

RECORDS of the INDIAN MUSEUM

Vol. XVIII.

REPORT ON THE
AQUATIC FAUNA OF SEISTAN
WITH SUBSIDIARY STUDIES.

Part V.

April, 1921.

	PAGE
Note on the Leech <i>Limnatis nilotica</i>	213
Report on the Freshwater Gastropod Molluscs of Lower Mesopotamia. Part III. The Families Neritidae, Hydrobiidae and Melaniidae	215
Notes on Larval Trematodes from Seistan	229
The Aquatic Fauna of Seistan : A Summary	235

Calcutta :

PUBLISHED BY THE DIRECTOR, ZOOLOGICAL SURVEY OF INDIA.
PRINTED AT THE BAPTIST MISSION PRESS.

1921.

Price Two Rupees.

NOTE ON THE LEECH *LIMNATIS*
NILOTICA.

By TOKIO KABURAKI, *Research Student,*
Imperial University, Tokyo.

(*From the Zoological Laboratory, The Museums, Cambridge.*)

A considerable number of accidents caused by the leech *Limnatis nilotica* (Savigny), which is well known under the term "Horse-leech," exist in literature.¹ In the process of being swallowed, the leech attaches itself to the mouth, throat and nasal cavity of men and beasts, causing hæmorrhage as well as hindering respiration. When it penetrates deeper the hæmorrhage may sometimes be very serious and even fatal.

I owe to Dr. N. Annandale of the Indian Museum the opportunity of examining one specimen of leech, which seems to be identical with the species mentioned. The material was obtained, apparently at Quetta, Baluchistan, from the throat of an Austrian prisoner, who had been brought from Persia. In drinking from dirty pools in Persia, he sucked up six individuals, all of which had been at the back of his throat for eight days. This information comes from Capt. A. G. R. Hardwick, R.A.M.C., who has communicated it to Dr. Annandale.

The specimen is of large size, measuring 85 mm. long, exclusive of the posterior sucker, by 16 mm. across, taken almost in front of the posterior fifth of the body, from which the trunk tapers more gradually to the anterior end than to the posterior. The trunk is subcylindrical, presenting on the ventral surface of its anterior end the sucker which is destitute of the three powerful jaws, and in this respect it is unlike the medical leech. The upper lip of the sucker is divided on its inferior surface into two lobes by a deep longitudinal groove. The jaws are covered by papillae and provided with more than 100 minute teeth. The posterior sucker, which is distinctly separated from the trunk by a constriction, is of a circular shape, the diameter being about 12 mm.

The leech, being preserved in spirit, cannot be expected to have retained its original colour. The body is of a uniform brownish grey colour, without being traversed on the dorsal surface by any trace of such four black lines and a median yellow or green stripe as has been described by Blanchard.² Along each side,

¹ Blanchard, R., *Courtes notices sur les Hirudinées*, 1. *Bull. de la Soc. Zool. de France*, XVI, 1891, p. 218. *Hirudinées de l'Italie continentale et insulaire. Boll. Mus. Zool. Univ. di Torino*, IX, 1894, p. 42. Masterman, E. W. G., *Hirudinea as Human Parasites in Palestine. Parasitology*, 1, 1908, p. 282.

² See Blanchard, *loc. cit.*, 1894, p. 43.

separating the dorsal from the ventral surface, is a well-defined, dull orange lateral stripe. In colouration the present specimen can be easily distinguished from *Limnatis* (*Poecilobdella*) *granulosa* (Savigny), which presents the colour-pattern peculiar to the sub-genus *Poecilobdella*.¹ The latter species is common in British India.

The trunk is made up of 101 annuli, of which the 5th and 6th are fused ventrally to form the posterior margin of the anterior sucker. The same is true of the 7th and 8th annuli. In the 95th and 96th annuli I have been unable to demonstrate such a tendency of dividing into two as has been put on record by Blanchard.²

There are five pairs of eyes, of which the first three pairs are arranged on the first three annuli, forming a semicircle; the 4th pair lie on the 5th annulus; the 5th pair on the 8th annulus.

The male genital aperture lies in the posterior edge of the 30th annulus, appearing to exist between the 2nd and 3rd annuli of the X somite; the female aperture occurs five annuli behind the male, between the 2nd and 3rd annuli of the XI somite.

The nephridial pores lie in the posterior edge of the last annulus of each somite, but their total number could not be enumerated.

The alimentary tract agrees in the main with the medical leech, the crop being provided with some ten pairs of coeca, which are filled with blood, revealing a deep red colour. The intestine opens out on the dorsal surface of the last annulus, just in front of the posterior sucker.

Limnatis nilotica is of wide distribution, extending from the Azores, through part of Western Europe as well as Northern Africa, to part of Western Asia. It is of interest that its range extends, as stated by Dr. Annandale,³ into the borders and even within the boundaries of the Indian Empire.

¹, ² Blanchard, Révision des Hirudinées du Musée de Turin. *Boll. Mus. Zool. Univ. di Torino*, VIII, 1893, pp. 27, 28.

³ Annandale, N., Note on the Occurrence of the Leech *Limnatis nilotica* in Seistan and the Afghan-Baluch Desert. *Rec. Indian Mus.*, XVIII, pt. III, 1920, p. 135.



REPORT ON THE FRESHWATER
GASTROPOD MOLLUSCS OF
LOWER MESOPOTAMIA.

PART III.—THE FAMILIES NERITIDAE, HYDROBIIDAE
AND MELANIIDAE.

By B. PRASHAD, D.Sc., Assistant Superintendent,
Zoological Survey of India.

Since the publication of the first two parts of this series, the Indian Museum has received a valuable collection of Mesopotamian molluscs from Dr. E. W. Howell, made by him at Basra during August 1917—February 1919, and placed with great generosity at our disposal. This collection, together with the collections mentioned in the previous parts of this report has rendered the working out of the Mesopotamian molluscs much easier and more satisfactory. Specimens of the families reported on in the first two parts of the report are also represented in this collection, but these do not offer any specially interesting points for further discussion. They belong to the following species:—

<i>Limnaea tenera euphratica.</i>	<i>Gyraulus convexiusculus.</i> ¹
<i>Limnaea peregra canalifera.</i>	<i>Gyraulus euphraticus.</i>
<i>Bullinus contortus.</i>	<i>Gyraulus intermixtus.</i>

The only point to be noted in reference to these is that the large series of *L. peregra canalifera* exhibits much greater individual variability than the specimens previously examined.

Family NERITIDAE.

Genus *Neritina*, Lamarck.

Subgenus *Dostia*, Gray.

1919. *Dostia*, Annandale and Prashad, *Rec. Ind. Mus.*, XVI, pp. 242, 243.

In the paper cited above Dr. Annandale and I considered *Dostia*, Gray, as distinct from *Neritina*, Lamarck, but as a result of further examination of the rich collections in the Indian Museum I am inclined to consider it as worthy of subgeneric rank only.

¹ We would invite attention to the fact that there has been an unfortunate transposition of lettering in reference to *Gyraulus euphraticus* and *Segmentina calathus* in fig. 5 on page 40 of this volume. The figure D refers to the *Segmentina* and the figure F to the *Gyraulus*. [N. A. and B. P.].

In the Mesopotamian collection before me it is represented by Mousson's species *N. schlaeflii* which was originally described from the Persian Gulf.

***Neritina schlaeflii*, Mousson.**

1874. *Neritina* (*Mitrula*) *schlaeflii*, Mousson, *Journ. Conchyliol.* XXII, pp. 49, 50.
 1874. *Neritina crepidularia*? var. *Schlaeflii*, von Martens, *Vorder Asiat. Conchyl.*, pp. 44, 67, 124.
 1879. *Neritina crepidularia* (in part), von Martens, in Chemnitz, *Conch.-Cab., Neritina*, pp. 37-45, pl. vii, figs. 9-11.

This species was described by Mousson from shells collected on the island of "Ghaes" in the Persian Gulf. He noted the resemblance between it and the Oriental species, *N. crepidularia* and *N. depressa*, but considered it distinct from either owing to the much smaller size of the shell, the much less convex and laterally compressed dorsal surface, in the spire being more recurved and flattened, the nucleus being more prominent and in having a much smaller though comparatively more elongate mouth-opening. According to von Martens, it is only a variety of *N. crepidularia*, but the two Mesopotamian specimens collected by Dr. Bowell at Basra leave no doubt in my mind that it is specifically distinct.

The Mesopotamian specimens have a purplish background with a large number of irregular white spots resulting in a network of rather broad purple lines surrounding the white spots; near the margins of the shell it assumes a blackish tint owing to the darkness of the ground colour and absence of the white spots.

Through the kindness of Major Froilano de Mello of the Portuguese Medical Service in Goa, the Indian Museum has received a specimen of this species from near Goa on the west coast of Peninsular India. This specimen is of a uniform dark brown colour. This record greatly extends the range of *N. schlaeflii*.

Subgenus *Neritaea*, Roth.

1879. *Neritaea*, von Martens, *op. cit.*, p. 16.
 1899. *Neritina* (*Neritaea*), Kobelt in Rossmässler's *Icon. Land.-u. Süssw.-Moll.* (n. f.) VIII, p. 1.
 1913. *Theodoxis*, Preston, *Journ. As. Soc. Bengal*, IX, pp. 470, 471.
 1915. *Theodoxis*, Preston, *Faun. Brit. Ind. Freshw.-Moll.*, p. 5.

In his monograph of the genus *Neritina*, von Martens divided it into six subgenera, and included the species dealt with here in the subgenus *Neritaea*, Roth. This subgenus he further subdivided into eight groups according to the shape, sculpture, etc., of the shell. In the synopsis of these groups he included *N. jordani* and the other Mesopotamian species of the genus in the group *Pictae*, but further on in the descriptive part of his monograph included them in the account of the group *Semicirculatae*. This is evidently a mistake since the group *Semicirculatae* is confined to Central America and South Africa, while the *Pictae* group is found in the tropical and subtropical regions of Asia, Africa and

America. Moreover the structural characters of *N. jordani* and its allies do not justify their inclusion in the group Semicirculatae.

