. Boeck described this species as *Clausia elongata,* but as that generic name had been previously used by Claparède for a genus of parasitic Copepods, he withdrew it and substituted the name *Pseudocalanus.*

Family Ætideidæ.

Genus (4) **Bradyidius,** Giesbrecht, 1897.

4. *Bradyidius armatus* (G. S. Brady).

1878. *Pseudocalanus armatus,* G. S. Brady, Monogr. Brit. Copep., vol. i. p. 46, pl. iv. figs. 1-11.
1897. *Bradyidius armatus,* Giesbrecht, Zool. Anzeiger, No. 536.
1898. ,, ,, T. Scott, Sixteenth F. B. Rept., pt. iii. p. 264, pl. xii. figs. 1-19.
1902. *Undinopsis Bradyi,* G. O. Sars, Crustacea of Norway, vol. iv. p. 32, pls. xix., xx.

Hab.—Off St Monans and a few other places near the seaward limits of the estuary. I have given several synonyms for this species, as there appears to be some doubt about the name that should be used for it.

Family Stephidæ.

Genus (5) **Stephos**, T. Scott, 1892.

5. *Stephos minor*, T. Scott.

1892. *Stephos minor*, T. Scott, Tenth F. B. Rept., pt. iii. p. 245, pl. vii. figs. 1-13.

Hab.—Off St Monans and other parts of the estuary; not common. Dredged in 7 fathoms off the east side of Inchkeith, 23rd May 1901.

6. *Stephos Scotti*, G. O. Sars.

1897. *Stephos gyrans*, T. Scott (not *S. gyrans*, Giesb.), Fifteenth F. B. Rept., pt. iii. p. 146; pl. ii. figs. 2-9; pl. iii. figs. 17, 18.
1902. ,, *Scotti*, G. O. Sars, Crustacea of Norway, vol. iv. p. 63, pl. xliii.
1903. ,, ,, T. Scott, Twenty-first F. B. Rept., pt. iii. p. 110, pl. ii. figs. 1-4.

Hab.—Obtained in a gathering collected in 1892, but not examined till 1902; also in a gathering from an old quarry near Granton to which the sea has access, collected in 1894; rather rare.

Family Pseudocyclopiidæ.

Genus (6) **Pseudocyclopia**, T. Scott, 1892.

7. *Pseudocyclopia crassicornis*, T. Scott.

1892. *Pseudocyclopia crassicornis*, T. Scott, Tenth F. B. Rept., pt. iii. p. 246, pl. vii. figs. 15-29.

Hab.—Off St Monans, 1891; off the east side of Inchkeith in May 1901, and at a few other places; not common.

8. *Pseudocyclopia minor*, T. Scott.

1892. *Pseudocyclopia minor*, T. Scott, Tenth F. B. Rept., pt. iii. p. 247, pl. viii. figs. 1-10.

Hab.—Off St Monans, 1891; not common. This is a smaller, and apparently a rarer species than the last.

9. *Pseudocyclopia caudata*, T. Scott.

1894. *Pseudocyclopia caudata*, T. Scott, Twelfth F. B. Rept., pt. iii. p. 236, pl. v. figs. 1-8.

Hab.—Off St Monans in 1893; off the east side of Inchkeith, in about 5 fathoms, in May 1901.

10. *Pseudocyclopia Giesbrechti*, Wolfenden.

1902. *Pseudocyclopia Giesbrechti*, Wolfenden, Jour. M. B. A. Plymouth, January 1902, p. 370, pl. iv.

Hab.—West of Queensferry; rare. A single male was dredged to the west of Queensferry, 17th November 1893, but was only recently identified. A female (the one he describes and figures) was taken by Dr Wolfenden with a surface tow-net off the island of Bressay, Shetland, in March 1900.

Family Centropagidæ.

Genus (7) **Centropages**, Kröyer, 1848.

11. *Centropages typicus*, Kröyer.

1848. *Centropages typicus*, Kröyer, Naturh. Tidsskr. (N.S.), vol. ii. p. 588, pl. vi. figs. 22-26.

Hab.—Not uncommon in the seaward portion of the estuary, especially during summer; but it appears to become rarer in the winter months.

12. *Centropages hamatus* (Lilljeborg).

1853. *Ichtyophorba hamata*, Lillj., De Crust. ex ord. tribus in Scania occurrentibus, p. 185, pl. xxi.; pl. xxvi. figs. 9-12.

Hab.—This species, which is rather more common than the last, has a seasonal distribution somewhat similar to it.

Family Diaptomidæ.

Genus (8) **Diaptomus**, Westwood, 1836.

13. *Diaptomus castor* (Jurine).

1820. *Monoculus castor*, Jurine, Hist. des Monocles, p. 50, pl. iv. figs. 1-6 *et seq.*

Hab.—In an old quarry on the Braid Hills, Edinburgh, in April 1888: this quarry is now included within the public park. Roslin Curling Pond (♂ and ♀), 3rd March 1906 (Evans).

14. *Diaptomus gracilis*, G. O. Sars.

1862. *Diaptomus gracilis*, G. O. Sars, Oversigt af de indenlandske Ferskvandscopepoder, Chr. Vid.-Selsk. Forh., 1862, p. 9.

Hab.—Duddingston Loch, Loch Leven, and in most of the fresh-water lochs within the area; common. Loch a Chroin, 2500 feet, September 1906 (W. Evans).

15. *Diaptomus hircus*, G. S. Brady.

1891. *Diaptomus hircus*, Brady, Nat. Hist. Trans. Northumb. and Durham, vol. ii. p. 35, pl. x. figs. 2-4.

Hab.—Loch Katrine, Trossachs, 16th March 1898; rather rare.

16. *Diaptomus Wierzejskii*, J. Richard.

1888. *Diaptomus Wierzejskii*, Richard, Bull. Soc. Zool. de France, vol. xiii. p. 53.
1891. ,, *serricornis*, Lillj., Brady, *l. c.*, p. 36, pl. ix. figs. 3-10.

Hab.—Loch Achray, Trossachs, 27th November 1897. Though this is the only loch within the area of the Forth basin in which I have obtained *Diaptomus Wierzejskii*, it is a widely distributed species in the north of Scotland, Shetland, and the Outer Hebrides.

Family Temoridæ.

Genus (9) **Temora**, Baird, 1830.

17. *Temora longicornis* (O. F. Müller).

1792. *Cyclops longicornis*, Müller, Entomostraca Daniæ et Norvigiæ, p. 115.

Hab.—Common, and generally distributed throughout the estuary.

Genus (10) **Eurytemora**, Giesbrecht, 1881.

18. *Eurytemora velox* (Lilljeborg).

1853. *Temora velox*, Lillj., De Crust. ord. tribus in Scania occurrentibus, p. 177, pl. xx. figs. 2-9 (♀).

Hab.—In the estuary near South Queensferry.

19. *Eurytemora affinis* (Poppe).

1881. *Temora affinis*, Poppe, Abhandl. d. Naturh. ver. Bremen, vol. vii. p. 55, pl. iii.
1891. *Eurytemora affinis*, G. S. Brady, Nat. Hist. Trans. Northumb., Durh., and Newcastle-upon-Tyne, vol. ix. p. 42, pl. xiii. figs. 6-9.

Hab.—Taken in the vicinity of Culross, and between Kincardine-on-Forth and Alloa, in July 1891 and February 1892; moderately common.

Family METRIDIIDÆ.

Genus (11) **Metridia**, Boeck, 1864.

20. *Metridia lucens*, Boeck.

1864. *Metridia lucens*, Boeck, Chr. Vid.-Selsk. Forh., p. 238.
1878. ,, *armata*, G. S. Brady, Monograph, vol. i. p. 42, pl. ii. figs. 1-12.

Hab.—Obtained sparingly near the mouth of the estuary, and from there west to near Inchkeith.

Family PSEUDOCYCLOPIDÆ.

Genus (12) **Pseudocyclops**, Brady, 1872.

21. *Pseudocyclops crassiremis*, G. S. Brady.

1872. *Pseudocyclops crassiremis*, Brady, Nat. Hist. Trans. Northumb. and Durham, vol. iv. p. 431, pl. xvii. figs. 1-8.

Hab.—Off St Monans, 1893; rare.

22. *Pseudocyclops obtusatus*, G. S. Brady and D. Robertson.

1873. *Pseudocyclops obtusatus*, B. and R., Ann. and Mag. Nat. Hist. (4), vol. xii. p. 128, pl. viii. figs. 4-7.

Hab.—Taken sparingly with the dredge off St Monans. Also off the north-west end of Inchkeith, in about 5 fathoms, on 23rd May 1901.

Family CANDACIIDÆ.

Genus (13) **Candacia**, Dana, 1846.

23. *Candacia armata*, Boeck.

1872. *Candace armata*, Boeck, Nye Slægter og Arter Saltvands-Copepoder, Chr. Vid.-Selsk. Forh., p. 39.
1878. ,, *pectinata*, Brady, Monograph, vol. i. p. 49, pl. viii. figs. 14, 15; pl. x. figs. 1-12.
1902. *Candacia armata*, G. O. Sars, *l. c.*, vol. iv. p 135, pl. xci.

Hab.—Occasionally captured with the tow-net between Inchkeith and May Island. This species appears to be more frequent in winter and spring than during the summer months.

Family PONTELLIDÆ.

Genus (14) **Anomalocera**, Templeton, 1837.

24. *Anomalocera Patersoni*, Templeton.

1837. *Anomalocera Patersoni*, Templ., Trans. Ent. Soc. Lond., vol. ii. p. 35, pl. v. figs. 1-3.

Hab.—This species is, at times, moderately frequent in the Forth estuary, especially during summer and autumn.

Genus (15) **Labidocera**, Lubbock, 1853.

25. *Labidocera Wollastoni*, Lubbock.

1857. *Pontella Wollastoni*, Lubbock, Ann. and Mag. Nat. Hist. (2), vol. xx. p. 406, pls. x., xi.

Hab.—Off the east side of Inchkeith; collected 8th June 1891, but not examined till 1899.

Family PARAPONTELLIDÆ.

Genus (16) **Parapontella**, G. S. Brady, 1878.

26. *Parapontella brevicornis* (Lubbock).

1857. *Pontellina brevicornis*, Lubbock, Ann. and Mag. Nat. Hist. (2), vol. xx. p. 407, pl. xi. figs. 4-8.

Hab.—This species has been observed above Queensferry, off Musselburgh, in the neighbourhood of Inchkeith, off the Wemyss, and in the neighbourhood of Dunbar.

Family Acartiidæ.

Genus (17) **Acartia**, Dana, 1846.

27. *Acartia longiremis* (Lilljeborg).

1853. *Dias longiremis*, Lillj., De Crust. ex ord. tribus in Scania occurrentibus, p. 181, pl. xxiv.

Hab.—Generally distributed throughout the estuary; not usually uncommon, but at some seasons it appears to be more numerous than at others.

28. *Acartia Clausi*, Giesbrecht.

1889. *Acartia Clausi*, Giesb., Atti Accad. Lincei Rend. Roma (4), vol. v. sem. 2, p. 25.

Hab.—The distribution and frequency of this species is somewhat similar to the last.

29. *Acartia bifilosa*, Giesbrecht.

1881. *Dias bifilosus*, Giesb., Zool. Anzeiger, vol. iv. p. 257.
1882. ,, ,, Giesb., Die frei-leb. Copep. der Kieler Föhrde, p. 147, pl. iii. figs. 4, 22, 23 *et seq.*

Hab.—Taken in the vicinity of Culross, near the head of the estuary, in 1891.

30. *Acartia discaudata*, Giesbrecht.

1882. *Dias discaudatus*, Giesb., Die frei-leb. Copep. der Kieler Föhrde, p. 148, pl. iii. figs. 4, 22, 23 *et seq.*

Hab.—Collected with a tow-net between Portobello and Cockenzie in 1890, and on several subsequent occasions, chiefly in the same part of the estuary. The female of this species is readily distinguished by the character of the furcal joints, which are of the form of broad flattened plates fringed with stout and not very long setæ.

Division HARPACTICOIDA.

I have decided to omit the separating of the Harpacticoida into families, because Professor G. O. Sars, in his work now in course of publication, is creating an entirely new arrangement of these Copepoda. The reader is therefore referred to vol. v. of *The Crustacea of Norway*, part of which is already published, for the systematic distribution of this group.

Genus (18) **Misophria**, Boeck, 1864.

31. *Misophria pallida*, Boeck.

1864. *Misophria pallida*, Boeck, Chr. Vidensk.-Selskab. Forhandl., p. 248.
1904. ,, ,, Sars, Crustacea of Norway, vol. v. p. 6, pls. i., ii.

Hab.—Dredged off St Monans, west of Queensferry, and other parts of the estuary, but not very common.

Genus (19) **Longipedia**, Claus, 1863.

32. *Longipedia Scotti*, G. O. Sars.

1893. *Longipedia coronata*, T. and A. Scott (not *L. coronata*, Claus), Ann. Scot. Nat. Hist., vol. ii. pt. ii. p. 91, pl. ii. figs. 4-6.
1904. ,, *Scotti*, G. O. Sars, *l. c.*, vol. v. p. 11, pl. v. fig. 1.

Hab.—Moderately common throughout the estuary.

33. *Longipedia minor*, T. and A. Scott.

1893. *Longipedia coronata*, var. *minor*, T. and A. Scott, Ann. Scot. Nat. Hist., vol. ii. p. 93.
1893. ,, ,, ,, ,, T. Scott, Eleventh F. B. Rept., pt. iii. p. 200, pl. ii. figs. 14-20.
1904. ,, *minor*, G. O. Sars, *l. c.*, vol. v. p. 12, pl. v. fig. 2.

Hab.—Not uncommon in various parts of the estuary, as off Musselburgh, Largo Bay, etc.

Genus (20) **Canuella**, T. and A. Scott, 1893.

34. *Canuella perplexa*, T. and A. Scott.

1893. *Canuella perplexa*, T. and A. Scott, *l. c.*, p. 92, pl. ii. figs. 1-3.
1893. ,, ,, T. Scott, Eleventh F. B. Rept., pt. iii. p. 201, pl. ii. figs. 21-35.
1904. ,, ,, G. O. Sars, *l. c.*, vol. v. p. 17, pls. viii., ix.

Hab.—Frequent in material dredged off Musselburgh, Largo Bay, Aberdour Bay, and other places.

Genus (21) **Neobradya**, T. Scott, 1892.

35. *Neobradya pectinifer*, T. Scott.

1892. *Neobradya pectinifer*, T. Scott, Tenth F. B. Rept., pt. iii. p. 249, pl. xiii. figs. 19-32.

Hab.—Dredged off the north end of Inchkeith in November 1889, and also off St Monans in 1891. This species appears to have a fairly wide distribution, as it has been found in the Clyde by myself, and off the Isle of Man by the late I. C. Thompson of Liverpool.

Genus (22) **Zosime**, Boeck, 1872.

36. *Zosime typica*, Boeck.

1872. *Zosime typica*, Boeck, Chr. Vid.-Selsk. Forhandl. (1872 , p. 46.
1880. ,, ,, G. S. Brady, Monogr. Brit. Copep., vol. ii. p. 15, pl. xxxix. figs. 1-12.

Hab.—Taken off Musselburgh; frequent.

Genus (23) **Ectinosoma**, Boeck, 1864.

37. *Ectinosoma Sarsi*, Boeck.

1872. *Ectinosoma Sarsi*, Boeck, Chr. Vid.-Selsk. Forhandl. (1872), p. 45.
1880. ,, *spinipes*, G. S. Brady, *l. c.*, vol. ii. p. 9, pl. xxxvi. figs. 1-10.
1904. ,, *Sarsi*, G. O. Sars, Crust. of Norway, vol. v. p. 30, pl. xvi.

Hab.—Moderately common throughout the estuary.

38. *Ectinosoma melaniceps*, Boeck.

1864. *Ectinosoma melaniceps*, Boeck, Chr. Vid.-Selsk. Forhandl. (1864), p. 30.
1880. ,, ,, G. S. Brady, *l. c.*, vol. ii. p. 11, pl. xl. figs. 17-20.

Hab.—Moderately common, especially among weeds in shallow inshore water.

39. *Ectinosoma propinquum*, T. and A. Scott.

1896. *Ectinosoma propinquum*, T. and A. Scott, Trans. Linn. Soc. Zool. (S. 2), vol. vi. p. 428, pl. xxxvi. figs. 19, 27, 46 *et seq.*

Hab.—Taken off Musselburgh, not very common; but as it is somewhat similar to *E. Sarsi* in size and general appearance, it is easily overlooked.

40. *Ectinosoma Herdmani*, T. and A. Scott.

1896. *Ectinosoma Herdmani*, T. and A. Scott, *op. cit.*, p. 432, pl. xxxvi. figs. 16, 44 *et seq.*

Hab.—Moderately common in material dredged in Aberdour Bay and off Musselburgh; taken also sparingly off St Monans.

41. *Ectinosoma Normani*, T. and A. Scott.

1896. *Ectinosoma Normani*, T. and A. Scott, *op. cit.*, p. 435, pl. xxxvi. figs. 21, 29, 39 *et seq.*
1904. ,, ,, G. O. Sars, *op. cit.*, p. 35, pl. xix. fig. 2.

Hab.—Dredged sparingly off Burntisland.

42. *Ectinosoma curticorne*, Boeck.

1872. *Ectinosoma curticorne*, Boeck, Chr. Vid.-Selsk. Forhandl. (1872), p. 45.
1896. ,, ,, T. and A. Scott, *op. cit.*, p. 430, pl. xxxvi. figs. 22, 30, 34 *et seq.*

Hab.—Taken off Burntisland and Musselburgh, and a few other inland parts of the estuary.

43. *Ectinosoma erythrops*, G. S. Brady.

1880. *Ectinosoma erythrops*, Brady, Monogr. Brit. Copep., vol. ii. p. 12, pl. xxxvi. figs. 11-17.
1896. ,, ,, T. and A. Scott, *op. cit.*, p. 431, pl. xxxvi. figs. 24, 31, 36 *et seq.*

Hab.—Off St Monans; moderately rare.

44. *Ectinosoma gothiceps*, Giesbrecht.

1882. *Ectinosoma gothiceps*, Giesb., Die frei-leb. Copep. d. Kieler Föhrde, p. 106, pl. i. figs. 3, 12 *et seq.*
1896. ,, *pygmæum*, T. and A. Scott, *op. cit.*, p. 433, pl. xxxvi. figs. 15, 41 *et seq.*

Hab.—Off St Monans; not common.

45. *Ectinosoma armiferum*, T. and A. Scott.

1896. *Ectinosoma armiferum*, T. and A. Scott, *op. cit.*, p. 434, pl. xxxvi. figs. 20, 43 *et seq.*

Hab.—Obtained off the west side of May Island in moderately deep water; rare.

46. *Ectinosoma tenuipes*, T. and A. Scott.

1896. *Ectinosoma tenuipes*, T. and A. Scott, *op. cit.*, p. 436, pl. xxxvi. figs. 25, 32, 35 *et seq.*

Hab.—Dredged off St Monans; rare.

47. *Ectinosoma longicorne*, T. and A. Scott.

1896. *Ectinosoma longicorne*, T. Scott, *op. cit.*, p. 439, pl. xxxvi. figs. 23, 38 *et seq.*

Hab.—Dredged off St Monans; rare.

48. *Ectinosoma tenuireme*, T. and A. Scott.

1896. *Ectinosoma tenuireme*, T. and A. Scott, *op. cit.*, p. 439, pl. xxxvi. fig. 33 *et seq.*

Hab.—Dredged off St Monans; rare.

49. *Ectinosoma gracile*, T. and A. Scott.

1896. *Ectinosoma gracile*, T. and A. Scott, *op. cit.*, p. 429, pl. xxxvi. figs. 18, 37 *et seq.*
1904. ,, ,, G. O. Sars, Crust. of Norway, vol. v. p. 39, pl. xxii. fig. 1.

Hab.—Dredged off St Monans; not very common.

Genus (24) **Microsetella**, Brady and Robertson, 1873.

50. *Microsetella norvegica* (Boeck).

1864. *Setella norvegica*, Boeck, Chr. Vid.-Selsk. Forhandl. (1864), p. 281.
1873. *Microsetella atlantica*, Brady and Robertson, Ann. and Mag. Nat. Hist. (4), vol. xii. p. 130, pl. ix. figs. 11-16.
1904. *Microsetella norvegica*, G. O. Sars, *l. c.*, vol. v. p. 44, pl. xxiv.

Hab.—Taken near Inchkeith, with the surface tow-net, in November 1890, and subsequently in various parts of the estuary, sometimes in considerable numbers.

Genus (25) **Pseudobradya**, G. O. Sars, 1904.

51. *Pseudobradya minor* (T. and A. Scott).

1896. *Bradya minor*, T. and A. Scott, Trans. Linn. Soc. Zool. (S. 2), vol. vi. p. 425, pl. xxxv. figs. 5, 9, 13, 21 *et seq.*
1904. *Pseudobradya minor*, G. O. Sars, *l. c.*, vol. v. p. 41, pl. xxii. fig. 2.

Hab.—Taken off St Monans and near Musselburgh, but apparently not very common.

52. *Pseudobradya elegans* (T. and A. Scott).

1896. *Bradya elegans*, T. and A. Scott, *op. cit.*, vol. v. p. 422, pl. xxxv. figs. 4, 10, 15 *et seq.*

Hab.—Taken sparingly in Largo Bay and off Musselburgh.

53. *Pseudobradya hirsuta* (T. and A. Scott).

1896. *Bradya hirsuta*, T. and A. Scott, *op. cit.*, p. 423, pl. xxxv. figs. 2, 8, 17 *et seq.*

Hab.—Taken in Largo Bay in 1891, and afterwards in other parts of the estuary, but always very sparingly.

54. *Pseudobradya similis* (T. and A. Scott).

1896. *Bradya similis*, T. and A. Scott, *op. cit.*, p. 424, pl. xxxv. figs. 3, 7, 16, 27 *et seq.*
1904. *Pseudobradya similis*, G. O. Sars, Crustacea of Norway, vol. v. p. 42, pl. xxiii. fig. 2.

Hab.—The distribution of this species is similar to the last, but it is a smaller species, being little more than half the size. It resembles that species in having the furcal joints comparatively long and spreading.

55. *Pseudobradya fusca* (T. and A. Scott).

1896. *Bradya fusca*, T. and A. Scott, *op. cit.*, p. 424, pl. xxxv. figs. 6, 12, 18, 20 *et seq.*

Hab.—Taken very sparingly in Largo Bay. This is a moderately stout species, but the abdominal part of the body tapers more gradually towards the furcal joints than does some of the others.

Genus (26) **Bradya**, Boeck, 1872.

56. *Bradya typica*, Boeck.

1872. *Bradya typica*, Boeck, Chr. Vid.-Selsk. Forhandl. (1872), p. 47.
1904. ,, ,, G. O. Sars, *l. c.*, vol. v. p. 46, pl. xxv.

Hab.—Obtained off the west side of May Island, and in some other parts of the estuary; not very rare.

Genus (27) **Harpacticus**, M.-Edwards, 1838.

57. *Harpacticus chelifer* (O. F. Müller).

1785. *Cyclops chelifer*, O. F. Müller, Entomostraca. p. 114, pl. xix. figs. 1-3.
1904. *Harpacticus chelifer*, G. O. Sars, *l. c.*, p. 49, pls. xxvii., xxviii.

Hab.—This species appears to be moderately common throughout the estuary, especially in the littoral and laminarian zones.

58. *Harpacticus uniremis*, Kröyer.

1838-40. *Harpacticus uniremis*, Kröyer, in Gaimard's Voy. en Scand., pl. xliii. fig. 1 *a-p*.
1904. ,, ,, G. O. Sars, *l. c.*, vol. v. p. 51, pl. xxix.

Hab.—Taken in the vicinity of Dunbar on 26th April 1894, but not previously recorded.

59. *Harpacticus flexus*, Brady and Robertson.

1873. *Harpacticus flexus*, B. and R., Ann. and Mag. Nat. Hist. (4), vol. xii. p. 134, pl. ix. figs. 17-21.
1904. ,, ,, G. O. Sars, *l. c.*, vol. v. p. 53. pl. xxx. fig. 2.

Hab.—Obtained off St Monans, in Largo Bay, and off Musselburgh, but not very common.

60. *Harpacticus obscurus*, T. Scott.

1895. *Harpacticus obscurus*, T. Scott, Thirteenth F. B. Rept , pt. iii. p. 170, pl. iv. figs. 4-12.

Hab.—Taken sparingly in an old quarry at Granton, open to the sea. This species has a superficial resemblance to the last, but is smaller, and the posterior foot-jaws (second maxillipedes) are different.

Genus (28) **Tigriopus**, Norman, 1868.

61. *Tigriopus fulvus* (Fischer).

1860. *Harpacticus fulvus*, Fischer, Abhandl. d. König. Bayer. Akad., vol. viii. p. 656, pl. i. figs. 30-33; pl. ii. figs. 34-39.
1904. *Tigriopus fulvus*, G. O. Sars, *l. c.*, vol. v. p. 54, pls. xxxi., xxxii.

Hab.—Moderately common in pools about high-water mark on Cramond Island.

Genus (29) **Zaus**, Goodsir, 1845.

62. *Zaus spinatus*, Goodsir.

1845. *Zaus spinatus*, Goodsir, Ann. and Mag. Nat. Hist., vol. xvi. p. 326, pl. xi. figs. 1-8.
1880. ,, ,, Brady, Monograph, vol. ii. p 153, pl. lxvi. figs. 1-9.
1904. ,, ,, G. O. Sars, *l. c.*, vol. v. p. 57, pl. xxxi.

Hab.—Frequent in dredged material collected off Musselburgh, in Largo Bay, and various other places.

63. *Zaus Goodsiri*, G. S. Brady.

1880. *Zaus Goodsiri*, Brady, Monograph, vol. ii. p. 156, pl. lxvi. figs. 10-13.
1904. ,, ,, G. O. Sars, *l. c.*, vol. v. p. 59, pl. xxxv.

Hab.—Frequent in dredged material collected off St Monans, and also occasionally off the east side of Inchkeith.

Genus (30) **Alteutha**, Baird, 1845.

64. *Alteutha interrupta* (Goodsir).

1845. *Sterope interrupta*, Goodsir, Ann. and Mag. Nat. Hist., vol. xvi. p. 326, pl. xi. fig. 10.
1863. *Alteutha bopyroides*, Claus, Die frei-lebenden Copepoden, p. 143, pl. xxii. figs. 10-17.
1904. ,, *interrupta*, G. O. Sars, *l. c.*, vol. v. p. 62, pls. xxxvi. and xxxvii.

Hab.—Frequent in tow-net gatherings collected amongst Laminaria, and also in inshore dredgings.

Genus (31) **Eupelte**, Claus.

65. *Eupelte purpurocincta* (Norman).

1868. *Alteutha purpurocinctum*, Norman, Brit. Assoc. Rept., p. 298.
1880. *Peltidium depressum*, Brady (not Baird), Monograph, vol. ii. p. 160, pl. lxxii. figs. 1-5.
1904. *Alteutha depressa*, G. O. Sars, *l. c.*, vol. v. p. 64, pl. xxxviii.

Hab.—Taken off Musselburgh, off the north end of Inchkeith, and at other parts of the estuary, but not very common.

Genus (32) **Tegastes**, Norman, 1903.

66. *Tegastes falcata*, Norman.

1869. *Amymone falcata*, Norman, Brit. Assoc. Rept. for 1868, p. 296.
1880. ,, *sphærica*, Brady (not Claus), Brit. Copep., vol. ii. p. 28, pl. xlix. figs. 1-11.
1904. *Tegastes falcatus*, G. O. Sars, *l. c.*, vol. v. p. 69, pl. xli.

Hab.—Found sparingly throughout the estuary. This curious species was first recorded for the Forth in Part III. of the *Sixth Annual Report of the Fishery Board for Scotland* (1888). The *A. sphærica* of Claus (*A. nigrans*, T. and A. Scott) has not yet been observed in the Forth.

Genus (33) **Porcellidium**, Claus, 1860.

67. *Porcellidium fimbriatum*, Claus

1863. *Porcellidium fimbriatum*, Claus, Die frei-lebenden Copepoden, p. 140, pl. xxii. fig. 1.
1904. ,, ,, G. O. Sars, *l. c.*, vol. v. p. 76, pls. xliv., xlv.

Hab.—Obtained in Largo Bay on seaweed brought up with the dredge. This species frequents the fronds of Laminaria and other seaweeds, to which it can adhere very firmly; and from its colour and very flattened form it is, though not uncommon, easily missed unless the weed be carefully examined.

Genus (34) **Aspidiscus**, Norman, 1868.

68. *Aspidiscus littoralis*, G. O. Sars.

1880. *Scutellidium fasciatum*, G. S. Brady (not Norman), Monograph, vol. ii. p. 178, pl. lxviii. fig. 11; pl. lxix. figs. 1-9.

1904. *Aspidiscus littoralis*, G. O. Sars, *l. c.*, vol. v. p. 79, pls. xlvi., xlvii.

Hab.—This species was obtained very sparingly in a shore gathering near the mouth of the estuary.

Genus (35) **Tisbe**, Lilljeborg, 1853.

69. *Tisbe furcata* (Baird).

1837. *Cyclops furcatus*, Baird, Mag. Zool. and Bot., vol. i. p. 330, pl. ix. figs. 26-28.

1850. *Canthocamptus furcatus*, idem, Brit. Entomostraca, p. 210, pl. xxv. figs. 1 and 2; pl. xxx. figs. 1-6.

1863. *Tisbe furcata*, Claus, Die frei-lebenden Copepoden, p. 116, pl. xv. figs. 1-10.

1880. *Idya furcata*, G. S. Brady, *l. c.*, vol. ii. p. 172, pl. lxvii. figs. 1-11.

Hab.—Various parts of the estuary. Common, especially within the littoral and laminarian zones.

70. *Tisbe gracilis* (T. Scott).

1895. *Idya gracilis*, T. Scott, Thirteenth F. B. Rept., pt. iii. p. 171, pl. iv. figs. 13-21.

Hab.—In an old quarry at Granton, open to the sea; rare. Collected by hand-net near low-water.

Genus (36) **Thalestris**, Claus, 1863.

71. *Thalestris longimana*, Claus.

1863. *Thalestris longimana*, Claus, Die frei-lebenden Copepoden, p. 130, pl. xviii. figs. 1-11.

Hab.—In rock pools near high-water on Cramond Island;

in the neighbourhood of Inchkeith; at Station VII. and other parts of the estuary; usually not very plentiful.

Genus (37) **Parathalestris**, G. O. Sars, 1905.

72. *Parathalestris Clausi* (Norman).

1869. *Thalestris Clausi*, Norman, Brit. Assoc. Report for 1868, p. 297.
1888. ,, ,, G. S. Brady, Monograph vol. ii. p. 128, pl. lxii. figs. 1-12.

Hab.—Largo Bay, washed from seaweed brought up by the dredge, frequent; dredged also in shallow water off Musselburgh.

73. *Parathalestris harpactoides* (Claus).

1863. *Thalestris harpactoides*, Claus, *l. c.*, p. 133, pl. xix. figs. 2-12.
1905. *Parathalestris harpacticoides*, G. O. Sars, Crust. of Norway, vol. v. p. 112, pl. lxvii.

Hab.—Dredged off St Monans in 1891, but only a few specimens were observed.

Genus (38) **Phyllothalestris**, G. O. Sars, 1905.

74. *Phyllothalestris mysis* (Claus).

1863. *Thalestris mysis*, Claus, *l. c.*, p. 130, pl. xviii. figs. 12-16.
1880. ,, ,, G. S. Brady, *l. c.*, vol. ii. p. 121, pl. lviii. figs. 1-13.

Hab.—Firth of Forth, 1894,—a fine species, very sparingly but widely distributed.

Genus (39) **Halithalestris**, G. O. Sars, 1905.

75. *Halithalestris Croni* (Kröyer).

1849. *Harpacticus Croni*, Kröyer, in Gaimard's Voyages en Scand., Zool., pl. xliii fig. 3 *a-n*.
1880. *Thalestris serrulatus*, G. S. Brady, *l. c.*, vol. ii. p. 133, pl. lix. figs. 2-11.

Hab.—East of Inchkeith, several taken with surface tow-net in 1889; and in surface tow-net in June 1891 at Station IX. This appears to be a truly pelagic species, and widely distributed, but which only occasionally enters the Forth estuary. As the colour of these Copepods is bright red they are easily noticed, but the colour quickly disappears when they are preserved in alcohol.

Genus (40) **Rhynchothalestris**, G. O. Sars, 1905.

76. *Rhynchothalestris rufocincta* (Norman).

1880. *Thalestris rufocincta*, Norman (MS. name), in G. S. Brady, *l. c.*, vol. ii. p. 125, pl. lvii. figs. 1-9.
1905. *Rhynchothalestris rufocincta*, G. O. Sars, Crust. of Norway, vol. v. p. 120, pls. lxxiii., lxxiv.

Hab.—In pools between tide-marks about Joppa and Granton, 1887, frequent, and subsequently in various other parts of the estuary, but more common in the littoral zone than in deep water.

77. *Rhynchothalestris helgolandica* (Claus).

1863. *Thalestris helgolandica*, Claus, *l. c.*, p. 131, pl. xvii. figs. 12-21.
1880. ,, ,, G. S. Brady, *l. c.*, vol. ii. p. 123, pl. lxi. figs. 9-14.
1905. *Rhynchothalestris helgolandica*, G. O. Sars, Crust. of Norway, vol. v. p. 121, pl. lxxv.

Hab.—Washed from some seaweed obtained while dredging in Largo Bay in April 1891. Also obtained in dredged material collected off the north-east end of Inchkeith in May 1901.

Genus (41) **Microthalestris**, G. O. Sars, 1905.

78. *Microthalestris forficula* (Claus).

1863. *Thalestris forficula*, Claus, *l. c.*, p. 131, pl. xvii. figs. 7-12.
1894. ,, *forficuloides*, T. and A. Scott, Ann. and Mag. Nat. Hist. (6), vol. xii. p. 142, pl. ix. figs. 4-9.
1905. *Microthalestris forficula*, G. O. Sars, *l. c.*, vol. v. p. 123, pl. lxxvi.

Hab.—In pools near low-water between Leith and Portobello, not very common. The part of the shore where the specimens were chiefly obtained was opposite Seafield, where there is a good deal of mud.

Genus (42) **Amenophia**, Boeck, 1864.

79. *Amenophia peltata*, Boeck.

1864. *Amenophia peltata*, Boeck, Oversigt af Norges Copepoder, Chr. Vid.-Selsk. Forhandl., p. 45.
1880. *Thalestris peltata*, G. S. Brady, *l. c.*, vol. ii. p. 138, pl. liii. figs. 11-19.
1895. ,, ,, T. and A. Scott, Ann. and Mag. Nat. Hist. (6), vol. xiv. p. 35, pl. xv. figs. 11-15; pl. xvi. figs. 1-8.

Hab.—Dredged off Musselburgh; not common. The species differs from the typical *Thalestris* in the body being very depressed and in the structure of some of the appendages, as shown by the drawings in the works referred to.

Genus (43) **Westwoodia**, Dana, 1855.

80. *Westwoodia nobilis* (Baird).

1845. *Arpacticus nobilis*, Baird, Trans. Berw. Nat. Club, vol. ii. p. 155.
1880. *Westwoodia nobilis*, Brady, Brit. Copep., vol. ii. p. 141, pl. lxiii. figs. 1-13.

Hab.—Taken at Cramond Island in rock-pools between tide-marks, and in dredged material collected off Musselburgh in 3 to 4 fathoms; not common.

Genus (44) **Pseudothalestris**,[1] Brady, 1883.

81. *Pseudothalestris Andrewi* (T. Scott).

1894. *Pseudowestwoodia Andrewi*, T. Scott, Twelfth F. B. Rept., pt. iii. p. 257, pl. ix. figs. 21-29.

Hab.—Dredged off Burntisland in 3 to 4 fathoms water; frequent.

This group of Copepods have so close a general resemblance to *Westwoodia*, Dana, that I ascribed the first species to a new genus, *Pseudowestwoodia*, which recognised that resemblance, but afterwards I discovered that they were identical

[1] The genus *Pseudothalestris* is closely related to *Westwoodia*, Dana, but as it contains a group of species which differ distinctly in the structure of the first pair of thoracic feet, I prefer to retain it as a separate genus.

with the genus *Pseudothalestris*, Brady, described by that author in his "Report on the Challenger Copepoda."[1]

82. *Pseudothalestris pygmæa* (T. and A. Scott).

1895. *Pseudothalestris pygmæa*, T. and A. Scott, Ann. and Mag. Nat. Hist. (6), vol. xv. p. 55, pl. vi. figs. 8-16 (January 1895).