Preston, following Locard¹ and Dautzenberg,² assigns these species to the genus or subgenus *Theodoxis* or rather *Theodoxus*, Montfort. This is certainly wrong, since Montfort's name *Theodoxus*, as both von Martens and Kobelt have shown, should be reserved for the Palaearctic species of the *fluviatilis* type; the shells of the *jordani* type being included in the subgenus *Neritaea*, Roth.

Dr. Annandale recorded four species of the genus *Neritina* from Lower Mesopotamia. I have, however, found specimens of another in the collections made by Dr. Bowell at Basra. This form (*N. macrii* var. *michoni*) was only known hitherto from Syria and Palestine.

***Neritina mesopotamica* (Mousson), Martens.**

1874. *Neritina meridionalis*, var. *Mesopotamica*, Mousson, *op. cit.*, p. 36.

1874. *Neritina anatolica*, var. *Mesopotamica*, v. Martens, *op. cit.*, pp. 33, 34, pl. v, fig. 42.

1879. *Neritina mesopotamica*, v. Martens, *op. cit.*, pp. 90, 91, pl. xiii, figs. 20, 21.

1899. *Neritina mesopotamica*, Kobelt, *op. cit.*, p. 4, pl. ccxi, fig. 1325.

Mousson confused this species with the Sicilian *N. meridionalis* and gave a very incomplete description of his new variety *mesopotamica*. The same form was also described in the same year by von Martens under the same name as Mousson's, but apparently in ignorance of his work. Von Martens considered it to be a form of *N. anatolica*, but published a full description and a good figure, and also compared the variety with the species *N. michoni* and *N. bellardii*. Later in his monograph of the genus he considered it to be a species distinct from *N. anatolica* and worthy of specific rank. I have compared the single Mesopotamian specimen before me with specimens of *N. macrii*, var. *michoni*, from Palestine and Mesopotamia and with those of *N. anatolica*, var. *bellardii*, from Damascus, and am of opinion that the species, as von Martens decided, is distinct from either.

The single Mesopotamian specimen was collected by Dr. Boulenger on the banks of the Khandag creek, Basra. The spire of this specimen is not so prominent as is shown in von Marten's figures, but in other respects closely agrees with his figures and description. The inner lip is straight and has minute denticulations on its inner border.

***Neritina macrii*, var. *michoni* (Bourg.).**

1879. *Neritina Macrii*, var. *michoni*, von Martens, *op. cit.*, pp. 88-90, pl. iv, figs. 11-13 and pl. xiii, figs. 27-29.

¹ *Arch. Mus. Hist. Nat. Lyon*, III, p. 231 (1883).

² *Rev. Biol. Nord. France*, VI, p. 349 (1894).

1883. *Theodoxis michoni*, Locard, *Arch. Mus. Hist. Nat. Lyon*, III, pp. 232, 233.
 1894. *Neritina* (*Theodoxia*) *michoni*, Dautzenberg, *Rev. Biol. Nord. France*, VI, pp. 351, 352.
 1913. *Theodoxis michoni*, Preston, *op. cit.* p. 471.

There has been a great deal of confusion in literature as to the exact status of this form. Von Martens, who gives complete references to previous literature, was the first to recognize its relationship with *N. macrii*, Recluz, but in later works Locard, Dautzenberg and Preston have treated the species as distinct, and as belonging to the subgenus or genus *Theodoxis*. This view, as I have pointed out above, is not correct and the species should be assigned to the genus *Neritina* and the subgenus *Neritaea*. Kobelt¹ in his account of *N. macrii* says, "Martens hat *Neritina karasuna* und *michonii* mit *macrii* vereinigt, und zwar mit Recht," and therefore includes *michoni* only as a synonym of *N. macrii*. However, owing to the differences between the typical *N. macrii* and the form *michoni* I consider the latter as a distinct variety of the species.

The shells of this variety are less ovate than the typical form, have the spire a little more pronounced, the suture more impressed, the outer lip of the aperture extending much further over the columellar region, a relatively broader and more flat columellar region and the mouth shorter but broader.

In the Mesopotamian collections there are five specimens of this form, four collected by Dr. Bowell at Basra and the fifth from the Khandag creek, collected by Dr. Boulenger.

It may also be pointed out here that some of the specimens, collected by Dr. Annandale from the exit of the R. Jordan, Palestine, were described by Preston as being of an intermediate character between *N. michoni* and *N. jordani*. I have examined these specimens but can find no resemblances between them and *N. jordani* except for their colouration. This point is considered further under *N. jordani*.

Neritina jordani, Sowerby.

1861. *Neritina jordani*, and var. *turris*, Mousson, *Vierteljahrsschr. Naturf. Ges. Zurich* VI, pp. 151-152.
 1879. *Neritina jordani*, von Martens, *op. cit.*, pp. 84-86, pl. ii, figs. 14-16.
 1883. *Theodoxia jordani*, Locard, *op. cit.*, pp. 231, 232.
 1894. *Neritina* (*Theodoxia*) *jordani*, with var. *aberrans*, Dautzenberg, *op. cit.*, pp. 349, 350.
 1899. *Neritina jordani*, var. *turris*, Kobelt, *op. cit.*, pp. 2, 3, pl. ccxi, figs. 1319, 1320.
 1913. *Theodoxis jordani*, Preston, *op. cit.*, p. 470.
 1918. *Neritina jordani*, Annandale, *Rec. Ind. Mus.* XV, p. 162.

Dr. Annandale recorded the occurrence of this species in Mesopotamia from specimens sent to him from Nasariyeh. Since then we have received several shells from Basra collected by Dr. Bowell. This large series, together with the Palestine shells

¹ Rossmässler's *Icon. Land.- u. Süßw. Moll.* (n. f.) VIII, p. 5.

already in the Indian Museum, makes it possible to discuss the individual variation in form and colour.

Sowerby¹ figures three shells of what he calls the three varieties of *N. jordani*, without indicating a typical form; his figures also are very poor. Reeve's² figures show a rather ovoid shell with a relatively small and scarcely exerted spire and with the body-whorl nearly smooth or with only a slight constriction on it. Mousson did not figure the shells he examined, but described a new variety under the name *turris*, which he distinguished from the typical form by its much larger size, more elevated apex, which makes the shell almost subcylindrical in shape, and by the body-whorl having a more prominent constriction. The figure of the typical form, the only one illustrated in von Marten's monograph, differs from that of Reeve's in having a comparatively shorter but more prominent spire; the columellar border narrower, the mouth relatively smaller and the constriction on the body-whorl much more pronounced. Dautzenberg, who followed Locard as to nomenclature, added a new variety (*aberrans*), which, according to him, is distinguished by the almost complete absence of the constriction on the body-whorl and by its variable but different colouration. Kobelt has given good figures of the typical form and of var. *turris*, Mousson. His figure of the typical form is quite similar to that of von Martens. Preston does not add any notes on the specimens examined by him, but says in his account of *T. michoni* that some of the specimens of this species link up the two species, *T. jordani* and *T. michoni*, and that these two are probably extreme forms of the same species only. Annandale, however, refers to some of the shells from Palestine and reported on by Preston as belonging to the var. *turris* of Mousson. In view of the above remarks it is clear that we have to deal with three forms. (i) *N. jordani* s.s. which von Martens' and Kobelt's figures may be taken to represent, and which appears to be a true lake-form occurring in the Lake of Tiberias and probably in the Lake of Homs. (ii) *N. jordani*, var. *turris*, described by Mousson and of which Kobelt's figure is a good representation. This form is stated to have been taken in the Lake of Tiberias, but the exact biological conditions under which it was found are not stated by either Mousson or Kobelt. In Dr. Annandale's collections and those of the late Dr. Anderson from those areas the form is only represented in the collections from the exit of the River Jordan. The form is probably a true stream phase. (iii) *N. jordani*, var. *aberrans*, described by Dautzenberg, but of which no figures have been published. The type specimens of this form were collected in the Lake of Homs and all the specimens from Mesopotamia in my opinion belong to it. This form appears to be confined to closed or slow-running waters.

The three phases discussed above may be distinguished by the following key :—

¹ *Conchological illustrations, Neritina*, pp. 4, 6, fig. 49 (1841).

² *Conch. Icon., Neritina*, species 129 (1856).

- I. Shell with a distinct transverse constriction on the body-whorl.
 - A. Shell not more than 8 mm. in maximum diameter; more or less ovoidal in shape ... *N. jordani typica.*
 - B. Shell measuring up to 15 mm. in maximum diameter; almost subcylindrical in shape and with the constriction of the body-whorl better marked than in the typical form ... *N. jordani*, var. *turris.*
- II. Shell with the body-whorl almost smooth or with only a faint transverse constriction across it ... *N. jordani*, var. *aberrans.*

The major part of the Palestine collection reported on by Preston and the shells from the Lake of Tiberias from the late Dr. Anderson's collection belong to the typical form (fig. 1a). They have the shell of an ovato-conical form with a prominent spire and a distinct though not very deep constriction across the

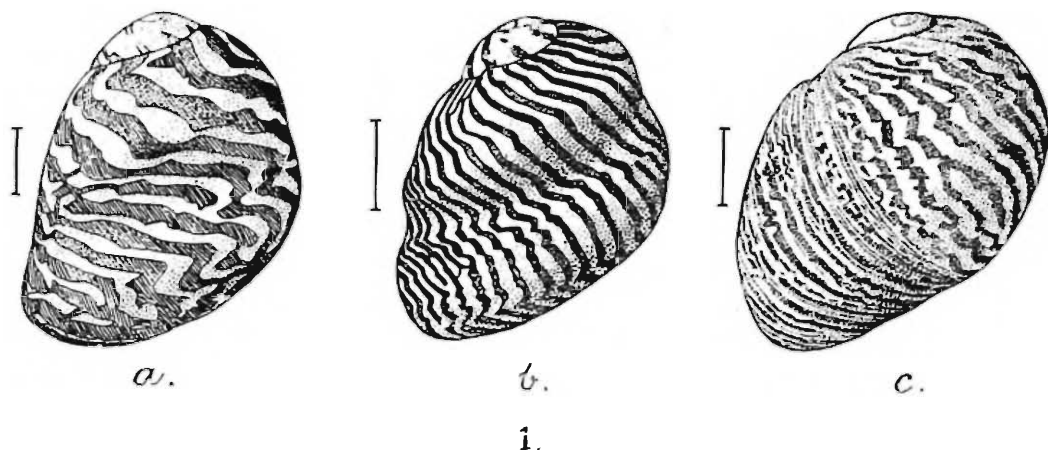


FIG. 1.—*Neritina jordani*, Sowerby.