Hab.—Dredged sparingly in the neighbourhood of Dunbar.

83. [2]*Pseudothalestris major* (T. and A. Scott).

(?) 1863. *Westwoodia minuta*, Claus, Die frei-lebenden Copepoden, p. 118, taf. xxi. figs. 10-14.

1895. *Pseudowestwoodia major*, T. and A. Scott, *loc. cit.*, p. 56, pl. vi. figs. 17-26.

Hab.—Dredged in the neighbourhood of Granton, and near Dunbar.

Genus (45) **Dactylopusia**, Norman, 1903.[3]

84. *Dactylopusia tisboides* (Claus).

1863. *Dactylopus tisboides*, Claus, Die frei-lebenden Copepoden, p. 127, pl. xvi. figs. 24-28.

Hab.—Shore-pools at Cramond Island; dredged off Musselburgh and other parts of the estuary; frequent in the littoral and laminarian zones.

85. *Dactylopusia neglecta*, G. O. Sars.

1880. *Dactylopus tisboides*, G. S. Brady (brackish-water var.), *l. c.*, vol. ii. p. 108, pl. liv. figs. 14-16.

1905. *Dactylopusia neglecta*, G. O. Sars, Crust. of Norway, vol. v. p. 127, pl. lxxviii. fig. 2.

Hab.—This brackish-water form was observed in the lagoon at the mouth of the Cocklemill Burn (east end of Largo Bay).

[1] Cf. paper by T. and A. Scott in *Ann. and Mag. Nat. Hist.* (6), vol. xv. p. 463 (June 1895).

[2] See remarks on this species and also on the genus in Part III. of the *Twenty-fourth Annual Report of the Fishery Board for Scotland*, at page 277 (1906).

[3] The name *Dactylopus*, Claus, being preoccupied by Gill for a genus of fishes, was by Canon Norman changed to *Dactylopusia*.

86. *Dactylopusia vulgaris,* G. O. Sars.

1863. *Dactylopus Strömi,* Claus, *l. c.*, p. 126, pl. xvi. figs. 1-6.

Hab.—Forth, west of Queensferry, washed from lumps of hardened mud; not very common. According to G. O. Sars, this is not the *Canthocamptus Strömi,* Baird, as Claus supposed it to be.

87. *Dactylopusia littoralis* (T. Scott).

1903. *Dactylopus littoralis,* T. Scott, Twenty-first F. B. Rept., pt. iii. p. 124, pl. iii. figs. 2-8.

Hab.—Obtained in pools between tide-marks at Musselburgh in 1894, but not recorded till 1903. This seems to be a rare species.

88. *Dactylopusia finmarchica,* T. Scott.

1903. *Dactylopus longirostris,* Claus, var. *finmarchicus,* T. Scott, Ann. and Mag. Nat. Hist. (7), vol. xi. (Jan. 1903), p. 21, pl. ii. figs. 4-8.
1903. ,, *mixtus,* T. Scott, Twenty-first F. B. Rept., pt. iii. (pub. 20th July 1903), p. 126, pl. iii. figs. 9-16.

Hab.—This *Dactylopusia* was first described from specimens obtained in East Finmark, within the Arctic Circle, in a collection made by Canon Norman in the summer of 1890. The species was also observed in a gathering collected in 1894 in the old quarry at Granton, where several other interesting Copepoda have been captured. This gathering was not thoroughly examined till 1903, when the *Dactylopusia* was by an oversight redescribed as a "new species," under the name of *D. mixtus.*

89. *Dactylopusia debilis* (Giesbrecht).

1882. *Dactylopus debilis,* Giesb., Frei-leb. Copep. d. Kieler Föhrde, p. 122, pl. i. figs. 7, 19 *et seq.*
1903. ,, ,, T. Scott, Twenty-first F. B. Rept., pt. iii. p. 128, pl. v. figs. 20-31.

Hab.—This species occurred very sparingly in a gathering dredged off Musselburgh in 4 to 5 fathoms.

90. *Dactylopusia brevicornis* (Claus).

1868. *Dactylopus brevicornis,* Claus, Die Copepoden-fauna von Nizza, p. 29, pl. iii. figs. 20-25.

1906. *Dactylopusia brevicornis,* T. Scott, Twenty-fourth F. B. Rept., pt. iii. p. 276, pl. xiv. figs. 10-18.

Hab.—Dredged in Largo Bay and in the old quarry at Granton; not common.

Genus (46) **Dactylopodella,** G. O. Sars, 1905.

91. *Dactylopodella flava* (Claus).

1866. *Dactylopus flavus,* Claus, *l. c.*, p. 28, pl. iii. figs. 13-16.

Hab.—Taken very sparingly with the dredge in Largo Bay and at Station III.

Genus (47) **Idomene,** Philippi, 1843.

92. *Idomene forficata,* Philippi.

1843. *Idomene forficata,* Philippi, Archiv. f. Naturgesch., 1843, p. 65, taf. iii. fig. 4.

1880. *Dactylopus flavus,* Brady, Monograph, vol. ii. p. 116, pl. lvi. figs. 1-11 (♂).

Hab.—I have occasionally dredged this species in the Forth estuary, but it was usually passed over as the male of *Dactylopodella flava.*

Genus (48) **Idomenella,** T. Scott, nov. gen., 1896.

This genus has a general resemblance to *Idomene,* Philippi.

The antennules (anterior antennæ) short, six- or seven-jointed.

Posterior antennæ tolerably well developed, and composed of two joints.

Mandibles, with masticatory edge, moderately broad, and armed with several stout but irregular teeth. Mandible-palp well developed, and furnished with two uniarticulate branches of moderate size, the outer one wanting the strong spines that appear to be characteristic of species belonging to *Idomene.*

Maxillæ similar in structure to those of the genus mentioned. The first and second maxillipeds are also similar to those of the same species.

The first pair of thoracic feet resemble those of *Idomene*, but the first joint of the inner branch is not nearly so robust, and the terminal setæ of the end joint are not so strongly clawed.

The second, third, and fourth pairs in the female are similar to those of *Idomene*, but the second pair in the male has the inner branch armed with a strong claw-like spine.

The fifth pair comparatively small, lamelliform, and the primary and secondary joints are sub-equal, and only moderately developed (cf. *Twelfth Annual Report Fishery Board for Scotland*, pt. iii. p. 255, pl. lx. fig. 19, etc.).

Furcal joints short. One ovisac.

The differences that separate this genus from *Idomene* are comparatively small; but in the following two species, which I have ascribed to it, the armature of the mandible-pulp, and the structure of the inner branch of the first pair of thoracic feet, preclude them from a place in Philippi's genus.

93. *Idomenella rostrata*, T. Scott.

1893. *Dactylopus rostratus*, T. Scott, Eleventh F. B. Rept., pt. iii. p. 205, pl. iii. figs. 7-20.

Hab.—The specimens from which this species was described were obtained by carefully washing shells inhabited by the common hermit crab, *Eupagurus*, Bernhardus, which were dredged off the west side of Inchkeith.

94. *Idomenella coronata*, T. Scott.

1894. *Dactylopus coronatus*, T. Scott, Twelfth F. B. Rept., pt. iii. p. 255, pl. ix. figs. 12-20.

Hab.—Dredged near the Bass Rock and also in Largo Bay; not common. It has also been obtained very sparingly off Musselburgh, and at the north end of Inchkeith.

Genus (49) **Amphiascus**, G. O. Sars, 1905.

95. *Amphiascus minutus* (Claus).

1863. *Dactylopus minutus*, Claus, Die frei-lebenden Copepoden, p. 126, taf. xvi. figs. 14, 15.
1880. ,, ,, Brady, *l. c.*, vol. ii. p. 119, pl. lxvii. figs. 12-14.

Hab.—In dredged material from Largo Bay,—the only place within the estuary where this species has been noticed.

96. *Amphiascus Catharinæ*, T. Scott.[1]

1906. *Amphiascus Catharinæ*, T. Scott, Twenty-fourth F. B. Rept., pt. iii. p. 275, pl. xiv. figs. 10-18.

Hab.—Collected by hand-net in an old quarry at Granton, open to the tide, where many interesting forms have been obtained.

97. *Amphiascus tenuiremis* (Brady and Robertson).

1876. *Dactylopus tenuiremis*, B. and R., Brit. Assoc. Report for 1875, p. 197.
1880. ,, ,, Brady, *l. c.*, vol. ii. p. 115, pl. lvi. figs. 12-18.

Hab.—Dredged in Largo Bay, where it occurred very sparingly.

98. *Amphiascus similis* (Claus).

1866. *Dactylopus similis*, Claus, Die Copepoden-fauna von Nizza, p. 25, taf. ii. figs. 29, 30.
1880. ,, ,, Brady, *l. c.*, vol. ii. p. 110, pl. lv. figs. 14-16.

Hab.—Dredged west—off Queensferry, 17th November 1893; not common.

99. *Amphiascus imus* (G. S. Brady).

1872. *Canthocamptus imus*, Brady, Nat. Hist. Trans. Northumb. and Durham, vol. iv. p. 436, pl. xix. figs. 1-5.
1880. *Stenhelia ima*, idem, Monograph, vol. ii. p. 35, pl. xliii. figs. 1-14.

Hab.—Collected near Cramond and North Berwick in 1887, and near Inchkeith in 1901, but apparently not very common.

[1] Named in compliment to a friend of the author.

Genus (50) **Stenhelia**, Boeck, 1864.

100. *Stenhelia hispida*, G. S. Brady.

1880. *Stenhelia hispida*, Brady, Monograph, vol. ii. p. 32, pl. xlii. figs. 1-14.

Hab.—This Copepod was observed sparingly in some material dredged off St Monans in 1893, and off North Berwick in July 1901.

101. *Stenhelia hirsuta*, I. C. Thompson.

1893. *Stenhelia hirsuta*, I. C. Thompson, Revised Rept. on the Copepoda of L—pool Bay, p. 20, pl. xxxi.

Hab.—Dredged off St Monans in 1893, and in the neighbourhood of Inchkeith in 1901. The female of this species carries two ovisacs instead of one, and thus differs from some of the other forms grouped under this genus.

102. *Stenhelia dispar*, T. and A. Scott.

1894. *Stenhelia dispar*, T. and A. Scott, Ann. and Mag. Nat. Hist. (6), vol. xii. p. 141, pl. viii. figs. 8-12.

Hab.—Dredged in the neighbourhood of the Bass Rock in 1893; apparently rare.

103. *Stenhelia denticulata*, I. C. Thompson.

1893. *Stenhelia denticulata*, I. C. Thompson, *l. c.*, p. 20, pl. xxx. figs. 1-11.

Hab.—This very distinct species was dredged off St Monans in 1893, and it has also been obtained near Inchkeith, but appears to be somewhat rare in the estuary.

104. *Stenhelia reflexa*, T. Scott.

1895. *Stenhelia reflexa*, T. Scott, Thirteenth F. B. Rept., pt. iii. p. 166, pl. iii. figs. 1-9.

Hab.—This species was obtained in pools between tidemarks on the shore north-east of Dunbar in 1894. Only a few specimens were observed. It resembles *Amphiascus imus* in some respects, but differs in the structure of the anterior antennæ and of the first and fifth pairs of thoracic feet, as pointed out in the description.

105. *Stenhelia Blanchardi*, T. and A. Scott.

1895. *Stenhelia Blanchardi*, T. and A. Scott, Ann. and Mag. Nat. Hist. (6), vol. xvi. p. 353, pl. xv. figs. 1-10.

Hab.—This tolerably distinct form was dredged off St Monans in 1896. The species was described from specimens obtained in some material dredged off Arisaig, Argyleshire, in 1892. Although this form appears to be widely distributed, it does not seem to be very common.

106. *Stenhelia pygmæa*, A. M. Norman and T. Scott.

1905. *Stenhelia pygmæa*, N. and S., Ann. and Mag. Nat. Hist. (7), vol. xv. p. 284.
1906. ,, ,, idem, Crust. of Devon and Cornwall, p. 142, pl. x. figs. 1-3; pl. xi. figs. 1, 2 *et seq.*

Hab.—Station II., Forth, dredged 26th December 1894. This species, which is very small, appears to be widely distributed, as the type specimens were collected by the Rev. Canon Norman near Eddystone Lighthouse.

107. *Stenhelia confusa*, T. Scott.

1902. *Stenhelia confusa*, T. Scott, Twentieth F. B. Rept., pt. iii. p. 458, pl. xxii. figs. 17-25.

Hab.—Dredged at Station III., 7th June 1901. Apparently rare.

Genus (51) **Ameira**, Boeck, 1864.

108. *Ameira longipes*, Boeck.

1864. *Ameira longipes*, Boeck, Oversigt af Norges Copepoder, Chr. Vid.-Selsk. Forhandl., p. 55.
1880. ,, ,, Brady, Monograph, vol. ii. p. 37, pl. liii. figs. 1-10.

Hab.—Dredged off St Monans and in other parts of the estuary, but not very common.

109. *Ameira longicaudata*, T. Scott.

1892. *Ameira longicaudata*, T. Scott, Tenth F. B. Rept., pt. iii. p. 250, pl. ix. figs. 1-18.

Hab.—Taken in various parts of the estuary. First noticed in material dredged off St Monans in 1891. This species appears to be moderately frequent in the Firth.

110. *Ameira exilis*, T. and A. Scott.

1894. *Ameira exilis*, T. and A. Scott, Ann. and Mag. Nat. Hist. (6), vol. xii. p. 139, pl. viii. figs. 18-20; pl. ix. figs. 1-3.
1894. ,, ,, T. Scott, Twelfth F. B. Rept., pt. iii. p. 242, pl. ix. fig. 30; pl. x. figs. 1-12.

Hab.—This moderately large and distinct species was taken in shore-pools, near low-water, at Seafield, Leith; it was subsequently obtained at Musselburgh and near Dunbar, and in a somewhat similar situation.

111. *Ameira longiremis*, T. Scott.

1894. *Ameira longiremis*, T. Scott, Twelfth F. B. Rept., pt. iii. p. 241, pl. v. figs. 29-32; pl. vi. figs. 1-5.

Hab.—This *Ameira* was taken very sparingly off St Monans in 1893, and this is the only record of it that I have for the Forth estuary, but it has since been obtained in the Clyde in Kilbrannan Sound.

112. *Ameira exigua*, T. Scott.

1894. *Ameira exigua*, T. Scott, *op. cit.*, p. 243, pl. vi. figs. 15-23.

Hab.—Off St Monans, not very common. This species, like the last, has also been obtained in the Clyde.

113. *Ameira tenuiremis*, T. Scott.

1902. *Ameira tenuiremis*, T. Scott, Twentieth F. B. Rept., pt. iii. p. 459, pl. xxiv. figs. 1-9.

Hab.—Dredged off St Monans; rather rare.

114. *Ameira propinqua*, T. Scott.

1902. *Ameira propinqua*, T. Scott, *op. cit.*, p. 460, pl. xxii. figs. 36-42; pl. xxiii. fig. 1; pl. xxiv. figs. 10-18.

Hab.—Dredged off St Monans; rare.

115. *Ameira pusilla*, T. Scott.

1903. *Ameira pusilla*, T. Scott, Twenty-first F. B. Rept., pt. iii. p. 114, pl. v. figs. 1-10.

Hab.—This, which appears to be the smallest member of the genus, was taken sparingly, in shallow water, off Musselburgh; it has not, so far, been noticed anywhere else.

116. *Ameira ambigua*, T. Scott.

1903. *Ameira ambigua*, T. Scott, *op. cit.*, p. 114, pl. v. figs. 11-19.

Hab.—Taken off Musselburgh, in shallow water; apparently rare.

117. *Ameira elegans*, T. Scott.

1905. *Ameira elegans*, T. Scott, Twenty-third F. B. Rept., pt. iii. p. 144, pl. x. figs. 18, 19; pl. xi. figs. 1-9.

Hab.—Collected with hand-net in pools on the shore near low-water, north-west from Dunbar, and also in a shore gathering collected the same year near Musselburgh.

Genus (52) **Robertsonia**, G. S. Brady, 1880.

118. *Robertsonia tenuis* (G. S. Brady and Robertson).

1876. *Ectinosoma tenue*, Brady and Robertson, British Assoc. Rept. for 1875, p. 196.

1880. *Robertsonia tenuis*, Brady, Brit. Copep., vol. ii. p. 25, pl. xli. figs. 1-14.

Hab.—This species, which was first noticed in material dredged off North Berwick in 1887, appears to be sparingly distributed throughout the estuary.

Genus (53) **Heteropsyllus**, T. Scott, 1894.

119. *Heteropsyllus curticaudatus*, T. Scott.

1894. *Heteropsyllus curticaudatus*, T. Scott, Twelfth F. B. Rept., pt. iii. p. 252, pl. viii. figs. 27-34; pl. ix. fig. 1.

Hab.—Dredged off Musselburgh and near Aberdour; frequent. This species, though extensively distributed, having been observed in the Firth of Clyde and on the south coast of England, is readily passed over from its resemblance to more widely-known forms.

Genus (54) **Delavalia**, G. S. Brady, 1868.

120. *Delavalia palustris*, G. S. Brady.

1868. *Delavalia palustris*, Brady, Nat. Hist. Trans. Northumb. and Durham, vol. iii. p. 134, pl. v. figs. 10-15.
1880. ,, ,, idem, Monograph, vol. ii. p. 43, pl. l. figs. 1-8.

Hab.—Taken in the neighbourhood of Culross, west of Queensferry, where the water is brackish, and also in brackish-water pools at the mouth of the Peffer Burn, Aberlady Bay, 1895.

121. *Delavalia robusta*, Brady and Robertson.

1875. *Delavalia robusta*, B. and B., Brit. Assoc. Rept. (1875), p. 196.
1880. ,, ,, Brady, *l. c.*, vol. ii. p. 46, pl. li. figs. 15-21.

Hab.—In pools at the mouth of the Cocklemill Burn at the east end of Largo Bay, 16th August 1890; rare.

122. *Delavalia reflexa*, Brady and Robertson.

1875. *Delavalia reflexa*, B. and R., Brit. Assoc. Rept. (1875), p. 196.
1880. ,, ,, Brady, *l. c.*, vol. ii. p. 45, pl. li. figs. 1-14.

Hab.—Dredged off Burntisland in November 1893; moderately rare.

Genus (55) **Beatricella**,[1] T. Scott, 1905.

123. *Beatricella mimica*, T. Scott.

1897. *Delavalia mimica*, T. Scott, Fifteenth F. B. Rept., pt. iii. p. 150, pl. i. figs. 1-9.
1905. *Beatricella mimica*, T. Scott, Ann. and Mag. Nat. Hist. (7), vol. xvi. p. 568.

Hab.—Dredged in the neighbourhood of Granton and off

[1] This genus has been named in compliment to Miss Beatrice Sprague, daughter of Dr T. B. Sprague, Edinburgh, whose names are so frequently referred to in this Catalogue as successful students of Scottish fresh-water Crustacea.

Musselburgh; not very rare. Dredged also off the north-west end of Inchkeith.

124. *Beatricella æmula*, T. Scott.

1893. *Delavalia æmula*, T. Scott, Eleventh F. B. Rept., pt. iii. p. 204, pl. iv. figs. 36-47.
1905. *Beatricella æmula*, T. Scott, Ann. and Mag. Nat. Hist. (7), vol. xvi. p. 569 (footnote).

Hab.—Dredged in Largo Bay, and subsequently in one or two other places.

Genus (56) **Tachidius**, Lilljeborg, 1853.

125. *Tachidius discipes*, Giesbrecht.

1853. *Tachidius brevicornis*, Lilljeborg (non *Cyclops brevicornis*, O. F. Müller, 1776), De Crust. ex ordinibus tribus, Clad. Ostrac. Copep., p. 196.
1880. ,, ,, Brady (non *C. brevicornis*, Müller), Monograph, vol. ii. p. 20, pl. xxxvii.
1881. ,, *discipes*, Giesb., Die frei-leb. Copep. der Kieler Föhrde, p. 108, pl. ii. fig. 4; pl. iv. figs. 25, 28 *et seq.*

Hab.—Brackish-water pools at the mouth of the Cocklemill Burn at the east end of Largo Bay, 1890. This is a moderately common species in places such as that referred to.

126. *Tachidius littoralis*, Poppe.

1885. *Tachidius littoralis*, Poppe, Die frei-leb. Copep. des Jadebusens, Abhandl. d. nat. Ver. zu Bremen, vol. xi. p. 167, pl. vii. figs. 10-20.
1891. ,, *crassicornis*, T. Scott, Tenth F. B. Rept., pt. iii. p. 250, pl. viii. figs. 14-27.

Hab.—Dredged near Culross, west of Queensferry, 1892; not very rare. This, like *T. discipes*, is a brackish-water species, and appears to be generally distributed where the conditions are favourable.

Genus (57) **Pontopolites,** T. Scott, 1894.

127. *Pontopolites typicus,* T. Scott.

1894. *Pontopolites typicus,* T. Scott, Twelfth F. B. Rept., pt. iii. p. 251, pl. viii. figs. 9-17.

Hab.—This species was described from specimens dredged off Musselburgh in 1893, and was at that time regarded as rare; subsequently, however, it was found to be moderately frequent in gatherings collected in shallow inshore waters. Like *Tachidius discipes,* this species has the fifth pair of thoracic feet composed each of a single lamelliform joint, but it differs very markedly in the structure of the other thoracic legs, so much so that it is with some hesitation I have placed it under this family.

Genus (58) **Canthocamptus,** Westwood, 1836.

128. *Canthocamptus minutus* (Müller).

1785. *Cyclops minutus,* O. F. Müller, Entomostraca, p. 101, pl. xvii. figs. 1-7.

1820. *Monoculus staphylinus,* Jurine, Hist. des Monocles, p. 74, pl. vii. figs. 1-19.

1880. *Canthocamptus minutus,* G. S. Brady, Monograph, vol. ii. p. 48, pl. xliv. figs. 1-17.

Hab.—Moderately common, and generally distributed in lochs, ponds, etc., throughout the district.

129. *Canthocamptus horridus,* S. Fischer.

1860. *Canthocamptus horridus,* Fischer, Akad. d. Wissensch., 8ten Bd. 3te Abth., p. 760, pl. ii. figs. 57-59, 59A.

1880. *Canthocamptus northumbricus,* Brady, *l. c.*, vol. ii. p. 57, pl. xlv. figs. 1-14.

Hab.—Duddingston Loch, 1892; Lochgelly Loch, Fifeshire, 19th August 1896. "Vicinity of Edinburgh" (Dr and Miss Sprague). This species does not appear to be very common in Scotland.

130. *Canthocamptus gracilis,* G. O. Sars.

1863. *Canthocamptus gracilis,* G. O. Sars, Vidensk. i Christiania Forhandl., 1862 (Aftr.), p. 22.

1897. ,, *inornatus,* T. Scott, Fifteenth F. B. Rept., pt. iii. p. 323, pl. ix. figs. 1-12.

1902. ,, *gracilis,* Lillj., Synopsis Spec. hucusque in aquis dulc. Suec. observ. Fam. Harpactic., p. 26, pl. ii. figs. 8-13.

Hab.—Linlithgow Loch, Upper Elf Loch (near Edinburgh), Loch Achray (Trossachs); not very rare. It appears to be more frequent in small lakes or ponds than in large bodies of water.

131. *Canthocamptus lucidulus*, Rehberg.

1863. *Canthocamptus minutus*, Claus, Die frei-lebenden Copep., p. 122, pl. xii. figs. 1-3 (name preoccupied by O. F. Müller).
1880. ,, *lucidulus*, Rehberg, Beitrag. z. Kenntn., p. 551.
1895. ,, *minutus*, T. and A. Scott, Ann. Scot. Nat. Hist. (Oct. 1895), p. 236, pl. iv. figs. 14-20.

Hab.—Duddingston Loch, Upper Elf Loch, Loch Leven, Loch Katrine, and others; Humbie Reservoir, near Winchburgh (Evans); moderately frequent, and generally distributed.

132. *Canthocamptus hirticornis*, T. Scott.

1895. *Canthocamptus hirticornis*, T. Scott, Thirteenth F. B. Rept., pt. iii. p. 251, pl. ix. figs. 13-26.
1902. ,, *megalops*, Lillj., *l. c.*, p. 30, pl. ii. figs. 14-19.
1903. ,, *hirticornis*, T. Scott, Ann. and Mag. Nat. Hist. (7), vol. xi. p. 188.

Hab.—In brackish-water pools at the mouth of the Cocklemill Burn at the east end of Largo Bay. This species is sometimes not uncommon where the conditions are favourable.

133. *Canthocamptus palustris*, G. S. Brady.

1880. *Canthocamptus palustris*, Brady, Monograph, vol. ii p. 53, pl. xxxix. figs. 13-23.
1895 ,, ,, var. *elongatus*, T. and A. Scott, Ann. and Mag. Nat. Hist. (6), vol. xv. p. 459, pl. xvi. figs. 7-17.

Hab.—In pools on May Island, 1889.

134. *Canthocamptus parvus*, T. and A. Scott.

1896. *Canthocamptus parvus*, T. and A. Scott, *l. c.* (6), vol. xviii. p. 6, pl. ii. figs. 14-22.

Hab.—Between tide-marks at Aberlady, and dredged in shallow water off Musselburgh; not common.

135. *Canthocamptus inconspicuus*, T. Scott.

1900. *Canthocamptus inconspicuus*, T. Scott, Eighteenth F. B. Rept., pt. iii. p. 390, pl. xiv. figs. 1-8.

Hab.—Off Musselburgh, 1894; rare. This species was described from specimens found in the Moray Firth.

136. *Canthocamptus Schmeili*, Mrazek.

1893. *Canthocamptus Schmeili*, Mrazek, Zool. Jahrb. Sieb. Bd., p. 116, pl. vii. figs. 107-117.
1895. ,, ,, T. and A. Scott, Ann. Scot. Nat. Hist. (Oct. 1895), p. 234, pl. iv. figs. 1-13.

Hab.—Loch Leven, Kinross; moderately frequent.

137. *Canthocamptus crassus*, G. O. Sars.

1863. *Canthocamptus crassus*, G. O. Sars, Chr. Vidensk.-Selsk. Forhandl., 1862 (Aftr.), p. 23.
1880. *Attheyella spinosa*, Brady, Monograph, vol. ii. p. 58, pl. xliii. figs. 15-18; pl. xlvi. figs. 13-18.

Hab.—Frequent in lochs and ponds throughout the district.

Genus (59) **Attheyella**, G. S. Brady, 1880.

138. *Attheyella pygmæa* (G. O. Sars).

1863. *Canthocamptus pygmæus*, G. O. Sars, *op. cit.*, p. 21.
1880. *Attheyella cryptorum*, Brady, Monograph, vol. ii. p. 60, pl. lii. figs. 1-18.
1893. ,, ,, T. Scott, Eleventh F. B. Rept., pt. iii. p. 225, pl. vi. figs. 21-31.

Hab.—Moderately common, and generally distributed throughout the district.

139. *Attheyella Zschokkei* (Schmeil).

1893. *Canthocamptus Zschokkei*, Schmeil, Copep. des Rhätikon-Geberges, p. 31, pl. iii.
1893. *Attheyella propinqua*, T. Scott, Eleventh F. B. Rept., pt. iii. p. 227, pl. vii. figs. 1-11.

Hab.—Loch Leven, Duddingston Loch, Upper Elf Loch; not very rare, but easily overlooked. Ben Ledi, at about 2500 feet (Evans).

140. *Attheyella Duthiei*, T. and A. Scott.

1895. *Attheyella Duthiei*, T. and A. Scott, Ann. and Mag. Nat. Hist. (6), vol. xviii. p. 4, pl. ii. figs. 1-13.
1902. *Canthocamptus Duthiei*, Lillj., Synops. sp. huc usque in aquis dulcibus Sueciae observ. Fam. Harpact., p. 41, pl. iii. figs. 5-10.

Hab.—Loch Leven is the only locality within the district where this species has been observed; it was obtained in gatherings collected by hand-net in 1890, 1897, and 1898.

141. *Attheyella cuspidata* (Schmeil).

1893. *Canthocamptus cuspidatus*, Schmeil, *op. cit.*, p. 36, pl. iv.
1897. ,, ,, T. Scott, Fifteenth F. B. Rept., pt. iii. p. 323, pl. ix. figs. 21, 22.

Hab.—Loch Vennachar, Perthshire; not common. In spring at 2500 feet on Ben Ledi, September 1906 (W. Evans).

Genus (60) **Nitocra**, Boeck, 1864.

142. *Nitocra tau*, Giesbrecht.

1882. *Nitocra tau*, Giesb., Die frei-leben. Copep. der Kieler Foehrde, p. 117, pl. i. figs. 9, 13; pl. iii. fig. 13; pl. iv. figs. 2, 11, 29 *et seq.*

Hab.—In pools overflowed by the tide at the mouth of the Cocklemill Burn at the east end of Largo Bay; not common.

Genus (61) **Moraria**, T. and A. Scott, 1893.

143. *Moraria brevipes* (G. O. Sars).

1863. *Canthocamptus brevipes*, G. O. Sars, Vidensk. i Christiania Forhandl., 1862 (Aftr.), p. 64.
1893. *Moraria Anderson-Smithi*, T. and A. Scott, Ann. and Mag. Nat. Hist. (6), vol. vi. p. 213, pl. viii.

Hab.—Loch Vennachar, Loch Leven, Duddingston Loch, and the Upper Elf Loch are some of the places where this species has been obtained.

144. *Moraria Mrazeki*, T. Scott.

1893. *Ophiocamptus brevipes*, Mrazek (not *Canthocamptus brevipes*, G. O. Sars), Zool. Jahrb. 7ter Bd., p. 116, pl. v. fig. 66; pl. vi. figs. 67-70.
1903. *Moraria Mrazeki*, T. Scott, Ann. and Mag. Nat. Hist. (7), vol. xi. p. 194.

Hab.—Loch Lubnaig, Loch Achray, Loch Vennachar.

Genus (62) **Maraenobiotus**, Mrazek, 1893.

145. *Maraenobiotus Vejdovskyi*, Mrazek.

1893. *Maraenobiotus Vejdovskyi*, Mrazek, *op. cit.*, p. 103, pl. iv. figs. 17-32; pl. v. figs. 33-37.
1896. ,, ,, T. and A. Scott, Ann. and Mag. Nat. Hist. (6), vol. xviii. p. 3, pl. i. figs. 13-21; pl. ii. fig. 23.

Hab.—The only locality within the district where I have found this species is Loch Vennachar.

Genus (63) **Mesochra**, Boeck, 1864.

146. *Mesochra Lilljeborgi*, Boeck.

1864. *Mesochra Lilljeborgi*, Boeck, Oversigt Norges Copepoder, p. 51.
1873. *Paratachidius gracilis*, Brady and Robertson, Ann. and Mag. Nat. Hist. (4), vol. xii. p. 131, pl. viii. figs. 8-16.
1880. *Mesochra Lilljeborgi*, Brady, Brit. Copep., vol. ii. p. 62, pl. xli. figs. 15-21; pl. xlvii. figs. 16-21.

Hab.—Frequent in rock-pools near high-water, Cramond Island (1888); in pools at the mouth of the Cocklemill Burn, Largo Bay, 1890; and subsequently in other parts of the estuary.

147. *Mesochra spinicaudata*, T. and A. Scott.

1895. *Mesochra spinicaudata*, T. and A. Scott, Ann. and Mag. Nat. Hist. (6), vol. xv. p. 52, pl. v. figs. 12-25.

Hab.—Shore at Musselburgh, in pools near low-water; frequent.

148. *Mesochra MacIntoshi*, T. and A. Scott.

1895. *Mesochra Mac-Intoshi*, T. and A. Scott, *l. c.*, p. 53, pl. vi. figs. 1-7.

Hab.—Shore at Musselburgh, in pools near low-water, not uncommon, 1894; and also in a gathering dredged off St Monans in July 1901.

149. *Mesochra propinqua*, T. Scott.

1896. *Mesochra propinqua*, T. Scott, Fourteenth F. B. Rept., pt. iii. p. 162, pl. iii. figs. 11-22.

Hab.—In pools between tide-marks at Aberlady Bay, collected by hand-net.

Genus (64) **Danielssenia,** Boeck, 1872.

150. *Danielssenia typica,* Boeck.

1872. *Danielssenia typica,* Boeck, Nye Slægter og arter af Saltvands Copepoder, Vid. Selsk. Forhandl., p. 55.
1876. *Zosime spinulosa,* Brady and Robertson, British Assoc. Rept. for 1875, p. 196.
1880. *Jonesiella spinulosa,* G. S. Brady, *l. c.*, vol. ii. p. 41, pl. xlviii. figs 14-17; pl. xlix. figs. 14, 15.

Hab.—Largo Bay, 1890, and afterwards in other parts of the estuary, but nowhere very plentiful. The food in the stomachs of a sample of small plaice, *Pleuronectes platessa,* measuring off and on about 2 inches in length, sent from Annan on the Solway in 1900, consisted entirely of this species.

Genus (65) **Thompsonula,** T. Scott, 1905.

151. *Thompsonula hyænæ* (I. C. Thompson).

1889. *Jonesiella hyænæ,* I. C. Thompson, Proc. Biol. Soc. L—pool, vol. viii. p. 193, pl. ix. figs. 1-10.
1893. ,, ,, T. Scott, Eleventh F. B. Rept., pt. iii. p. 202, pl. iii. figs. 1-6.
1905. *Thompsonula hyænæ,* T. Scott, Ann. and Mag. Nat. Hist. (7), vol. xvi. p. 570.

Hab.—Dredged near the island of Fidra in February 1893, and later off Musselburgh; not common. The species appears to be widely distributed, but not very plentiful.

Genus (66) **Laophonte,** Philippi, 1840.

152. *Laophonte lamellifera* (Claus).

1863. *Cleta lamellifera,* Claus, Die frei-lebenden Copepoden, p. 123, pl. xv. figs. 21-25.
1880. *Laophonte lamellifera,* Brady, Monograph, vol. ii. p. 83, pl. lxxv. figs. 15-23.

Hab.—Dredged off Musselburgh; collected by hand-net in rock-pools between tide-marks at Cramond Island; and dredged at various other parts of the estuary; frequent.

153. *Laophonte curticauda*, Boeck.

1864. *Laophonte curticauda*, Boeck, Oversigt af Norges Copepoder, p. 65.
1880. ,, ,, Brady, *l. c.*, vol. ii. p. 80, pl. lxxiii. figs. 15-18; pl. lxxvi. figs. 1-9.

Hab.—Rock-pool on the shore, Cramond Island; dredged off North Berwick and in other parts of the estuary.

154. *Laophonte longicaudata*, Boeck.

1864. *Laophonte longicaudata*, Boeck, Oversigt af Norges Copepoder, p. 55.
1880. ,, ,, Brady, *l. c.*, vol. ii. p. 82, pl. lxxiv. figs. 12-15; pl. lxxvi. figs. 10-15.

Hab.—Dredged off St Monans in 1889; scarce.

155. *Laophonte longiremis*, T. Scott.

1905. *Laophonte longiremis*, T. Scott, Twenty-third F. B. Rept., pt. iii. p. 145, pl. xi. figs. 10-20.

Hab.—In an old quarry at Granton which is open to the sea, collected 25th August 1894. Apparently rare.

156. *Laophonte thoracica*, Boeck.

1864. *Laophonte thoracica*, Boeck, Oversigt af Norges Copepoder, p. 54.
1880. ,, ,, Brady, *l. c.*, vol. ii. p. 76, pl. lxxvii. figs. 1-8.

Hab.—Dredged in the neighbourhood of Inchkeith; off Musselburgh and other parts of the estuary; not very common.

157. *Laophonte similis*, Claus.

1866. *Laophonte similis*, Claus, Copepoden-Fauna von Nizza, p. 23, pl. v. figs. 13, 14.
1880. ,, ,, Brady, *l. c.*, vol. ii. p. 78, pl. lxxv. figs. 1-14.

Hab.—In rock-pools between tide-marks at Cramond Island and in one or two other places, but not common.

158. *Laophonte horrida* (Norman).

1876. *Cleta horrida*, Norman, Rept. of the "Valorous" Exped., Proc. Roy. Soc. London, 1876, p. 206.
1880. *Laophonte horrida*, Brady, *l. c.*, vol. ii. p. 74, pl. lxxiv. figs. 1-12.

Hab.—Dredged off St Monans, and at Station V., to the west of May Island; not common. Dredged at the west end of Station VI., 22nd May 1901.

159. *Laophonte denticornis*, T. Scott.

1890. *Laophonte serrata*, T. Scott (not Claus), Eighth F. B. Rept., pt. iii. p. 318.
1894. ,, *denticornis*, idem, Twelfth F. B. Rept., pt. iii. p. 246, pl. vii. figs. 13-23.

Hab.—Dredged off St Monans, 1889; dredged off Musselburgh, 30th May 1891; and at Station III. (near the west end, in 5 fathoms), 23rd May 1901.

160. *Laophonte inopinata*, T. Scott.

1892. *Laophonte inopinata*, T. Scott, Tenth F. B. Rept., pt. iii. p. 256, pl. xi. figs. 1-12.

Hab.—Off the west side of May Island. Several specimens were washed from a large "root" of sea-weed brought up in the trawl-net of the fishery cruiser "Garland" while at work in the neighbourhood of May Island in 1891; males and females carrying ovisacs were obtained. *L. inopinata* appears to be a rare species in the Forth.

161. *Laophonte intermedia*, T. Scott.

1895. *Laophonte intermedia*, T. Scott, Thirteenth F. B. Rept., pt. iii. p. 168, pl. iii. figs. 10-20.

Hab.—Shore at Musselburgh, in pools near low-water; dredged off the same place in 3 to 4 fathoms. Obtained also near Granton in an old quarry open to the sea. This is a distinct and easily recognised species.

162. *Laophonte littorale*, T. and A. Scott.

1893. *Laophonte littorale*, T. and A. Scott, Ann. and Mag. Nat. Hist. (6), vol. xii. p. 238, pl. xi. figs. 7-14.

Hab.—In brackish pools at the mouth of the Peffer Burn, near Aberlady.

163. *Laophonte gracilis*, T. Scott.

1903. *Laophonte gracilis*, T. Scott, Twenty-first F. B. Rept., pt. iii. p. 118, pl. vi. figs. 6-12.

Hab.—Collected by hand-net near Granton, in an old quarry open to the sea.

164. *Laophonte depressa*, T. Scott.

1894. *Laophonte depressa*, T. Scott, Twelfth F. B. Rept., pt. iii. p. 245, pl. vi. figs. 24-31; pl. vii. figs. 1-3.

Hab.—Off St Monans and Musselburgh; very sparingly in dredged material from both places.

165. *Laophonte hispida* (Brady and Robertson).

1873. *Asellopsis hispida*, B. and R., Ann. and Mag. Nat. Hist. (4), vol. xii. p. 137, pl. ix. figs. 6-10.

1880. *Laophonte hispida*, Brady, Monograph, vol. ii. p. 85, pl. lxxxi. figs. 1-11.

Hab.—Largo Bay, frequent; dredged also off Musselburgh and at various other parts of the estuary.

Genus (67) **Harrietella**,[1] T. Scott, 1906.

166. *Harrietella simulans*, T. Scott.

1894. *Laophonte simulans*, T. Scott, Twelfth F. B. Rept., pt. iii. p. 248, pl. vii. figs. 24-32; pl. viii. fig. 1.

1906. *Harrietella simulans*, T. Scott, Ann. and Mag. Nat. Hist. (7), vol. xvii. p. 464, pl. xi. figs. 9, 10.

Hab.—Off West Wemyss and other places. The first specimens were obtained inside the valves of a dead *Cyprina*, among trawl refuse; but specimens were found afterwards to be moderately frequent in the crevices of partly decayed pieces of wood brought up in the dredge or trawl-net.

Genus (68) **Laophontodes**, T. Scott, 1894.

167. *Laophontodes typicus*, T. Scott.

1894. *Laophontodes typicus*, T. Scott, Twelfth F. B. Rept., pt. iii. p. 249, pl. viii. figs. 2-8.

Hab.—Dredged at the north end of Inchkeith. This

[1] This genus has been named in complement to Miss Harriet Richardson, M.A., D.Phil., Washington, U.S.A., author of *A Monograph on the Isopods of North America*.

species, which is very small—scarcely $\frac{1}{60}$ of an inch in length—but quite distinct, is apparently very rare in the Firth of Forth. I have only met with it in the neighbourhood of Inchkeith; it seems, however, to have a fairly extensive distribution. Frequent in a gathering of small Crustacea from an old quarry at Granton collected in 1894.

Genus (69) **Normanella**, G. S. Brady, 1880.

168. *Normanella dubia* (Brady and Robertson).

1875. *Laophonte dubia*, B. and R., Brit. Assoc. Report for 1874, p. 196.
1880. *Normanella dubia*, Brady, Monograph, vol. ii. p. 87, pl. lxxviii. figs. 12-22.

Hab.—Dredged off Musselburgh ; not very rare, but easily overlooked.

169. *Normanella attenuata*, A. Scott.

1896. *Normanella attenuata*, A. Scott, Lancashire Sea-Fish Lab. Report for 1895, p. 47, pl. iv. figs. 8-20.
1902. ,, ,, T. Scott, Twentieth F. B. Rept., pt. iii. p. 464, pl. xxiii. figs. 2-4.

Hab.—Dredged off St Monans, in about 10 fathoms; rare. This species was described from specimens dredged off Spanish Head, Isle of Man, in 1895.

Genus (70) **Cletodes**, Brady, 1872.

170. *Cletodes limicola*, G. S. Brady.

1872. *Cletodes limicola*, Brady, Nat. Hist. Trans. Northumb. and Durham, vol. iv. p. 438, pl. xxi. figs. 10-17.
1880. ,, ,, idem, Monograph, vol. ii. p. 90, pl. lxxix. figs. 1-12.

Hab.—Dredged off North Berwick, off Musselburgh, and off the east side of Inchkeith, but not very common. It seems to be sparingly distributed throughout the estuary.

171. *Cletodes propinqua*, Brady and Robertson.

1876. *Cletodes propinqua*, B. and R., Brit. Assoc. Report for 1875, p. 196.
1880. ,, ,, Brady, Monograph, vol. ii. p. 94, pl. lxxvii. figs. 9-17.

Hab.—In pools between tide-marks at Newhaven and Cramond Island; also dredged off Musselburgh; not very common.

172. *Cletodes Sarsi*, T. Scott.

1905. *Cletodes Sarsi*, T. Scott, Twenty-third F. B. Rept., pt. iii. p. 146, pl. xii. figs. 1-9.

Hab.—Firth of Forth, 1901; rare. This species was one of several in a bottle containing specimens from various parts of the estuary collected during 1901.

173. *Cletodes curvirostris*, T. Scott.

1894. *Cletodes curvirostris*, T. Scott, Twelfth F. B. Rept., pt. iii. p. 250, pl. viii. figs. 18-26.

Hab.—Dredged in Largo Bay; dredged off the east side of Inchkeith, and a few other places; not very rare. In this species the rostrum is distinctly, though not strongly, recurved.

174. *Cletodes irrasa*, T. and A. Scott.

1894. *Cletodes irrasa*, T. and A. Scott, Ann. and Mag. Nat. Hist. (6), vol. xii. p. 141, pl. viii. figs. 8-12.

Hab.—Dredged in 1893 in the neighbourhood of the Bass Rock. It seems to be a rare species, as I have observed it on only one or two occasions since; but it has also been taken in the Clyde and the Moray Firth.

175. *Cletodes tenuipes*, T. Scott.

1897. *Cletodes tenuipes*, T. Scott, Fifteenth F. B. Rept., pt. iii. p. 170, pl. i. figs. 19-27.

Hab.—Off Musselburgh, dredged in 3 to 4 fathoms, in 1891; rare. The species was described from specimens taken in the Clyde in 1896. The Forth examples, which had been put aside when collected, were not identified till later.

176. *Cletodes lata,* T. Scott.

> 1892. *Cletodes lata,* T. Scott, Tenth F. B. Rept., pt. iii. p. 257, pl. x. figs. 10-18.

Hab.—Dredged off St Monans, off Musselburgh, and other parts of the estuary; not common.

177. *Cletodes similis,* T. Scott.

> 1895. *Cletodes similis,* T. Scott, Thirteenth F. B. Rept., pt. iii. p. 168, pl. iii. figs. 12-26; pl. iv. figs. 1-3.

Hab.—In the same gatherings with the last, as well as in pools between tide-marks, but always sparingly distributed. This species has a somewhat close resemblance to *C. lata,* and was at first regarded as a variety of it, but afterwards it was found to be quite distinct.

178. *Cletodes longicaudata,* Brady and Robertson.

> 1876. *Cletodes longicaudata,* B. and R., Brit. Assoc. Report for 1875, p. 196.
> 1880. ,, ,, Brady, Monograph, vol. ii. p. 92, pl. lxxix. figs. 13-19.
> 1902. ,, ,, T. Scott, Twentieth F. B. Rept., pt. iii. p. 465, pl. xxiii. figs. 26-33.

Hab.—Dredged off St Monans in 1889; dredged off the east side of Inchkeith in June 1901; rare.

179. *Cletodes neglecta,* T. Scott.

> 1903. *Cletodes neglecta,* T. Scott, Twenty-first F. B. Rept., pt. iii. p. 120, pl. iv. figs. 20-31.

Hab.—Dredged in Aberlady Bay in 1895; not common. This species, which has been known to me for a considerable time, is somewhat intermediate between *C. longicaudata* and *C. limicola;* the furcal joints are about half as long as those of *C. longicaudata;* it thus differs from both the species named. Though collected in 1895, this is the first time it has been recorded for the Forth. The species was described from Moray Firth specimens.

Genus (71) **Itunella**, Brady, 1894.

180. *Itunella tenuiremis* (T. Scott).

1893. *Cletodes tenuiremis*, T. Scott, Thirteenth F. B. Rept., pt. iii. p. 204, pl. iii. figs. 21-28.

1894. *Itunella subsalsa*, G. S. Brady, Nat. Hist. Trans. Northumb., Durh., and Newcastle-upon-Tyne, vol. xiii. p. 6, pl. i. (separate reprint).

Hab.—Dredged in the neighbourhood of Inchkeith in February 1893; and subsequently, but very sparingly, in several other places.

Genus (72) **Fultonia**, T. Scott, 1902.

181. *Fultonia hirsuta*, T. Scott.

1902. *Fultonia hirsuta*, T. Scott, Twentieth F. B. Rept., pt. iii. p. 466, pl. xxiii. figs. 5-12.

Hab.—Dredged very sparingly off St Monans, in 14 to 15 fathoms, on 22nd May 1901.

Genus (73) **Enhydrosoma**, Boeck, 1872.

182. *Enhydrosoma curvatum* (Brady and Robertson).

1876. *Rhizothrix curvata*, B. and R., Brit. Assoc. Report for 1875, p. 197.

1880. *Enhydrosoma curvatum*, Brady, Monograph, vol. ii. p. 98, pl. lxxxi. figs. 12-15; pl. lxxxii. figs. 11-19.

Hab.—Largo Bay and other parts of the estuary; moderately frequent.

183. *Enhydrosoma gracile*, T. Scott.

1903. *Enhydrosoma gracile*, T. Scott, Twenty-first F. B. Rept., pt. iii. p. 122, pl. ii. figs. 16-26; pl. iii. fig. 1.

Hab.—Musselburgh, pools on the shore near low-water; moderately rare. This is a smaller species than *E. curvatum*.

Genus (74) **Nannopus**, G. S. Brady, 1880.

184. *Nannopus palustris*, G. S. Brady.

1880. *Nannopus palustris*, Brady, *l. c.*, vol. ii. p. 101, pl. lxxvii. figs. 18-20.

1902. ,, ,, T. Scott, Twentieth F. B. Rept., pt. iii. p. 466, pl. xxiii. figs. 13-25.

Hab.—Brackish-water pools at the mouth of the Cocklemill

Burn at the east end of Largo Bay, also in shore-pools at Musselburgh, and in an old quarry near Granton which is open to the sea; not common.

Genus (75) **Platychelipus**, G. S. Brady, 1880.

185. *Platychelipus littoralis*, G. S. Brady.

1880. *Platychelipus littoralis*, Brady, *l. c.*, vol. ii. p. 103, pl. lxxix. figs. 20-23; pl. lxxx. figs. 15-19.
1893. ,, ,, T. Scott, Eleventh F. B. Rept., pt. iii. p. 205.

Hab.—Sparingly in a gathering of dredged material collected near Culross, and in an old quarry at Granton; dredged in shallow water off Musselburgh and in Aberlady Bay; scarce.

Genus (76) **Cylindropsyllus**, G. S. Brady, 1880.

186. *Cylindropsyllus lævis*, G. S. Brady.

1880. *Cylindropsyllus lævis*, Brady, *l. c.*, vol. iii. p. 30, pl. lxxxiv. figs. 1-8.
1892. ,, ,, T. Scott, Tenth F. B. Rept., pt. iii. p. 258, pl. xiii. figs. 1-18.

Hab.—Dredged off St Monans; frequent. I have found this species in other parts of the estuary, but much less frequently than in the "Fluke Hole" off St Monans.

187. *Cylindropsyllus minor*, T. Scott.

1892. *Cylindropsyllus minor*, T. Scott, *op. cit.*, p. 260, pl. xi. figs. 17-24.
1900. ,, ,, idem, Eighteenth F. B. Rept., pt. iii. p. 349, pl. xiv. figs. 23-32.

Hab.—Dredged off St Monans along with *C. lævis*, but not so common.

Genus (77) **Leptopontia**, T. Scott, 1902.

188. *Leptopontia curvicauda*, T. Scott.

1902. *Leptopontia curvicauda*, T. Scott, Twentieth F. B. Rept., pt. iii. p. 463, pl. xxii. figs. 26-35.

Hab.—Dredged off St Monans; not very common.

Genus (78) **Leptastacus**, T. Scott, 1906.

189. *Leptastacus macronyx*, T. Scott.

1892. *Tetragoniceps macronyx*, T. Scott, Tenth F. B. Rept., pt. iii. p. 253, pl. x. figs. 19-28.
1906. *Leptastacus macronyx*, T. Scott, Ann. and Mag. Nat. Hist. (7), vol. xvii. p. 461.

Hab.—Dredged off St Monans in 1891, and again in May 1901; not very common.

Genus (79) **Evansula**, T. Scott, nov. nom.

(Syn. *Evansia*, T. Scott, preoccupied for a genus of Spiders.[1])

190. *Evansula incerta*, T. Scott.

1892. *Tetragoniceps incertus*, T. Scott, Tenth F. B. Rept., pt. iii. p. 254, pl. xii. figs. 1-17.
1906. *Evansia incerta*, T. Scott, Ann. and Mag. Nat. Hist. (7), vol. xvii. p. 461.

Hab.—Dredged off St Monans in 1891, and again in May 1901; not common.

191. *Evansula pygmæa*, T. Scott.

1903. *Tetragoniceps pygmæus*, T. Scott, Twenty-first F. B. Rept., pt. iii. p. 117, pl. iv. figs. 11-19.
1906. *Evansia pygmæa*, T. Scott, Ann. and Mag. Nat. Hist. (7), vol. xvii. p. 461.

Hab.—Collected near Musselburgh in 1894. This differs from the last by its smaller size, and in the structure of fifth thoracic feet and caudal joints.

[1] In the *Annals and Magazine of Natural History* for May 1906 I instituted a genus of the Copepoda under the name of *Evansia*, in compliment to William Evans, Edinburgh, a successful investigator in various departments of Scottish natural history. I find, however, that the name *Evansia* is preoccupied for a genus of spiders, described by the Rev. O. Pickard Cambridge in *Proc. Dorset Nat. Hist. and Antiquarian Field Club*, vol. xxi. p. 37, and I therefore adopt the modified form *Evansula* for the Copepod genus referred to.

Genus (80) **Tetragoniceps**, G. S. Brady, 1880.

192. *Tetragoniceps* (?) *maleolata*, G. S. Brady.

1880. *Tetragoniceps maleolata*, Brady, Monograph, vol. ii. p. 66, pl. lxxviii. figs. 1-11.
1892. ,, (?) ,, T. Scott, Tenth F. B. Rept., pt. iii. p. 252, pl. viii. figs. 11, 12.
1900. ,, ,, idem, Eighteenth F. B. Rept., pt. iii. p. 391, pl. xiv. figs. 9-17.

Hab.—Dredged off St Monans in 1892, apparently not very rare; and again on 22nd May 1901, several specimens were obtained. This form differs from the *T. maleolata* described by Dr Brady in the structure of fifth pair of thoracic feet, but is otherwise identical with it.

193. *Tetragoniceps brevicauda*, T. Scott.

1900. *Tetragoniceps brevicauda*, T. Scott, Eighteenth F. B. Rept., pt. iii. p. 392, pl. xiv. figs. 18-22.

Hab.—This species was obtained somewhat sparingly in material dredged off St Monans in 1896, and again in 1901. It has a general resemblance to *T. maleolata*, but the furcal joints are distinctly shorter.

Genus (81) **Phyllopodopsyllus**, T. Scott, 1896.

194. *Phyllopodopsyllus Bradyi*, T. Scott.

1892. *Tetragoniceps Bradyi*, T. Scott, Tenth F. B. Rept., pt. iii. p. 253, pl. lix. figs. 19-32.
1906. *Phyllopodopsyllus Bradyi*, T. Scott, Ann. and Mag. Nat. Hist. (7), vol. xvii. p. 459.

Hab.—Dredged off St Monans in 1891, and again in 1901; apparently rare. This species and the next are easily distinguished by the large size and leaf-like form of the fifth pair of thoracic feet of the female.

Genus (82) **Pteropsyllus**, T. Scott, 1906.

195. *Pteropsyllus consimilis*, T. Scott.

1894. *Tetragoniceps consimilis*, T. Scott, Twelfth F. B. Rept., pt. iii. p. 244, pl. vii. figs. 4-12.
1906. *Pteropsyllus consimilis*, T. Scott, Ann. and Mag. Nat. Hist. (7), vol. xvii. p. 459, pl. xi. figs. 7, 8.

Hab.—Dredged off St Monans; rare. This species is similar in its general appearance to *T. Bradyi*, but there are a few structural differences, one of the most important being the three-jointed inner branches of the first pair of thoracic feet: in *T. Bradyi* these branches are only two-jointed.

Genus (83) **Leptopsyllus**, T. Scott, 1894.

196. *Leptopsyllus typicus*, T. Scott.

1894. *Leptopsyllus typicus*, T. Scott, Twelfth F. B. Rept., pt. iii. p. 254, pl. ix. figs. 2-11.

Hab.—West of Queensferry, washed from lumps of hardened mud, which were composed for the most part of the agglutinated tubes of a species of *Sabella*, collected 25th January 1894; rare.

197. *Leptopsyllus Robertsoni*, T. and A. Scott.

1895. *Leptopsyllus Robertsoni*, T. and A. Scott, Ann. Scot. Nat. Hist. (January 1895), p. 30, pl. ii. figs. 1-14.

Hab.—In pools between tide-marks at Musselburgh, 20th August 1894; rare.

198. *Leptopsyllus minor*, T. and A. Scott.

1895. *Leptopsyllus minor*, T. and A. Scott, *op. cit.*, p. 31, pl. ii. figs. 15-22.

Hab.—In pools between tide-marks at Musselburgh, taken at the same time as *L. Robertsoni;* moderately rare.

199. *Leptopsyllus intermedius*, T. and A. Scott.

1895. *Leptopsyllus intermedius*, T. and A. Scott, Ann. and Mag. Nat. Hist. (6), vol. xv. p. 51, pl. v. figs. 1-11.

Hab.—In pools between tide-marks at Musselburgh, in company with *L. minor*, *L. Robertsoni*, and a few of the other rare things mentioned elsewhere in this Catalogue. This species appeared to be rather more frequent than the other two.

Genus (84) **Paramesochra**, T. Scott, 1892.

200. *Paramesochra dubia*, T. Scott.

1892. *Paramesochra dubia*, T. Scott, Tenth F. B. Report, pt. iii. p. 252, pl. xii. figs. 18-32.

Hab.—Dredged off the west side of May Island in February

1892, and off St Monans, in 13 fathoms, on 22nd May 1901. This curious form was also taken near Port Erin, Isle of Man, by the late I. C. Thompson of Liverpool.

Division CYCLOPOIDA.

Family CYCLOPIDÆ.

Genus (85) **Oithona**, Baird, 1843.

201. *Oithona similis*, Claus.

1866. *Oithona similis*, Claus, Copepoden-Fauna von Nizza, p. 14.

Hab.—Generally distributed in the Firth of Forth, and sometimes common. This is the form which, in my earlier papers on "Scottish Marine Copepoda," is recorded under the name of *Oithona spinifrons*, Boeck.

202. *Oithona* (?) *setigera*, Dana.

1849. *Oithona setigera*, Dana, U.S. Explor. Exped. [Amer. Jour. Sci. (2), vol. viii.].
1892. ,, ,, Giesb., Fauna u. Flora Golfes v. Neapel; Monogr. xix.—Pelag. Copep., p. 548, pl. xxxiv. figs. 3, 14, 41 *et seq.*

Hab.—Obtained in a bottom tow-net gathering collected east of Inchkeith in March 1891, and again on 22nd April 1901.

Genus (86) **Cyclopina**, Claus.

203. *Cyclopina gracilis*, Claus.

1863. *Cyclopina gracilis*, Claus, Die frei-lebenden Copepoden, p. 104, pl. x. figs. 9-15.
1878. ,, ,, Brady, Monograph, vol. i. p. 93, pl. xxiv. figs. 1-9; vol. ii. pl. xci. figs. 10, 11.
1900. ,, ,, Giesb., Mitth. über Copep., Mitth. a. d. Zool. Station z. Neapel, Bd. 14, p. 45.

Hab.—Generally, though somewhat sparingly, distributed in the Firth of Forth. I have taken it as far west as Charlestown, as well as near the outside limits of the estuary.

204. *Cyclopina littoralis* (G. S. Brady).

1872. *Cyclops littoralis*, Brady, Nat. Hist. Trans. Northumb. and Durham, vol. iv. p. 429, pl. xvii. figs. 9-14.
1878. *Cyclopina littoralis*, idem, Monograph, vol. i. p. 92, pl. xv. figs. 1-9.
1900. ,, ,, Giesb., Mitth. über Copep., Mitth. a. d. Zool. Station z. Neapel, Bd. 14, p. 43, pl. iii. figs. 1-13.

Hab.—Collected at Cramond Island in rock-pools; dredged off Musselburgh and other parts of the estuary, especially in the littoral and laminarian zones; not uncommon.

205. *Cyclopina elegans*, T. Scott.

1894. *Cyclopina elegans*, T. Scott, Twelfth F. B. Rept., pt. iii. p. 237, pl. v. figs. 9-19.
1900. ,, ,, Giesb., Mitth. über Copep., Mitth. a. d. Zool. Station z. Neapel, Bd. 14, p. 44, pl. iii. figs. 14-22.

Hab.—This species has been taken off St Monans, but not common.

Genus (87) **Pterinopsyllus**, G. S. Brady, 1880.

(Syn. *Lophophorus*, Brady, 1878, a name preoccupied by Temminck in 1815 for a genus of Birds.)

206. *Pterinopsyllus insignis*, G. S. Brady.

1878. *Lophophorus insignis*, G. S. Brady, Monograph, vol. i. p. 122, pl. xiii. figs. 1-10; pl. xv. fig. 10.
1880. *Pterinopsyllus insignis*, idem, *ibidem*, vol. iii. p. 23.

Hab.—This species was on several occasions observed moderately frequent in dredged material collected to the west of Queensferry, but appeared to be rare near the seaward limits of the estuary.

Genus (88) **Cyclops**, O. F. Müller, 1776.

The members of this genus are, with few exceptions, fresh-water or brackish-water species. Those recorded here may be conveniently arranged according to the number of joints in the antennules.

(*a*) Species with Seventeen-Jointed Antennules.

207. *Cyclops strenuus*,[1] Fischer.

1851. *Cyclops strenuus*, Fischer, Bull. Soc. Imp. des Nat. Moscou, vol. xxiv. p. 419, taf. ix. figs. 12-21.

Hab.—Duddingston Loch, and most of the other lochs within the district, where it occurs nearly all the year round. *Cyclops pulchellus* and *Cyclops abyssorum* are other names by which the species is known.

208. *Cyclops Leuckarti*, Claus.

1857. *Cyclops Leuckarti*, Claus, Das gen. Cycl., Archiv. f. Naturg., Jahrg. xxiii. Bd. 1, p. 35, taf. ii. figs. 13, 14.
1897. ,, ,, T. Scott, Fifteenth F. B. Rept., pt. iii. p. 322, pl. ix. figs. 23-25.

Hab.—Loch Vennachar and Loch Voil, Perthshire; frequent. (See also note on this species in Appendix, p. 380.)

209. *Cyclops bicuspidatus*, Claus.

1857. *Cyclops bicuspidatus*, Claus, *op. cit.*, p. 209, taf. xi. figs. 6 and 7.
1892. ,, ,, Schmeil, Deutschl. freileb. Süssw.-Copep. (Cyclopidæ), p. 75, taf. ii. figs. 1-3.

Hab.—Loch Achray (Trossachs), Loch Leven, Duddingston Loch, ponds on the Braid Hills, Edinburgh (April 1888), as well as in other lochs and ponds throughout the district, but usually not very common.

210. *Cyclops vernalis*, Fischer.

1853. *Cyclops vernalis*, Fischer, Bull. Soc. Imp. des Nat. Moscou, vol. xxvi. p. 90, taf. iii. figs. 1-5.
1891. ,, *elongatus*, G. S. Brady, Revis. Brit. Cyclopidæ and Calanidæ, p. 5, pl. i. figs. 1-5.
1892. ,, *vernalis*, Schmeil, *l. c.*, p. 88, taf. ii. figs. 4-7.

Hab.—The distribution of this species is somewhat similar

[1] *Cyclops Ewarti*, Brady, was described in the *Sixth Annual Report of the Fishery Board for Scotland*, p. 232, pl. viii. figs. 1-6, from specimens obtained above Queensferry. I am now inclined to consider this as representing a scarcely mature stage of *C. strenuus*, Fischer.

to that of *C. bicuspidatus.* It has been obtained in several localities near Edinburgh, *i.e.*, Upper Elf Loch, Braids (Scott and Lindsay), and pond at Bonaly Golf Course (Dr and Miss Sprague). Ben Ledi, at 2500 feet (W. Evans).

211. *Cyclops bisetosus,* Rehberg.

1880. *Cyclops bisetosus,* Rehberg, Beitrag. z. Kenntnis der freileb. Süssw.-Copep., Abhand. d. Natur. Ver. zu Bremen, vol. vii. p. 533, pl. iv.

1901-1902. ,, ,, Dr and Miss Sprague, Entom. of Midlothian, Trans. Edin. Field Natur., vol. iv. p. 255, pl. xxxi. figs. 18-22.

Hab.—Loch Achray, Loch Leven, and Duddingston Loch. Pond on House-o'-Hill Farm, Midlothian (Dr and Miss Sprague).

212. *Cyclops viridis* (Jurine).

1820. *Monoculus quadricornis* var. *viridis,* Jurine, Hist. des Monocles, p. 46, pl. iii. fig. 1.

1878. *Cyclops gigas,* G. S. Brady, Monograph, vol. i. p. 105, pl. xx. figs. 1-16.

Hab.—Loch Katrine, Loch Leven, Duddingston Loch, etc. Burntisland Reservoir and Loch a Chroin (Evans). A common and generally distributed species.

213. *Cyclops signatus,* Koch.

1820. *Monoculus quadricornis fuscus,* Jurine, *l. c.*, p. 47, pl. ii. fig. 2.

1838. *Cyclops signatus,* Koch, Deutschlands Crustaceen, Myriapoden, und Arachniden, Heft. 21, fig. 8.

Hab.—Loch Katrine, Loch Achray, Loch Lubnaig, Perthshire. Ravelston Cottage Quarry, May 1900 (Dr and Miss Sprague). Side of river Teith, near Callander (W. Evans).

214. *Cyclops annulicornis,* Koch.

1820. *Monoculus quadricornis albidus,* Jurine, *l. c.*, p. 44, pl. ii. figs. 10 and 11.

1838. *Cyclops annulicornis,* Koch, Deutschlands Crustaceen, Myriapoden, und Arachniden, Heft. 21, pl. vi.

Hab.—This is a common and generally distributed species throughout the entire area.

(*b*) Species with Sixteen-Jointed Antennules.

215. *Cyclops languidus*, G. O. Sars.

1863. *Cyclops languidus*, G. O. Sars, Forhandl. Vidensk.-Selsk. i Christiania, p. 249.
1901-1902. ,, ,, Dr and Miss Sprague, *l. c.*, p. 255, pl. xxxi. figs. 1-7.

Hab.—This species, which was observed for the first time in Scotland in Loch Doon, in Ayrshire,[1] was obtained in a pond near Tynehead, Midlothian, on 30th March 1901 (Dr and Miss Sprague).

(*c*) Species with Twelve-Jointed Antennules.

216. *Cyclops serrulatus*, Fischer.

1851. *Cyclops serrulatus*, Fischer, Bull. Soc. imp. des Natur. Moscou, vol. xxiv. (2) p. 423, pl. x. figs. 22, 23, 26-31.

Hab.—The *Cyclops*, generally referred to as "*Cyclops serrulatus*, Fischer," is common in lochs and ponds throughout the district. A form with short furcal joints, which appears to be the var. *brachyurus* of *Cyclops varius*, Lilljeborg, has been observed in Duddingston Loch and other places. Another form with the furcal joints elongated, and which may be the var. *speratus* of the same species, has also been observed, but they approximate so closely to the species described by Fischer, that I prefer, for the present, to regard them as varieties of that species.

217. *Cyclops macrurus*, G. O. Sars.

1863. *Cyclops macrurus*, G. O. Sars, *l. c.*, p. 254.
1878. ,, ,, G. S. Brady, Monograph, vol. i. p. 111, pl. xxiv. figs. 1-5.

Hab.—Loch Vennachar, Loch Katrine, Loch Leven, Black Loch near Loch Glow (Kinross-shire), and Loch Lubnaig.

[1] Cf. *Seventeenth Annual Report of the Fishery Board for Scotland*, pt. iii. p. 187 (1899).

(*d*) Species with Eleven-Jointed Antennules.

218. *Cyclops affinis*, G. O. Sars.

1863. *Cyclops affinis*, G. O. Sars, *l. c.*, p. 256.
1878. ,, ,, Brady, Monograph, vol. i. p. 112, pl. xv. figs. 11-14; pl. xxiv. figs. 10-15.

Hab.—Raith Lake, near Kirkcaldy, Fifeshire, 1890. Elf Loch, and ponds in Penicuik grounds, 1900 (Dr and Miss Sprague). Humbie Reservoir, near Winchburgh, June 1906 (W. Evans).

219. *Cyclops diaphanus*, Fischer.

1853. *Cyclops diaphanus*, Fischer, *l. c.*, vol. xxvi. p. 93, pl. iii. figs. 6-12.
1863. ,, *nanus*, G. O. Sars, *l. c.*, p. 42.
1899. ,, ,, T. Scott, Seventeenth F. B. Rept., pt. iii. pp. 141, 172, 187.
1901. ,, *diaphanus*, Lillj., Kongl. Sv. Vet.-Handlingar, vol. xxxv. No. 4, p. 63, pl. iv. figs 13-15.
1901-1902. ,, *nanus*, Dr and Miss Sprague, Trans. Edin. Field Naturalists, vol. iv. p. 256, pl. xxxiA. figs. 7-12.

Hab.—This small species, first added to the British fauna in 1899, was obtained at Auchencorth Moss, Midlothian, in April 1901, by Dr and Miss Sprague.

(*e*) Species with Ten-Jointed Antennules.

220. *Cyclops phaleratus*, Koch.

1838. *Cyclops phaleratus*, Koch, Deutschl. Crustaceen, Heft 21, pl. ix.
1878. ,, ,, Brady, Monograph, vol. i. p. 116, pl. xxiii. figs. 7-13.

Hab.—Duddingston Loch; Lochgelly Loch and Raith Lake, Fifeshire. Marl-pit, Davidson's Mains, near Edinburgh, June 1900 (Dr and Miss Sprague). This species also occurs in some material from the marl-pit collected by myself in May 1888. Teith at Callander (Evans).

(*f*) Species with Eight-Jointed Antennules.

221. *Cyclops fimbriatus*, Fischer.

1853. *Cyclops fimbriatus*, Fischer, *l. c.*, p. 94, pl. iii. figs. 19-28 and 30.
1878. ,, *crassicornis*, Brady, Monograph, vol. i. p. 118, pl. xxiii. figs. 1-6.

Hab.—Moderately common in ponds and lakes throughout the district.

Genus (89) **Halicyclops**, Norman, 1903.

222. *Halicyclops æquoreus* (Fischer).

1860. *Cyclops æquoreus*, Fischer, Abhandl. Math. Classe der Königl. Bayer. Akad. der Wiss. München, vol. viii. (3) p. 654, pl. xx. figs. 26-29.
1878. ,, ,, Brady, Monograph, vol. i. p. 119, pl. xix. figs. 8-10; pl. xxi. figs. 10-17.

Hab.—Cramond Island, in pools above high-tide mark, 1888; and in brackish-water pools at Aberlady in May 1895. Dr and Miss Sprague have also collected this species in a rock-pool on Cramond Island in July 1901.

Genus (90) **Euryte**, Philippi, 1843.

223. *Euryte longicauda*, Philippi.

1843. *Euryte longicauda*, Philippi, Archiv. fur Naturh., Jahrg. 9, p. 63, pl. iii. fig. 3, *a-d.*
1864. *Thorellia brunnea*, Boeck, Översigt Norges Copepoder, p. 26.
1872. ,, ,, Brady, *op. cit.*, vol. i. p. 95, pl. xvi. figs. 1-10.

Hab.—Moderately frequent throughout the estuary.

Family Lichomolgidæ.

For further information concerning the Lichomolgidæ and Hersiliidæ, the reader is referred to Dr Canu's work, *Les Copepodes du Boulonnais.*

Genus (91) **Lichomolgus**, Thorell, 1859.

224. *Lichomolgus fucicolus*, G. S. Brady.

1880. *Lichomolgus fucicolus*, Brady, Monograph, vol. iii. p. 41, pl. lxxxv. figs. 1-11.

Hab.—Firth of Forth; moderately rare. It has usually been obtained in shallow inshore water, amongst Laminaria, etc.

225. *Lichomolgus furcillatus*, Thorell.

1859. *Lichomolgus furcillatus*, Thorell, Om Krustaceer i Ascidier, p. 74, taf. 13, fig. 30.
1880. „ „ Brady, *l. c.*, vol. iii. p. 49, pl. lxxxviii. figs. 10-14.

Hab.—Collected near May Island and in the vicinity of Inchkeith, in the branchial cavity of large Ascidians; not common.

226. *Lichomolgus hirsutipes*, T. Scott.

1893. *Lichomolgus hirsutipes*, T. Scott, Eleventh F. B. Rept., pt. iii. p. 206, pl. iv. figs. 1-12.

Hab.—Taken with the dredge a short distance north of the Bass Rock, and off the North Craig; rather rare. On one occasion I found a considerable number of specimens adhering to the outside surface of the tubes of a large species of *Sabella* brought up on the hooks when line-fishing in 1895, in 15 to 20 fathoms, where the bottom consisted of mud. The Copepods were white, and therefore easily noticed on the mud-tubes made by the Annelids.[1]

227. *Lichomolgus agilis* (Leydig).

1853. *Doridicola agilis*, Leydig, Zeitschr. f. Wiss. Zool., Bd. 4, p. 377, taf. 14.
1892. *Lichomolgus agilis*, Canu, Les Copep. du Boulonnais, p. 228, pl. xxii. figs. 1-14.
1892. „ *concinnus*, T. Scott, Tenth F. B. Rept., pt. iii. p. 261, pl. ii. figs. 25-33.

Hab.—Dredged off St Monans in 1891; rare. Taken also

[1] *Ann. Scot. Nat. Hist.* (October 1895), p. 238.

in the neighbourhood of Granton in 1893, on the branchial appendages of *Doris* (?) *tuberculatus*.[1]

Genus (92) **Pseudanthessius**, Claus, 1889.

228. *Pseudanthessius gracilis*, Claus.

1889. *Pseudanthessius gracilis*, Claus, Arb. Zool. Inst. Wien., t. viii. p. 344, taf. 4, figs. 1-7.
1893. ,, ,, T. and A. Scott, Ann. and Mag. Nat. Hist. (6), vol. xii. p. 241, pl. xii. figs. 15-20.

Hab.—Dredged off Musselburgh in 1891; not common.

229. *Pseudanthessius liber* (Brady and Robertson).

1876. *Lichomolgus liber*, B. and R., Brit. Assoc. Rept. for 1875, p. 197.
1880. ,, ,, Brady, Monograph, vol. iii. p. 44, pl. lxxxvi. fig. 197.

Hab.—Dredged very sparingly off the north end of Inchkeith in 1894. Also dredged in the neighbourhood of Inchkeith on 23rd May, and off North Craig on 4th July 1901.

230. *Pseudanthessius Thorelli* (Brady and Robertson).