- a. Shell of the typical form from Palestine.
- b. Shell of Mousson's var. *turris* from River Jordan.
- c. Shell of var. *aberrans*, Dautzenberg, from Mesopotamia.

body-whorl. The colouration is variable. Most of the specimens have zigzag vertical stripes of a red, chocolate or dark brown colour alternating with white stripes of the same shape, in a few cases the stripes coalesce here and there to produce a reticulate pattern; still further, a few have a uniform dark-brown or black colour with only a few pale spots. The specimens which Preston regarded as being of an intermediate character between his *T michoni* and *T jordani* are no more than uniformly coloured specimens of this form of *N jordani* and have no relationship with *N macrii*, var. *michoni*.

The var. *turris* of Mousson (fig. 1b) is, as I have stated above, represented by specimens from the River Jordan only. These are much larger, of a subcylindrical shape, have a much less prominent spire and the constriction on the body-whorl is much more impressed. In colour the shells show great variation; the stripes are of various colours as in the typical form but are narrower and

much closer ; a reticulate pattern is also formed in some cases by the fusion of the stripes with one another.

I assign all the Mesopotamian specimens to the var. *aberrans*, Dautzenberg (fig. 1c.), since the constriction on the body-whorl in most cases is quite absent or only faintly indicated. The specimens are, further, less elongate than the typical form and have a comparatively broader columellar area. The colouration is very variable. In some cases the shells are uniformly dark-brown or black, in others they have purple, red, chocolate or brownish wavy stripes alternating with much broader white stripes, while most of them show a distinct network of white spots alternating with coloured ones, the latter formed by the fusion of the stripes with one another. Most of the specimens are of a smaller size than those of the typical form.

Family HYDROBIIDAE.

Specimens of the genera *Tricula*, *Bithynia* and *Amnicola* (*Alocinma*) are represented in the Mesopotamian collections before me. Dr. Annandale (*loc. cit.*, p. 163) assigned an imperfect shell from Nasariyeh to the genus *Lithoglyphus*, Mühl., with some doubt. I have examined this specimen and agree with Dr. Annandale in considering it as possibly belonging to the genus *Lithoglyphus*, but it is too imperfect for a precise diagnosis.

Genus *Tricula*, Benson.

- 1843. *Tricula*, Benson, *Cal. Journ. Nat. Hist.*, p. 467.
- 1851. *Bithinella*, Moquin Tandon, *Journ. Conchyliol.* II, p. 239.
- 1852. *Paludina* (in part), Küster, Mart., *Chemn. Conch.-Cab., Paludina, etc.*, p. 1.
- 1856. *Bythinella*, Moquin Tandon, *Hist. Moll. Terr.-Fluv. France*, p. 516.
- 1858. *Tricula*, H. and A. Adams, *Gen. Rec. Moll.* I, p. 306, pl. xxxii, figs. 5, 5a, 5b.
- 1862. *Tricula*, Benson, *Ann. Mag. Nat. Hist.* X, pp. 415, 416.
- 1863. *Paludinella* (in part), Frauenfeld, *Verh. Zool.-bot. Ges. Wien*, XIII, p. 199.
- 1885. *Tricula* and *Hydrobia* subgen. *Bythinella* (in part), Nevill, *Hand-List. Moll. Ind. Mus.* II, pp. 62, and 49 respectively.
- 1887. *Tricula*, Fischer, *Man. Conchyliol.*, p. 727.
- 1892. *Bythinella*, Kobelt, Rossmässler, *Icon. Eur. Moll.* (n. s.), V, pp. 36, 37.
- 1915. *Tricula*, Preston, *Faun. Brit. Ind. Freshw.-Moll.* p. 68.

I have carefully compared shells of the Himalayan species *Tricula montana*, on which Benson founded his genus, with those of certain European species assigned by most recent authors to *Bithinella*, Moquin Tandon, and can find no generic difference. Kobelt's figures of the various species of *Bithinella*, moreover, strongly support the view that the two are identical. A short review of the confusion that has existed in literature regarding the exact status of the genus *Tricula* may be given before considering the question of its synonymy.

Benson in his original description described the genus as belonging to the Melaniidae, basing his argument partly on shell-characters, which according to him showed the same relationships to *Melania* s.s. as "certain Egyptian and Syrian species of *Paludomus*" bore to that genus; and partly on anatomical grounds, the animal being, according to him, *Melania*-like. In this supposition he was followed by Gray and H. and A. Adams, but Brot in his revision of the Melaniidae, differing from them, stated that the genus was probably referable to the Paludinidae. Benson in his subsequent work slightly elaborated his original arguments, and considered Brot's position untenable owing to the "very fundamental difference between the concentric operculum of *Paludina* and the subspiral one of *Tricula*"; he again laid stress on the resemblance of the animal of *Tricula* to that of *Melania*. Stimpson, Stoliczka, Blanford and Nevill considered *Tricula* to be a Rissoid genus. Fischer in doubtfully placing it amongst the Hydrobiidae compared it with *Acicula*, a genus of land-molluscs, and remarked, "La classification de ce genre est embarrassante." He had, however, come to a nearly correct conclusion. Preston followed him in assigning *Tricula* to the Hydrobiidae, or what he calls Paludestrinidae. I have pointed out above the resemblance between the shell of *T. montana* and that of the various species assigned to the genus *Bithynella*. The resemblance between its animal and that of the genus *Melania*, on which Benson laid so much stress, is only superficial and his own description does not show any differences between the animal of *Tricula* and that of any other Hydrobiid. Assuming, therefore, that the genus is a true Hydrobiid and that there is no difference between it and the genus *Bithynella*, Moquin Tandon, the name *Tricula*, Benson will have priority over Moquin Tandon's.

It may be noted here that the Indian brackish-water species referred to as *Bithynella miliacea* in a recent paper¹ by Dr. Annandale and myself is not assignable to the genus *Tricula*, but has relationships with the genus *Stenothyra*, Benson.

I have here to express my indebtedness to Dr. N. Annandale for pointing out to me the exact status of the genus *Tricula* and for the help he has so generously given me in clearing up its synonymy.

***Tricula palmyrae* (Dautzenberg).**

1918. *Bithynella palmyrae*, Annandale, *op. cit.*, p. 162.

The only specimens of this species are the shells referred to in Dr. Annandale's paper cited above. I have carefully compared them with Dautzenberg's description and figure of the species and can find no differences.

Genus *Bithynia*, Gray.

In the Mesopotamian collection this genus is represented by two species: (i) *B. badiella*, a species common in Palestine and

¹ *Rec. Ind. Mus.*, XVI, p. 248 (1919).

Syria and recently recorded by Dr. Annandale from Mesopotamia and (ii) *B. rubens*, a species widely distributed in Italy, Sardinia, Greece, Algeria, Syria and probably in Upper Mesopotamia.

***Bithynia badiella*, Parreyss.**

1919. *Bithynia badiella*, Annandale, *op. cit.*, p. 162.

In addition to the specimens reported on by Dr. Annandale there is a shell in the collection made by Dr. C. L. Boulenger from the area between Nasiriyeh and Hama Lake, Lower Mesopotamia. These specimens agree closely with the specimens from Palestine and Syria in the Indian Museum collection.

***Bithynia rubens* (Menke).**

1892. *Bithynia rubens*, Kobelt, *op. cit.*, pp. 70, 71, pl. cxxxvii, fig. 866.

Specimens of this very variable species collected by Dr. Boulenger and Dr. Bowell at Basra agree with Kobelt's figures and with the specimens in the Indian Museum collection from Damascus.

Nevill¹ gave names to a number of well characterized forms of the species from various localities and the specimens he marked are in the collection of the Indian Museum. As he did not describe these forms and some of them have since been described by Preston under other names, Nevill's names will have to be taken as *nomina nuda* only, but the whole question is too complicated to be dealt with here.

Genus *Amnicola*, Gould and Haldemann.

Subgenus *Alocinma*, Annandale and Prashad.

1919. *Alocinma*, Annandale and Prashad, *Rec. Ind. Mus.*, XVIII, pp. 23, 24.

1920. *Alocinma*, Annandale *Rec. Ind. Mus.*, XIX, pp. 42, 43.

Dr. Annandale and I recently proposed this subgenus for certain Indian and Persian species hitherto assigned to the genera *Bithynia* and *Amnicola*. We regarded this subgenus as being of an intermediate character between *Amnicola* s.s. and *Pseudamnicola*, both of which also must be considered as subgenera only. Recently Dr. Annandale has pointed out that "*Bythinia ejecta*," a species described by Mousson from Lower Mesopotamia, also belongs to this subgenus.

***Amnicola (Alocinma) ejecta* (Mousson).**

1874. *Bythinia ejecta*, Mousson, *op. cit.*, p. 46.

A few of the specimens in Dr. Boulenger's collection from the banks of the Euphrates at Nasiriyeh and at Feluja agree with Mousson's description and are, therefore, assigned to his species.

¹ *Hand-List Moll. Ind. Mus.*, II, pp. 40, 41 (1885).

At the end of his description of the species he adds the following: "D'après la forme de l'ouverture et surtout du bord, que est obtus à sa terminaison, je considère cette espèce comme une Bythinie, bien que l'opercule manque et que sa petitesse rappelle plutôt les Amnicoles." It is clear from this quotation that Mousson was not quite definite about the generic position of his form. The specimens before me, however, leave no doubt that the species *B. ejecta*, Mousson, as was considered by Dr. Annandale, is not a member of the genus *Bithynia*, Gray, but belongs to our new subgenus *Alocinma*.