1876. *Lichomolgus Thorelli*, B. and R., Brit. Assoc. Rept. for 1875, p. 197.
1880. ,, ,, Brady, *l. c.*, vol. iii. p. 47, pl. lxxxviii. figs. 1-9.

Hab.—Dredged very sparingly off St Monans in 1893-1894. Also off the east side of Inchkeith on 23rd May 1901; rare.

231. *Pseudanthessius Sauvagei*, Canu.

1891. *Pseudanthessius Sauvagei*, Canu, Bull. Sci. France et Belgique, vol. xxiii. p. 481.
1894. ,, ,, T. and A. Scott, Ann. and Mag. Nat. Hist. (6), vol. xii. p. 146.

Hab.—Dredged off St Monans in 1894; rare. During 1895 the fishery steamer "Garland" was engaged in some line-fishing experiments, when various things were brought up on the hooks, and the common Sea-Urchin, *Echinus*

[1] *Ann. and Mag. Nat. Hist.* (6), vol. ii. (March 1893) p. 212, pl. vii. figs. 12-15.

esculentus, among others. Some of these urchins I put into a bottle containing strong methylated spirit; after washing them in this spirit, an examination of the residue revealed a considerable number of specimens of this rare Copepod, and of little else.

Genus (93) **Modiolicola**, Aurivilius, 1883.

232. *Modiolicola insignis*, Aurivilius.

1883. *Modiolicola insignis*, Aur., Akad. Afhandl. Stockholm (1883), pp. 10 and 39, taf. 2, figs. 1-10; taf. 4, figs. 13-16.
1893. ,, ,, T. Scott, Eleventh F. B. Rept., pt. iii. p. 207, pl. iv. figs. 13-24.

Hab.—Frequent in the shells of living "Horse Mussels," *Mytilus modiolus*. The species was obtained in most of the large mussels examined.

Genus (94) **Herrmannella**, Canu, 1891.

233. *Herrmannella rostrata*, Canu.

1891. *Herrmannella rostrata*, Canu, Bull. Sci. France et Belgique, t. xxiii. p. 480.
1892. ,, ,, idem, Les Copep. du Boulonnais, p. 236, pl. xxiv. figs. 1-13.
1892. *Lichomolgus agilis*, T. and A. Scott, Ann. and Mag. Nat. Hist. (6), vol. x. p. 201, pl. xv. figs. 1-14.

Hab.—Frequent in the shells of living Cockles, *Cardium edule*, found in the cockle-beds at Cramond.

234. *Herrmannella maxima* (I. C. Thompson).

1893. *Lichomolgus maximus*, I. C. T., Trans. L—pool Biol. Soc., vol. vii. p. 34, pl. xxxv.

Hab.—Frequent in the shells of the Clam, *Pecten opercularis*, dredged on the clam-beds to the east of Inchkeith, but this Copepod was first observed by I. C. Thompson in the shell of living *Pecten maximus*, hence its name. This is not a true *Lichomolgus*, and as it agrees very closely with *Herrmannella*, I place it meanwhile under that genus.

235. *Herrmannella arenicola* (G. S. Brady).

1872. *Boeckia arenicola*, Brady, Nat. Hist. Trans. Northumb. and Durham, vol. iv. p. 430.
1880. *Lichomolgus arenicolus*, idem, Monograph, vol. iii. p. 46, pl. lxxxvii. figs. 1-7.
1892. ,, ,, T. and A. Scott, Ann. Scot. Nat. Hist. (July 1892), p. 151, pl. vii. figs. 1-10.

Hab.—Dredged off St Monans in 1891; rare.

Genus (95) **Sabelliphilus**, M. Sars, 1862.

236. *Sabelliphilus Sarsi*, Claparède.

1870. *Sabelliphilus Sarsi*, Clap., Ann. des Sci. Nat. (5), vol. xiii. p. 6, pl. vii.
1887. *Lichomolgus sabellæ*, I. C. Thompson, Proc. L—pool Biol. Soc., vol. ii. p. 68, pl. ii.

Hab.—Collected off St Monans, 7th July 1897, on the plumes of *Sabella* sp. (? *S. pavonina*); rare.

Family Clausiidæ.

Genus (96) **Hersiliodes**, Canu, 1888.

237. *Hersiliodes aberdonensis* (T. and A. Scott).

1892. *Lichomolgus aberdonensis*, T. and A. Scott, Ann. Scot. Nat. Hist. (July 1892), p. 149, pl. vi. figs. 1-12.

Hab.—Dredged off the east side of Inchkeith on 23rd May 1901. The specimens from which the species was described in 1892 were obtained in a tow-net gathering collected in Aberdeen Bay.

238. *Hersiliodes littoralis* (T. Scott).

1892. *Lichomolgus littoralis*, T. Scott, Tenth F. B. Rept., pt. iii. p. 260, pl. x. figs. 1-9.

Hab.—Collected in the neighbourhood of Culross in 1891. This appears to be a rare species in the Forth estuary, and is probably parasitic on some other invertebrate.

Family ASTEROCHERIDÆ.[1]

Genus (97) Asterocheres, Boeck, 1859.

239. *Asterocheres Lilljeborgi*, Boeck.

1859. *Asterocheres Lilljeborgi*, Boeck, Forhandl. Vid.-Selsk. Chr. (1859), p. 6, pl. ii. figs. 1-11.
1880. *Artotrogus Lilljeborgi*, Brady, Monograph, vol. iii. p. 64.

Hab.—Firth of Forth; rare (cf. Giesbrecht, *Asterocheridæ*, pp. 70 and 73).

240. *Asterocheres echinicola* (Norman).

1869. *Ascomyzon echinicola*, Norman, Brit. Assoc. Rept. for 1868, p. 300.
1880. *Cyclopicera lata*, Brady, *l. c.*, vol. iii. p. 56, pl. lxxxix. fig. 12; pl. xc. figs. 11-14.
1893. ,, ,, T. Scott, Eleventh F. B. Rept., pt. iii. p. 210, pl. iii. figs. 41 and 42.

Hab.—Obtained, in 1889, by washing a number of Sponges in methylated spirit; the sponges were dredged in Aberlady Bay.

241. *Asterocheres Boeckii* (G. S. Brady).

1880. *Artotrogus Boeckii*, Brady, *l. c.*, vol. iii. p. 60, pl. xci. figs. 1-9.

Hab.—Obtained at Granton Harbour in the water-passages of Sponges (*Chalina oculata*) growing on the walls of the pier; frequent.

[1] In *Fauna und Flora des Golfes von Neapel*, Monograph 25, the Asterocheridæ, by Dr W. Giesbrecht (1899), the Forth species belonging to this family are for the most part described and figured by the author; and he also refers to their Scottish habitats in his remarks on the distribution of the various forms. The reader should consult this fine work, which contains a full synonymy and other information.

Genus (98) **Dermatomyzon**, Claus, 1889.

242. *Dermatomyzon nigripes* (Brady and Robertson).

1876. *Cyclopicera nigripes*, B. and R., Brit. Assoc. Rept. for 1875, p. 197.
1880. ,, ,, Brady, *l. c.*, vol. iii. p. 54, pl. lxxxix. figs. 1-11.
1892. ,, ,, T. Scott, Tenth F. B. Rept., pt. iii. p. 267.

Hab.—Collected in the neighbourhood of May Island in 1892. Dredged at Station I. on 30th August 1894, and subsequently captured at a few other places, but always very sparingly.

Genus (99) **Rhynchomyzon**, Giesbrecht, 1895.

243. *Rhynchomyzon purpurocinctum* (T. Scott).

1893 *Cyclopicera purpurocincta*, T. Scott, Eleventh F. B. Rept., pt. iii. p. 209, pl. iii. figs. 29-40.

Hab.—Dredged on the "Rath ground," to the north of the Bass Rock, on 20th November 1889, and off the east side of Inchkeith on 23rd May 1901. This species, which appears to be rare in the Forth estuary, has a wide distribution, having been recorded not only from various parts of the British seas, but also from the Gulf of Naples.

Genus (100) **Collocheres**, Canu, 1893.

244. *Collocheres gracilicauda* (G. S. Brady).

1880. *Cyclopicera gracilicauda*, Brady, *l. c.*, vol. iii. p. 58, pl. lxxxiii. figs. 1-10.

Hab.—Dredged off St Monans; rare.

Genus (101) **Scottomyzon**, Giesbrecht, 1897.

245. *Scottomyzon gibberum* (T. and A. Scott).

1894. *Dermatomyzon gibberum*, T. and A. Scott, Ann. and Mag. Nat. Hist. (6), vol xii. p. 144, pl. ix. figs. 10-14.
1894. ,, ,, T. Scott, Twelfth F. B. Rept., pt. iii. p. 260, pl. x. figs. 26-34.

Hab.—Dredged in the neighbourhood of the Bass Rock in

1893. In 1895 a number of specimens—adults and young—were obtained by washing specimens of the common Starfish, *Asterias rubens,* in a bottle containing methylated spirit, and afterwards examining the residue. These specimens were of a brick-red colour on the back, but nearly white beneath. Their normal habitat is apparently on this kind of starfish.

Genus (102) **Acontiophorus,** Brady, 1880.

246. *Acontiophorus scutatus* (Brady and Robertson).

1873. *Solenostoma scutatum,* B. and R., Ann. and Mag. Nat. Hist. (4), vol. xii. p. 141.
1880. *Acontiophorus scutatus,* Brady, *l. c.,* vol. iii. p. 69, pl. xc. figs. 1-10.

Hab.—Collected near Inchkeith in 1888. Off Musselburgh, dredged 30th May 1891, and subsequently collected in various other parts of the estuary; moderately frequent.

247. *Acontiophorus ornatus* (Brady and Robertson).

1876. *Ascomyzon ornatum,* B. and R., Brit. Assoc. Rept. for 1875, p. 197.
1880. *Acontiophorus armatus,* Brady, *l. c.,* vol. iii. p. 71, pl. lxxxvii. figs. 8-15.

Hab.—Dredged off North Craig on 4th July 1901; rare.

Genus (103) **Scottocheres,** Giesbrecht, 1897.

248. *Scottocheres elongatus* (T. and A. Scott).

1894. *Acontiophorus elongatus,* T. and A. Scott, Ann. and Mag. Nat. Hist. (6), vol. xii. p. 145, pl. ix. figs. 15-20.
1898. *Scottocheres elongatus,* T. Scott, Sixteenth F. B. Rept., pt. iii. p. 278, pl. xiii. figs. 10-21.

Hab.—Obtained in 1893 in material dredged in the neighbourhood of the Bass Rock; frequent.

Genus (104) **Cribropontius**, Giesbrecht, 1899.

249. *Cribropontius Normani* (Brady and Robertson).

1876. *Dyspontius Normani*, B. and R., Brit. Assoc. Rept. for 1875, p. 197.

1880. *Artotrogus Normani*, Brady, *l. c.*, vol. iii. p. 63, pl. xci. figs. 12-15; pl. xcii. fig. 10.

1897. *Bradypontius Normani*, T. Scott, Fifteenth F. B. Rept., pt. iii. p. 154, pl. ii. figs. 1 and 2; pl. iii. figs. 1-11.

Hab.—Taken off the North Craig in material dredged on 4th July 1901; rare. This large and sometimes higbly-coloured species appears to be rare in Firth of Forth.

Genus (105) **Bradypontius**, Giesbrecht, 1895.

250. *Bradypontius magniceps* (G. S. Brady).

1880. *Artotrogus magniceps*, Brady, *l. c.*, vol. iii. p. 61, pl. xciii. figs. 1-9.

Hab.—Dredged west of Queensferry in 1888, and at the north-west end of Inchkeith on 23rd May 1901. Several fine specimens were obtained in material dredged off the North Craig on 4th July 1901, when a few of the females were found with ovisacs attached.

251. *Bradypontius papillatus* (T. Scott).

1888. *Artotrogus papillatus*, T. Scott, Sixth F. B. Rept., pt. iii. p. 232, pl. viii. figs. 7-12.

1899. *Bradypontius chelifer*, Giesbrecht, Fauna u. Flora Golfes v. Neapel, Monogr. 25 (Asterocheridæ), p. 88, pl. vi. figs. 15-25.

1899. *Bradypontius papillatus*, T. Scott, Seventeenth F. B. Rept., pt. iii. p. 262, pl. xi. fig. 21; pl. xii. figs. 7-15

Hab.—Dredged in the neighbourhood of Inchkeith in 1888; apparently very rare. The specimen from which the description and drawings were prepared is the only one that has yet been observed in the Forth estuary. This specimen is, I think, certainly identical with the *Bradypontius chelifer* described by Dr Giesbrecht in his fine work on the Asterocheridæ.

Genus (106) **Dyspontius**, Thorell, 1859.

252. *Dyspontius striatus*, Thorell.

1859. *Dyspontius striatus*, Thorell, Om Krustaceer i Acidier, p. 81, pl. xiv. fig. 22.
1880. ,, ,, Brady, *l. c.*, vol. iii. p. 66, pl. xcii. figs. 1-12.

Hab.—Dredged at the north-west end of Inchkeith on 23rd May 1901. *D. striatus* has not previously been noticed within the limits of the Forth estuary, but it is a widely distributed species in our seas, though not very plentiful.

253. *Dyspontius curticaudatus*, T. Scott.

1905. *Dyspontius curticaudatus*, T. Scott, Twenty-third F. B. Rept., pt. iii. p. 148, pl. xiii. figs. 1-10.

Hab.—Dredged in the vicinity of Culross, a few miles above Queensferry; rare.

Genus (107) **Parartotrogus**, T. and A Scott, 1893.

254. *Parartotrogus Richardi*, T. and A. Scott.

1893. *Parartotrogus Richardi*, T. and A. Scott, Ann. and Mag. Nat. Hist. (6), vol. xi p. 211, pl. vii. figs. 1-11.

Hab.—Dredged near Fidra in 1889, but not recorded till 1893. It has subsequently been dredged off St Monans, in Largo Bay, and one or two other places, but nowhere very common.

Family Corycæidæ.

Genus (108) **Corycæus**, Dana, 1845.

255. *Corycæus anglicus*, Lubbock.

1857. *Corycæus anglicus*, Lubb., Ann. and Mag. Nat. Hist. (2), vol. xx., pl. xi. figs. 16-19.
1880. ,, ,, Brady, *l. c.*, vol. iii p. 34, pl. lxxxi. figs. 16-19 *et seq.*
1900. ,, ,, T. Scott, Eighteenth F. B. Rept., pt. iii. p. 397, pl. xiii. figs. 1-14.

Hab.—Dredged in the "Fluke Hole" off St Monans; also washed from trawl refuse collected off West Wemyss, October 1895. This species appears to be of rare occurrence in the Forth estuary.

Family NICOTHOIDÆ.

Genus (109) **Nicothoë**, Audouin and Milne-Edwards, 1826.

256. *Nicothoë astaci*, Aud. and M.-Edwards.

1826. *Nicothoë astaci*, Aud. and M.-Edwards, Ann. Sci. Nat., 1st ser., vol. ix. p. 345, taf. 49, figs. 1-9.

Hab.—Found adhering to the gills of a Lobster sent from Dunbar. I am indebted to my colleague, Dr H. C. Williamson, for the specimens of the *Nicothoë*. The distribution of the parasite appears to be co-extensive with that of its host.

Family ERGASILIDÆ.

Genus (110) **Bomolochus**, Nordmann, 1832.

257. *Bomolochus soleæ*, Claus.

1864. *Bomolochus soleæ*, Claus, Zeitschrift für Wissenschaft, Zool., vol. xiv. p. 374, pl. xxxv.
1893. ,, ,, T. Scott, Eleventh F. B. Rept., pt. iii. p. 212, pl. v.
1902. ,, ,, idem, Twentieth F. B. Rept., pt. iii. p. 288, pl. xiii. figs. 13-18.

Hab.—Firth of Forth; found on the back of a Black Sole, *Solea vulgaris*, and among dredged material, but in this case the specimens must, in some way, have been detached from the fish. Found in the nostrils of a Cod-fish by John Lindsay, Edinburgh. This *Bomolochus* has been obtained in the nasal fossæ of several kinds of fishes, but it is most frequent in those of the cod.

258. *Bomolochus onosi*, T. Scott.

1902. *Bomolochus onosi*, T. Scott, Twentieth F. B. Rept., pt. iii. p. 289, pl. xiii. figs. 19-22.

Hab.—Firth of Forth, on the inside of the gill-covers of a Five-bearded Rockling, *Onos mustelus* (Linn.), captured in the estuary in May 1901. This *Bomolochus* has also been obtained on a specimen of the same kind of fish captured off Kinnaird Head in July 1901.

Genus (111) **Thersitina**, Norman, 1905.

(Syn. *Thersites*, Pagenstecher, 1861, preoccupied by Spence Bate in 1857 for a genus of Amphipods.)

259. *Thersitina gasterostei* (Pagenstecher).

1861. *Thersites gasterostei*, Pagenst., Arch. f. Naturh., vol. xvii. p. 118, pl. vi. figs. 1-9.
1899. *Ergasilus gasterostei*, Bassett-Smith, Proc. Zool. Soc. Lond. (April 1899), p. 444.
1900. *Thersites gasterostei*, T. Scott, Eighteenth F. B. Rept., pt. iii. p. 146, pl. v. figs. 1-7.

Hab.—On the inside of the gill-covers of a Three-spined Stickleback, *Gasterosteus aculeatus*, captured in the river Forth, near Alloa, in February 1896. I have also taken this minute Copepod on the same species of fish captured in a small loch in Barra, Outer Hebrides; and in brackish-water ditches at Aberdeen, as well as on a Fifteen-spined Stickleback, *Gasterosteus spinachia*, captured in Loch Etive, on the west of Scotland.

Division NOTODELPHYOIDA.

Family NOTODELPHYDÆ.

Genus (112) **Notodelphys**, Allman, 1847.

260. *Notodelphys Allmani*, Thorell.

1860. *Notodelphys Allmani*, Thorell, Bidrag til Känned. Krust. Art. Slägtet Ascidia, p. 31, pl. i., and pl. ii. fig. 1.
1878. ,, ,, Brady, Monograph, vol. i. p. 126, pl. xxv. figs. 1-10.

Hab.—In the branchial cavity of Ascidians found adhering to the walls of Granton Harbour, and dredged in the neighbourhood of Inchkeith and elsewhere; moderately frequent.

261. *Notodelphys agilis*, Thorell.

1860. *Notodelphys agilis*, Thorell, *l. c.*, p. 40, pl. iv.; pl. v. fig. 6.
1878. ,, ,, Brady, *l. c.*, vol. i. p. 130, pl. xxvi. figs. 1-10.

Hab.—In the branchial cavity of Ascidians found adhering to the pier at Granton.

Family DOROPYGIDÆ.

Genus (113) **Doropygus**, Thorell, 1859.

262. *Doropygus Normani*, G. S. Brady.

1878. *Doropygus Normani*, Brady, *l. c.*, vol. i. p. 136, pl. xxxii. figs. 1-14.

Hab.—In the branchial cavity of Ascidians dredged off Musselburgh, not uncommon, but apparently rare in other parts of the estuary.

263. (?) *Doropygus porcicauda*, G. S. Brady.

1878. *Doropygus porcicauda*, Brady, *l. c.*, vol. i. p. 138, pl. xxvii. figs. 1-9; pl. xxxiii. figs. 14-16.
1888. (?) ,, ,, T. Scott, Sixth F. B. Rept., pt. iii. p. 239.

Hab.—A specimen that appeared to belong to this species was obtained among some material dredged near Inchkeith in 1887, but as it is not now in my collection, I am unable to verify the record.

Family ASCIDICOLIDÆ.

Genus (114) **Ascidicola**, Thorell, 1859.

264. *Ascidicola rosea*, Thorell.

1859. *Ascidicola rosea*, Thorell, *l. c.*, p. 59, pl. ix.; pl. x. fig. 13.
1878. ,, ,, Brady, *l. c.*, vol. i. p. 145, pl. xxx. figs. 1-10.

Hab.—Obtained occasionally in the branchial chambers of Ascidians dredged in the neighbourhood of Inchkeith, off Musselburgh, and at a few other places in the estuary.

Genus (115) **Aplostoma**, Canu, 1886.

Syn. *Enterocola*, T. Scott, 1892 (not *Enterocola*, P. J. v. Beneden).

265. *Aplostoma affinis*, T. Scott, nov. nom.

1869. (?) *Enterocola eruca*, Norman, Last Report of Dredging among the Shetland Isles (Brit. Assoc. Rept. for 1868), p. 300.
1892. ,, ,, T. and A. Scott, Ann. and Mag. Nat. Hist. (6), vol. x. p. 203, figs. 1-11.

Hab.—A few specimens of this curious species were obtained within the intestines of Ascidians found frequently adhering to the inside of the valves of dead mussels and other shells, dredged in various parts of the estuary. These specimens were mistakenly ascribed to *Enterocola*, van Beneden, but they more nearly resemble *Aplostoma brevicauda*, Canu. They differ, however, in some respects from that species, as shown by the description and drawings. I have therefore named the species as above.

Family LAMIPPEIDÆ.

Genus (116) **Lamippe**, Bruzelius, 1859.

266. *Lamippe proteus*, Claparède.

1867. *Lamippe proteus*, Claparède, Ann. des Sci. Nat., ser. 5, vol. viii. p. 23, pl. v.
1895. *Alcyonicola fusiformis*, T. and A. Scott, Ann. and Mag. Nat. Hist. (6), vol. xvi. p. 357, pl. xvi. figs. 10-14; pl. xvii. fig. 13.
1896. *Lamippe* (?) *proteus*, T. Scott, Fourteenth F. B. Rept., pt. iii. p. 164.

Hab.—On *Alcyonium digitatum*, dredged in various parts of the estuary; frequent. This curious species appears to live in the cells of the polyps. If an *Alcyonium* be broken into pieces, and the fragments washed in a bottle containing methylated spirit, numbers of the *Lamippe* will generally be found amongst the sediment.

267. *Lamippe Forbesi*, T. Scott.

1896. *Lamippe* sp., T. Scott, Fourteenth F. B. Rept., pt. iii. p. 164, pl. iv. figs. 9-13.
1901. *Lamippe Forbesi*, T. Scott, Nineteenth F. B. Rept., pt. iii. p. 256.

Hab.—This, which is a larger and apparently a much rarer species than *L. proteus*, has been found along with it on *Alcyonium digitatum*, dredged in the Firth of Forth. It has been observed on the same *Alcyonium* from other parts of the Scottish coast, and my son has also obtained it in Liverpool Bay.[1]

[1] Cf. *Tenth Ann. Rept. Liverpool Marine Biological Committee*, p. 21 (1897).

Genus (117) **Jeanella**, T. Scott, *F. B. Rept.*, 1904, pt. iii. p. 258.

(Syn. *Platypsyllus*, T. Scott, 1902, a name preoccupied by Dr Ritsema and Prof. Westwood in 1869.)

268. *Jeanella minor*, T. Scott.

1902. *Platypsyllus minor*, T. Scott, Twentieth F. B. Rept., pt. iii. p. 455, pl. xxv. figs. 15, 16.

Hab.—This somewhat remarkable species was obtained in a gathering dredged in about 8 fathoms in the neighbourhood of the North Craig on 4th July 1901. Only a few specimens—all females, and one or two carrying ovisacs—were observed.

Division MONSTRILLOIDA.

Family MONSTRILLIDÆ.

Genus (118) **Monstrilla**, Dana, 1848.

269. *Monstrilla anglica*, Lubbock.

1857. *Monstrilla anglica*, Lubbock, Ann. and Mag. Nat. Hist. (2), vol. xx. p. 409, pl. x. figs. 7 and 8.
1904. ,, ,, T. Scott, Twenty-second F. B. Rept., pt. iii. p. 246, pl. xiii. fig. 13; pl. xiv. figs. 12-14.

Hab.—Captured to the west of May Island, with a townet, on 26th July 1901, and also to the east of May Island on 20th August 1903, but only females were observed in both gatherings.

270. *Monstrilla longicornis*, I. C. Thompson.

1890. *Monstrilla longicornis*, I. C. Thompson, Trans. L—pool Biol. Soc., vol. iv. p. 119, pl. iv. figs. 1, 2, and 4 (♂).
1892. ,, *longiremis*, Giesb., Pelag. Copep. des Golfes v. Neapel, p. 589, pl. xlvi. figs. 10, 14, 22, 37, and 41 (♀).
1904. ,, *longicornis*, T. Scott, *l. c.*, p. 244, pl. xiii. figs. 1-7 (♂ and ♀).

Hab.—This species was taken in the estuary very sparingly in 1890, 1891, 1893, 1894, and 1901.

271. *Monstrilla gracilicauda,* Giesbrecht.

1892. *Monstrilla gracilicauda,* Giesb., *l. c.*, p. 587, pl. xlvi. figs. 9, 16, 18 *et seq.*
1904. ,, ,, T. Scott, Twenty-second F. B. Rept., pt. iii. p. 245, pl. xiii. figs. 8-10; pl. xiv. fig. 15.

Hab.—Taken with tow-net above Queensferry, 26th June 1890; and off Musselburgh, 29th September 1892. Also captured east of May Island on 20th August 1903. All the specimens were females.

272. *Monstrilla dubia,* T. Scott.

1904. *Monstrilla dubia,* T. Scott, Twenty-second F. B. Rept., pt. iii. p. 247, pl. xiii. fig. 14; pl. xiv. figs. 16-18.

Hab.—This species was captured east of Inchkeith on 14th August 1891, and is apparently rare. It resembles *Monstrilla Danæ,* Claparède, but that author shows only three setæ instead of four on each furcal joint; there are also one or two other differences.

Genus (119) **Thaumaleus,** Kröyer, 1849.

273. *Thaumaleus rigidus* (I. C. Thompson).

1888. *Cymbasoma rigidum,* I. C. Thompson, Jour. Linn. Soc. (Zool.), vol. xx. p. 154, pl. xiii. figs. 1-4.
1892. *Thaumaleus Claparèdei,* Giesb., *op. cit.*, p. 381, pl. xlvi. figs. 5, 15, 21, 26.
1904. ,, *rigidus,* T. Scott, Twenty-second F. B. Rept., pt. iii. p. 248, pl. xiii. figs. 15-17; pl. xiv. fig. 19.

Hab.—Captured off St Monans, by tow-net, on 6th September 1890; apparently rare.

Division CALIGOIDA.

Family CALIGIDÆ.

Genus (120) **Caligus,** O. F. Müller, 1785.

274. *Caligus curtus,* Müller.

1785. *Caligus curtus,* Müller, Entomostraca, p. 130, pl. xxi. fig. 1.
1850. ,, *diaphanus,* Baird, British Entomostraca, p. 269, pl. xxxii. fig. 1 (♂).
1850. ,, *Mülleri,* idem, *l. c.*, p. 271, pl. xxxii. figs. 4 and 5.

Hab.—Frequent on different kinds of fishes, especially

Gadoids. The male *Caligus*, which Dr Baird describes and figures in his *British Entomostraca* under the name of *Caligus diaphanus*, Nordmann, is not Nordmann's species, but is the male of *C. curtus*, Müller.

275. *Caligus rapax*, M.-Edwards.

1840. *Caligus rapax*, M.-Edw., Hist. Nat. Crust., vol. iii. p. 453, pl. xxxviii. fig. 9.

Hab.—Common on several kinds of fishes, especially Gadoids, as well as on flat fishes, Skate, Dogfishes, and others. From Short Sunfish, North Berwick, September 1905 (W. Evans). It is also frequently captured by tow-net in the open sea.

276. *Caligus minimus*, Otto.

1828. *Caligus minimus*, Otto, Beschreib. neuer Crust., Nov. Act. Acad. Cæs. Leop., vol. xiv. p. 354, pl. xxii.
1901. ,, ,, A. Scott, Trans. L—pool Biol. Soc., vol. xv. p. 349, pl. i. figs. 1-8.

Hab.—Found inside the throat of a Bass, *Labrax lupus*, Cuv. and Valenc., captured in the Forth, above Queensferry, in February 1903.

277. *Caligus diaphanus*, Nordmann.

1832. *Caligus diaphanus*, Nordm., Mikrog. Beiträge, vol. ii. p. 26.
1894. ,, *isonyx*, T. Scott, Twelfth F. B. Rept., pt. iii. p. 310 (not *C. isonyx*, Stp. and Lütk.).
1900. ,, *diaphanus*, idem, Eighteenth F. B. Rept., pt. iii. p. 149, pl. v. figs. 20-25.

Hab.—Taken in the gill-cavity of Grey Gurnards, *Trigla gurnardus*, captured in the estuary; not very rare.

Genus (121) **Pseudocaligus**, A. Scott, 1900.

278. *Pseudocaligus brevipedis* (Bassett-Smith).

1896. *Caligus brevipedis*, Bassett-Smith, Ann. Nat. Hist. (6), vol. xviii. p. 11, pl. iii. fig. 1.
1901. *Pseudocaligus brevipedis*, A. Scott, Trans. L—pool Biol. Soc., vol. xv. p. 350, pl. ii. figs. 1-6.
1902. ,, ,, T. Scott, Twentieth F. B. Rept., pt. iii. p. 291.

Hab.—Found inside the throat of a Three-bearded Rockling, *Onos tricirratus*, captured at Dunbar in 1892. In this species the fourth pair of feet are more rudimentary than in typical *Caligus*.

Genus (122) **Lepeophtheirus**, Nordmann, 1832.

279. *Lepeophtheirus pectoralis* (O. F. Müller).

1776. *Lernæa pectoralis*, Müller, Zool. Dan. Prodr., vol. i. p. 41, pl. xxxiii. fig. 7.
1850. *Lepeophtheirus pectoralis*, Baird, Brit. Entom., p. 275, pl. xxxii. fig. 10.
1900. ,, ,, T. Scott, Eighteenth F. B. Rept., pt. iii. p. 150, pl. v. figs. 26-31.

Hab.—Frequent under the pectoral fins of Plaice, Flounders, and Dabs.

280. *Lepeophtheirus Thompsoni*, Baird.

1850. *Lepeophtheirus Thompsoni*, Baird, Brit. Entom., p. 278, pl. xxxiii. fig. 2.
1900. ,, ,, T. Scott, *l. c.*, p. 152, pl. v. figs. 43-45.
1900. ,, *obscurus*, idem, *l. c.*, p. 153, pl. vi. figs. 16-19.

Hab.—Frequent on the gills of Turbot, *Bothus maximus*, captured off St Monans. The form I referred doubtfully to *L. obscurus*, Baird, appears to be identical with *L. Thompsoni*; it is sometimes common on the gills of the Brill, *Bothus rhombus*.

281. *Lepeophtheirus pollachii*, Bassett-Smith.

1896. *Lepeophtheirus pollachii*, Bassett-Smith, Ann. and Mag. Nat. Hist. (6), vol. xviii. p. 12, pl. iv. fig. 1.
1900. ,, ,, T. Scott, *op. cit.*, p. 153, pl. vi. figs. 9-15.

Hab.—Firth of Forth, on the gills of Lythe, *Gadus pollachius*, 8th February 1895; apparently not very rare.

282. *Lepeophtheirus salmonis* (Kröyer).

1837. *Caligus salmonis*, Kröyer, Naturhist. Tidssk., vol. i., pl. vi. fig. 7 *a-c*; vol. ii. (1838) pp. 13, 18.
1847. ,, *Stromi*, Baird, Trans. Berw. Naturalists Club.
1850. *Lepeophtheirus Stromi*, Baird, Brit. Entom., p. 274, pl. xxxii. figs. 8 and 9.
1850. ,, *obscurus*, idem, ibidem, p. 277, pl. xxxii. fig. 11.

Hab.—On Salmon caught in the salmon nets in Largo Bay and other parts of the estuary; frequent.

Genus (123) **Trebius,** Kröyer, 1838.

283. *Trebius caudatus*, Kröyer.

1838. *Trebius caudatus*, Kröyer, Naturhist. Tidsskr. (1838), R. i. B. ii. p. 30, pl. i. fig. 4.
1900. ,, ,, T. Scott, Eighteenth F. B. Rept., pt. iii. p. 155, pl. vi. figs. 20-26.

Hab.—Taken on the backs of grey (or blue) Skates, *Raia batis;* moderately frequent.

Genus (124) **Cecrops,** Leach, 1816.

284. *Cecrops Latreillei*, Leach.

1816. *Cecrops Latreillei*, Leach, Encycl. Brit., Suppl. i., pl. xx. figs. 1-5.
1850. ,, ,, Baird, Brit. Entom., p. 293, pl. xxxiv. fig. 1.

Hab.—Found on the gills of a Short Sunfish, captured in the estuary in October 1890 (A. Scott). *Cecrops* appears to be a common parasite on the gills of this species of Sunfish.

Genus (125) **Orthagoriscola,** Franz Poche, 1902.

(Syn. *Læmargus*, Kröyer, 1838, name preoccupied for a genus of Fishes.)

285. *Orthagoriscola muricata* (Kröyer).

1850. *Læmargus muricatus*, Baird, Entomostraca, p. 295, pl. xxxiv. figs. 3 and 4.
1900. ,, ,, T. Scott, Eighteenth F. B. Rept., pt. iii. p. 158, pl. vi. figs. 39-42.
1902. *Orthagoriscola muricata*, Franz Poche, Zool. Anzeiger, vol. xxvi. p. 15.

Hab.—On the same Sunfish with the *Cecrops* just recorded not, however, attached to the gills, but burrowing in hollows formed in the flesh of the fish, behind the anal fin (A. Scott). Off a Short Sunfish captured at North Berwick, 28th September 1905 (W. Evans).[1] This appears to be a rarer species than the *Cecrops.*

Division LERNÆOIDA.

Family Lernæidæ.

Genus (126) **Lernæa**, Linné, 1767.

286. *Lernœa branchialis*, Linné.

1767. *Lernœa branchialis*, Linn., Systema Naturæ, ed. 12, vol. i. pt. ii. p. 1092.
1850. ,, ,, Baird, Brit. Entom., p. 344, pl. xxxv. fig. 12.

Hab.—Frequent on the gills of Whitings and some other Gadoids.

Genus (127) **Lernæenicus**, Lesueur, 1824.

287. *Lernœenicus spratta* (Sowerby).

1806. *Lernœa spratta*, Sowerby, Brit. Miscell., vol. ii. p. 17, pl. lxviii.
1900. *Lernœenicus sprattœ*, T. Scott, Eighteenth F. B. Rept., pt. iii. p. 161, pl. vii. figs. 7-10.

Hab.—On the eye of a Sprat, *Clupea spratta,* seen in one of the Leith Docks (J. Scott, August 1890). This Copepod is apparently seldom met with in the Firth of Forth, and this is the only record of its occurrence in the estuary known to me.

Genus (128) **Hæmobaphes**, Steenstrup and Lütken, 1861.

288. *Hœmobaphes cyclopterinus* (Fabricius).

1780. *Lernœa cyclopterina*, Fabr., Fauna Grönlandica, p. 337.
1900. *Hœmobaphes cyclopterinus*, T. Scott, Eighteenth F. B. Rept., pt. iii. p. 162, pl. vii. fig. 14.

Hab.—Found on the gills of a Pogge, *Agonus cataphractus*, captured at Dunbar; and on a Butterfish, *Pholis gunnellus*, taken near Fidra in 1901.

[1] *Ann. Scot. Nat. Hist.*, 1906, p. 57.

Family Chondracanthidæ.

Genus (129) **Oralien**, Bassett-Smith, 1899.

289. *Oralien asselinus* (Linné).

1761. *Lernæa asselina*, Linn., Fauna Suecica, 2101.
1850. *Lernentoma asselina*, Baird, Brit. Entom., p. 329, pl. xxxv. fig. 4.

Hab.—Found on the gills of the Grey Gurnard, *Trigla gurnardus;* not uncommon. What appears to be the same species is also found on the gills of Plaice and one or two other fishes.

Genus (130) **Chondracanthus**, De la Roche, 1811.

290. *Chondracanthus cornutas* (O. F. Müller).

1776. *Lernæa cornuta*, Müll., Zool. Dan. Prodr., vol. i., pl. xxxiii. fig. 6.
1850. *Lernentoma cornuta*, Baird, *l. c.*, p. 328, pl. xxxv. fig. 2.

Hab.—Found on the gills of Plaice, *Pleuronectes platessa;* not uncommon.

291. *Chondracanthus clavatus*, Bassett-Smith.

1896. *Chondracanthus clavatus*, Bassett-Smith, Ann. and Mag. Nat. Hist. (6), vol. xviii. p. 13, pl. v. fig. 6.

Hab.—Found on the gills of Lemon Dabs, *Pleuronectes microcephalus,* especially large fishes.

292. *Chondracanthus fluræ*, Kröyer.

1864. *Chondracanthus fluræ*, Kröyer, Naturh. Tidsskr., R. iii. B. ii. p. 323, pl. xiii. fig. 6.
1900. ,, ,, T. Scott, Eighteenth F. B. Rept., pt. iii. p. 166, pl. vii. figs. 32-34.

Hab.—Found on the gills of Long Rough Dabs, *Drepanopsetta platessoides,* captured in the estuary in 1891, and at Station III. in May 1901.

293. *Chondracanthus soleæ*, Kröyer.

1839. *Chondracanthus soleæ*, Kröyer, Naturh. Tidsskr. (1838-39), p. 139, pl. iii. fig. 4.

Hab.—Found on the gills of the Black Sole, *Solea vulgaris*, captured in the estuary.

294. *Chondracanthus depressus*, T. Scott.

1905. *Chondracanthus depressus*, T. Scott, Twenty-third F. B. Rept., pt. iii. p. 114, pl. vi. figs. 7-13.

Hab.—Found on the gills of Dabs, *Pleuronectes limanda*, Linn., captured in the estuary; not very common.

295. *Chondracanthus merluccii* (Holten).

(?) 1802. *Lernæa merluccii*, Holten, Mem. Soc. Hist. Nat. Copenhagen, vol. v., pl. viii. fig. 2.

1837. *Chondracanthus merluccii*, Kröyer, Naturh. Tidsskr., vol. i. p. 278, pl. iii. fig. 9*a-d*.

Hab.—Found in the gill-cavity of a Hake, *Merluccius vulgaris*, landed at Newhaven in February 1885. This is a moderately common parasite on the Hake; it may frequently be found clinging to the roof and sides of the mouth, and sometimes on the underside of the tongue, as well as inside the gill-covers.

296. *Chondracanthus lophii*, Johnston.

1836. *Chondracanthus lophii*, Johnston, Lond. Mag. Nat. Hist., p. 81, fig. 16.

1850. *Lernentoma lophii*, Baird, Brit. Entom., p. 330, pl. xxxv. fig. 3.

Hab.—Common in the gill-chambers of the Angler-fish, *Lophius piscatorius*, captured in the estuary. This is one of the most common species of the Chondracanthi I have observed in the Firth of Forth.

297. *Chondracanthus zei*, De la Roche.

1811. *Chondracanthus zei*, De la Roche, Nouv. Bull. de Soc. Philom., vol. ii. p. 270, pl. ii. fig. 2.

1850. *Lernentoma zei*, Baird, Brit. Entom. p. 327, pl. xxxv. fig. 1.

Hab.—Found on the gills of a John Dory, *Zeus faber*, captured in the estuary in 1891.

Family LERNÆOPODIDÆ.

Genus (131) **Charopinus**, Kröyer, 1863.

298. *Charopinus Dalmanni* (Retzius).

1829. *Lernæa Dalmanni*, Retz., Kongl. Vetensk. Acad. Handl. för 1829; Froriep's Notizen, Bd. 29, N. 617, p. 6.
1900. *Charopinus Dalmanni*, T. Scott, *op. cit.*, p. 169, pl. viii. figs. 6-10.

Hab.—In the nasal fossæ of a large Grey Skate, *Raia batis*, captured near May Island in 1891. This curious parasite is frequent in the nasal fossæ of large skates, but seldom in small specimens.

Genus (132) **Brachiella**, Cuvier, 1817.

299. *Brachiella insidiosa*, Heller.

1865. *Brachiella insidiosa*, Heller, Reise der Novara, p. 239, pl. xxiv. fig. 1.
1896. ,, ,, Bassett-Smith, Ann. and Mag. Nat. Hist. (6), vol. xviii. p. 14, pl. vi. fig. 2.

Hab.—Found on the gills of a Hake captured in the estuary. This species is less common than the *Chondracanthus merluccii*, which is also found on the Hake.

300. *Brachiella triglæ*, Claus.

1860. *Brachiella triglæ*, Claus, Zur Morp. der Copepoden, pl. i. fig. 6.
1896. ,, ,, Bassett-Smith, Jour. M. B. Assoc. Plymouth, p. 163.

Hab.—Found on *Trigla lineata* captured at Station VIII. in September 1897.

Genus (133) **Anchorella**, Cuvier, 1817.

301. *Anchorella emarginata*, Kröyer.

1837. *Anchorella emarginata*, Kröyer, Naturh. Tidsskr., R. i. B. i. p. 287, pl. iii. fig. 7.
1900. ,, ,, T. Scott, Eighteenth F. B. Rept., pt. iii. p. 176, pl. viii. figs. 49-51.

Hab.—Found on the gills of a Twaite Shad, *Clupea finta*, captured near Dunbar in February 1897. This appears to be a rare species.

302. *Anchorella rugosa*, Kröyer.

1837. *Anchorella rugosa*, Kröyer, *l. c.*, p. 294, pl. iii. fig. 6.
1850. ,, ,, Baird, Brit. Entom., p. 338, pl. xxxv. fig. 8.

Hab.—Found on gills and gill-covers and inside the throat of the Cat- or Wolf-fish, *Anarrhichas lupus;* not uncommon.

303. *Anchorella uncinata* (O. F. Müller).

1776. *Lernæa uncinata*, Müll., Zool. Dan. Prodr., vol. i., pl. xxxiii. fig. 2.
1850. *Anchorella uncinata*, Baird, *l. c.*, p. 337, pl. xxxv. fig. 9.

Hab.—Found on the gills and inside the throat of Cod-fish, and probably on other Gadoids, not uncommon; but the *Anchorellæ* of these other Gadoids require further study, as they may not all belong to the same species.

304. *Anchorella brevicola*, M.-Edwards.

1840. *Anchorella brevicola*, M.-Edw., Hist. Nat. Crust., vol. iii. p. 418.
1901. ,, ,, T. Scott, Nineteenth F. B. Rept., pt. iii. p. 135, pl. viii. figs. 11-16.

Hab.—Found on a Haddock. The parasite was attached on the under side of the fish, and near the anal fin. Only one specimen was observed.

I add here two other interesting parasitic Copepods, each of which represents a different family, viz.:—

Family HERPYLLOBIIDÆ.

Genus (134) Salenskya, Giard and Bonnier, 1893.

305. *Salenskya tuberosa*, Giard and Bonnier.

1893. *Salenskya tuberosa*, G. and B., Compt.-rend. de l'Acad. des Sci. (25th Sept. 1893).
1895. ,, ,, idem, Bull. Sci. de la France et de la Belgique, vol. xxv. p. 472, pl. xiii.
1902. ,, ,, T. Scott, Twentieth F. B. Rept., pt. iii. p. 474, pl. xxv. figs. 17-22.

Hab.—Found in the marsupium of specimens of *Ampelisca* *spinipes*, Boeck; several examples of this species of Amphipod were infested with the parasite.

Family CHONIOSTOMATIDÆ.

Genus (135) **Aspidœcia**, Giard and Bonnier, 1889.

306. *Aspidœcia Normani*, Giard and Bonnier.

1889. *Aspidœcia Normani*, G. and B., Compt.-rend. de l'Acad. des Sci., 29th April.
1897. ,, ,, H. J. Hansen, The Choniostomatidæ, p. 187, pl. xii. figs. 3*a*, 3*b*.
1898. ,, ,, T. Scott, Sixteenth F. B. Rept., pt. iii. p. 279.

Hab.—Found adhering to a specimen both of *Erythrops elegans* (G. O. Sars) and *Erythrops erythrophthalmus* (Goës), captured in 1901 to the west of May Island; rare.

THE THYROSTRACA OR CIRRIPEDIA.

Scarcely any addition has been made to the number of Forth Crustacea belonging to this group since the publication of Leslie and Herdman's work on the *Invertebrate Fauna of the Estuary*.

THORACICA.

Family LEPADIDÆ.

Genus (1) **Lepas**, Linné, 1767.

1. *Lepas anatifera*, Linné.

1767. *Lepas anatifera*, Linn., Systema Naturæ, ed. xii., vol. i. pt. ii. p. 1109.
1851. ,, ,, Darwin, Monogr. of the Cirripedia (The Lepadidæ), p. 73, pl. i. fig. 1.

Hab.—Attached to floating timber (Edin. Mus., Leslie and Herdman). Aberlady Bay, on piece of stranded timber, September 1893 (Evans).

Genus (2) **Conchoderma**, Olfers, 1814.

2. *Conchoderma aurita* (Linné).

1767. *Lepas aurita*, Linn., Systema Naturæ, ed. xii., vol. i. part ii. p. 1110.
1851. *Conchoderma aurita*, Darwin, *l. c.*, p. 41, pl. iii. fig. 4.

Hab.—Attached to floating timber (Edin. Mus., Leslie and Herdman).

3. *Conchoderma virgata* (Spengler).

1790. *Lepas virgata*, Spengler, Skrift. Naturh. Selbsk., vol. i., pl. vi. fig. 9.
1851. *Conchoderma virgata*, Darwin, *l. c.*, p. 146, pl. iii. fig. 2; pl. ix. fig. 4.

Hab.—Attached to floating timber (Edin. Mus., Leslie and Herdman).

Family Balanidæ.

Genus (3) **Balanus**, Da Costa, 1778.

4. *Balanus porcatus*, Da Costa.

1778. *Balanus porcatus*, Da Costa, Hist. Nat. Test. Brit., p. 249.
1854. ,, ,, Darwin, Monograph: Balanidæ, p. 256, pl. vi. figs. 4*a*-4*e*.

Hab.—Not uncommon attached to stones, etc. (Leslie and Herdman).

5. *Balanus crenatus*, Bruguière.

1789. *Balanus crenatus*, Bruguière, Encycl. Method. (des vers).
1854. ,, ,, Darwin, *l. c.*, p. 261, pl. vi. figs. 6*a*-6*g*.

Hab.—Shore at Portobello (Leslie and Herdman). East side of Inchkeith.

6. *Balanus balanoides* (Linné).

1767. *Lepas balanoides*, Linn., Systema Naturæ, vol. i. part ii. p. 1108.
1854. *Balanus balanoides*, Darwin, *l. c.*, p. 267, pl. vii. figs. 2*a*-2*d*.

Hab.—Common on rocks and stones between tide-marks, and also in deep water.

7. *Balanus Hameri* (Ascanius).

1767. *Lepas Hameri*, Ascan., Icones rerum Naturalium, Tab. 10.
1854. *Balanus Hameri*, Darwin, *l. c.*, p. 277, pl. vii. figs. 5*a*-5*c*.

Hab.—Largo Bay, and off the west side of Inchkeith, single specimens, and occasionally a cluster attached to pieces of wood.[1]

Genus (4) **Verruca**, Schumacher, 1817.

8. *Verruca Strömia* (O. F. Müller).

1776. *Lepas Strömia*, Müll., Zool. Dan. Prodr., No. 3025.
1854. *Verruca Strömia*, Darwin, *l. c.*, p. 518, pl. xxi. figs. 1*a*-1*f*.

Hab.—Frequent on stones, dead shells, etc., brought up in the dredge.

RHIZOCEPHALA.

Family SACCULINÆ.

Genus (5) **Sacculina**, Thompson.

9. *Sacculina carcini*, Thompson.

Hab.—Attached to the abdomen of Shore Crabs, *Carcinus mœnas*, at Joppa (J. Anderson [2]); not very rare.

10. *Sacculina triangularis*, J. Anderson.[2]

Hab.—Firth of Forth (J. Anderson). Dunbar, attached to the abdomen of *Cancer pagurus;* rare (H. C. Williamson).

11. *Sacculina* sp.

Hab.—Attached to the abdomen of *Portunus holsatus;* this Sacculine has been observed very sparingly in different parts of the estuary.

[1] *Balanus tintinnabulum* (Linn.), from Leith Dock, in Leslie and Herdman's *Invertebrate Fauna*, is, as stated by these authors, "a foreign importation," and is not included with the others here.

[2] Cf. *Proc. Roy. Phys. Soc.*, vol. ii.

Genus (6) **Peltogaster**, Rathke.

12. *Peltogaster paguri*, Rathke.

Hab.—On the abdomen of the common Hermit (or Soldier) Crab, *Eupagurus bernhardus* (J. Anderson [1]). This Cirriped does not appear to be rare in the Forth estuary.

13. *Peltogaster carcini* (Anderson [1]).

Hab.—Firth of Forth, at Joppa (J. Anderson).

APPENDIX.

The following are some alterations in names, and additions to the species and localities, recorded in Part I. The total number of species enumerated in this Catalogue is now 794.

Genus **Eupagurus**, Brandt, 1851 (p. 112).

The genus name *Pagurus*, Fabricius, 1793, has been restored, and included under it are the four species recorded in Part I. under *Eupagurus*. See *Crustacea of Devon and Cornwall*, by Canon A. M. Norman and T. Scott, p. 8 (1906).

Leptognathia Lilljeborgia, Stebbing (p. 132).

This species has been removed to another genus, viz., *Tanaissus*, Norman and Scott. See *Crustacea of Devon and Cornwall*, p. 34.

Genus **Idothea**, Fabricius (p. 135).

To the species recorded under *Idothea*, add *Idothea granulosa*, Rathke, *Beiträge zur Fauna Norwegens*, p. 23. In March 1906 Mr William Evans obtained near Aberdour, Fife, two

[1] Cf. *Proc. Roy. Phys. Soc.*, vol. ii.

specimens of an *Idothea* that appear to me to belong to this species.

After *Porcellio pictus* (p. 140), add

The genus **Metoponorthus**, Budde-Lund, 1879, and the species *M. pruinosus* (Brandt). This Oniscoidan species has been captured (in April this year) at Slateford, near Edinburgh, by Mr William Evans, and is recorded by him in the *Annals of Scottish Natural History* for July 1906, p. 187.

Gammarus Duebeni, Lillj. (p. 163).

To the localities for this species add: Brackish pools, Luffness, near Aberlady, July 1906 (W. Evans).

Genus **Jassa**, Leach (p. 170).

The two species, *Jassa falcata* (Montagu) and *Jassa pusilla* (G. O. Sars), have been removed to the new genus **Bruzeliella**, Norman. See *Crustacea of Devon and Cornwall*, p. 92.

Corophium grossipes, Linné (p. 172).

This species, under the name of *Cancer grossipes*, was described by Linné in 1767 in *Systema Naturæ*, vol. i. part 2, p. 1055; but as Pallas had already, in 1766, described under the name of *Oniscus volutator*, what appears to be the same form (cf. *Miscellanea Zoologica*, p. 102, pl. xiv. fig. 20), the name of the species should be *Corophium volutator* (Pallas), with *C. grossipes* as a synonym.

Protella phasma, Montagu (p. 174).

Professor Mayer in his work on the "Caprellidæ of the Bay of Naples," *Caprelliden des Golfes von Neapel, Nachtrag*, p. 19, refers this species to the new genus **Pseudoprotella**.

Scapholeberis mucronata, O. F. Müller (p. 179).

To the localities given for this species add:—Side of river Teith, at Callander, September 1906 (W. Evans).

Cyclops Leuckarti, Claus (Part II. p. 347).

While this part of the Catalogue was passing through the press, Mr W. Evans sent me numerous specimens of a *Cyclops* which he had recently captured at the Falls of Leny, by holding a net so that some of the falling water would pass through it. The identification of the specimens somewhat puzzled me at first, but on carefully dissecting one or two of them, I found them to be the young of *Cyclops Leuckarti;* they were in the penultimate or antipenultimate stage; the segmentation of the body being slightly incomplete, while the antennules were furnished with only eleven articulations. Loch Voil, one of the two lochs from which the species is recorded, is situated to the north of Ben Ledi, and the river Balvaig carries its overflow water to Loch Lubnaig; this, in turn, is the source of the river Leny. It is probable, therefore, that *Cyclops Leuckarti* occurs in this loch also, though I have not as yet found it there. The loch and river were in flood when Mr Evans visited the Falls, and the specimens were very likely carried from the loch by the increased force of the current.

The normal habitat of *Cyclops*, as of most fresh-water Entomostraca, is in the comparatively still waters of lochs, ponds, and other similar places, and their presence in the rapid currents of rivers is usually accidental. The occurrence of this *Cyclops* in the Leny is, therefore, of interest from its bearing on the question of distribution, and as showing that the species is probably present in Loch Lubnaig as well as in the other two lochs from which it has been recorded.

ADDITIONAL NOTE.—As the second part of this Catalogue was ready to go to press, I received a copy of an important work on the Amphipoda Gammaridea by the Rev. T. R. R. Stebbing, M.A., F.R.S., etc. This work, which has just been published, forms the twenty-first of the series of Monographs that are being issued under the general title *Das Tierreich.* The Amphipoda are here divided into three legions, viz., the Gammaridea, the Hyperiidea, and the Caprellidea, and it is the first that forms the subject of Mr Stebbing's volume. The number of known species belonging to the Gammaridea as given in it is 1333. Of these, 1076 are "accepted species," while the remaining 257 are regarded as doubtful. Their classification differs to some extent from that of the Monograph by G. O. Sars. There are also a considerable number of changes in the nomenclature, and I take the opportunity to indicate the more important of these, so far as they concern the species recorded in this Catalogue.

In the work referred to—*Talitrus locusta* (Pall.) becomes *T. saltator* (Mont.), and *Orchestia littorea* (Mont.) *O. gammarellus* (Pall.), while *Hyale Nilssoni* (Rathke) takes the name of *H. Prevostii* (M.-E.). The genus *Callisoma*, A. Costa, becomes *Scopelocheirus*, Bate, and *Orchomene humilis* (A. Costa) becomes *O. Batei*, O. Sars. *Tryphosella*, Bonnier, is replaced by *Tryphosa*, Boeck, but *Tryphosa nana* (Kröy.) becomes *Orchomenella nanus* (Kröy.). *Anonyx nugax* (Phipps) becomes *A. lagena*, Kröy., and the genus *Tmetonyx*, Stebb., replaces *Hoplonyx*, O. Sars. *Phoxocephalus Fultoni*, T. Scott, becomes *Paraphoxus Fultoni* (T. S.), *Harpinia neglecta*, O. Sars, becomes *H. antennaria*, Meinart, and *Amphilochoides serratipes* (Norm.) resumes the name of *A. Boeckii*, O. Sars. *Metopa Bruzelii* (Göes) becomes *M. sinuata*, O. Sars, and *M. robusta* is restored to its place in the same genus. *Synchelidium brevicarpum* (B. & W.) becomes *S. haplocheles* (Grube), and *Halimedon parvimanus* (B. & W.) *Westwoodilla cæcula*, Bate. The genus *Paramphithoë*, Bruz., becomes *Neopleustes*, Stebb., and *Paratylus*, O. Sars, *Nototropis*, A. Costa; *N. uncinatus*, O. Sars, is also made a synonym to *N. falcatus* (Metzg.). *Iphimedia minuta*, O. Sars, becomes *Panoplœa minuta* (O. Sars). The genus *Amathilla*, Bate, is replaced by *Gammarella*, Herbst, and *Gammaropsis*, Lillj., by *Eurystheues*, Bate, while *Gammaropsis nana*, O. Sars, becomes *E. palmatus* (Stebb. and Rob.). *Podoceropsis excavata* (Bate) becomes *P. nitida*, Stimps., *Jassa Herdmani* (A. O. Walker) *J. dentex* (Czern.), and *Jassa pelagica*, Leach, *Parajassa pelagica* (Leach). *Erichthonius abditus* (Templ.) becomes *E. brasiliensis* (Dana), and *Siphonoëcetes Whitei* (Gosse) *E. Colletti*, Boeck.

The following two species are additions to my list, viz., *Peltocoxa Marioni*, Catta, and *Cressa minuta*, Boeck, both being recorded from the Forth. This raises the total to 796.

I need scarcely add that this important work, by one of the foremost of living Carcinologists, is indispensable to those engaged in the study of the Amphipoda.

Before closing I desire to take this opportunity to express my indebtedness to Mr William Evans, F.R.S.E., President of the Royal Physical Society, for the whole-hearted assistance he has given me while this Catalogue was passing through the press. I am also not forgetful of other friends who have shown an interest in my efforts to make this contribution to Scottish Natural History, unpretentious though it be, of some use to students of the Crustacea of Scotland.

Errata in First Part.

Page 99. Near bottom; for *Homarus vulgarus* read *Homarus vulgaris*, and for *Crangon vulgarus* read *Crangon vulgaris*.

,, 103. Near top; for *Paramphithoë monocupis* read *Paramphithoë monocuspis*.

,, 107. Near top; for "Stalked-eyed Crustacea" read "Stalk-eyed Crustacea."

,, 110. Near bottom; in the reference "1767, *Cancer rostratus*, Linn., Syst. Nat., ed. xii., vol. ii. p. 1014," for vol. ii. p. 1014 read "vol. i. part ii. p. 1045"; and in the subsequent references to the twelfth edition of *Systema Naturæ*, Linné, for "vol. ii." read "vol. i. part ii."

,, 113. Near top; for *Turretella* read *Turritella*.

,, 120. Near top; for *Nyctiphanus* read *Nyctiphanes*.

,, 122. Near bottom; in the reference "Reise i Chr. oy," etc., "oy" should be "og."

,, 125. In footnote; for "Dr Welley" read "Dr Willey."

,, 137. In footnote; for *Leptospidia* read *Leptaspidia*.

,, 144. Near bottom; *Calisoma* should be *Callisoma* in each of the four lines where it occurs.

,, 165. Near top; the name *Platessoides limandoides* is a synonym of *Drepanopsetta platessoides*. (See also p. 150.)

,, 165. Middle; for *Cheirocrates* read *Cheirocratus* in four places.

,, 189. Near the middle; for "Sonntagshlatt." read "Sonntagsblatt."

Part of the cost of publication of the foregoing Catalogue has been defrayed by a Grant made to the Author by the Carnegie Trust for the Universities of Scotland.

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TO

GENERA AND PRINCIPAL LARGER DIVISIONS.

(Pages 108 to 190 are in Part I.)

For some recent changes in nomenclature, see p. 381.

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PROCEEDINGS

OF THE

ROYAL PHYSICAL SOCIETY

FOR THE

PROMOTION OF ZOOLOGY AND OTHER BRANCHES OF NATURAL HISTORY.

SESSION 1905-1906.

No. 8. VOL. XVI. PAGES 387-435.

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Price of the "Proceedings" continued on page 3 of Cover.

XXIV. *The Mammals of the Edinburgh or Forth Area.* Supplementary Notes. By WILLIAM EVANS, F.R.S.E.

(Read 27th November 1905.)

In 1891 I submitted to the Royal Physical Society an account of the Mammalian Fauna of this district,[1] which, with some slight alterations and additions, was published in book form in 1892. During the thirteen years that have since elapsed, two species (the Whiskered Bat and Risso's Grampus) not included in my former list, and one (the Harp Seal) then only doubtfully included, have been recorded. Additional occurrences of a few of the rarer residents and visitors, and further observations on some of the common species, have also been noted. To bring these records and notes together is the purpose of the present communication.

The number of species of mammals now positively known to have occurred within the Forth area in the course of the last hundred years is fifty. There is still the possibility of one or two additions—an evasive bat, or a wandering seal or cetacean—but at best they can be but few. Among the recently described races or sub-species of certain mice and voles, the yellow-breasted form of the Long-tailed Field-Mouse (*Mus sylvaticus wintoni*) seems the only one at all likely to be met with here.

Much attention has lately been given to the critical study, and the distribution of British Mammals, with the result that there has been a corresponding growth of literature. On the general subject two books—*Handbook of British Mammals*, by Lydekker (1895), and *British Mammals*, by Sir Harry Johnston (1903)—have been published, and Mr J. G. Millais's monumental 3-vol. work on British Mammals is in course of publication. In the case of the two first-named, apparently not much effort was made to give the Scottish distribution down to date: it is otherwise, however, with the last-named work; and we may expect

[1] *Proceedings*, Vol. XI. pp. 85-171.

equal attention to distribution in the new edition of Bell's *British Quadrupeds,* on which Captain Barrett-Hamilton is engaged. Interest in the study of Scottish Mammals has risen high of late, with very gratifying results.

Changes of nomenclature, like many other unpleasant things, are unfortunately always with us. Some necessary ones are adopted in this Supplement.[1]

Long-Eared Bat (*Plecotus auritus* (L.)).

On 3rd February 1897 a Bat of this species was found dead near some rocks on the south side of Dumglow, Cleish Hills, Kinross-shire, and sent to me by a friend for identification. The interest attaching to the record lies in the out-of-the-way and hilly nature of the locality.

[Natterer's Bat (*Vespertilio nattereri,* Kuhl).]

Referring to what I wrote in 1891 (*Mammalian Fauna,* p. 22) regarding the supposed occurrence of this Bat in Dalkeith Park, a roughly-preserved specimen has since been discovered among some objects of natural history left by the late Robert Gray. Unfortunately no label or other clue to its origin is associated with it. Although there is consequently no proof of its being one of the Dalkeith Bats, I think it highly likely that it is (see my article in *Ann. Scot. Nat. Hist.,* 1901, pp. 129-131).

I would again make an appeal for Bats from well-wooded localities in this area, with a view to the removal of the "square brackets" from this species.

Whiskered Bat (*Vespertilio mystacinus,* Leisl.).

A welcome addition to my list was an example of this Bat (received in the flesh from Mr G. Pow) which was knocked down by a fisher-boy on the links about a mile east of Dunbar on 20th March 1893, as recorded in my note sent at the time to the *Annals of Scottish Natural*

[1] See papers by Oldfield Thomas in *Zoologist,* 1895 and 1898, and by F. W. True, *Proc. U.S. National Museum,* vol. xxi. (1898) pp. 617-635.

History (1893, p. 146). This is the East Lothian record mentioned in vol. i. of Mr Millais's book; and it is but the second occurrence of the species in Scotland.

HEDGEHOG (*Erinaceus europæus* (L.)).

To the early records north of the Forth given in my first paper, the following from the New Statistical Account of the Parish of Alloa, 1846, should perhaps be added:—"Not known in the parish when the Old Statistical Account was written. It is now found in the woods" (vol. viii., Clackmannanshire, p. 9).

As evidence of the continued abundance of this animal in the neighbourhood of Edinburgh, I may mention that close on a hundred were killed on the estate of Mortonhall during 1903.

A few years ago Captain Barrett-Hamilton proposed to separate the British Hedgehog from Continental ones, under the sub-specific name of *Erinaceus europæus occidentalis,* taking as the type a specimen in the British Museum, from Haddingtonshire. The character he relied upon—a slight cranial difference—in separating British from typical (Scandinavian) *E. europæus,* is, Dr Lönneberg states, not constant, and is not borne out by the examination of a series of Swedish specimens. *E. e. occidentalis* was therefore apparently premature, as Captain Barrett-Hamilton has himself admitted (see *Ann. and Mag. Nat. Hist.*, 1900 and 1901). Our Hedgehogs are much infested by a species of flea, *Pulex erinacei,* Bouché.[1]

LESSER SHREW (*Sorex minutus* (L.)).

The Lesser Shrew is widely distributed in the Forth area, and common, more especially, it seems to me, in the moorland districts. This conclusion is based on observations extending over a period of fully fifteen years. Since the publication of my book, I have met with examples, dead or alive, on a good many occasions, among them being the

[1] For records of this and other *Pulicidæ* from Forth Mammals and Birds, see my notes in *Ann. Scot. Nat. Hist.*, 1904 and 1906.

following, which I find entered in my note-book:—One found dead among heather, on south side of Caerketton, Pentland Hills, 23rd November 1892; one lying on path, Braid Burn, Edinburgh, 1st April 1896; two watched for a considerable time, chasing each other about a low-growing juniper bush on Swanston Hill, Pentlands, 26th May 1898; one dead on roadside, Greenbank, Morningside, 5th February 1899. When digging out a bee's nest on a bank at Bavelaw Moss, Balerno, in August 1903, I came upon a Lesser Shrew hiding in an adjoining hole.

WATER SHREW (*Crossopus fodiens* (Pall.)).

On 24th April 1893, my son and I caught a Water Shrew alive in a flooded quarry between Winchburgh and Hopetoun. Though every care was taken of it, it died after thirty-one days' confinement. On 6th July 1894, several were seen by me in Bilston Burn, near Seafield, Roslin. In June 1899, the Braid Burn colony was met with five or six hundred yards farther down than where I used previously to see them: this year, however, they have reappeared in the old haunt. Mr Millais possesses a specimen of the dark-bellied variety, from a ditch at Loch Leven (*Mammals of Great Britain and Ireland*, vol. i. p. 157).

The Water Shrew has been noted on the Carron, Stirlingshire, by Mr Harvie-Brown.

MOLE (*Talpa europæa*, L.).

The excavation of many more "fortresses" hàs amply confirmed my original observations and illustration (*Mammalian Fauna*, etc., 1892, p. 32), showing that the arrangement of the galleries and other tunnels are very far from being symmetrical or uniform in plan. The subject has also recently been investigated by Mr Lionel Adams (*Memoirs and Proceedings Manchester Lit. and Phil. Soc.*, xlvii., 1903), whose excellent observations [1] and figures are quoted by Sir H. Johnston and Mr Millais in their respective books.

[1] Some further observations on the Mole by Mr Adams will be found in the said *Memoirs* for 1906.

In January 1897, among an unusual number of large "fortresses" in a mossy meadow near Innerleithen, I examined one which was fully 8 feet in diameter and about $2\frac{1}{2}$ feet in height.

The Moles inhabiting the upland districts look to me on the average rather larger than those in the low country. A specimen with a white head, the rest of the body being of the ordinary colour, was caught in October 1880 on Dysart estate, and I have recently seen a cream-coloured one from Luffness Links.

Dr O. C. Bradley having expressed a wish for Mole embryos at all stages of development, I obtained for him, from mole-catchers in this neighbourhood, some dozens of female Moles during the spring and early summer of 1904. The first embryos (very small) were got from a Mole trapped on 7th April, a fortnight after the examination of specimens began, and in the course of the next few days a good many more were secured. By the end of the month both well-developed and small ones were occurring. The last Moles examined were caught on 12th May, and all yielded well-grown embryos. Four naked young, about $2\frac{1}{2}$ inches long, and probably about a week old, were found in a nest near the Pentlands on 24th May; another nest containing young a third larger was got at same time. Of the twenty-one pregnant females obtained,

1	contained	2	embryos.
5	"	3	"
11	"	4	"
4	"	5	"

This gives an average of 3·86, or nearly 4 per litter. Adams, in his paper above referred to, gives the average as "rather more than $3\frac{1}{2}$." Cases of 6 and even 7 embryos have been reported to me by mole-catchers, but I cannot vouch for them myself. I am also told that pregnant Moles are occasionally trapped about harvest time.

No animal is more infested by vermin than the Mole; judged from our standpoint, it must lead a decidedly uncomfortable life. Every newly caught Mole that I have examined has harboured in its sleek coat some, usually many, examples of the little flea, *Typhlopsylla gracilis*, Taschb., and I have seen baby Moles spotted all over with their bites; but if you would fully understand what the Mole has to endure in this way, dig up his snug grassy or mossy nest and shake it over a sheet of white paper. Besides scores of the said *T. gracilis* you will probably find several giant fleas, *Hystrichopsylla talpæ*, Curt., truly a formidable looking Pulicid. Numbers of the Mites *Gamasus terribilis* and *Hæmogamasus hirsutus* will likewise be seen running to and fro, and the more minute, and consequently less easily detected *Glycyphagus platygaster* and *G. crameri* will most likely also be there. Several kinds of beetles, too, have a way of taking up their abode in Moles' nests.

Wild Cat (*Felis catus*, L.).

In October 1892 the late Thomas Gordon, banker, Edinburgh, informed me that his father, who lived at Temple, shot a Wild Cat in Arniston Glen in 1830, and that its stuffed skin remained in the family "till a few years ago," when it was destroyed. Like so many other so-called Wild Cats, it possibly was only a domestic cat run wild, but Mr Gordon would not hear of this suggestion. (See my note in *Ann. Scot. Nat. Hist.*, 1897, p. 122.)

Fox (*Canis vulpes*, L.).

On 8th November 1900 I saw a Fox cross the road close to the tramway terminus, Morningside, Edinburgh, and leisurely proceed westwards through the fields at Greenbank. He evidently had come from the Braid Hills, and was making his way to Craiglockhart.

Otter (*Lutra lutra* (L.)).

Besides the Tyne and other rivers which they habitually frequent, Otters turn up from time to time in unexpected places. In 1867 a writer using the pseudonym "Umbra," stated that he once encountered a "sea-otter" in the cave at the Bass Rock (*Hotch Pot*, 2nd ed., p. 190). In March 1894 a large male Otter, weighing about 22 lbs., which I afterwards examined, was shot beside a ditch in a plantation at Gosford, East Lothian. In 1902 one frequented Harper-rig reservoir, and it, or another, was seen at Cockburn, near Balerno, about the same time. A young one, a month old, was captured alive at Dunipace, Stirlingshire, on 1st April 1904 (Harvie-Brown). While staying at Aberfoyle in April 1902, I found a pair of Otters frequenting a deep lochan near the village, and had several excellent opportunities of studying their habits. About sunset they would appear in the water and engage in wild play, rolling and splashing together for a quarter of an hour on end. On one occasion, having reached unobserved a spot at which they were accustomed to land, I stood perfectly still, and waited. Presently one of them was seen approaching rapidly, swimming on the surface and beneath it alternately. A few seconds more and it shot on to the margin of the pond within a couple of yards of my feet, and commenced fuffing and spitting like an enraged cat. Suddenly, in somersault fashion, it plunged into the water, reappearing about a dozen yards off. Disappearing again, it landed in front of me a second time, repeated the scolding, and took another "header" backwards. Having gone through this performance a third time, it went off to another part of the lochan, and I lost sight of it in the growing darkness.

BADGER (*Meles meles* (L.)).

The oldest local record of this animal I have met with is contained in Sibbald's *History of Fife and Kinross*, published in 1710. It is as follows:—"In Benartie are foxes and badgers, which the heritors hunt at certain times." A number of Fifeshire records will be found in Mr Harvie-Brown's paper on the Badger in the *Zoologist* for 1882.

Some years ago I saw in the Chambers Institute, Peebles, two specimens, obtained on Portmore estate in 1859. As regards the animal in East Lothian, I have little to add to what I wrote in my first paper. In 1893 I was shown a stuffed specimen, which had been killed at Deuchrie in the Lammermoors about 1875, and I was assured they still existed on that farm. At Presmennan, some ten years ago, I saw one which was killed there about 1885, and was told another had been obtained in 1891. They were also said to be still about Elmscleugh at that time.

In May 1895 a Badger was dug out of an earth on the south side of the Pentlands near Boghall, but there is little doubt it was an animal which escaped a short time before from confinement at Craiglockhart (see my note in *Ann. Scot. Nat. Hist.*, 1895, p. 249).

Offshoots from the colony introduced into Dalmeny Park in 1889 have reached, and for a time, at least, established themselves at Corstorphine Hill to the east and Hopetoun woods to the west. I examined a specimen from the former locality in August 1903, and three—all females, the largest weighing only 17½ lbs.—from the latter in March and April 1904. A pair from Dalmeny were turned down on Rosebery estate in 1900 (B. Campbell). The native stock among the hills at the head of the Forth valley still holds out in a few places. Two captured in 1898 and 1901 respectively, in the Balquhidder district, have come under my notice. In April 1897, one was got near Dunipace, Stirlingshire (Harvie-Brown).

Much has been written recently in reference to the period of gestation in the case of the Badger, but uncertainty still surrounds the question (*cf.* the *Zoologist* for 1903 and 1904, where some evidence for a period of eight months is put forward [1]). About all we know is that the young are born in spring; evidence of this has, on several occasions, come under my own observation. An interesting little book on the Badger, by Sir Alfred Pease, was published in 1898. The author has much to say in the animal's favour. It is not, however, so near the vanishing point in Scotland as he supposed.

POLECAT (*Mustela putorius*, L.).

There is an old undated specimen, labelled Polmaise, Stirlingshire, preserved in the Kelvingrove Museum, Glasgow. In the New Statistical Account of the parish of St Ninian's,

[1] Millais thinks between five and six months more probable (*Mammals of Great Britain and Ireland*, vol. ii., 1906).

Stirlingshire, 1841, we are told that "the foumart occasionally makes its appearance in the poultry yard, and often commits great ravages among domestic fowls." It is also mentioned in the same work among the animals found in the parishes of Stirling and Gargunnock. Another old and undated specimen, from Haystoun, near Peebles, may be seen at the Chambers Institute in that town.

In May 1894, when staying at Callander, I was assured that a Polecat had been seen the previous month running into a cairn on a hill west of Ben Ledi, but I am not aware of any having been killed there in recent years.

WEASEL (*Mustela vulgaris*, Erxl.[1]).