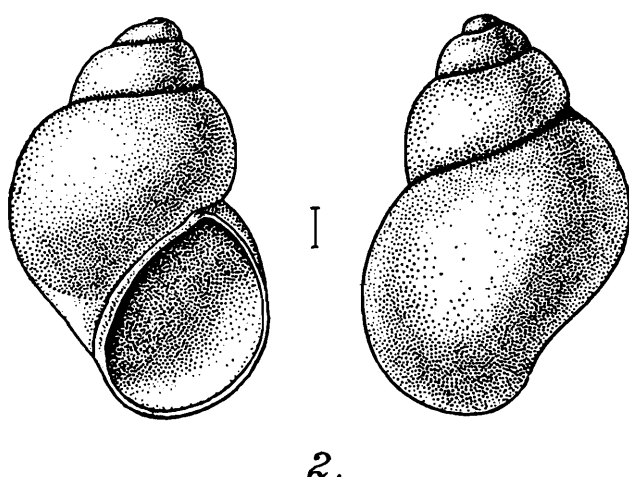


FIG. 2.—*Amnicola (Alocinma) ejecta* (Mousson) from the banks of the Euphrates at Nasiriyeh.

Family MELANIIDAE.

Genus *Melanoides*, Olivier.

Melanoides tuberculata (Müller).

1874. *Melania tuberculata*, Mousson, *op. cit.*, pp. 47, 48.
 1887. *Melania tuberculata*, Schepmann and Snellmann, *Moll. in Veth. Mid.-Sum. Reiz. Ind. Sumatra-Exped.*, pp. 16, 17, pl. iii, fig. 11 (radula).
 1919. *Melanoides tuberculata*, Annandale and Prashad, *Rec. Ind. Mus.*, XVIII, pp. 31, 32, pl. vi, fig. 1.

In the paper cited above Dr. Annandale and I have given the diagnostic characters of this widely distributed and very variable species. The radula of the mollusc had been figured by us previously in another paper.¹ Schepmann had previously figured and described the radula of the Sumatran form in the obscure publication cited above. The two differ from one another, but the differences are more apparent than real, being due mainly to different views of the teeth having been figured; other differences in the number of denticulations are only of the nature of a variation exhibited by the species.

¹ Annandale and Prashad, *Rec. Ind. Mus.*, XVI, p. 146, pl. v, fig. 5 (1919).

The species is represented in the Mesopotamian collection by a large number of dry shells from Basra and a few preserved in spirit from the banks of the Euphrates. Most of the specimens are rather small but a few measuring up to 35 mm. in length are also represented.

***Melanoides pyramis*, var. *flavida* (Nevill).**

1919. *Melanoides pyramis* var. *flavida*, Annandale and Prashad, *op. cit.*, pp. 34, 35.

In the paper cited above we referred to a rather dark specimen of this form collected by Dr. C. L. Boulenger from the flooded area near Khandag creek, Basra, Lower Mesopotamia. This specimen agrees in all particulars with the specimens from the Persian frontier and Baluchistan, but is darker in colour. It measures 27.5 mm. in length by 9.9 mm. in breadth, the aperture measures 9.8 mm. by 5.7 mm.

Genus *Melanopsis*, Férussac.

***Melanopsis nodosa*, Férussac.**

1874. *Melanopsis nodosa*, Mousson, *Journ. Conchylol.* XXII, p. 48.
1874. *Melanopsis nodosa*, Brot, "Die Melaniaceen" in Chemnitz, *Conch.-Cab.* (ed. Küster), p. 432, pl. xvi, figs. 17-24 (in part).
1918. *Melanopsis nodosa*, Annandale, *Rec. Ind. Mus.*, XV, p. 163.

The species was recorded by Mousson from the Euphrates and the Tigris below Mosul on the basis of the collections made by Dr. A. Schlaefli in this region, and Annandale has recently recorded its occurrence in Lower Mesopotamia.

In the collections made by Dr. C. L. Boulenger and Dr. E. W. Bowell the species is represented by a large number of shells from Nasariyeh and from Khandag creek, Basra. All the specimens are of the typical *nodosa*-type and none belong to Mousson's var. *moderata*, described in his paper cited above. Most of the specimens are quite fresh and distinctly show the three rows of large tubercles on the body-whorl—a characteristic of this species.

The specimens vary in colour from chestnut-brown to black, except for the subfossil shells which are white and chalky. The largest specimen measures 23.4 mm. in length and 11.3 mm. in maximum breadth; the aperture measures 10.8 mm. by 5.2 mm.

***Melanopsis costata* (Olivier).**

1874. *Melanopsis turcica*, Mousson, *op. cit.*, pp. 48, 49.
1879. *Melanopsis costata*, Brot, *op. cit.*, pp. 426-429, pl. xlv, figs. 4-7.
1913. *Melanopsis costata*, Preston, *Journ. As. Soc. Bengal*, IX, p. 467.

Melanopsis costata is a widely distributed species throughout Syria, Palestine and Mesopotamia. In the Mesopotamian collections under report, it is represented by shells from the banks of a dry creek connected with Diala River between Baguba and Sharoban, and from the Khandag creek, Basra.

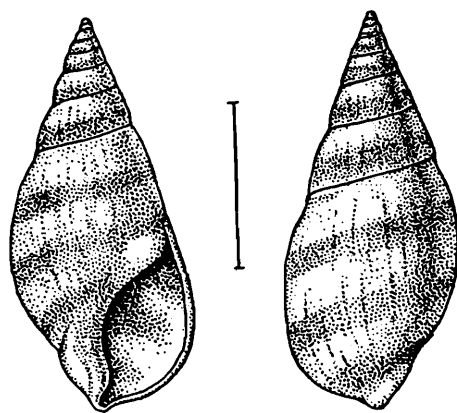
The species, though closely allied to *M. nodosa*, is distinguished from it by the costae on the surface of the shells being more regular and continuous and in having two instead of three rows of tubercles on the body-whorl.

In the large series before me there are shells corresponding to Brot's figures of the *typical* form, var. *B* and *M turcica bellio*, Parreyss. There are, however, intermediate forms connecting the various varieties and it is therefore not necessary to distinguish them as different forms.

***Melanopsis subtingitana* (Nevill), Annandale.**

1918. *Melanopsis subtingitana*, Annandale, *op. cit.*, pp. 163, pl. xx, figs. 1, 2.

This species has only recently been described by Annandale from two shells in the Indian Museum recorded as *Melanopsis*



3.

FIG. 3.—Type-specimen of *Melanopsis subtingitana*, var. *laevis* from the creek connected with Diala River, Mesopotamia.

costata, var. by the late Mr. G. Nevill, and from two others from Mesopotamia presented to the Indian Museum by Colonel W. H. Lane. Dr. Bowell's collection from Basra also contains a good series of the species. These shells agree closely with the type-shells, except that most of them are a little larger and have the ribs more obsolete.

Var. *laevis*, nov.

Two specimens from Mesopotamia, one from the banks of a dry creek connected with Diala River between Baguba and Sharoban collected by Dr. Boulenger, and the other from Basra by Dr. Bowell, are so different from the typical *M subtingitana* as to deserve varietal rank. Both the shells are nearly smooth and have the whorls much more regular than in the typical form. In other respects the two shells resemble the forma *typica*.

Type-specimen No. M 11807/2 in the Zoological Survey of India (Indian Museum, Calcutta).

Measurements of shells (in millimetres).

Specimen A is from Basra, and B (the type) from the creek connected with the Diala River.

	A.	B.
Length of shell	16·8	17·6
Breadth of shell	7·4	8·3
Length of aperture	8·2	9·1
Breadth of aperture	3·9	5

NOTES ON LARVAL TREMATODES FROM SEISTAN.

By STANLEY KEMP, Sc.D., *Superintendent, Zoological
Survey of India.*

The following notes on larval trematodes obtained during our visit to Seistan are admittedly very incomplete. In the field it was not possible to follow out the detailed anatomy of the various forms from living specimens and for this, it is to be feared, no subsequent work on preserved material can compensate. My notes are in the main based on preserved cercariae and on sections of infected livers. As a fixative Schaudinn's solution, used hot, was employed; while for staining haematoxylin followed by eosin gave the best results.

In some instances cercariae were obtained in such small numbers that it has not been found possible to give any account of their anatomical characters. Of these one is a *Xiphiocercaria* obtained in *Melanoides pyramis* var. *flavida* at Saindak in the extreme west of Baluchistan and the other a furcocercous form with extremely long tail-flukes obtained in *Gyraulus euphraticus* in the Hamun-i-Helmand. Of each of these only a single infection was discovered. The other three forms of cercariae are partially described below. One of them (Cercaria A) is a leptocercous form with rediae resembling those of *Fusciola hepatica*¹. The other two (Cercaria B and C) are furcocercous forms; one of these (B) bears a close resemblance to the larva of *Schistosoma japonicum*, but is distinguished by a number of characters.

For the names of the molluscan hosts I am indebted to Dr. Annandale and Dr. Baini Prashad (see page 17 of this volume).

Cercaria A (text-figs. 1 a-c).

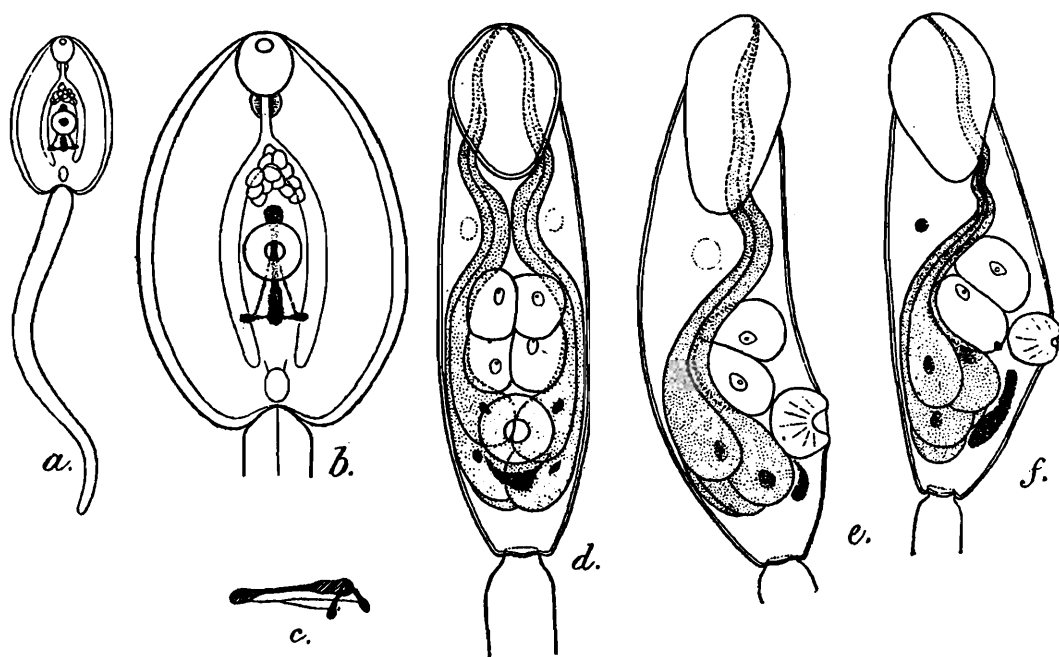
In well-preserved specimens the length of the body is from 290 to 360 μ (average 320 μ) and the breadth 170 to 220 μ (average 200 μ). The tail is twice or more than twice as long as the body, being from 670 to 780 μ in length (average 730 μ).