In September 1905, a pure white Weasel was killed near Dunbar, and later in the same year another was got near North Berwick. A similar specimen, trapped in Fifeshire in the winter of 1900-1901, was reported in *The Field* of 8th February 1902. The Dunbar one, which I saw, was a true albino. As regards the size of the female Weasel, one sent to me from Dunfermline in January 1905 was only $6\frac{7}{8}$ inches in length (excluding tail), and weighed exactly 2 ounces. On 6th May 1905 a nest of well-grown young Weasels was found in a wall near West Linton (R. S. Anderson *in lit.*). About midsummer I have seen the young following their mother in quest of prey—Dalkeith Park, June 1892; Fala Moor, ♀ and four young, July 1897.

STOAT (*Mustela erminea*, L.).

In this part of the country, the completeness of the change to the white dress of winter does not seem to depend on the severity of the season. During the open winter of 1903-1904, for instance, I examined over a dozen white, or nearly white, Stoats killed in this neighbourhood. Two from the Pentlands in January were entirely white, as were also several others from other localities during the same month. By the end of February and opening days of March the change to summer dress was beginning to set in.

[1] Perhaps, with Thomas, we should follow the Scandinavian naturalists and use the specific name, *nivalis*, L., for the Weasel (cf. *Zoologist*, 1895).

GREENLAND OR HARP SEAL (*Phoca grœnlandica*, Fabr.).

It is gratifying to be able to remove the square brackets from this species. During the winter of 1902-1903 a distinct southern movement of this and other boreal seals took place, some of the animals finding their way to the east coast of Scotland. On 7th March 1903, a fine Harp Seal, a male, 6 feet in length, was captured alive on a "slag" bank at Grangemouth, in the upper estuary of the Forth, and sent to the Zoological Gardens, Glasgow, where it died on 9th April. It was presented to the Kelvingrove Museum, where its stuffed skin may now be seen (see record by Mr J. MacNaught Campbell, *Ann. Scot. Nat. Hist.*, 1903, p. 243).

According to Mr Millais (*Mammals of Gt. Brit. and Irel.*, vol. i., 1904, p. 347) another (smaller and a female) was secured a few days later close to the same place, and sent to the Zoological Gardens, London; but there appears to have been some doubt as to the species, for Mr Pocock informs me it was variously identified at the Gardens as "Common," "Grey," and "Harp."[1] Allusion may be made to the fact that a Harp Seal, now in the Perth Museum, was caught in Invergowrie Bay, Firth of Tay, on 6th September 1895 (*Proc. Perthsh. Soc. Nat. Sci.*, vol. ii. p. xciv.).

The figure is from a sketch of the Grangemouth specimen mentioned above.

[1] Since the above was written I have communicated with Mr Millais, who tells me he twice saw this seal alive at the Zoological Gardens, and feels nearly certain it was an immature Harp Seal.

SQUIRREL (*Sciurus vulgaris*, L.).

Bell and MacGillivray, in their respective "Histories" of British Quadrupeds, state that the young of this species are born "in June" or "about midsummer," and Lydekker and Johnston simply repeat the statement, as has also been done by J. L. Bonhote in the *Zoologist* for 1901. In point of fact, however, the Squirrel is quite as early a breeder as any of our other quadrupeds, and the usual time for the birth of the young is in spring, from March to May, the majority being produced in April. At the time of writing my former paper (1891) I held this opinion, and mentioned three instances within my knowledge of young in April in the south of Scotland. Messrs Blagg and Harting, in the *Zoologist* for 1891 (p. 101), gave several instances of young having been found in the nest in March and April in England, and in the same magazine for 1892 (p. 403) I repeated my experience. Since then I have obtained further evidence, all going to prove that the usual time for production of the young in Scotland, as in England, is that stated above, namely, in spring, and not about midsummer, as given in the works above mentioned.[1] Litters as late as July or even August, however, occasionally occur. The further records referred to are as follows:—

In the *Naturalist* for June 1854, Mr J. J. Dalgleish recorded finding a Squirrel's nest with two young ones in it on 20th March of that year, at West Grange, near Alloa.

Mr H. Raeburn tells me that on or about 30th March 1879 he found a nest containing young near St Andrews.

On 6th April 1893, a "half-grown" Squirrel was caught on the ground in Dalmeny Park by Mr C. Campbell.

[1] Since this paper was written, Vol. II. of Millais's *Mammals of Great Britain and Ireland* has been issued. It contains his article on the Squirrel, and gives as the ordinary date for birth of the young, 10th March to 20th April.

On 22nd May 1899, another young Squirrel was got in Dalmeny Park. "The old one was carrying it in its mouth, and dropped it on the sudden approach of a cyclist" (C. Campbell *in lit.*).

On 11th May 1901, my son found a two-thirds grown one on the ground in a plantation at Ravelrig, near Balerno. It was apparently just out of the nest, and was scarcely able to climb when placed on the stem of a tree, where it was photographed.

On 23rd April 1903, a nest, which I inspected, in a hole in a tree at Dreghorn, near Edinburgh, contained young. Little as the nest was interfered with, the old Squirrel removed her family to some other place of retreat.

Mr J. B. Dobbie told me recently that he saw a nest of young Squirrels at Invertrossachs, in the month of May, a few years ago.

On 14th April 1904, Mr J. Fairbairn found a nest in a fir tree in a wood at Bavelaw, near Balerno, and having ascertained, by inserting his finger, that there were young in it, he kindly informed me of the fact. On 21st April I climbed to this nest, and was pleased to find therein three little Squirrels, apparently about ten days old, and still blind. They seemed to be rather less than $3\frac{1}{2}$ inches in length, exclusive of tail, which might be fully $2\frac{1}{2}$ inches, and showed no tendency to curl upwards over the back. They were covered on the upper surface with very short, silky hair of a rich chestnut or rufous colour; skin on upper parts of legs and about the eyes bluish; under-surface yellowish-white; tail straight, and clothed with short, blackish hairs. When touched in the nest, they snorted and tried to scratch the hand, and squeaked when lifted out. Wishing to photograph the youngsters, I went back to the nest next morning, only to find, however, that Mrs Squirrel had removed them! While I was at the nest the previous day, she gave me a good scolding from a distance of not more than 4 or 5 feet.

On 4th May 1904, another nest was discovered in a spruce tree at Dreghorn. It contained three young ones, naked and blind, and not more than three or four days old. One of them was taken for me, and is figured here. Its length was 75 mm., excluding the tail, which measured 40 mm.; colour, dark bluish-grey. Two days later, when I went to see the nest, the others had been removed as usual.

A female Squirrel shot at Polmaise, Stirlingshire, on 18th February 1905, was examined by Dr Bradley, to whom I handed it, and found to contain very small embryos.

In August 1894 Mr Hugh Miller, as he informed me in October following, saw a Squirrel carrying its young from the nest in the woods at Loch Vennachar.

An excellent article on the seasonal changes of fur in the common Squirrel, by Mr Oldfield Thomas, was published in

the *Zoologist* for November 1896. There are, according to this account, two annual changes of fur so far as the body and limbs are concerned, but the long hairs of the brush of the tail are only changed once, namely, in the autumn. In March 1904 I examined several Squirrels from this district, and found them to agree very well with Thomas's description of Dorset specimens obtained in January and February. I have several notes of having seen examples with cream-coloured, *i.e.*, very bleached, tails in August, and of others with nearly black, *i.e.*, freshly-clad, tails in October.

I have always been very reluctant to believe in the stories of Squirrels killing and devouring birds, but I fear I must admit that the charge, in so far as it relates to young birds in the nest, is occasionally true. In the *Proceedings* of this Society (Vol. II. p. 361, under date 1862), Durham Weir gave two instances of Squirrels devouring young birds—one having been shot at Wallhouse, Linlithgowshire, with a young bird in its claws; and a few years ago Mr C. Campbell informed me that one had destroyed a brood of young Fly-catchers in Dalmeny Park. In May 1899, near Comrie, I disturbed a Squirrel on the ground, when it ascended a tree in which a pair of Starlings were nesting. The fierce manner in which the birds attacked it and drove it off the tree, showed that they had a strong aversion to its presence in the vicinity of their nest.

That Squirrels eat fungi is well known to many. I have myself on a good many occasions watched them so engaged. In Dalkeith Park last September, observing a Squirrel on the ground in an open, grassy space where agarics were plentiful, I walked towards it, when it made off and ascended a tree, carrying one of these fungi in its mouth.

I have several times seen a Squirrel, when hotly pursued in a wood where the trees were not high, come to the ground and take refuge in a rabbit-hole; and a few years ago I dug out and captured one which did so in a wood on the Pentlands.

Clean and trim as it appears to be, the Squirrel, like the Hedgehog and the Mole, is greatly infested by a flea, the species in this instance being *Ceratophyllus sciurorum*, Bouché, which is invariably present, and usually in abundance, both in the nests and on the animals themselves.

Along with the statement in Sibbald's *Scotia Illustrata*, referred to in my former paper, regarding the presence of the Squirrel in the south of Scotland in the seventeenth century, should be read another a few pages farther on in the same work, namely, in the Appendix to the *Historia Animalium in Scotiâ* (p. 37), where he mentions, on the authority of Dr Archibald, the occurrence of the animal in the south and west of Scotland. (*Cf.*, in this connection, Harvie-Brown's "History of the Squirrel in Great Britain," *Proc. Roy. Phys. Soc. Edin.*, VI. p. 40).

BANK VOLE (*Evotomys glareolus*, Schreb.).

As the localities for this Vole given in my former paper are mainly in the vicinity of Edinburgh, the following further localities, in which I have since identified it in other parts of the area, may here be mentioned:—Tynefield, near Dunbar, common about the garden in August and September 1894 (a typical example of the Field Vole, *Microtus agrestis*, was obtained there at same time); Dirleton station, a colony on the railway embankment, January 1905; Pendreich, near Bridge of Allan, several trapped, December 1893; Culross, a few, April 1901—on the 26th one was observed climbing along the slender branches of a wild rose, and nibbling the young leaves. Traps set in the neighbourhood of Aberfoyle in May 1896 yielded only *M. agrestis*.[1]

BLACK RAT (*Mus rattus*, L.).

Mr J. G. Millais has quite recently described, in the *Zoologist* (June 1905, p. 205), a new sub-species of this animal, under the name of *Mus rattus ater*, or Black Alexandrine Rat, and Mr Eagle Clarke informs me that the Black Rats obtained by him in 1890 from a Leith steamer belong to this form and not to the "Old English" Black Rat, which Millais designates *Mus rattus rattus*. Black Rats occurring in our seaports are likely to be *M. r. ater*, but any obtained should be carefully identified.

MOUNTAIN HARE (*Lepus timidus*, L.=*L. variabilis*, Pall.).

Not long after the publication of my *Mammalian Fauna* of this district, it came to my knowledge that there were Blue Hares on the Lammermoor Hills, and on 12th September 1903 I had the pleasure of coming upon one at the head of Faseny Water, about four miles south-east of Gifford, and well within the county of Haddington. On the Moorfoots I met with three, all practically still in the white dress of winter, near the head of Moorfoot Water, on 30th March

[1] In an interesting letter, dated April 1894, the late James Bennie told me that in the arctic plant-bed of the ancient Corstorphine lake he had found a jaw-bone, with the teeth in it, which Mr E. T. Newton had identified as that of a Lemming.

1904. One of them was very loath to quit some peat hags in which lay patches of snow, and several times it allowed me to approach within 5 or 6 yards, present my camera, and expose a plate. On the range of hills between Loch Ard and the Trossachs, I found this species common in April 1896, as also on Stuc-a-Chroin in September this year.

Note.—An albino Common Hare (*Lepus europæus*, Pall.), shot near Lauder in January 1862, was exhibited at a meeting of this Society the following month (*Proceedings*, II. p. 363). I may here also mention that in August 1904 I caught a rabbit on the Isle of May—where at one time a well-marked variety existed—in no way different from the ordinary wild ones of the mainland.

Red Deer (*Cervus elaphus*, L.).

While staying at Aberfoyle in May 1896, I saw several Red Deer on the Duchray Castle shootings. Monochyle Glen, where I saw a herd of about forty in September 1902, and the hills about Am Binnein, are now the home of a fair number of Red Deer, the first settlers having come, it is said, from the Black Mount. When Smeaton Lake, in East Lothian, was being cleaned out between 1828 and 1830, remains of both Red and Roe Deer were found in the moss of the pond, as narrated by Sir Archibald Buchan-Hepburn in his address to the Berwickshire Naturalists' Club in October 1902; and a few years ago, antlers and other remains of Red Deer were found in the superficial deposits of Hailes Quarry, near Edinburgh, as described by Dr Hepburn and Mr Simpson at a meeting of the Edinburgh Geological Society in March 1899.[1] Mr G. Scott, Oxgangs, tells me Red Deer remains were got many years ago where the Craiglockhart skating-ponds now are.

Roe Deer (*Capreolus capræa*, Gray).

Roe Deer still inhabit the woods about Arniston and

[1] Bones of the Reindeer (*Rangifer tarandus*) and a frontal bone with horn cores of *Bos primigenius*, found under 6 feet of peat when a lake at Dundas Castle, Linlithgowshire, was being enlarged, were exhibited by Dr R. H. Traquair at a meeting of the Royal Society of Edinburgh on 2nd May 1904.

Penicuik, and in September 1903 I startled one in Saltoun Wood, East Lothian. In June 1901, and again on 6th May 1905, I met with them in Blairadam woods, near Kinross—on the latter occasion, no less than twelve were in view at one time. In the course of the last few years I have seen Roe in the woods at Duchray near Aberfoyle, at Balquhidder, and at Callander. "Roe-deer," says the writer of the New Statistical Account of Gargunnock, 1841, "breed in great numbers in the glen of Boquhan," Stirlingshire. My brother-in-law, the late David Deuchar, possessed the antlers of a Roe which was shot on his father's ground at Morningside, Edinburgh, about 1844.

COMMON RORQUAL (*Balænoptera physalus* (L.) = *B. musculus*, Auct.).

On 19th February 1903, a Common Rorqual or Razorback—a female about 46 feet in length—got stranded on the beach at Kirkcaldy, where it was attacked and killed by some men armed with a hedgebill. I had several opportunities of examining this animal, and an illustrated description of it, which I prepared, was published in the *Annals Scot. Nat. Hist.*, 1904, pp. 71-74. It was sold by the Board of Trade for the small sum of £2. No example of this whale had been identified in the Firth of Forth since 1808.

LESSER RORQUAL (*Balænoptera acuto-rostrata*, Lacép.).

The carcase of a Lesser Rorqual was washed ashore to the east of Barnes-ness Lighthouse, near Dunbar, on 29th September last (1905). It was a female, and measured about 27 feet in length. I went to see it on 2nd October, and found it in a very dilapidated condition; from its appearance I should say it had been dead for several weeks, if not months. The baleen was of a creamy white colour throughout (specimen exhibited).

A list of occurrences of this species of whale in Scottish waters prior to 1892 will be found in a paper by Sir William

Turner, published in the *Proceedings of the Royal Society of Edinburgh*, vol. xix. pp. 36-75. The Granton Quarry specimen (Jan. 1888) is there very fully described.

BEAKED WHALE (*Hyperoödon rostratus* (Chemn.)).

Examples of the Beaked Whale continue to be taken in the estuary of the Forth from time to time. Since the date of my first paper (1892) I have noted the following:—

Male, stranded at Grangemouth, March 1894.

One, about 25 feet long, captured near Bo'ness, October 1895; examined by J. Simpson (*Ann. Scot. Nat. Hist.*, 1896, p. 2).

Young female, about 6 feet long, found dead on shore near Cockburnspath, November 1895.

One, weighing 6½ cwts., caught in salmon-net near Stirling, 13th July 1897.

Two, 10 and 11 feet in length respectively, stranded near Culross, 24th July 1898.

One, about 20 feet long, captured on the south side of the Forth near Grangemouth, 14th August 1905.

SOWERBY'S WHALE (*Mesoplodon bidens* (Sowerby)).

The second example of Sowerby's Whale for the Firth of Forth came ashore at Morrison's Haven, Haddingtonshire, in the latter part of April 1895, and its buried remains were exhumed and examined in June following by the late James Simpson—see his note in *Ann. Scot. Nat. Hist.*, 1895, p. 250. The specimen was a male, probably about 15 feet in length.

RISSO'S GRAMPUS (*Grampus griseus* (G. Cuv.)).

An example of this rare cetacean—10 feet in length, and the first obtained in the Forth estuary—was captured near Kincardine-on-Forth on 15th October 1904, and sent to the Kelvingrove Museum, Glasgow, as reported in the *Glasgow Herald* of 28th October. The newspaper report was kindly confirmed by Mr MacNaught Campbell in a letter to me. I was at Kincardine a few days after the capture of the animal, and was informed that it had been observed passing up and down the channel with the tide almost daily for over a fortnight. I have since seen the specimen (♀) in the taxidermist's hands in Glasgow.

A skull and attached neck-vertebræ of this species, taken up in a trawl about 16 miles east of the Isle of May in August 1897, were sent to the Edinburgh Museum, as recorded by Dr Traquair in the *Ann. Scot. Nat. Hist.*, 1899, p. 197.

XXV. *The Myriapods (Centipedes and Millipedes) of the Forth Area.* By William Evans, F.R.S.E.

(Read 26th February 1906.)

The Centipedes and Millipedes, or, as they are collectively called, the Myriapods, are still among the "neglected" groups, so far as the British Islands are concerned. This neglect was remarked upon by Newport long ago, and after the lapse of more than sixty years it is strange to think that a book on the British species has yet to be written. No one, probably, has studied them more thoroughly than Mr R. I. Pocock, and I have been hoping for some years past to see a full account, or at least a synopsis, of the known British species from his pen. Judged by the ordinary standards, Myriapods are certainly not attractive creatures; yet to the zoologist few groups are of greater interest. Popular prejudice, and the fact that they are not showy objects for display in a cabinet are doubtless mainly responsible for their neglect by collectors; but the want of an English treatise for their identification must have deterred not a few field-naturalists with more advanced ideas from working at them. Consequently local lists of them are exceedingly few and incomplete, and very little is known from actual observation regarding their distribution in this country.

The number of known British Centipedes and Millipedes is, according to Mr Pocock, about 50, but all of them have not yet been put on record in print. In his recent list for Hampshire (14) only 17 are recorded. Mr F. G. Sinclair, in a somewhat disappointing article on the Myriapoda of Cambridgeshire (15), gives the names of about 30 British species, but is able to record only 9 of them from the county. Pocock, Carpenter, and Brölemann, in their respective notes on collections made in Ireland (9, 10, 11), record 26 species for that island.

For Scotland we owe a few early authoritative records to Dr W. E. Leach, in whose papers, published ninety years ago (2, 3, 4), 6 Myriapods (a Chilopod and 5 Diplopods) are recorded from near Edinburgh, namely *Geophilus longicornis*, *Polydesmus complanatus*, *Craspedosoma rawlinsii* (named after its discoverer, Richard Rawlins, a zealous young naturalist who died shortly afterwards), *Julus niger*, *J. pulchellus*, and *J. pusillus*. These, however, are not the earliest local records, for we find in a list of "Insects" found in the neighbourhood of Edinburgh, by C. Stewart, dated 1809 (1), the following names:—*Scolopendra forficata*, *Julus terrestris*, *J. sabulosus*, and *J. oniscoides*.

In 1835 Dr G. Johnston published a list of 11 species found in Berwickshire (5).

In 1882 Mr (now Sir) Thomas Gibson-Carmichael submitted a preliminary list of Scottish Myriapoda—17 in all—to this Society (7). Six have Forth localities there definitely assigned to them.

In 1900 and 1901 I reported, in the *Annals of Scottish Natural History* (12), 11 species from the Forth Area, most of them being additions to the Scottish list.

Lastly, the British Association Handbook on the Natural History of the Clyde Area (13), published in 1901, contains a list of 13 species by Mr D. A. Boyd.

The known Scottish species, so far as recorded, would appear to number about 30.

In the present list, which is based on a fairly large collection of specimens and notes made from time to time during the last ten years in various parts of the Forth Area, I am able to record 17 Centipedes (including *Scolopendrella*) and 16 Millipedes. This is exclusive of a few aliens such as *Paradesmus gracilis,* that have established themselves in green-houses, etc. That each group will be considerably added to in the course of time may be confidently predicted. Reference to Ellingsen's Norwegian list[1] suggests several that might be expected to occur here.

While it is still the common practice to speak of the Centipedes and Millipedes as forming one class, the Myriapoda, or Myriopoda as some prefer to write it, unanswerable reasons have been given for their separation into three classes, namely—Chilopoda, Symphyla, and Diplopoda (*cf.* Pocock's paper "On the Classification of the Tracheate Arthropoda," *Zoologischer Anzeiger,* xvi. (1893) p. 271; and C. H. Bollman's "The Myriapoda of North America," *Bulletin U.S. National Museum,* No. 46, 1893). But many points in the classification and nomenclature of the Myriapods are by no means settled, and I can only hope that the arrangement and names here employed will not differ materially from those adopted in the authoritative work on the British species when it makes its appearance.

The identification of Chilopods and Diplopods is, at present, a matter of very considerable difficulty, and, but for the assistance which Mr Pocock kindly gave me four or five years ago, and for which my best thanks are due, this list might never have been drawn up. Specimens of nearly all the species recorded were determined by him. Some exceptionally puzzling questions in synonymy exist, and not having myself investigated them, I simply adopt the names given me by Mr Pocock. To Sir Thomas Gibson-Carmichael, Bart., I am indebted for the equivalents of some of the names used by him in his 1882 list. In Latzel's *Die Myriopoden der österreichisch-ungarischen Monarchie,* 1880-1884, most of the British species are described.

Myriapods may be found in every month of the year, but spring is in my experience about the best time to seek for them. When the sun has gained sufficient strength

[1] Edv. Ellingsen, "Bidrag til Kundskaben om de norske Myriopoder Udbredelse" (*Christiania Videnskabs-Selskabs Forhandlinger* for 1891), and "Mere om norske Myriopoder" (*ibid.* for 1896 and 1903).

to impart warmth to the surface of the earth, they emerge from their deeper winter retreats, and are then to be found in plenty under stones, planks, bark, etc., where some dampness exists, in almost any situation having a southern exposure. They breed in spring and summer, and during the summer and autumn months quite young ones are frequent. The Centipedes, it may be mentioned, are carnivorous, while the Millipedes are vegetable feeders.

Since this paper was read, Messrs H. W. Brölemann of Pau (formerly of Paris) and Edv. Ellingsen of Kragerö, Norway, have each been so kind as to examine some specimens for me, a favour I greatly appreciate. To have had a number of my records authenticated by them adds greatly to the value of the list.[1]

Class CHILOPODA (Centipedes).

Family **LITHOBIIDÆ.**

Lithobius forficatus (Linn.).

Scolopendra forficata, Stewart's 1809 list (1).

Abundant throughout the area under stones, boards, logs, etc. Behind the turf at the foot of a wall, and under loose bark on a rotten tree trunk, are favourite haunts. While plentiful in the neighbourhood of houses and about gardens, it is by no means confined to these, but is likewise quite common in outlying woods and on the hills—indeed, almost anywhere. Recorded by Leach (2) under the name of *L. lævilabrum*, as "common in Scotland in rocky places." Extra-British range very extensive.

Local data.—The following localities—a few only of those from which specimens have been identified during the last five or six years—will show how widely this species is distributed. Has been found in every month of the year, though most in evidence from March to October, and probably breeds during the greater part of this period. Quite young ones have been observed in autumn, and in spring, no doubt after hibernation:—Morningside; Mortonhall, !P.; Salisbury Crags; Polton; fir-wood, near Kirknewton, ad. ♂♂, ♀♀, common, 31st March, !E., etc.; Aberlady; Boltonmoor Wood; Dalmeny; Bo'ness; Dysart, !E.; Aberdour; North Queensferry; Cleish Hills; Culross; Abbey Craig, near Stirling; Ochils; Aberfoyle; Callander; etc.

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[1] The mark ! after a record signifies that a specimen has been determined by Brölemann, Ellingsen, or Pocock, as indicated.

Lithobius variegatus, Leach.

This fine species, which is generally regarded as confined to the British Islands and Jersey, appears to be almost entirely of western distribution in Scotland (*cf.* Gibson-Carmichael, 7, p. 240): it is common, for instance, about Oban. In the Forth area it occurs sparingly in the oak woods at the head of the valley. I have not yet detected it farther east than Culross.

Local data.—Neighbourhood of Loch Katrine, rare (Gibson-Carmichael, *l.c.*); and I believe I met with it in the woods bordering Loch Ard, in April 1902, though I cannot now lay my hands on the specimen. One under stone in wood near Culross, 26th April 1901, ! P.

Lithobius melanops, Newp.

Lithobius glabratus, C. L. Koch.

This form is common, and widely distributed with us, and has already been recorded by me (12*b*). A favourite habitat is under bark on a dead tree; but it occurs with equal frequency under stones. Recorded from south of England (14), Ireland (9, 11), Norway, and other parts of Europe.

Local data.—Ravelrig, near Balerno, common under bark on dead fir, April 1901, ! P.; Hillend Wood, Pentlands, March 1902; Listonshiels, Sept. 1905; Roslin Woods, April 1906; Culross, April 1901, ! P.; Blairadam, under bark, May 1905; West Wemyss, ! E., and North Queensferry, common under stones, April 1905; Elie, Aug. 1904; North Berwick, Nov. 1905, several (some young); Bo'ness, May 1901 (from R. Godfrey); near Bridge of Allan, April 1906.

Lithobius calcaratus, C. L. Koch.

Common under stones, turfs, etc., chiefly on moors and hillsides. Recorded by me in 1901 (12*b*). Colour usually a dark blackish-brown. Pocock (14) records it from Hampshire. Frequent in North Europe.

Local data.—Bavelaw Moss, two, May 1900 (determined by Pocock); woods and moors near Kirknewton, one, Jan. 1902, common, April 1905; Blackford Hill, one, March 1905; summit of Caerketton, Pentlands, common under stones, March 1906, ! B., ! E.; Tyninghame, one in Moss, May; East Grange, Fife, April 1901; Aberfoyle, July 1900; hillsides, near Callander, April 1900, ! P.; etc.

Lithobius borealis, Mein.?

A *Lithobius*, unfortunately somewhat damaged, from Ben Ledi is, Mr Ellingsen thinks, this species, which has already been thought to occur on the Scottish hills (Carmichael, 7). Recorded from Scandinavia, etc.

Local data.—Ben Ledi, at about 2500 feet, ♀, 4th Sept. 1906.

Lithobius crassipes, L. Koch.

Common and generally distributed, under stones, pieces of wood, etc. A small species, with only twenty antennal segments. Recorded in my 1901 note. Sinclair (15) records it from Dartmoor and Cornwall. Common in North Europe.

Local data.—Mortonhall, March 1900 (determined by Pocock); Hillend (Pentlands), Dec. 1900; Glencorse, Sept. 1901; summit of Caerketton, March 1902 and 1906, ! B.; Ravelrig, April 1901; Kirknewton, abundant, March, ! E.; Abercorn Glen, May 1901; near Linlithgow, Aug. 1901; Craigiehall, April 1906; near Gifford, Oct. 1901 and April 1906, ! E.; near Dysart, April; Aberdour and Culross, adults and half-grown ones, April 1901, ! B.; Bridge of Allan, Oct. 1901; Callander, Sept. 1906.

Henicops fulvicornis (Mein.).

I should not wonder if this tiny Lithobiid were not uncommon in the Highland portion of the area; but so far I have detected it only on Ben Ledi. It is said to frequent wet places. It may be known by its single pair of eyes, and rather short, fulvous antennæ. No previous record of its occurrence in this country has come under my notice. It is common in Norway—whence Mr Ellingsen has kindly sent me a specimen for comparison with mine—Denmark, etc.

Local data.—Ben Ledi, South Perthshire, at an elevation of about 2000 feet, ♀, 4th Sept. 1906, ! E. [I have also four ♀ ♀ from Loch Awe collected by Mr Godfrey July 1901.]

[Family **SCUTIGERIDÆ.**

Scutigera coleoptrata (L.).

Sir Thomas Gibson-Carmichael informs me that he got a full-grown specimen of this foreign species at Kinleith paper-mill, Currie, in 1905. He has also had it from wine-cellars in Leith, where he thinks it was breeding; and he has seen it at Granton. Its occurrence in paper-works near Aberdeen, where it had been established for over 25 years, was recorded by him in the *Ent. Mo. Mag.* for September 1883.]

Family SCOLOPENDRIDÆ.

Cryptops hortensis, Leach.

Fairly common in hot-houses; and no doubt also occurs in hot-beds, under flower-pots, etc., in the adjoining gardens, though I have not yet seen a specimen in the open. It is said to be common in gardens in the south of England and in Ireland. Ellingsen has found it in Norway. According to Pocock (14), it is certainly indigenous in Great Britain.

Local data.—Under flower-pots in greenhouses, Laird's Nurseries, Corstorphine, several, May 1905; also at Botanic Garden, Edinburgh, 1905.

Family GEOPHILIDÆ.

Geophilus longicornis, Leach.

Geophilus flavus (De Geer) ?, Auct.

This species, which is one of the most easily recognised in the family, is common and widely distributed in our area, at any rate in the lower districts. It appears in all the British lists, and has an extensive range on the Continent. In common with its allies, it lives in moist earth, under stones, etc.

Local data.—Lothianburn, March 1900, ! P.; King's Park, Edinburgh, common, April 1901, etc., ! E.; Ormiston, East Lothian, three, each coiled round a small cluster of eggs, in holes in a bank occupied by a colony of bees (*Andrena*), 22nd June 1900, ! P.; South Queensferry, March, Bo'ness, June, and Linlithgow, Aug. 1901; Cleish Hills, Aug. 1900; Aberdour, Culross, and Kincardine-on-Forth, April 1901; near Dysart, North Queensferry, and Bridge of Allan, April 1905; Aberlady, April; Kinchie, E. Lothian, ad. ♀, May; Callander, April 1900, ! P.

Geophilus proximus, C. L. Koch.

I find this species, which has already been recorded by me from the area (12*b*), quite as common, and about as widely distributed, as the preceding, from which it may be known by its somewhat shorter head and antennæ, uniformly shorter hairs thereon; and three-furrowed (or foveate) instead of one-furrowed anterior ventral plates. The next species is perceptibly more robust and chestnut in tint than either; and, besides, has a characteristic tooth and notch on the opposing edges of each anterior ventral plate. Sir T. G. Carmichael tells me the *G. electricus* of his Scottish list (7) was probably this species. Of its range in England I find no indication, but it is on the Irish list (Brölemann, 11). Apparently more plentiful than *G. longicornis* in Norway (Ellingsen), and frequent in Denmark (Meinert).

Local data.—Swanston (Lothianburn), several, March 1901, ! P.; Aberdour, Fife, two, March 1900, and one, April 1901, ! P.; foot of Salisbury Crags, ♂ and ♀, April 1901, ! B., and others, 1906, ! E.; Edinburgh Botanic Garden, a few, and Dalkeith Park gardens, in earth, common (ad. and imm.), March; Fairmilehead, a few from garden, April 1906, ! B.; South Queensferry, March, and near Bo'ness, August 1901; Culross district, common, April 1901; Kilconquhar, June 1905; Dunbar, March.

Geophilus carpophagus, Leach.

G. sodalis, Bergs. & Mein., and of Gibson-Carmichael's list.
G. condylogaster, Latzel.

Another generally distributed and common (perhaps our commonest) Geophilid, seeming, however, to prefer uncultivated places, and being, according to my experience, more abundant in moorland and Highland districts than in the low country. A common European species, extending west to Ireland, and St Kilda (Evans, *Ann. Scot. Nat. Hist.*, 1906, p. 87).

Local data.—Bonaly Hill (Pentlands), ad. ♂, June 1903, and Torduff, ad. ♀, March 1906; Blackford Hill, Edinburgh, several scarcely mature, Jan.; Leadburn Moss, ad. ♀ and imm. ♂, under cut peat, March 1905; near Kirknewton, common—many full-grown—under well-embedded stones on sunny bank at edge of a moorland wood, 31st March, ! E.; Lammermuirs, near Gifford, ad. ♂ and ♀, Sept. 1903; South Queensferry, March, Bo'ness, ad. and half-grown, May (from R. Godfrey), and near Linlithgow, several, Aug. 1901; Craigiehall, April; coast of Fife near West Wemyss, adults common under stones among herbage, April last, ! E.; Tulliallan Woods, and near Culross, common, April 1901, ! P.; Kelty Glen, Callander, and well up the hillsides, common, April 1900, ! P.; oak-woods by the side of Loch Ard, common in rotten stumps, June; Pass of Leny, adults and young (8-10 mm.), Sept.

Geophilus truncorum, Bergs. & Mein.

A small species (length about 15 mm.) of fairly common and widespread occurrence. A favourite habitat is under the bark of a decaying tree-stump; lives also under stones and dead leaves. Already recorded by me (12*b*). As to its occurrence elsewhere in the British Isles, I have no information. Has been found in Norway, etc. The anterior ventral plates are very distinctly three-furrowed. Care must be taken not to mistake young of the preceding for it.

Local data.—Clubbie-dean (Pentlands) and Ravelrig, under stones, April 1901, ! P.; Balerno, common in rotten fir-stump, April 1903, ! B.; Kirknewton, ! E., March, and Salisbury Crags, April; Boltonmoor, East Lothian, several under bark, April; Dalmeny Park, April 1905; Bo'ness, June 1901; St David's, Fife, Sept. 1903; Blairadam, common under bark, May 1905; Kincardine-on-Forth, April 1901; Abbey Craig, near Stirling, and Loch Watston, near Doune, April 1905; West Wemyss, Fife, April 1906; Aberlady, April.

Schendyla nemorensis (C. L. Koch).

Has only been identified on a few occasions, but it is a small and easily overlooked species. Was recorded by me in 1901 (12*b*). I gather that it is known to Mr Pocock from England, but I have not met with any record. It is common in Norway (Ellingsen) and other parts of Europe (Latzel).

Local data.—Mortonhall, near Edinburgh, one, March 1900, ! P.; foot of Salisbury Crags, ♂ and ♀, under stone, April 1901, ! B.; near Gifford, several, April 1906.

Linotænia crassipes (C. L. Koch).

Scolioplanes crassipes (C. Koch), Latzel's Die Myriopoden, etc.

In this country luminous Centipedes usually prove, I believe, to be of this species, in which the emission of luminescent matter, as the animal moves about on mild, damp nights in autumn, is a well-known habit. According to my experience, it is a rare species in this district. It is the *Geophilus* or *Scolioplanes acuminatus* of some authors, but not, I imagine, of Johnston's Berwickshire list (5), his remarks, "common under stones, especially on the sea-shore, and abundant on the Cheviot Hills," pointing rather to *L. maritima* and *G. carpophagus;* while in Gibson-Carmichael's Scottish list (7) the name probably covers both this species and the next. Europe west to Ireland.

Local data.—Dalmeny Park, West Lothian, one, Oct. 1895 (Evans, 12*a*), and another, 24th Jan. 1900, both captured by Mr C. Campbell; hour about 10 P.M.; weather mild and moist. The identification of the first specimen (a ♀), which Mr Campbell was kind enough to give me, has been confirmed by Mr Pocock. On each occasion Mr Campbell's attention was attracted by a bright, luminous speck, with a trail of fainter ones, on the edge of a woodland path; and grasping a handful of grass and earth from the spot, he took it home and found the Centipede in it. On Sept. 30, 1903, in Donibristle Grounds, near St David's, Fife, I found a specimen under a stone on a mossy bank. In former years I have more than once seen its luminous trail in the neighbourhood of Aberlady.

Linotænia maritima (Leach).

Interest in this species centres in its habitat. On the shores of the Firth of Forth, from which it has already been recorded by me (12*b*), it is common under partly embedded stones and rotting seaweed from high-water mark to a considerable distance below it, but never, so far as I have seen, beyond a point daily uncovered by the tide. Recorded from coast of Ireland, south of England, France, Denmark, and Norway.

Local data.—Shores of Firth of Forth at the following places:—Dalmeny, a dozen under stone, buried in rotting seaweed, March 1901, ! P.; near Aberdour, abundant, adult and young, from high-water mark to twenty yards below it, April 1901; again in same locality, Oct. 1903; near Culross, a few under rotten seaweed, April 1901 and May 1906; west of Charlestown, March 1905; east of Dysart, a few, April 1906; east of Dunbar, a few, Nov.

Stigmatogaster subterraneus (Leach).

Himantarium subterraneum of Carmichael's list (7).

Will probably be found to be locally not uncommon in gardens, though as yet I have obtained it from but one locality. It is our largest Geophilid—one of my specimens was 85 mm. (about 3½ ins.) long and 2 mm. broad (in middle) when alive—and lives, as its specific name implies, hidden away amongst earth. Johnston (5) recorded it as "rather rare" in Berwickshire; Boyd (13) has taken it in the "Clyde area"; and Carmichael regards it as common through south of Scotland. England, Ireland, and North Europe, but not in Ellingsen's Norwegian list.