The body (figs. 1 a, b) is oval in outline, distinctly excavate posteriorly at the insertion of the tail, and is relatively thick-walled. The oral sucker is about 0.05 mm. in diameter. The acetabulum is approximately the same size and is situated slightly behind the middle of the body. There is a small pharyngeal bulb situated on the undivided anterior portion of the gut close to

¹ Erroneously recorded as a monostome on p. 22 of this volume.

the oral sucker. The coeca are long reaching to the distal quarter of the body-length. Near the junction of the coeca there is a cluster of cells which have the appearance of glands, but no ducts leading to the oral sucker were detected in the preserved material. Close to the tail a small bladder can sometimes be observed with traces of a pair of ducts directed anteriorly and one running posteriorly down the middle of the tail.

The most characteristic feature of the anatomy is, however, the partially developed gonad which lies immediately above the acetabulum. The gonad is very conspicuous in stained preparations and in dorsal or ventral view appears T-shaped with a fine strand joining each cross-piece to the stem. In reality the structure is more complex than this view indicates. The principal portion consists of a rod, about twice as long as the diameter



TEXT-FIG. 1.—Cercariae from Seistan.
a-c. Cercaria A. d-e. Cercaria B.
f. Cercaria C.

of the acetabulum, which is dilated anteriorly and in its posterior third. At its hinder end a transverse portion, consisting of a slender shaft and swollen head, joins it on either side and each of these portions curves downwards, so that the head itself is on a much lower level than the central rod from which it arises (fig. 1 c). From the head of each transverse portion a fine strand runs forward; the two unite and the single strand so formed meets the dilated anterior part of the main axis on its ventral side. The disposition of the parts, as seen obliquely from the side, is indicated in text-fig. 1 c. The structure is remarkably constant in form, showing little variations in fully grown and well preserved individuals.

The space between the gut and the body-wall is filled with large cells which lie with their long axes placed transversely.

The cercariae develop in rediae which, as in those of *Fasciola hepatica*, bear a pair of processes near the hinder end; they reach a maximum length of about 2.5 mm.

Cercaria A was found in specimens of *Limnaea bactriana*, Hutton, living in small irrigation channels close to the British Consulate at Nasratabad in Seistan. Of one hundred molluscs which were examined for parasites nine contained this Cercaria.

Cercaria B (text-figs. 1 d, e).

This is a furcocercous form which appears to resemble rather closely the larva of *Schistosoma japonicum* as described by Cort.¹

The body in well-preserved specimens is from 167 to 193 μ in length and the mean of a number of observations is 186. Its breadth varies from 41 to 52 μ , the mean being 48. The undivided part of the tail is from 192 to 222 μ , with mean of 208 μ ; the furca are from 62 to 67 μ , with mean of 64 μ .

The oral sucker is from 31 to 33 μ in diameter and the acetabulum from 22 to 23 μ .

The alimentary canal appears to be altogether absent and the body is for the most part filled with large gland cells (figs. 1 d, e). The four anterior gland cells differ very decidedly in character from the remainder, for in preparations treated with eosin the posterior cells are always very heavily stained, while the four anterior remain colourless. No ducts leading forwards from the four anterior cells could be traced in preserved material, though on analogy with similar forms it is probable that they really exist. The ducts from the posterior cells stain readily with eosin and are very conspicuous. The number of posterior cells appears to be six, making five pairs of cells in all; but two are usually concealed by others which overlie them.

On either side of the ducts from the gland cells, in the anterior half of the body length there is a small semitransparent area which perhaps represents an unpigmented eye-spot. Posterior to the acetabulum the beginnings of the gonad are visible, consisting of a mass of cells which is usually crescentic in form when seen in dorso-ventral view.

This cercaria, so far as can be seen from preserved material, seems akin to that of *Schistosoma japonicum* or, more nearly, to the very closely allied form from Bengal recently described by Major Sewell (*loc. cit.*). There are, however, marked differences. In the Seistan cercaria the tail-flukes appear proportionately shorter, the acetabulum larger and unpigmented eye-spots are perhaps present. No trace of the gut could be found, nor of teeth on the anterior sucker.

Cercaria B was found in specimens of *Gyraulus convexiusculus* (Hutton) obtained in the Hamun-i-Helmand, Seistan. Forty-three

¹ Cort, *Univ. Calif. Publ. Zool.*, XVIII, p. 485 (1919); see also Sewell, *Rec. Ind. Mus.*, XVI, p. 425 (1919).

G. convexiusculus were examined of which three contained examples of the parasite.

Cercaria C (text-fig. 1 f).

The cercaria is a furcocercous form, similar in most respects in its internal anatomy to Cercaria B. It is, however, a much larger form and possesses pigmented eye-spots.

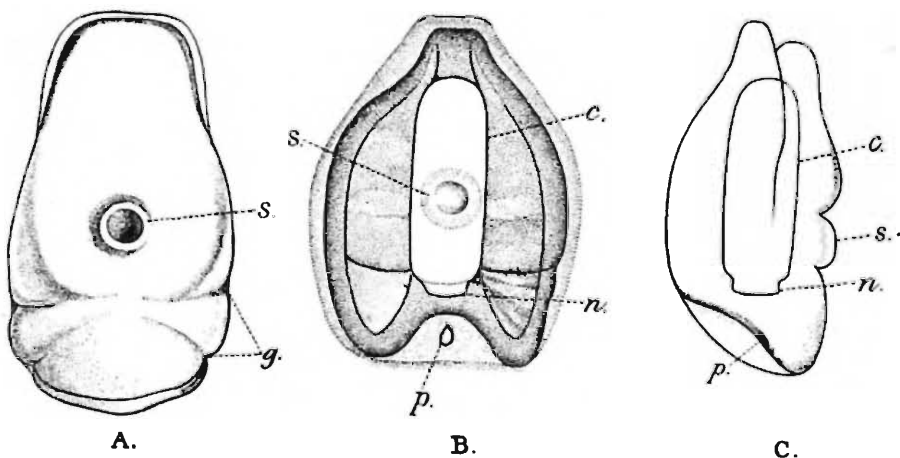
In well-preserved specimens the body is from 188 to 230 μ in length and from 56 to 80 μ in breadth, the mean of a number of observations being 206 by 70. The undivided part of the tail is from 247 to 360 μ , with mean of 305, and the furca are from 106 to 136 μ , with mean of 120.

The internal anatomy, so far as it can be made out, is very similar to that of Cercaria B; the same gland cells are to be seen and in stained specimens the four anterior cells differ in the same way from those placed further back. The gonad, however, is not crescentic in dorso-lateral view, the acetabulum is smaller and the eye-spots are deeply pigmented and black in colour.

This cercaria was found with the preceding in specimens of *Gyraulus convexiusculus* (Hutton) obtained in the Hamun-i-Helmand, Seistan. Two molluscs, out of forty-three which were examined, contained examples of the parasite.

ADDENDUM.

With Dr. Kemp's permission I add here three figures of the parasite of *Schizothorax zarudnyi* referred to by Mr. S. L. Hora



TEXT-FIG. 2.—Parasite from *Schizothorax zarudnyi*.

and myself on p. 173 of this volume. The figures have been placed at my disposal by Major R. B. Seymour Sewell, I.M.S. and represent three views of the animal as seen as a solid object (A) and mounted in glycerine (B & C) after extraction from the cysts in the muscles of the fish. Their magnification is not stated, but it is at least 12 as reproduced. The structure of the organism is so enigmatic that none of us are able even to suggest its taxonomic position. The preservative had apparently failed to penetrate the

peculiar cylinder in the interior of the animal and sections were a complete failure. Major Sewell notes in explanation of his figures that there is a more or less well-defined groove round what appears to be the anterior extremity and sucker-like disc (s) in the middle of the (?) ventral surface. The (?) posterior part of the organism is divided by faint grooves (g), as shown in fig. A. These are visible only on the (presumed) ventral surface. On the dorsal surface, near the posterior extremity, there is a small aperture (p). The outer parts seem to form a kind of test, lined by a thin membrane, and inside this there is a cylindrical body (c) with an apparently chitinous investment. At the end nearest the (?) dorsal grooves the extremity of this body is contracted to form a collar (n). Though the specimens had been fixed in Schaudinn's fluid and were apparently well preserved, no further structure could be made out.—*N. Annandale.*



THE AQUATIC FAUNA OF SEISTAN

A SUMMARY.

By N. ANNANDALE, D.Sc., F.A.S.B., Director, Zoological Survey of India.

The aquatic fauna of Seistan is a scanty one, fairly rich in individuals, as is usual in a fauna living in abnormal conditions, but poor in species. The most salient fact about it is that it is essentially a mountain fauna acclimatized to live in a swampy depression. Before discussing its geographical and biological relations as a whole I will first consider briefly the different species found in the different bodies of water that exist in the country, viz. desert springs, stagnant pools, rivers and other water courses, and the Hamun-i-Helmand or basin into which the Helmand finally drains. An account of these will be found in the Introduction to this volume. I have given in foot-notes references to the species of animals not otherwise noticed in the volume.

THE FAUNA OF SPRINGS IN THE SEISTAN DESERT.

In our hurried journey across the desert of Seistan and the Afghan-Perso-Baluch frontier we had little opportunity to examine many of the springs we passed, but those we did examine were very uniform in their animal life, which did not appear to be much affected by the varying degrees of salinity of water accepted under stress of necessity as potable by man and beast. None of the springs contained fish, but all the larger ones had a small but healthy fauna of molluscs, insects, Entomostraca and leeches.

MOLLUSCA. Only three species of molluscs were found, *Melanoides pyramis* (Benson), *Gyraulus euphraticus*, Mousson and *Corbicula fluminalis* (Müller). Of these the most commonly present was the *Melanoides*. Of this species all our specimens belonged to Nevill's var. *flavida*, a form perhaps peculiar to situations of the kind and originally described from Persian Baluchistan. The shell, though not of the largest size attained by the species, is not dwarfed or in any way distorted. A single specimen of this race is also known from Mesopotamia. The *Gyraulus* is perfectly normal, though found in water distinctly bitter to the taste. It is noteworthy that the species has an extraordinarily wide range (from Mesopotamia to China) and must, therefore, be extremely adaptable. The same is true of the *Corbicula*, which is found practically all over Africa and southern and middle Asia, was originally

described from Mesopotamia and occurs fossil in Great Britain. Shells from the springs are smaller and rather thinner than usual and perhaps a little broader in proportion to their height, but specimens from larger bodies of water exhibit great individual variation in these respects, merging gradually into the thick narrow form called *C. cor* by many conchologists.

The molluscs of the springs, therefore, may be said to show very little response to their environment in structure.

INSECTA. Insect life, even in the middle of winter, is by no means deficient in the springs. The most abundant and the most commonly observed species was the mosquito,¹ *Theobaldia longiareolata*, the larva of which was found in water so saline as to be almost undrinkable, as well as in the excellent spring at Hurmuk, claimed locally to contain the finest water in all Iran. Both larvae and pupae were seen in December and imagines were observed hatching out. The latter, which were common also at Nasratabad, were, however, very sluggish at this season and made no attempt to suck blood.

Small Rhynchota of the family Corixidae were frequently noted in the springs and in that at Hurmuk two species of *Micronecta* (*M. desertana* and *M. biskrensis*) were abundant. The former has been described by Mr. Distant as a new species, while the latter was described by Horvath from the oasis of Biskra in the Algerian desert.

Small Hydrophilid and Dytiscid beetles are not uncommon, and a large species of the latter family was captured in the spring at Hurmuk.

CRUSTACEA. The only Crustacea seen in the springs were Ostracods, which often swarmed on the bottom. In a sample from an artificial tank containing water pumped from a spring in the Baluch desert Mr. Gurney found tests of *Cyprinotus incongruens* and *Ilyocypris bradyi*, both widely distributed species.

HIRUDINEA. So far as I can judge, only one species of leech (*Limnatis nilotica*) occurs in the springs. It is common in all those at which transport animals are watered and is dangerous both to men and animals owing to its habit of entering their mouths while they are drinking and sticking to the tongue or pharyngeal wall.

THE FAUNA OF STAGNANT POOLS.

Under this heading I propose to consider pools connected neither with water-courses nor with small desert springs. Such pools are found occasionally in depressions, probably always of artificial origin, in Seistan and apparently owe their water to percolation. The largest pool of the kind we saw was at the village of Daulatabad towards the south of the country. It formed a fairly large village pond and lay at the base of a low ridge of stiff

¹ For the identification of this mosquito and of the other Nemocera mentioned in this paper I have to thank Mr. Edwards of the British Museum.

clay on which the village was built. Even in December it contained a considerable quantity of water, which was very foul but apparently slightly saline. It was used by the villagers for all domestic purposes. There was no macroscopic vegetation, but much evidence of the presence of a luxuriant growth of microscopic algae was present.

The macroscopic fauna of this pond consisted, so far as we were able to discover, of arthropods only. Cladocera, including large Daphniids and Copepoda, were abundant, but circumstances did not allow of their collection. The most noteworthy features were the wealth of insect life and the large size of some of the species present. This was particularly noteworthy in the Rhynchota, the representatives of which are mostly very small in Seistan. As at other places the only families of this order that we could find were the Corixidae and the Notonectidae, but in the latter family the relatively large and very widely distributed *Notonecta glauca*, which we did not see elsewhere in Seistan, was common, while in the Corixidae *Macrocorisa geffroyi* was also present in large numbers. Dipterous larvae were abundant, the most conspicuous being an exceptionally large Chironomid, the imagines of which were observed hatching out from the pupae on the surface. Water-beetles, including large Dytiscidae and Hydrophilidae of moderate size, were numerous.

The only other pools of the sort in which we collected were those in the parade-ground at Nasratabad. They occupied pits from which clay had been extracted for brick-making. Their water was fouled by the camels and donkeys that frequented them, but not or hardly saline. It was six or seven feet deep in places but blocked up by a profuse growth of the water-weed *Zannichellia palustris*. Insects, Entomostraca and molluscs were rich in individuals, but the number of species was small. No large species of Rhynchota were seen, but several species of Notonectidae and Corixidae were abundant. Mr. Distant has identified the following forms:—*Anisops fieberi* and *Corixa affinis*.

Mr. Gurney found the following species of Entomostraca in the collections made:—CLADOCERA: *Daphnia magna*, *Simocephalus vetulus*. COPEPODA: *Cyclops strenuus*, *C. leuckarti*. OSTRACODA: *Eucypris clavata*, *Ilyocypris bradyi*, *Potamocypris villosa*; all common and widely distributed forms.

The molluscs present were *Limnaea bactriana*, *Gyraulus cuphraticus*, *G. convexiusculus* and *Corbicula fluminalis*, all common species in Seistan and found, with the exception of the *Limnaea*, in all bodies of water containing luxuriant submerged vegetation in the country. *L. bactriana*, which appears to be mainly a pond mollusc, was found only in those pools and in small water-courses at the same place.

FAUNA OF IRRIGATION CHANNELS.

The small irrigation channels that form a close net-work over the whole of the habitable part of Seistan have, at any rate in

December, a very poor fauna. This is not altogether surprising, for the water in most of them is at that season intermittent, being shut off for several days each week. Even, however, where the stoppage of the flow does not cause desiccation and where a species of broad-leaved *Potamogeton* flourishes very few macroscopic animals could be found and even insects and Entomostraca were extremely scarce, if not altogether absent. The only crustacean obtained from this habitat was a single specimen of the Conchostracous *Leptestheria tenuis*. A small Tipulid fly (*Symplecta elongata*), the only species in our collection described from Persia proper, was common on the damp mud at the edge of similar channels and probably bred in them.

In the garden of the British Consulate at Nasratabad we examined an artificial water-course which had, however, a much richer vegetation and fauna, probably owing to the fact that it was less liable to desiccation and received the benefit of manure applied to the garden through which it flowed. Its flow was, however, intermittent like that of the irrigation channels outside, from one of which it received its supply. The vegetation consisted mainly of a narrow-leaved species of *Potamogeton* and of *Zannichellia palustris*, but a filamentous green alga forming cloud-like masses was also abundant. The water was fresh or practically so. The fauna was sufficiently rich to be treated group by group.

FISH.—Shoals of the small Cyprinid *Discognathus adiscus* occurred, remaining at the bottom in the day-time but rising to the surface in the evening. Among them was found a single specimen of *D. phryne*. The first species is known only from Seistan, while the second is common in the hill-country of Baluchistan.

MOLLUSCA.—The same molluscs were found as in the pools on the parade-ground hard by, namely *Limnaca bactriana*, *Gyraulus euphraticus*, *G. convexiusculus* and *Corbicula fluminalis*. No difference in the shell of any of these species could be discovered. A few empty shells of *Segmentina calathus*, a widely distributed North Indian species, were also obtained from this channel.

ARTHROPODA.—The insects and Entomostraca of the channel were the same, or practically the same, as those of the pools on the parade-ground.

OLIGOCHAETA.—The little Oligochaete worm *Nais communis* var. *punjabensis* was found in considerable abundance and in interesting circumstances. It inhabited small mucilaginous tubes, probably stolen from a Dipterous larva, in masses of filamentous algae and to each of the tubes a colony of the polyzoon *Lophopodella carteri* was attached. *N. communis* is a cosmopolitan species and the var. *punjabensis* is common in Northern India. Col. Stephenson¹ found among our specimens of this little worm a single individual probably belonging to another species common in North India, namely *Chaetogaster punjabensis*.

¹ Stephenson, *Mem. Ind. Mus.* VII, p. 196 (1920).

POLYZOA.—*Lophopodella carteri* was the only member of this group observed. Its geographical range is now known to be exclusively Asiatic, but to extend from Eastern Persia to Japan, the Chinese and Japanese race being slightly differentiated. It is not by any means always associated with Oligochaete worms, but a Chironomid larva not infrequently establishes itself at the base of the colony.

DELTAIC FAUNA OF THE HELMAND AND ITS EFFLUENTS.

We were unable to visit the main branches of the Helmand in its inland delta, but collections of fish and molluscs were made in this region by Sir Henry MacMahon and other officers of the Seistan Arbitration Commission. The fish they obtained were:—*Scaphiodon macmahoni*, *Discognathus phryne*, *Schizothorax zarudnyi*, *Schizopygopsis stoliczkae*, *Nemachilus stoliczkae*, *Adiposia rhadinaea* and *A. macmahoni*. Of these only three (*D. phryne*, *Sch. zarudnyi* and *A. macmahoni*) were found in the smaller streams of Seistan.

The molluscs collected by the Commission in the Seistan delta were *Vivipara helmandica*,¹ *Lamellidens marginalis* and *Corbicula fluminalis*. Of the first of these only single empty shells were found by us in other parts of Seistan, except for a number of completely bleached specimens found in a flood-deposit. There is, therefore, some reason to regard the species as peculiar to the estuaries of the Helmand, as it has not been found except in Seistan and the immediate vicinity to the east. The two bivalves are common throughout Seistan, in which the *Lamellidens* has become differentiated into a distinct race (*rhadinaea*). Shells from the Helmand are thinner and smaller than those from other parts of the country. The *Corbicula* is remarkable for its extreme variability.