Local data.—Dalkeith Park gardens, Dalkeith, three adult ♀♀—75-85 mm.—5th March (identification confirmed by Carpenter). I have to thank Mr J. Whytock for these and some other Geophilids obtained when ground in the gardens was being turned over preparatory to spring sowing.

(Continued in next Vol. (XVII.), p. 109.)

JOURNAL OF PROCEEDINGS.

SESSION CXXXIV.

First Meeting, 24th October 1904.—Wm. Evans, Esq., F.R.S.E., President, in the Chair.

Professor D. J. Cunningham, M.D., F.R.S., D.C.L., LL.D., and Professor T. Hudson Beare, B A., B.Sc., were elected Ordinary Fellows.

The following alterations in the Laws of the Society were sanctioned:—

Section VII.—1. *The Council.* Delete the word "third" in the second line, and substitute the word "second."

In the third line, delete the word "and" and substitute the word "or."

Section VIII.—*Private Business.* Alter "Chair taken at half-past seven o'clock" to "Chair taken at 7.45 p.m."

In the fifth line from the end of this Section, delete the words "any two of the Presidents," and substitute the words "the President and one of the Vice-Presidents."

The following communications were submitted:

1. "Exhibition of, and Remarks on, Specimens of the Orkney Vole (*Microtus orcadensis*, Millais); a Scottish Mammal new to Science." By Wm. Eagle Clarke, Esq., F.L.S., F.R.S.E.
2. "Morphological Variations in *Vipera berus.* Size and Scaling." By Gerald Leighton, Esq., M.D., F.R.S.E.
3. "On the Trapezium of the Horse's Carpus." By O. Charnock Bradley, Esq., M.B., F.R.S.E.
4. "Exhibition, with Remarks, of Living Specimens of *Limax tenellus.*" By Wm. Evans, Esq., F.R.S.E.

Second Meeting, 28th November 1904.—Wm. Evans, Esq., F.R.S.E., President, in the Chair.

The Annual Reports of the Council, Librarian, and Treasurer were submitted.

The following Office-Bearers were elected for the current Session:

President—Wm. Evans, F.R.S.E.

Vice-Presidents—B. N. Peach, LL.D., F.R.S.; R. H. Traquair, M.D., LL.D., F.R.S.; W. Eagle Clarke, F.L.S., F.R.S.E.

Secretary—O. Charnock Bradley, M.B., F.R.S.E.

Assistant-Secretary—J. Dunstan, M.R.C.V.S., F.R.S.E.

Treasurer—W. A. Middleton, C.A.

Librarian—T. N. Johnston, M.B., C.M., F.R.S.E.

Councillors—Professor Graham Kerr, M.A., F.R.S.E.; J. H. Ashworth, D.Sc.; L. W. Hinxman, B.A., F.R.S.E.; C. B. Crampton, M.B., C.M.; G. R. Leighton, M.D., F.R.S.E.; Professor J. C. Ewart, M.D., F.R.S.; W. S. Bruce, F.R.S.G.S.; D. Waterston, M.A., M.D., F.R.S.E.; F. H. A. Marshall, B.A., D.Sc., F.R.S.E.; Percy H. Grimshaw, F.E.S.; Malcolm Laurie, B.A., D.Sc., F.R.S.E.; Sir T. D. Gibson Carmichael, Bart.

The following communications were submitted:

1. "Scotia Collections.—Note on the Gonostyles of two Antarctic Siphonophora." By Professor J. Arthur Thomson, M.A., F.R.S.E.
2. "Hermaphroditism in a Ram." By D. Waterston, Esq., M.A., M.D., F.R.S.E.
3. "Two unusual Variations in the Brain and Spinal Cord." By D. Waterston, Esq.
4. "Exhibition of Specimens of the Planarian Worm, *Rhynchodemus terrestris*, etc., from the neighbourhood of Edinburgh." By Wm. Evans, Esq., F.R.S.E.

Third Meeting, 19th December 1904.—Wm. Evans, Esq., F.R.S.E., President, in the Chair.

Messrs Norman B. Kinnear, Robert N. Rudmose Brown, J. H. Harvey Pirie, and Bertram Ingram were elected Ordinary Fellows.

The following communications were submitted:

1. "Scotia Collections.—On the Tentacles of an Antarctic Siphonophore." By John Rennie, Esq., D.Sc.
2. "The Black-backed Gulls of the Bass." By Wm. Evans, Esq., F.R.S.E.
3. "Some further Additions to the List of Spiders collected in the Edinburgh District." By Professor G. H. Carpenter, B.Sc., and Wm. Evans, Esq., F.R.S.E.
4. "Exhibition of Flat-Worms." By J. H. Ashworth, Esq., D.Sc.
5. "Exhibition of a Species of Coleoptera new to the British Isles." By R. S. Bagnall, Esq.

Fourth Meeting, 23rd January 1905.—Wm. Evans, Esq., F.R.S.E., President, in the Chair.

Messrs W. E. Agar, James Murray, John Kerr, and H. B. Muff were elected Ordinary Fellows.

The following communications were submitted:

1. "On the Regional Distribution of Plankton Organisms in Scottish Fresh-Water Lochs." By JAMES MURRAY, Esq.
2. "Scotia Collections.—On a Ten-legged Pycnogonid from the South Orkneys." By T. V. HODGSON, Esq.
3. "Exhibition of—(*a*) Specimens of Oak and Lime injured by *Gecinus viridis*; (*b*) *Tetranychus lintearius* and its web on *Ulex europæus*." By R. STEWART MACDOUGALL, Esq., D.Sc., F.R.S.E.
4. "Exhibition, with Remarks, of Short-toed Lark (*Calendrella brachydactyla*), Lapland Bunting (*Calcarius lapponicus*), and Chick of Fork-tailed Petrel (*Oceanodroma leucorrhoa*), from the Flannan Islands." By WM. EAGLE CLARKE, Esq., F.L.S., F.R.S.E.

Fifth Meeting, 27th February 1905.—WM. EVANS, Esq., F.R.S.E., President, in the Chair.

Messrs Edward J. Bles, Robert N. Rudmose Brown, and H. Brantwood Muff were formally admitted Fellows of the Society.

The following communications were submitted:

1. "Exhibition, with Remarks, of a remarkable Fossil Vertebrate from the Triassic beds of Lossiemouth." By WM. TAYLOR, Esq.
2. "The Embryology of Dipnoan and Crossopterygian Fishes in its Relation with some of the General Problems of Vertebrate Morphology." By Professor J. GRAHAM KERR, M.A., F.R.S.E.
3. "The Hatching Process in Anura." By EDWARD J. BLES, Esq., B.A.
4. "Exhibition of—(*a*) Section of Stem of *Betula alba*, showing Adult and Larval Galleries of *Scolytus Ratzeburgii*, Jans; (*b*) Stem of *Betula alba*, showing wounds made by Woodpecker in search of *Scolytus Ratzeburgii*, Jans." By R. STEWART MACDOUGALL, Esq., M.A., D.Sc., F.R.S.E.

Sixth Meeting, 27th March 1905.—WM. EVANS, Esq., F.R.S.E., President, in the Chair.

Messrs R. C. MILLAR and R. BROWN were appointed Auditors.

Messrs J. H. Harvey Pirie and James Murray were formally admitted Fellows of the Society.

The following communications were submitted:

1. "A Possible Mode of Inheritance of Adaptive Characters." By CECIL B. CRAMPTON, Esq., M.B., C.M.
2. "Scotia Collections.—Three Species of Antipatharians." By Professor J. ARTHUR THOMSON, M.A., F.R.S.E.

3. "The Periodic Growth of Scales in Gadidæ as an Index of Age." By J. STEWART THOMSON, Esq., F.L.S.
4. "A Catalogue of Land, Fresh-Water, and Marine Crustacea found in the Basin of the River Forth and its Estuary. Part I.—Malacostraca, Cladocera, and Branchiura." By THOMAS SCOTT, Esq., LL.D., F.L.S.
5. "The Odonata (Dragon Flies) of the Forth Area." By WM. EVANS, Esq., F.R.S.E.

SESSION CXXXV.

First Meeting, 23rd October 1905.—WM. EVANS, Esq., F.R.S.E., President, in the Chair.

Nigel Kennedy Worthington, Esq., was elected an Ordinary Fellow.

The retiring Vice-President (B. N. PEACH, Esq., LL.D., F.R.S.) delivered an Address on "The Higher Crustacea of the Scottish Carboniferous Rocks."

Second Meeting, 27th November 1905.—WM. EVANS, Esq., F.R.S.E., President, in the Chair.

The following Office-Bearers were elected for the current Session:

President—WM. EVANS, F.F.A., F.R.S.E.

Vice-Presidents—R. H. TRAQUAIR, M.D., LL.D., F.R.S.; W. EAGLE CLARKE, F.L.S., F.R.S.E.; Professor GRAHAM KERR, M.A., F.R.S.E.

Secretary—O. CHARNOCK BRADLEY, M.B., D.Sc., F.R.S.E.

Assistant-Secretary—J. H. ASHWORTH, D.Sc.

Treasurer—W. A. MIDDLETON, C.A.

Librarian—T. N JOHNSTON, M.B., C.M., F.R.S.E.

Councillors—GERALD R. LEIGHTON, M.D., F.R.S.E.; Professor J. C. EWART M.D., F.R.S.E.; W. S. BRUCE, F.R.S.G.S.; D. WATERSTON, M.A., M.D., F.R.S.E.; F. H. A. MARSHALL, B.A., D.Sc., F.R.S.E.; PERCY H. GRIMSHAW, F.E.S.; MALCOLM LAURIE, B.A., D.Sc., F.R.S.E.; Sir T. D. GIBSON CARMICHAEL, Bart.; Professor T. HUDSON BEARE, B.A., B.Sc.; R. C. MOSSMAN, F.R.Met.S., F.R.S.E.; E. B. JAMIESON, M.B., Ch.B; B. N. PEACH, LL.D., F.R.S.

The Annual Reports of the Council, Librarian, and Treasurer were submitted.

Messrs Norman B. Kinnear, Nigel K. Worthington, and Arthur C. Edmonds were formally admitted Fellows of the Society.

The following communications were submitted:

1. "Bdelloid Rotifera from the Forth Area." By JAMES MURRAY, Esq.

2. "Mammalia of the Edinburgh (Forth) District: Supplementary Notes." By WM. EVANS, Esq., F.R.S.E.
3. "Note on the Development of the Inter-phalangeal Sesamoid of Ungulates." By O. CHARNOCK BRADLEY, Esq., M.B., D.Sc.
4. "Exhibition of Specimens of the Parasitic Copepod, *Læmargus muricatus*, Kröy., from a Short Sunfish captured at North Berwick on 28th September last." By WM. EVANS, Esq., F.R.S.E.
5. "Exhibition, with Remarks, of a Specimen of *Ctenopteryx fimbriatus.*" By J. H. ASHWORTH, Esq., D.Sc.

Third Meeting, 18th December 1905.—WM. EVANS, Esq., F.R.S.E., President, in the Chair.

Messrs Thos. J. Anderson, David W. Henderson, H. Maxwell Vickers, and Robert D. R. Troup were elected Ordinary Fellows.

John Kerr, Esq., was formally admitted a Fellow of the Society.

The following communications were submitted:

1. "Exhibition, with Remarks, of a Number of Remarkable Neuropterous Insects, chiefly from the Mediterranean Region." By K. J. MORTON, Esq., F.E.S.
2. "On the History of *Ptinus tectus* (Boield), with special reference to its introduction and rapid spread in Britain." By Professor T. HUDSON BEARE.
3. "Exhibition of Three Species of Coleoptera recently added to the British List." By R. S. BAGNALL, Esq.
4. "A Rare Sponge from the 'Scotia' Collections." By Professor J. ARTHUR THOMSON and J. D. FIDDES, Esq.
5. "Exhibition of Models illustrating the Development of the Mammalian Hind-Brain." By O. CHARNOCK BRADLEY, Esq., M.B., D.Sc.

Fourth Meeting, 22nd January 1906.—WM. EVANS, Esq., F.R.S.E., President, in the Chair.

Messrs Robert D. R. Troup, David W. Henderson, and H. Maxwell Vickers were formally admitted Fellows of the Society.

WM. EAGLE CLARKE, Esq., F.L.S., F.R.S.E., delivered an Address on "The Birds Collected by the Scottish National Antarctic Expedition."

Fifth Meeting, 26th February 1906.—WM. EVANS, Esq., F.R.S.E., President, in the Chair.

James Wm. Bowhill, Esq., was elected an Ordinary Fellow.

The following communications were submitted:

1. "The Luminous Neotenic Female of *Phengodes*, with Exhibition of Specimen." By EDWARD J. BLES, Esq.

2. "Some Falkland Island Fossils, with Exhibition of Specimens." By E. T. Newton, Esq., F.R.S.

3. "The Myriopoda (Centipedes and Millipedes) of the Forth Area." By Wm. Evans, Esq., F.R.S.E.

4. "Exhibition of a Magic Square inscribed in Hebrew Characters." By J. H. Ashworth, Esq., D.Sc.

Sixth Meeting, 26th March 1906.—Wm. Evans, Esq., F.R.S.E., President, in the Chair.

Messrs James R. Marshall and Harry B. Bryden were elected Ordinary Fellows.

Messrs R. C. Millar and R. Brown were appointed Auditors.

The following communications were submitted:

1. "Exhibition of Two Horses' Skulls obtained from a Roman Camp near Melrose." By Professor J. Cossar Ewart.

2. "The Development of the Horse." By Professor J. Cossar Ewart.

3 "Notes on the Geology and Petrology of Gough Island." By Messrs J. H. Harvey Pirie, B.Sc., M.B., and R Campbell, M.A., B.Sc.

4. "Notes on Trypanosomes." By Miss Muriel Robertson.

5. "A Catalogue of Land, Fresh-Water, and Marine Crustacea found in the Basin of the River Forth and its Estuary." Part II. By Thomas Scott, Esq., LL.D., F.L.S.

LIST OF SOCIETIES WHICH RECEIVE THE SOCIETY'S "PROCEEDINGS."

Those Institutions from which Publications are received in return are indicated by an asterisk.

ENGLAND.

BIRMINGHAM, . .	*Philosophical Society, King Edward's Grammar School.
Do. . .	*Natural History Society, Sir Josiah Mason's College.
CAMBRIDGE, . .	*Philosophical Society.
Do. . .	University Library.
CIRENCESTER, .	*Editor of the *Agricultural Students' Gazette.*
DURHAM, . .	University Library.
HALIFAX, . .	*Yorkshire Geological and Polytechnic Society.
LEEDS, . . .	*The Conchological Society of Great Britain and Ireland.
LIVERPOOL, . .	*Biological Society, University College.
Do. . .	*Literary and Philosophical Society.
Do. . .	*Engineering Society, Royal Institution.
LONDON, . .	British Museum Library.
Do. . .	*British (Natural History) Museum, South Kensington.
Do. . .	*Royal Society, Burlington House, Piccadilly, W.
Do. . .	Chemical Society, Burlington House, Piccadilly, W.
Do. . .	*Geological Society, Burlington House, Piccadilly, W.
Do. . .	*Linnean Society, Burlington House, Piccadilly, W.
Do. . .	*Royal Microscopical Society, King's College.
Do. . .	Museum of Economic Geology, Jermyn Street.
Do. . .	Editor of *Nature*, 29 Bedford Street, Covent Garden.
Do. . .	*Zoological Society, Hanover Square.
Do. . .	*Geologists' Association, University College, W.C.
MANCHESTER, .	*Geological Society, 36 George Street.
Do. . .	*Literary and Philosophical Society, 36 George Street.
Do. . .	The Victoria University.
NORWICH, . .	*Norfolk and Norwich Naturalists' Society, The Museum.
OXFORD, . .	The Bodleian Library.
TRURO, . .	*Royal Institution of Cornwall.
WATFORD, . .	*Hertfordshire Natural History Society and Field Club.

SCOTLAND.

ABERDEEN, . .	University Library.
COCKBURNSPATH, .	*Berwickshire Naturalists' Field Club, Old Cambus.
EDINBURGH, . .	Advocates' Library.
Do. . .	University Library.
Do. . .	*Royal Society.
Do. . .	Royal Medical Society.

EDINBURGH, . .	*Royal Scottish Society of Arts.
Do. . .	*Royal Scottish Geographical Society.
Do. . .	*Botanical Society.
Do. . .	*Highland and Agricultural Society.
Do. . .	*Geological Society.
GLASGOW, . .	*Philosophical Society.
Do. . .	*Natural History Society.
Do. . .	*Geological Society.
Do. . .	*Andersonian Society.
Do. . .	University Library.
PERTH, . . .	*Perthshire Society of Natural History.
ST ANDREWS, . .	University Library.

IRELAND.

BELFAST, . .	*Natural History and Philosophical Society.
DUBLIN, . .	*Royal Irish Academy.
Do. . .	*Royal Dublin Society.
Do. . .	*Royal Geological Society of Ireland.

HOLLAND.

AMSTERDAM, . .	*De Koninklijke Akademie van Wetenschappen.
LEYDEN, . .	*Museum van Naturlijke Histoire.
UTRECHT, . .	Provinciaal Genootschap an Kunsten en Wetenschappen.

SWITZERLAND.

BASLE, . . .	*Die Naturforschende Gesellschaft.
BERN, . . .	*Allgemeine Schweizerische Gesellschaft für die gesammten Naturwissenschaften.
Do. . . .	*Die Naturforschende Gesellschaft.
GENEVA, . .	*Société de Physique et d'Histoire Naturelle.
NEUFCHATEL, .	*Société des Sciences Naturelles.
ZÜRICH, . . .	*Die Naturforschende Gesellschaft.

GERMANY.

BERLIN, . . .	*Königliche Akademie der Wissenschaften.
Do. . . .	*Deutsche Geologische Gesellschaft.
Do. . . .	*Gesellschaft Naturforschender Freunde.
BONN, . . .	*Naturhistorischer Verein der preussischen Rheinlande Westfalens, und des Reg.-Bezirks Osnabrück.
BREMEN, . .	*Verein für Naturwissenschaft.
BRESLAU, . .	*Schlesische Gesellschaft für Vaterländische Cultur.
BRUNSWICK, . .	*Naturwissenschaftlicher Verein.
DRESDEN, . .	Königliche Sammlungen für Kunst und Wissenschaft.
Do. . .	*Der Verein für Erdkunde.
ELBERFELD, . .	*Naturwissenschaftlicher Verein.
ERLANGEN, . .	University Library.
FRANKFORT-ON-MAIN,	*Senckenbergische Naturforschende Gesellschaft.
Do.	*Deutsche Malakozoologische Gesellschaft, Dr Kobelt, Schwanheim.
FREIBURG, i. B., .	*Die Naturforschende Gesellschaft.
GÖTTINGEN, . .	*Königliche Gesellschaft der Wissenschaften.
HALLE, . . .	*Kaiserliche Akademie der Naturforscher.
HAMBURG, . .	Naturhistorisches Museum.

JENA,	*Medicinisch-naturwissenschaftliche Gesellschaft.
LEIPZIG,	*Königliche Sächsische Gesellschaft der Wissenschaften.
Do.	Naturforschende Gesellschaft.
Do.	Editor of the *Zoologischer Anzeiger*.
MUNICH,	*Königliche Baierische Akademie der Wissenschaften.
STUTTGART,	*Verein für Vaterländische Cultur in Württemberg.
WÜRZBURG,	*Physikalisch-medicinische Gesellschaft.

AUSTRIA.

AGRAM,	*Societas Croatica Historico-naturalis.
HERMANNSTADT,	*Siebenbürgischer Verein für Naturwissenschaft.
PRAGUE,	*Königliche-böhmische Gesellschaft der Wissenschaften.
TRIESTE,	Società Adriatica di Scienze Naturali.
VIENNA,	*K.k. zoologisch-botanische Gesellschaft.
Do.	*K.k. Naturhistorisches Hof-Museum.

ITALY.

BOLOGNA,	*Accademia delle Scienze dell' Istituto.
MILAN,	*Reale Istituto Lombardo di Scienze, Lettere ed Arti.
Do.	*Società Italiana di Scienze Naturali.
MODENA,	Società dei Naturalisti.
NAPLES,	Editor of the *Zoologischer Jahresbericht*, Zoological Station.
PADUA,	*Società Veneto-Trentina di Scienze Naturali residente in Padova.
ROME,	*Reale Accademia dei Lincei.
TURIN,	*Reale Accademia delle Scienze.

SPAIN.

MADRID,	*Real Academia de Ciencias exactas, fisicas e naturales.
Do.	*Sociedad española de Historia natural.

PORTUGAL.

COIMBRA,	*Bibliothèque de l'Université.
LISBON,	*Academia Real das Sciencias.

FRANCE.

BORDEAUX,	La Société Linnéenne.
CAEN,	*Société Linnéenne de Normandie.
CHERBOURG,	*Société Nationale des Sciences Naturelles.
PARIS,	*Académie des Sciences de l'Institut.
Do.	*Société Géologique de France, Rue des grands Augustins, 7.
Do.	*Société Zoologique de France, Rue des grands Augustins, 7.
Do.	Société de Biologie.
Do.	École des Mines.

BELGIUM.

BRUSSELS,	*Académie Royale des Sciences, des Lettres, et des beaux Arts.
Do.	*Société Royale Malacologique de Belgique.
Do.	Société Belge de Microscopie.

SCANDINAVIA.

BERGEN, . .	*The Museum.
CHRISTIANIA, .	*Den Naturhistoriske Forening.
Do. . .	Universitets Bibliothek.
COPENHAGEN, .	*Kongelige Danske Videnskabernes Selskab.
Do. . .	*Naturhistoriske Forening.
STOCKHOLM, . .	*Kongliga Svenska Vetenskaps-Akademie.
UPSALA, . .	*Kongliga Vetenskaps-Societeten.
Do. . .	*Observatoire Météorologique.

RUSSIA.

DORPAT, . .	*Naturforscher Gesellschaft.
KIEV, . . .	*Natural History Society.
MOSCOW, . .	*Société Impériale des Naturalistes.
ST PETERSBURG, .	*Académie Impériale des Sciences.
Do. .	*Imperial Botanic Garden.

AMERICA.

UNITED STATES.

ALBANY, N. Y., .	*New York State Library.
BALTIMORE, . .	*Johns-Hopkins University Library.
BOSTON, . .	*American Academy of Arts and Sciences.
Do. . .	*Society of Natural History.
BROOKVILLE, IND.,	*Brookville Society of Natural History.
CALIFORNIA, . .	University of California.
CAMBRIDGE, MASS,	*Harvard University Library.
Do.	*Museum of Comparative Zoology.
CHICAGO, . .	*Academy of Sciences.
CINCINNATI, . .	*Society of Natural History.
NEWHAVEN, CONN.,	*Connecticut Academy of Arts and Sciences.
Do.	Yale College Library.
NEW YORK, . .	*New York Academy of Sciences.
PHILADELPHIA, .	*Academy of Natural Sciences.
Do. .	*Wagner Free Institute.
SAN FRANCISCO, .	*California Academy of Sciences.
ST LOUIS, . .	*Academy of Sciences.
WASHINGTON, .	*Smithsonian Institute.
Do. . .	*Philosophical Society.
Do. . .	*United States National Museum.
Do. . .	*United States Geological Survey.
Do. . .	*United States Commissioner of Fish and Fisheries.
WISCONSIN, . .	*Academy of Sciences, Arts, and Letters.

MEXICO.

MEXICO, . .	*Ministerio de Fomento de la Republica, Osservatorio Meteorologico.
Do. . .	*Sociedad Cientifica, "Antonio Alzate," Osservatorio Meteorologico Central.

CANADA.

HAMILTON, . .	*The Hamilton Association.
KINGSTON, . .	*Queen's University.

MANITOBA, . .	*Historical and Scientific Society, Winnipeg.
MONTREAL, . .	*The Natural History Society.
OTTAWA, . .	*Canadian Geological Survey.
Do. . .	*Royal Society of Canada.
TORONTO, . .	*The Canadian Institute.

NOVA SCOTIA.

HALIFAX, . .	*Nova Scotia Institute of Natural Science.

BRAZIL.

RIO DE JANEIRO, .	Museu Nacional.

AFRICA.

CAPE TOWN, . .	*South African Philosophical Society.

ASIA.

BATAVIA, . .	*Koninklijke Natuurkundige Vereeniging in Nederlandsch Indie.
CALCUTTA, . .	Royal Asiatic Society of Bengal.
TOKIO, JAPAN, .	*Imperial University of Japan.

AUSTRALASIA.

ADELAIDE, . .	*Royal Society of South Australia.
MELBOURNE, . .	*Royal Society of Victoria.
SYDNEY, . .	*Royal Society of New South Wales.
Do. . .	*The Australian Museum.
Do. . .	*Linnean Society of New South Wales.
WELLINGTON, .	*New Zealand Institute.

LIST OF FELLOWS

At 31st October 1906.

*Those marked * are Life Members.*

Date of Election.

1905. Agar, W. E., B.A., 10 Caird Drive, Glasgow.
1905. Anderson, T. J., B.Sc., College of Agriculture and Horticulture, Holmes Chapel, Cheshire.
1901. Annandale, Nelson, B.A., D.Sc., The Museum, Calcutta.
1884. Armitage, J. A., B.A., 58 Waterloo Road South, Wolverhampton.
1902. *Ashworth, J. H., D.Sc. Natural History Department, University.
1904. Bailey, Edward B., B.A., H.M. Geological Survey, 28 Jermyn Street, London.
1885. Barbour, A. H. F., M.A., B.Sc., M.D., 4 Charlotte Square.
1904. Beare, Professor T. Hudson, B.A., B.Sc., M.I.C.E., University.
1880. *Beddard, Frank E., M.A., F.R.S., Zoological Gardens, London.
1897. Berry, Professor R. J. A., M.D., The University, Melbourne.
1881. *Berry, W., Tayfield, Newport, Fife.
1898. Bisset, James, M.A., F.L.S., F.G.S., 9 Greenhill Park.
1902. Black, J. Wyclif, F.C.S., 20 Mardale Crescent.
1903. Bles, Edward J., B.Sc., Natural History Laboratory, University, Glasgow.
1906. *Bowhill, Jas. Wm., B.A., Morelands, Grange Loan.
1892. Bowhill, Thomas, F.R.C.V.S., The Drostdy, Graham's Town, Cape Colony.
1893. *Bradley, O. Charnock, M.B., D.Sc., F.R.S.E., Royal Veterinary College—*Secretary*.
1876. Brown, J. A. Harvie-, F.Z.S., F.R.S.E., Dunipace House, Larbert, N.B.
1891. Brown, Richard, C.A., 23 St Andrew Square.
1904. Brown, R. N. Rudmose, B.Sc., 52 Beaconsfield Place, Aberdeen.
1876. *Bruce, W. P., Kinleith Mill, Currie.
1894. Bruce, W. S., F.R.S.E., F.R.S.G.S., Scottish Oceanographical Laboratory, Surgeons' Hall.
1906. Bryden, H. B., 16 Frederick Street.
1885. Burt, Robert F., M.B., 124 Stroud Green Road, Finsbury Park, London, N.
1902. Cameron, John, M.D., D.Sc., M.R.C.S.Eng., Anatomy Department, The Victoria University, Manchester.
1893. Campbell, Kenneth Findlater, C.E., Hon.M.Inst.C.E., M.S.I., Town Hall, Huddersfield.
1892. Carlier, Professor Edmond W. Wace, B.Sc., M.D., University, Birmingham.
1876. *Carmichael, Sir T. D. Gibson, Malleny, Balerno, Midlothian.

Date of Election.

1858. Carruthers, W., F.R.S., 14 Vermont Road, Norwood, London, S.E.
1888. Clarke, Wm. Eagle, F.L.S., F.R.S.E., Royal Scottish Museum.
1895. *Clough, C. T., M.A., H.M. Geological Survey, 33 George Square.
1893. Coates, H., F.R.S.E., Pitcullen House, Perth.
1881. Cook, C., W.S., 11 Belgrave Crescent.
1887. *Corke, H. C., F.R.S., 178 High Street, Southampton.
1902. Cowan, Francis, C.A., Westerlea, Murrayfield.
1897. Craig, E. H. Cunningham, B.A., F.G.S., Port of Spain, Trinidad.
1900. *Crampton, Cecil B., M.B., C.M., H.M. Geological Survey, 33 George Square.
1897. *Crawford, Francis C., 19 Royal Terrace.
1898. Crawford, John, M.B., C.M.
1874. Crawford, W. C., M.A., 1 Lockharton Gardens, Colinton Road.
1904. Cunningham, Professor D. J., M.D., D.Sc., D.C.L., LL.D., F.R.S., University.
1877. *Dalgleish, J. J., Brankston Grange, Bogside Station, Stirling.
1899. Davis, W. Richard, M.R.C.V.S., The Hermitage, Tonby Hill, Enfield.
1894. Day, T. Cuthbert, F.C.S., 36 Hillside Crescent.
1893. Donald, Charles W., M.D., F.R.C.S.E., 28 Portland Square, Carlisle.
1895. Douglas, William, 9 Castle Street.
1880. Drummond, W., S.S.C., 4 Learmonth Terrace.
1864. *Duns, Professor, D.D., F.R.S.E., 14 Greenhill Place.
1902. Dunstan, John, M.R.C.V.S., F.R.S.E., Liskeard, Cornwall.
1888. Edington, Alexander, M.B., C.M., c/o Lennox Ld., Durban, Natal; or 20 Kilmaurs Road.
1903. Edmunds, Arthur C., 10 Bright's Crescent.
1889. Elsworth, R. C., M.D., F.R.C.S.Eng., St Helen's Road, Swansea.
1880. *Evans, Wm., F.F.A., F.R.S.E., 38 Morningside Park.
1883. Ewart, Professor J. Cossar, M.D., F.R.S., University.
1901. Falconer, J. D., B.Sc., Lokoja, N. Nigeria.
1902. Farquharson, David A., M.B., C.M., Norwood, Canaan Lane.
1884. *Ferguson, James A. E., M.B., Eccles, East Bank, Demerara, British Guiana.
1885. Ferguson, James Haig, M.D., F.R.C.P.E., 7 Coates Crescent.
1895. Flett, John Smith, M.B., D.Sc., Museum of Practical Geology, Jermyn Street, London; or Inchmahone, Sutton, Surrey.
1880. Glover, J., S.S.C., 1 Hill Street.
1899. Godfrey, Robert, M.A., 46 Cumberland Street.
1877. Grieve, S., 21 Queen's Crescent.
1886. Grieve, Symington, 11 Lauder Road.
1893. Grimshaw, Percy H., F.E.S., Royal Scottish Museum.
1893. *Guppy, H.B., M.B., F.R.S.E., E.M.A., Pearl Harbour, Sandwich Islands.
1899. Hay, Wm. Peach, M.B., C.M., Lincoln Road, Peterborough.
1905. Henderson, D. W., M.A., 24 North Fort Street, Leith.
1883. Henderson, Professor, M.B., F.L.S.
1883. Hepburn, Professor David, M.D., University College, Cardiff.
1899. Heslop, Charles, Lothian Vale, Holyrood.

Date of Election.

1884. Hinxman, Lionel W., B.A., F.R.S.E., H.M. Geological Survey, 33 George Square.

1878. Horne, J., F.G.S., LL.D., F.R.S., H.M. Geological Survey, 33 George Square.

1883. Hoyle, W. E., M.A., D.Sc., F.R.S.E., The Victoria University, Manchester.

1904. Ingram, B., L.R.C.P. & S.E., Australasian Club.

1903. Jamieson, E. B., M.D., Anatomy Department, University.

1895. *Johnston, Surgeon-Major Henry Halcro, D.Sc., M.D., F.L.S., Ophir House, Kirkwall, Orkney.

1898. Johnston, T. Nicol, M.B., C.M., Corstorphine House, Corstorphine—*Librarian.*

1894. Johnstone, Lieut. George, R.N.R., F.R.S.G.S., British India Steam Navigation Co., 16 Strand Road, Calcutta.

1869. *Kennedy, Rev. J., M.A., B.D., 9 Hartington Place.

1892. Kerr, Professor J. Graham, M.A., F.R.S.E., University, Glasgow.

1905. Kerr, John, Sunnybrae, Corstorphine.

1878. Kidston, Robert, F.G.S., F.R.S.E., 12 Clarendon Place, Stirling.

1904. Kinnear, Norman B., Mem. Brit. Orn. Union, 12 Grosvenor Crescent.

1898. Lee, O. A. J., 58 Manor Place.

1902. *Leigh, J. Hamilton, F.L.S., F.Z.S., Matchams Park, Ringwood, Hants.

1903. Leighton, Gerald R., M.D., F.R.S.E., 51 East Trinity Road.

1886. Lisle, George, C.A., F.F.A., 5 N. St David Street.

1861. Logan, A., Register House.

1886. M'Cracken, Professor, Crewe.

1882. *M'Donald, L. M., Skaebost, Skye.

1896. *MacDougall, R. Stewart, M.A., D.Sc., 13 Archibald Place.

1900. M'Gillivray, W. L., Eoligary, Barra.

1893. Mackay, Alexander, Bank of Scotland, Thurso.

1904. Mackie, N. Alex., 13 Barnton Terrace.

1878. Maclauchlan, J., Albert Institute, Dundee.

1886. MacWatt, Major R. C., M.A., M.B., c/o Messrs Henry S. King and Co., 9 Pall Mall, London.

1901. Marshall, F. H. A., B.A., D.Sc., F.R.S.E., Physiological Laboratory, University.

1906. Marshall, James R., Rachan, Broughton, Peeblesshire.

1903. Middleton, W. A., C.A., 5 N. St David Street—*Treasurer.*

1889. *Millar, Robert C., C.A., 30 York Place.

1898. Miller, Hugh, F.Z.S., Zoological Laboratory, 21 Hill Place.

1903. Morrison, J. Melrose, Church Hill, Duddingston.

1898. Morton, Alexander, B.A., B.Sc., 17 Lutton Place.

1898. Morton, Kenneth J., F.E.S., 13 Blackford Road.

1890. Mossman, R. C., F.R.Met.S., F.R.S.E., 10 Blacket Place.

1905. Muff, H. B., B.A., F.G.S., The Red House, Bexley Heath, Kent.

1895. Munro, Robert, M.A., M.D., LL.D., F.R.S.E., F.S.A.(Scot.), 48 Manor Place.

1874. Murray, D. R., M.B., C.M., 41 Albany Street, Leith.

1905. Murray, James, Ardoch, Nerston, East Kilbride.

Date of Election.

1877. Murray, Sir John, K.C.B., Ph.D., LL.D., F.L.S., F.R.S.E., Challenger Lodge, Wardie.
1889. Musgrove, Professor James, M.D., University, St Andrews.
1904. Nash, J. Kirke, L.D.S., 6 Inverleith Row.
1887. Norman, Rev. Canon, M.A., D.C.L., The Red House, Berkhamstead, Herts.
1870. Peach, B. N., LL.D., F.G.S., F.R.S., 72 Grange Loan.
1891. Pentland, Young J., 5 Bruntsfield Terrace.
1904. Pirie, J. H. Harvey, B.Sc., M.B., Ch.B., 13 Alva Street.
1889. Purvis, G. Carrington, B.Sc., M.D., Bacteriological Institute, Graham's Town, Cape Colony.
1885. Raeburn, Harold, Raeburn's Brewery, Duddingston.
1881. *Ramsay, Lieut.-Col. Wardlaw, Whitehill, Rosewell, Midlothian.
1904. Rattallack, Cyrus, F.R.C.S.E., c/o Union Bank of Australia, Collin Street, Melbourne.
1861. *Robertson, T., c/o J. Nisbet & Co., 21 Berners Street, London, W.
1894. Roebuck, W. Denison, F.L.S., 259 Hyde Park Road, Leeds.
1900. Schäfer, Professor E. A., F.R.S., University.
1889. Scott, Thomas, LL.D., F.L.S., 280 Victoria Road, Aberdeen.
1902. Simpson, Professor J. Y., D.Sc., F.R.S.E., 52 Queen Street.
1886. *Somerville, Professor Wm., M.A., B.Sc., F.R.S.E., F.L.S., 121 Banbury Road, Oxford.
1880. Sprague, T. Bond, M.A., LL.D., F.R.S.E., 29 Buckingham Terrace.
1899. Stenhouse, Andrew G., 191 Newhaven Road, Leith.
1882. Stewart, R., S.S.C., 137 George Street.
1900. *Tait, David, H.M. Geological Survey, 33 George Square.
1894. Taylor, William, Lhanbryde, Elgin.
1893. Terras, James A., B.Sc., 40 Findhorn Place.
1887. Thomson, Professor J. Arthur, M.A., F.R.S.E., University, Aberdeen.
1876. *Thomson, John.
1885. Tomlinson, Henry T., M.B., C.M., Coton Road, Nuneaton.
1859. Traquair, R. H., M.D., LL.D., F.R.S., The Bush, Colinton.
1905. Troup, R. D. R., 5 Roseneath Street.
1858. *Turner, Sir Wm., K.C.B., M.B., D.Sc., D.C.L., LL.D., F.R.S., 6 Eton Terrace.
1905. Vickers, H. Maxwell, 21 Marchmont Road.
1901. Waddell, James Alexander, of Leadloch, 12 Kew Terrace, Glasgow.
1882. Wallace, Professor R., University.
1898. Waterston, David, M.A., M.D., F.R.C.S.E., F.R.S.E., Anatomy Department, University.
1894. Whitaker, J. Ryland, B.A., M.B., L.R.C.P.E., Anatomy Department, Surgeons' Hall.
1884. White, J. Martin, of Balruddery, Dundee; 1 Cumberland Place, Regent's Park, London.
1890. Williams, John Robert, M.B., C.M., Ardre, Penmaenmawr.
1895. *Wilson, Professor Gregg, Ph.D., D.Sc., Queen's College, Belfast.
1883. *Woodhead, Professor G. Sims, M.D., F.R.S.E., University, Cambridge.
1905. Worthington, Nigel K., 5 Wester Coates Gardens.
1896. Yeoman, John B., M.B., C.M., Neston, Cheshire.