We examined smaller streams of the deltaic system of the Helmand in the immediate vicinity of Nasratabad, near the ruined city of Jellalabad some 12 miles to the north and at Chilling considerably further south. Where the water was actually flowing the fauna was very scanty, but the high clay banks were full of bleached shells of *Corbicula fluminalis* and often of *Limnaea gedrosiana* and the different Planorbidae found in the country.

Insect-life is usually scarce in such streams, but a noteworthy feature of those of Seistan is that the Hydrometridae often seen on the surface of the stiller pools are replaced, at any rate in winter, by Diptera of the family Ephydriidae, which were often observed in large numbers resting on the surface film. Mr. Brunetti² has described a species (*Halmopota viridescens*) from Seistan that "skates" much like *Gerris*.

Near Jellalabad we found the Randa stream practically dry, except for shallow pools left in the bed and completely isolated.

¹ See Annadale, *Rec. Ind. Mus.* XIX, p. 114 (1920).

² Brunetti, *Rec. Ind. Mus.* XVI, p. 300 (1919).

The water in these pools was apparently fresh but very foul as wandering Baluchis watered their sheep, goats and donkeys at them. Most of the fish and other animals were dying in them in large numbers. The fauna was, or had been, fairly rich, but there was no macroscopic vegetation in an active state of growth. Remains of reeds and a few moribund plants of a broad-leaved *Potamogeton* were observed in several of the pools and the nodular roots of some plant were common in the water, evidently in a resting state. The fauna may be dealt with group by group.

FISH.—Four species of fish were found in the pools, viz. *Discognathus adiscus*, *Schizothorax zarudnyi*, *Schizocypris brucei* and *Adiposia macmahoni*. Of the *Schizothorax* only young and half-grown individuals were obtained, although we had the pools netted by Seistani fishermen. Both this species and *D. adiscus* were extremely abundant. The *Schizocypris*, of which we saw only young specimens, were much less abundant. The *Adiposia* was present in large numbers. This fish differs from the others in being a burrowing form. It was the only species in the pools that was in a healthy condition in December, the majority of the others being dead or moribund. Its stomach-contents consisted of the remains of Cyprinid fish and of May-fly larvae.

MOLLUSCA. With the exception of a few dead shells of *Gyraulus euphraticus* and *G. convexiusculus* and one of *Vivipara hilmandensis* found among the remains of reeds in one or two of the pools, the only specimens of Mollusca we obtained from them were shells of *Lamellidens marginalis rhadinæus* and *Corbicula fluminalis*. All those of the former species were empty, but a few living individuals of the *Corbicula* were dug from the mud, in which they were buried four to six inches deep.

INSECTA. The insect-fauna of the pools was scanty so far as most groups were concerned, but the larva of a large May-fly, probably identical with the common European *Palingenia longicauda*, was abundant in the mud and we obtained three species of Rhynchota from the pools, namely *Corixa hieroglyphica*, *C. affinis* and *C. randana*, a new species described by Mr. Distant. *C. hieroglyphica* and *C. affinis* are both Indian.

CRUSTACEA. Numerous specimens of the crab *Potamon gedrosianum* were dug from the mud, in which they were apparently hibernating with *Corbicula*, *Palingenia* larvae and the fish *Adiposia macmahoni*. The range of the crab extends from the Punjab Salt Range to Seistan.

POLYZOA. An interesting member of this group [*Plumatella* (*Afrindella*) *persica*, sp.nov.] was found in one of the pools, coating the stems and nodular roots of the plant to which I have referred above. The animal has not as yet been found elsewhere.

Near Nasratabad we visited a number of shallow pools which in the flood season were evidently backwaters of streams or large irrigation channels. In most of them the only traces of vegetation were the roots and dead stems of reeds and dried masses of filamentous algae stranded on land plants growing near the margin.

In drift of fragments of reeds, etc., that surrounded most of these pools, dead shells of *Limnaea gedrosiana* and the other common molluscs of the country, including one of the few endemic species (*Amnicola sistanica*), were abundant, with the statoblasts of *Lophopodella* and the gemmules of the sponges *Spongilla alba* and *S. (Eunapius) carteri*.

In most of the pools we found no macroscopic life, but in one, in which a broad-leaved *Potamogeton* was common though not in a flourishing condition, *Disocognathus adiscus* and young specimens of *Schizothorax zarudnyi* were abundant. *Schizocypris brucei* were also found, but in much smaller numbers. A peculiar form of *Limnaea gedrosiana* was also common in this pool. It is distinguished from the *forma typica* of the species by its much greater individual variability and by the fact that the curve of the outer lip of the shell is flattened to a straight line. This mollusc, for which the varietal name *rectilabrum* has been proposed, has been found elsewhere only in the Kushdil Khan reservoir in the north of the hill-country of Baluchistan. The reservoir is a large, shallow artificial lake with a luxuriant submerged vegetation in winter, but liable to complete desiccation in summer. The specimens of the mollusc from Seistan were mostly infected by the common North Indian Oligocheate worm *Chaetogaster bengalensis*, which frequented their pulmonary chamber in large numbers.

THE FAUNA OF THE HAMUN-I-HELMAND.

The Hamun-i-Helmand, or rather that part of it which is permanently filled with fresh or nearly fresh water, may be divided into three zones of life, that of the open lake, that of the reed-beds and that of the bare margin.

The zone of the open lake may be called more appropriately the Central Region. It is that part of the lake which is free from reeds and always, except in abnormal droughts, contains several feet of water. The reed-beds form in winter what is called in Persian the *naizar* or reed-country, but the name *nai* is applied in Seistan particularly to Phragmites, which is the most abundant of the three species of which the reed-beds are composed, namely *Phragmites communis*, *Scirpus littoralis* and *Typha angustifolia*. In the flood-season a great area in the *naizar* is under water and even when the water is low, as it is in December, the reed-beds extend out into the lake for considerable distances. In discussing the fauna of this zone we must, therefore, consider both the species living in pools among the reeds and also those of which remains are found in a dead or dormant condition in the soil of the *naizar*. By the zone of the bare region I mean the shore of the lake at or just below low-water level at places where there are no reeds.

THE FAUNA OF THE CENTRAL REGION. In December this region is very poor in life, both animal and vegetable. The bottom is a stiff, sticky clay which supports but a scanty growth of water-plants. A few beds of *Potamogeton lucens*, none of them at all

luxuriant, were all that were observed. On the bottom, shells of *Lamellidens marginalis* race *rhadinæus* and *Corbicula fluminalis* were abundant, but no living specimens were obtained. On one of these shells a living colony of the Polyzoon *Fredericella sultana* race *jordanica* was observed. Fish were very scarce, but we saw fishermen catching *Schizothorax zarudnyi* in nets in the open lake, near a reed-bed.

THE FAUNA OF THE REED-BEDS. This fauna is much the richest, or rather the least impoverished, in the lake. It is concentrated in small, comparatively deep pools which are choked even in December with submerged vegetation. In the composition of this, *Potamogeton pectinatus* is the dominant plant, but *P. perfoliatus*, *Nais major* and at least one species of Characeae also occur.

Among the reeds very few fish are found, and of those we caught all belong to one species (*Discognathus adiscus*) and seemed to be in a moribund condition, but the more open channels in the reed-beds are the proper home of *Schizothorax zarudnyi*, the largest fish found in Seistan and apparently the only one caught for food.

Limnaea gedrosiana, *Gyraulus euphraticus* and *G. convexiusculus* were the commonest molluscs in the small pools, but a few small specimens of *Amnicola sistana* were also found. Shells of this species, in much greater abundance and of a larger size, were dug from the soil of the *naizar*. The *Limnaea* belonged to the typical form of the species but the shells were smaller and a little narrower than those found in ponds at Quetta.

Insect-life was less abundant in this region than might have been expected. Larvae of Chironomid Diptera were fairly common, and so were those of two species of dragonflies. Major Fraser thinks that one of these is probably the larva of the common Palaearctic Agrionid *Ischnura elegans*, while he states that the other "combines some of the features of an Agrionine with those of a Lestine." He remarks that it is unusual to find dragonfly larvae active in winter, as these species were.

Adult insects were less abundant, both in the pools and among the reeds, than larvae. Mr. Edwards has found in our collection several species of *Chironmus*, all allied to, if not identical with European species but unfortunately, owing to an accident, not in sufficiently good condition for specific determination.

The Entomostraca found in this habitat were cosmopolitan species common in similar situations in other countries. None of the higher Crustacea were seen.

A sponge and two species of Polyzoa were fairly common on the stems of *Typha*. The sponge was a phase of the cosmopolitan *Ephydatia fluviatilis* and one of the Polyzoa an equally cosmopolitan species, *Fredericella sultana*. The latter belonged to a race (*jordanica*) hitherto known only from the Jordan and the Volga system, while the other member of the same group [*Plumatella* (*Hyalinella*) *bigemmis*] has been described as new in this volume.

MARGINAL FAUNA. The marginal fauna is very scanty. It includes no molluscs, fish or crustacea, and in winter we found no aquatic insects. The lower surfaces of blocks of clay, however, were covered with a fairly luxuriant growth of *Ephydatia fluviatilis*, in a different phase from that found in the reed-beds, and of *Fredericella sultana jordanica*. The latter were covered with Vorticellid Protozoa. Just above the water-level certain insects were not uncommon in the same position, notably the Tipulid *Symplecta punctipennis*, at least two species of Ephydrid flies, and a cricket (*Achtea bimaculata*) also found in a similar habitat on the shore of the Lake of Tiberias.

COMPOSITION OF THE FAUNA AS A WHOLE.

The composition of the aquatic fauna of Seistan cannot be described as abnormal, but there are certain deficiencies that call for discussion. Some of these are due to geographical cause, which will be discussed later, but others are not so easily explained and evidently depend on some factor in the environment not yet elucidated. The most noteworthy are the apparent absence of Crustacea Amphipoda and of most families of aquatic Rhynchota. Freshwater Amphipods are scarce in the plains of India and as a rule occur only in the large rivers, in which the species are immigrants from the sea.¹ At even moderately high altitudes in the Himalayas, however, species of *Gammarus* and *Talorchestia* occur and in the Quetta district of Baluchistan, between 5,000 and 6,000 feet, at least two species are abundant in every spring and stream. We could find none in Seistan.