CORRESPONDING.

Date of Election.

Andrew, Rev. J., Newbury, Fifeshire.
1875. Coughtrey, Professor Millen, M.D., University of Otago, New Zealand.
1858. Duncan, Rev. J., Denholm.
1870. Fraser, Rev. Samuel, Melbourne.
1871. Grieve, A. F., Brisbane, Queensland.
1852. Howden, J. C., M.D., Montrose.
1874. Joass, Rev. J. M., LL.D., Golspie.
1874. Jolly, William.
1885. Lindström, Professor Gustav, Stockholm.
1871. Macdonald, John, S.S.C., 19 York Place, Edinburgh.
Mushet, David, Gloucester.
1885. Nathorst, Professor A. G., Surveyor-General, Geological Survey of Sweden, Stockholm.
1867. Robb, Rev. Alexander, Old Calabar.

HONORARY.

1857. Chevrolat, Auguste, Paris.
1865. Colloredo-Mannsfeldt, Prince, Vienna.
1857. Dohrn, C. A., Zoological Station, Naples.
1883. Geikie, Sir Archibald (Ord. Fellow 1878), London, *Olim Præses.*
1895. Geikie, Professor James, LL.D., D.C.L., F.R.S., University, Edinburgh.
1857. Gerstaecker, A., Greifswald.
1857. Javet, Charles, Paris.
1857. Kraatz, G., Berlin.
1888. Lankester, Professor E. Ray, F.R.S., British Museum, London.
1893. Lapworth, Professor, F.R.S., Birmingham.
1857. Obert, M., St Petersburg.
1888. Vines, Sydney H., M.A., F.R.S., Christ's College, Cambridge.

Fellows are requested to intimate change of Address to
DR O. CHARNOCK BRADLEY, *Secretary*,
ROYAL VETERINARY COLLEGE, EDINBURGH.

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MFarlane & Erskine, Printers, Edinburgh.

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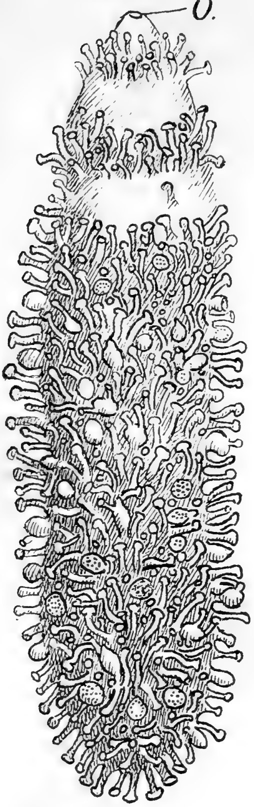
PLATE I.

Fig. I.



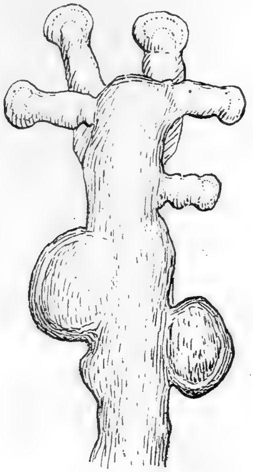


Fig. IV.

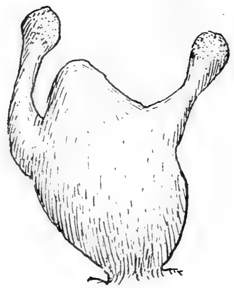
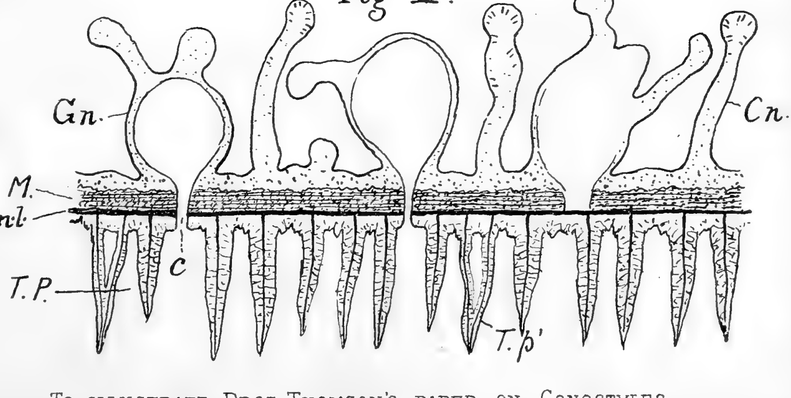


Fig. III.

Fig. II.

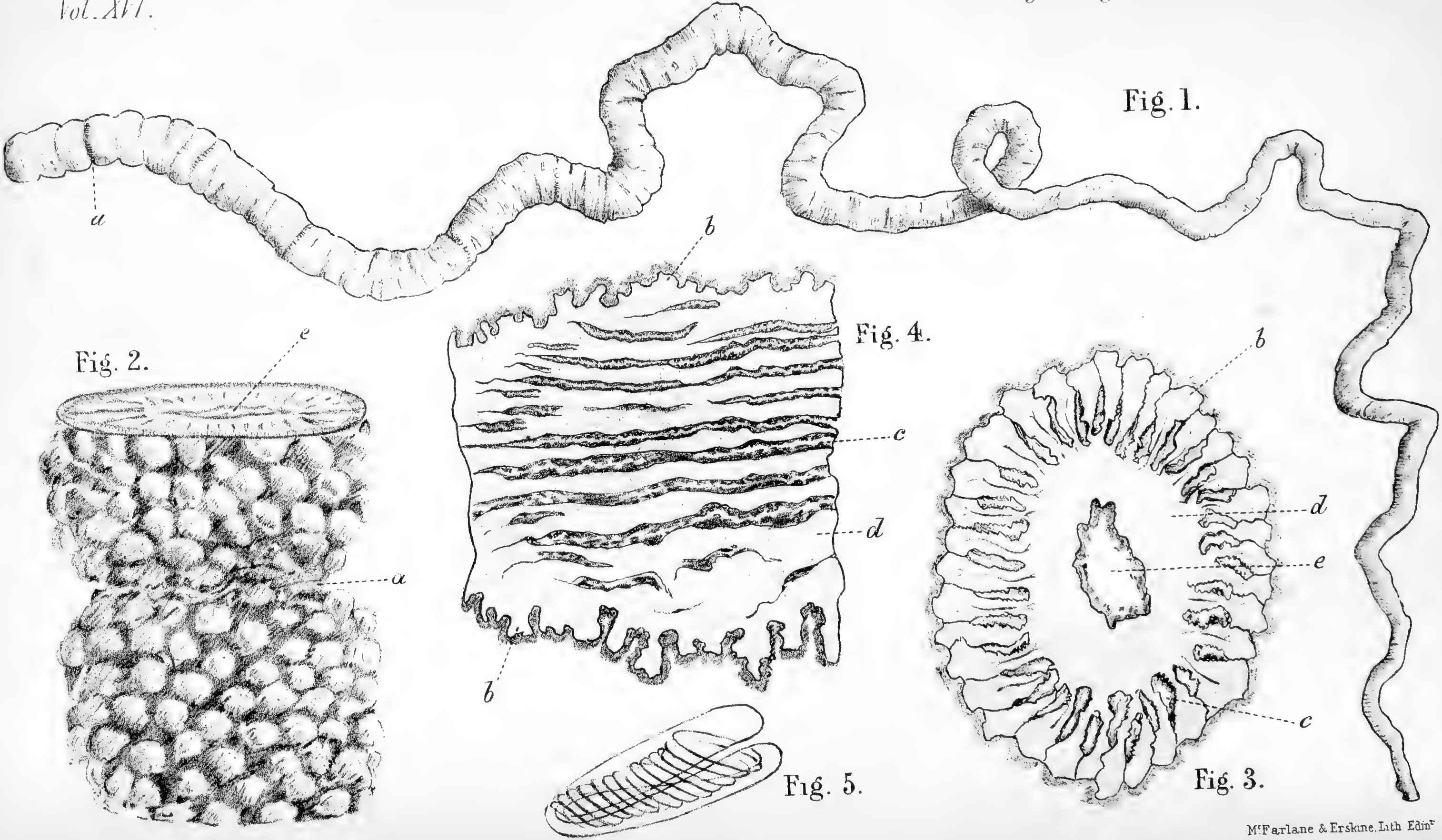


TO ILLUSTRATE PROF. THOMSON'S PAPER ON GONOSTYLES.

Vol. XVI.

PLATE II.

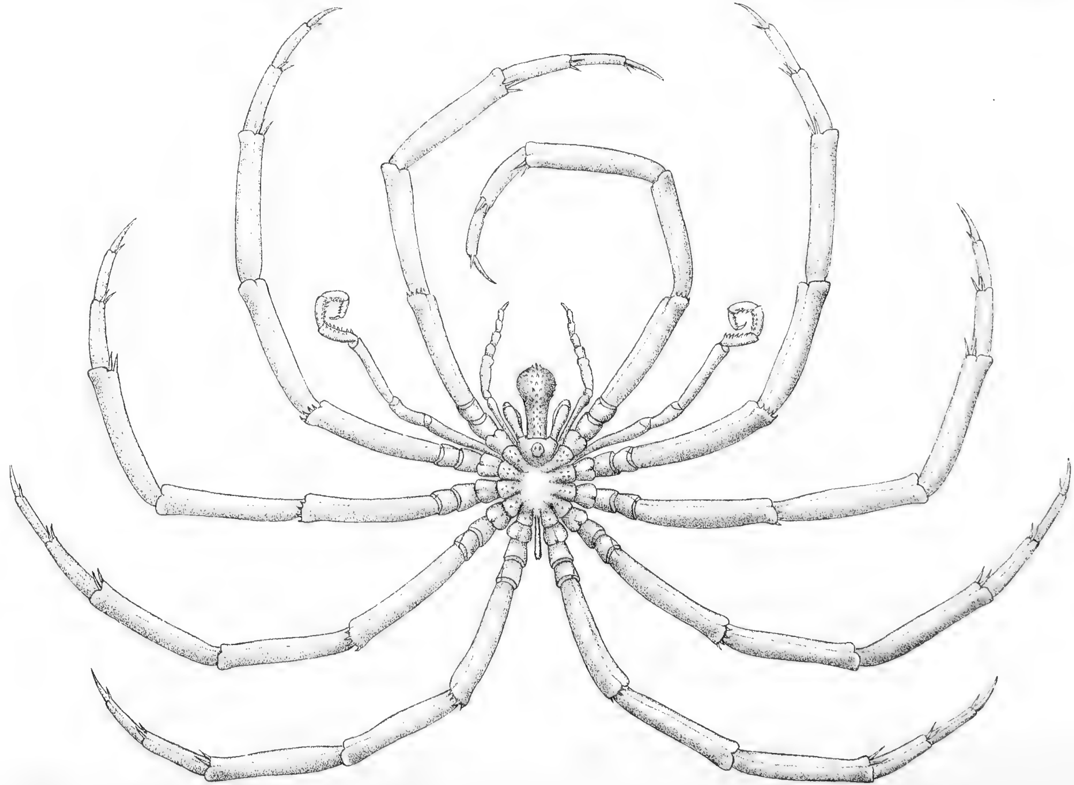
Royal Physical Society, Edinburgh.



Jas. Ritchie, del.

McFarlane & Erskine, Lith Edin^r

TO ILLUSTRATE DR. RENNIE'S PAPER ON TENTACLES OF SIPHONOPHORE.



M'Farlane & Erskine, Lith. Edin[r]

Decalopoda australis Eights. Natural Size.

Fig. 1.

MANDIBLE. × 6

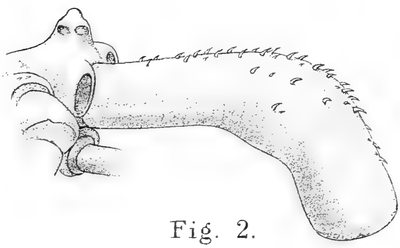


Fig. 2.

PROBOSCIS FROM RIGHT SIDE. × 4

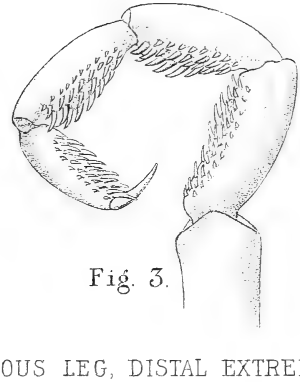


Fig. 3.

OVIGEROUS LEG, DISTAL EXTREMITY. × 6

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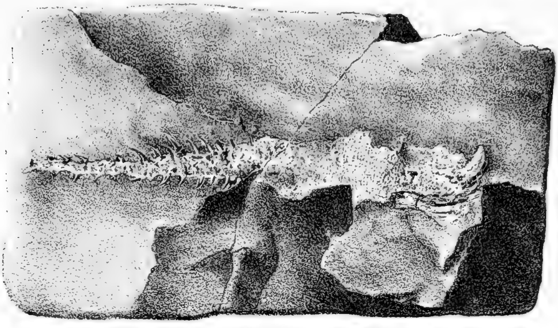


Fig. 5.

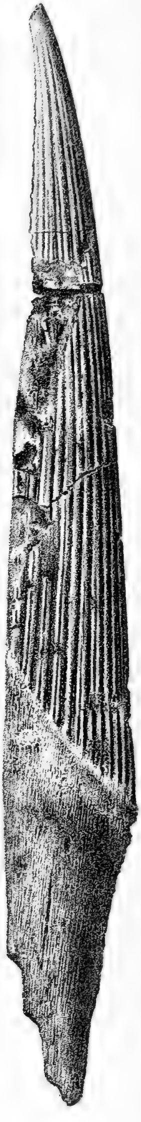
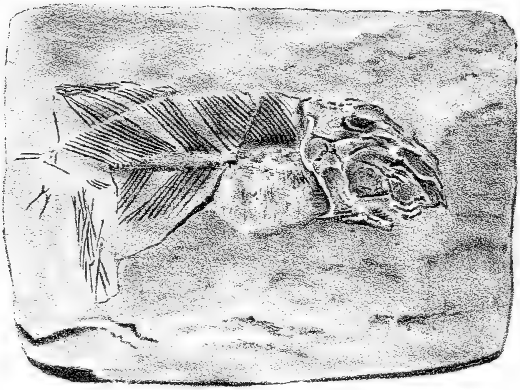


Fig. 3.



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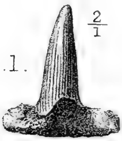


Fig. 1. 2/1

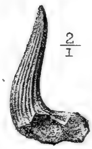


Fig. 2. 2/1

Fig. 6. 3/1

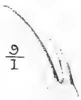
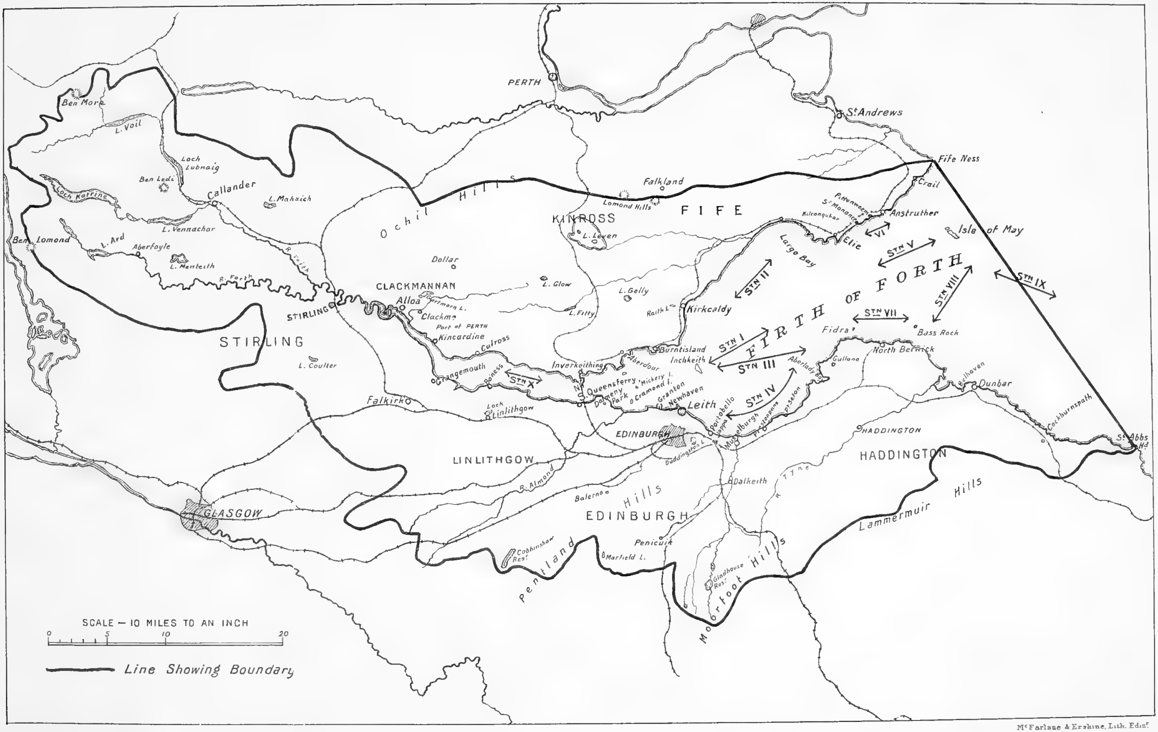


Fig. 7. 9/1

Figs. 4.5.6.7. R.H. Traquair.
Figs. 1.2.3. J. Green.

J. Green in lap.
Mintern Bros. imp. London.



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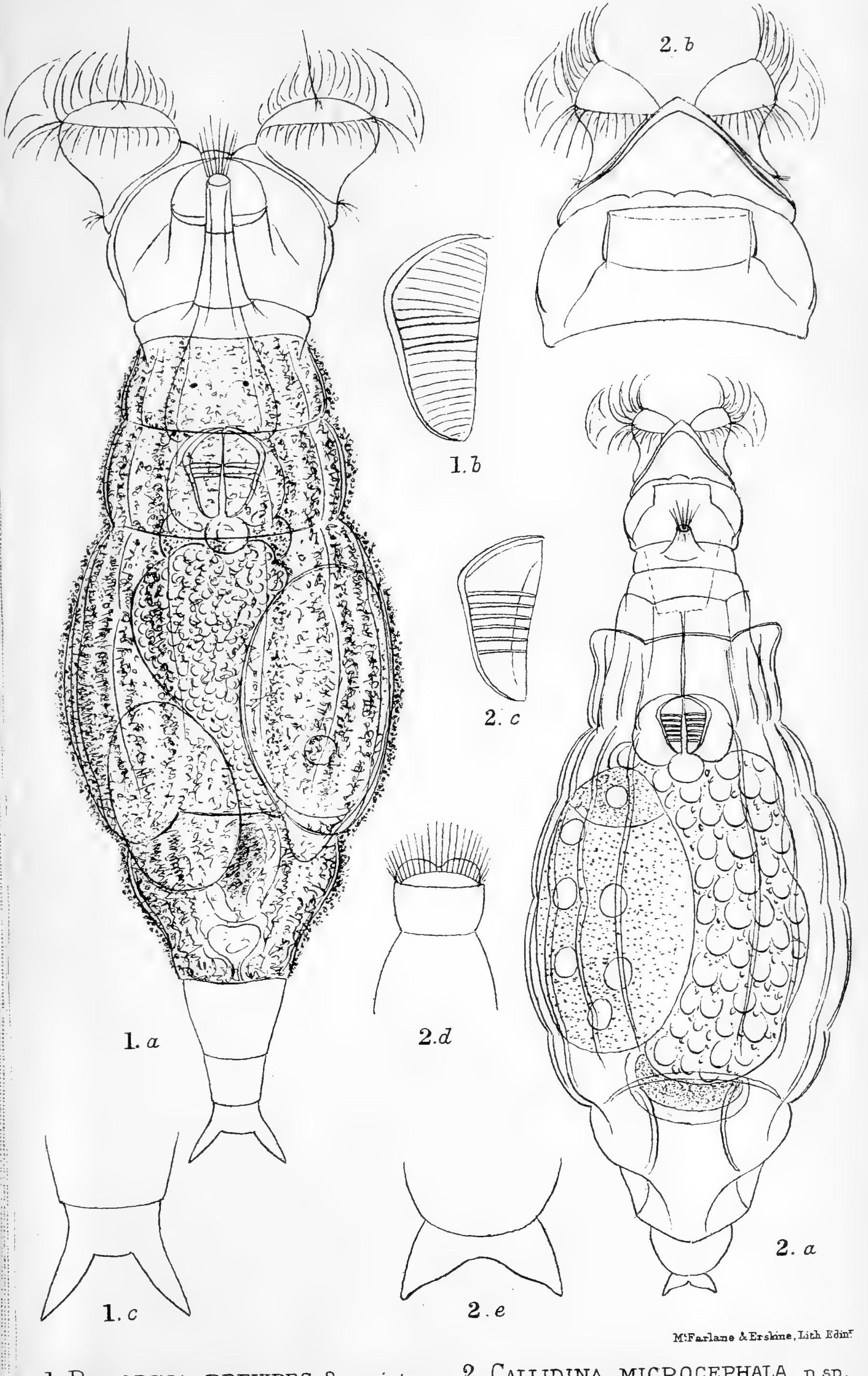
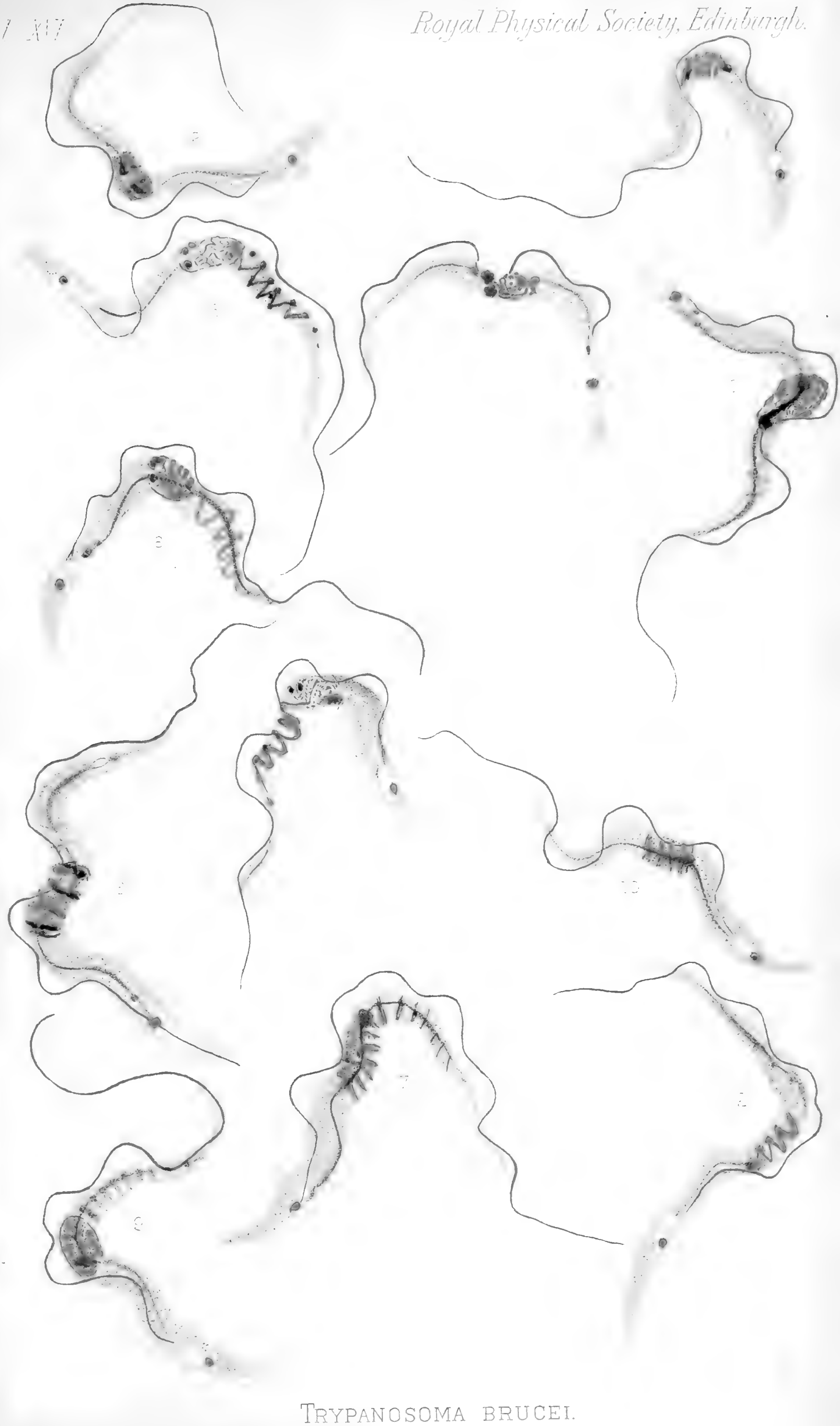
Sketch-Map showing the limits of the Basin of the River Forth and its Estuary.



1. PHILODINA BREVIPES ? variety. 2. CALLIDINA MICROCEPHALA, n.sp.



TRYPANOSOMA BRUCEI.

Plate IX.

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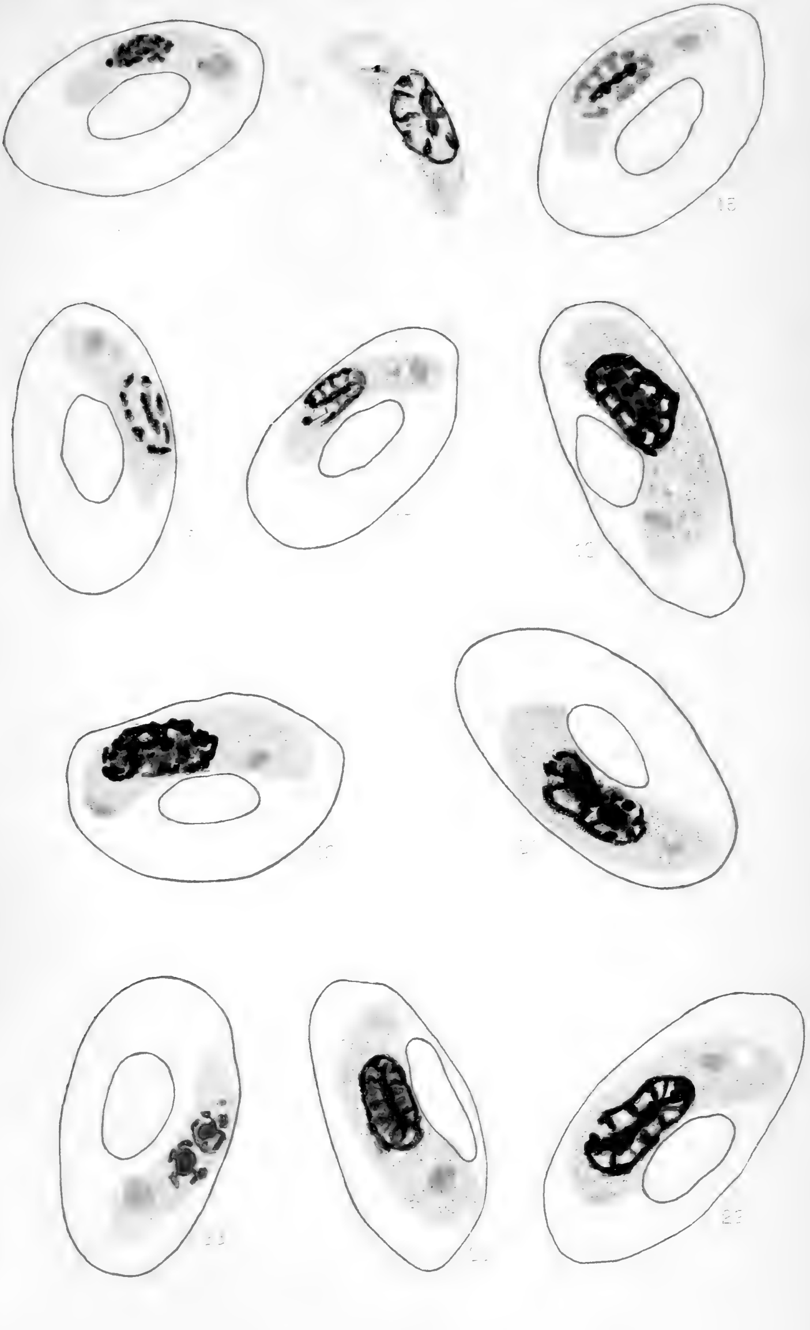
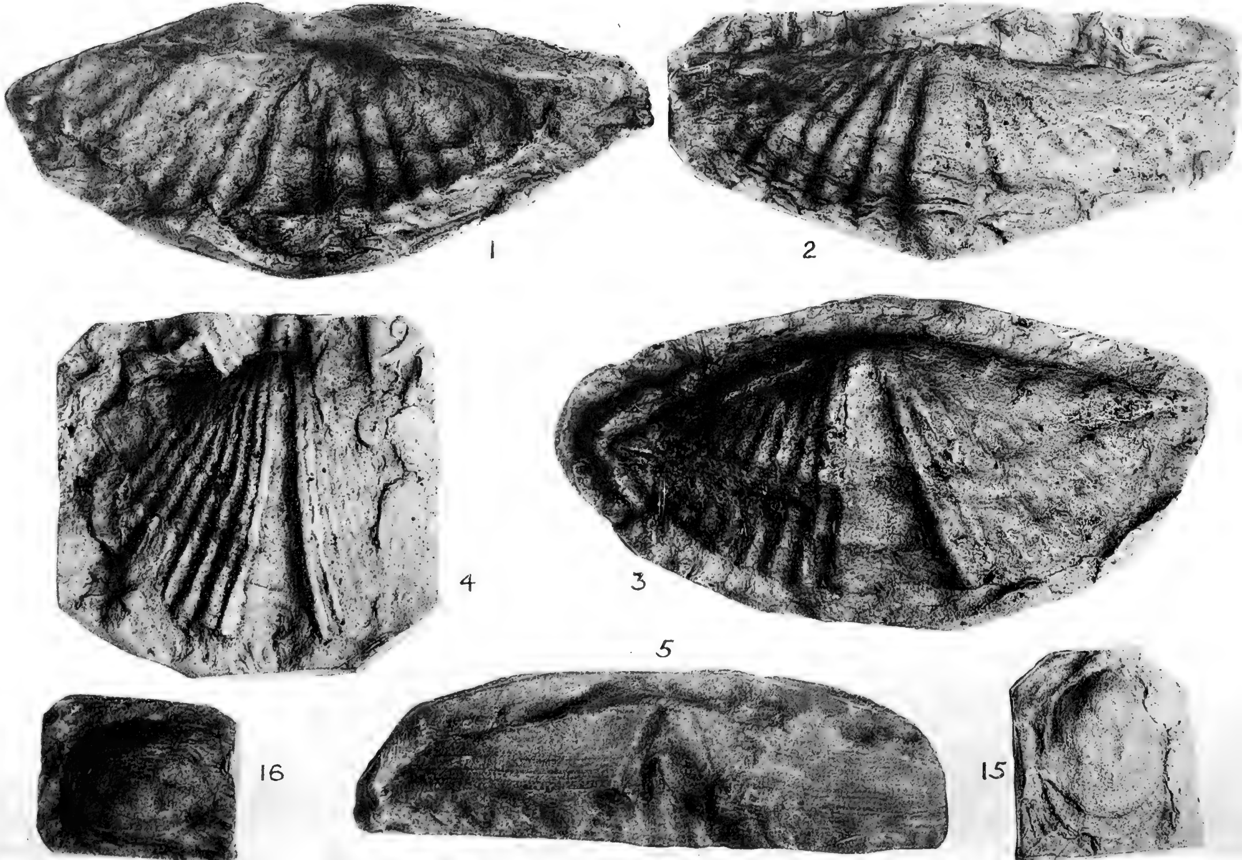
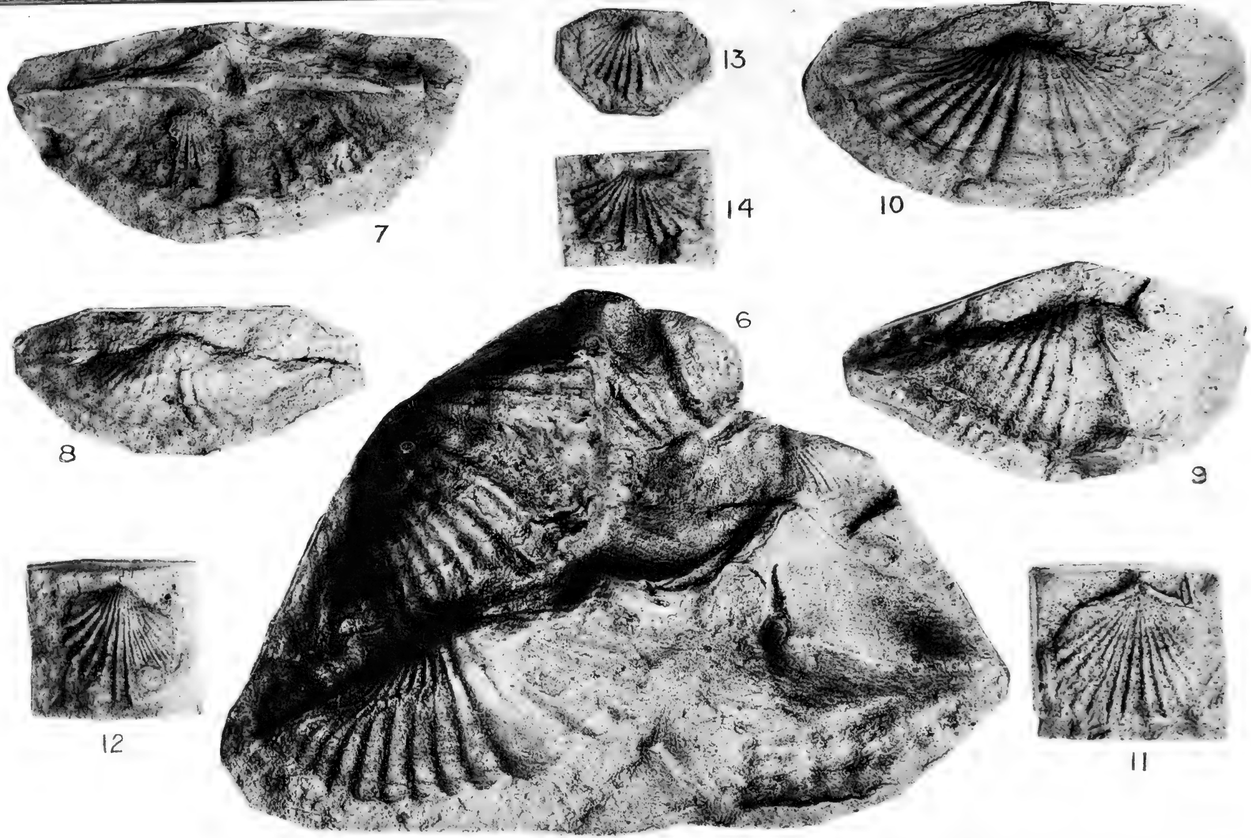


Haemogregarine from Pleuronectids

PLATE X.





BRACHIOPODA FROM FALKLAND ISLANDS.