The absence of all aquatic Rhynchota except Notonectidae and Corixidae struck us very much in Seistan, particularly in reference to that of the surface-haunting Hydrometridae. It is of course possible that we failed to find these species in winter because they were hibernating, but this is improbable for two reasons, firstly, because we sought for them carefully in spots in which they might have been expected to conceal themselves had they left the water temporarily, and secondly, because they are not uncommon on the water at the same season in adjacent districts. Dr. Kemp found a *Microvelia* abundant on the Zanginawar Lakes in the eastern part of the Baluch desert in December, and I noted a *Gerris* on small streams near Peshawar in large numbers in January. In neither instance was the temperature higher than it was in Seistan in November and December. The line of vegetable debris that marks the flood level on the bare shores of the Hamun-i-Helmand would seem to be an ideal retreat for hibernating Hydrometridae and we found amongst the fragments of reeds, etc., two species of Reduviid Rhynchota, several species of Carabid and Staphylinid and one of Curculionid beetles, at least two species of Diptera, a cricket and an earwig, a wood-louse and a

¹ Cf. Chilton, *Rec. Ind. Mus.* XIX, p. 79 (1920).

toad (*Bufo viridis*), all in a more or less torpid condition; but no Hydrometrid. Indeed, it seemed to us that this family was to a large extent replaced by Diptera, such as *Halmopota viridescens*, Brunetti, which skated on the surface of the water in almost the same way as these Rhynchota do.

The absence of molluscs of the family Melaniidae from the Hamun-i-Helmand and the waters connected with it is another point worthy of note. In the extreme south of Seistan we found one form (*Melanoides pyramis* var. *flavida*) in a desert spring, but neither living molluscs nor empty shells were found at any place in the irrigated part of the country. The absence of species of this genus, one of which is not uncommon in adjacent districts, may perhaps be due to lack of nutriment or the presence of mineral salts in the mud of which they invariably feed.

In other respects the limitations of the fauna seem to be due rather to geographical factors than to any peculiarities of the environment.

GEOGRAPHICAL RELATIONS OF THE FAUNA.

In considering the geographical relations of the aquatic fauna of Seistan five facts must be borne in mind:—firstly, that the country lies well within the limits of the Palaearctic Region and is separated from India not only by several hundreds of miles of desert but also by the great mass of mountains that occupies the more important part of Afghanistan and Baluchistan and juts down southwards almost to the Mekran coast west of the Indus; secondly, that the only waterways that reach it, and probably ever have reached it, come from the east and the north; thirdly, that even these waterways are of recent origin in their present course; fourthly, that it is much depressed below the surrounding districts, and fifthly, that the aquatic fauna, as follows from the third and fourth facts, is composed of immigrants from high mountainous tracts.

These facts account for many of its deficiencies, for example for the absence of aquatic Chelonia and Caridea, both of which are unknown from the higher regions of Central Asia. To the same facts we may trace the paucity of genera in the fish and molluscs, contrasted with the relative wealth of sponges and Polyzoa. It will be interesting to apply these deductions to the different groups of animals that are represented in turn.

Of the three Batrachia known to inhabit Seistan two are perhaps the most widely distributed of all the Palaearctic frogs and toads, namely *Rana esculenta* and *Bufo viridis*. One of these has evidently been stayed in its eastward range by the mass of mountains to which I have already referred. It does not seem to have penetrated beyond the eastern limits of the Baluch desert, or, from the north into the valleys of the western Himalayas, in which the toad has made itself at home. The fact that *Rana esculenta* is represented in Seistan and western Baluchistan by the race *ridibunda* hardly affects the situation, as this race itself has an immense range in

Eastern Europe, Western and Central Asia. The third Batrachian, *Rana cyanophlyctis*, has a much more peculiar geographical distribution—from near Aden to Penang. It is perhaps the commonest and most universally distributed of the Indian frogs, at all altitudes up to nearly 7,000 feet, but east of the Bay of Bengal becomes extremely rare. Throughout the greater part of its range no racial characters have been discovered, but in Seistan it is said to be distinguished by the size of its eyes and tympanum. If this be so—I have seen no specimens of the race *seistanica* of Nikolsky—the race provides evidence of the complete isolation of Seistan from other parts of the range of the species.

The number of fish (9 species in 7 genera) known from Seistan is small considering that the country possesses that rarest of phenomena in Central Asia and Persia, a freshwater lake; but here again the same facts are illustrated. This becomes clearer if we examine the fish-fauna in detail. Of the nine species three belong to the Central Asiatic subfamily Schizothoracinae, which are in a sense anadromous fish though far separated from the sea, three to the Cyprininae, which may be regarded as the dominant group in the great suborder Cyprinoidea, perhaps the most successful and characteristic of all the non-migratory freshwater fish, and three to the Cobitidae, a family of wide range in the Palaearctic and Oriental Regions and modified primarily for life on or in a soft bottom in water of no great speed.

Of the three Schizothoracinae one (*Schizothorax zarudnyi*) is indigenous to Seistan, but is little more than a local race of a species found in mountain streams at much higher altitudes to the north-east, another is identical with a species of similar habitat, namely *Schizopygopsis stoliczkae*, while the third has been known hitherto from Waziristan in the extreme east of the mass of mountains that forms the ultimate barrier between the Oriental and Palaearctic Regions in the Indian Empire. This is *Schizocypris brucei*. The Schizothoracinae are the most characteristic of the fish of the highlands of Central Asia, and particularly of the northern watershed of the Himalayas and Hindu Kush. A few species, including some of the least modified forms, have made their way across the great divide and live in the streams of the southern watershed and even in those on the lower slopes of the Himalayas and in the plains immediately at their base. It is not to these forms that the Schizothoracinae of Seistan are related, but to true Central Asiatic species.

The Cyprininae of Seistan belong to two genera, *Discognathus* and *Scaphiodon*. The latter seems to have its headquarters in Baluchistan and not to be essentially a mountain-dweller, while *Discognathus*, which is replaced in India by the closely allied but more specialized genus *Garra*, occurs in Syria, Mesopotamia, E. Persia, Baluchistan and Waziristan on the North-West Frontier of India. Neither genus is found in the highlands of Central Asia, and though both live commonly in hilly country, neither inhabits high mountainous regions.

The Cobitidae of Seistan, on the other hand, must be associated with the Schizothoracinae in origin. Two of the three species belong to the peculiar genus *Adiposia*, otherwise only known from Turkestan, and are apparently endemic as species. The third (*Nemachilus stoliczkae*) belongs to a group in its genus characteristic of the Central Asiatic highlands, and resembles its namesake of the genus *Schizopygopsis* in geographical range.

The majority of the fish of Seistan are, therefore, without doubt of Central Asiatic origin and can only have reached Seistan from the northern watershed of the Hindu Kush, while a minority have probably arrived in the district from the lower parts of Baluchistan.

From a geographical point of view, the molluscs are perhaps the most interesting group in our fauna except the fish. They differ considerably from the true Eurasian species that have penetrated from Central Asia as far south as the valley of Kashmir, and almost as much from those characteristic of the Persian Plateau. This fact is illustrated equally well by the species and genera that are present and by those that are absent. The Seistan fauna includes none of the widely-distributed Eurasian species found in Kashmir, such as *Limnaea stagnalis* and *Bithynia tentaculata*, nor does it include any representative of the essentially Eastern Palaearctic genus *Melanopsis*, common in Persia proper and Mesopotamia, or of *Bullinus*, one species of which is common in Mesopotamia. The species of *Limnaea* that do occur bear a distinct resemblance to European forms, but at least one of them (*L. bactriana*) also resembles an Indian form, *L. chlamys*. The three species of this genus, one of which (*L. hordeum*) is very rare and is only known from empty and possibly sub-fossil shells have all been found also in Lower Mesopotamia, though not in Persia proper, but are not dominant in the former country. Two of them (*L. bactriana* and *L. gedrosiana*) also occur commonly in the hill-country of Baluchistan and Afghanistan, but not, so far as we know, at high altitudes. The three Planorbidae have a wide range both in the Oriental Region and in neighbouring districts. That of the two species of *Gyraulus* (*G. convexiusculus* and *G. euphraticus*, extends at any rate from Mesopotamia to Burma and all over the Indian Empire, while the third species of the family (*Segmentina calathus*) is found in Burma and Sumatra as well as in northern India. The occurrence of a species of *Vivipara* in Seistan is an interesting feature. The genus is practically cosmopolitan, but for some unaccountable reason is absent from Syria, Palestine, Mesopotamia, the greater part of Persia and Baluchistan. Among living species the Seistan form (*V. helmandica*) is most closely related to one from Sind (*V. sindica*). It is, however, still more closely related to a fossil (tertiary) species from the Bugti Hills in south-eastern Baluchistan. Indeed, it can be separated specifically from the fossil form only with difficulty. Both *V. helmandica* and the only Unionid known from Seistan afford clear evidence of the existence of an Indian element

in the fauna. The bivalve, indeed, *Lamellidens marginalis rhadi-naeus*, is only a local race of one of the commonest Indian species.

The scarcity of endemic species of molluscs of Seistan is noteworthy as providing additional evidence for the recent origin of the fauna. Only two species apparently belong to this category, namely *Amnicola sistanica* and *Vivipara helmandica*.

The aquatic molluscs, therefore, are of more mixed origin than the fish, probably having had better opportunities for immigration, and include a much more distinct Indian element. They provide less evidence, moreover, of derivation from a high mountain fauna.

The only Decapod crustacean found in Seistan is a race of a species widely distributed in south-western Asia and clearly of western rather than eastern origin. The race is not known from higher altitudes than about 6,000 feet, but is common in the Quetta district of Baluchistan and extends its range southwards and eastwards from Seistan to the Punjab Salt Range. The absence of Caridea from the fauna of Seistan, and also of aquatic Isopoda, is noteworthy, but is easily explicable on geographical grounds. That of Amphipoda I have already discussed. The Entomostraca have little geographical significance.

The only leech discovered in Seistan (*Limnatis nilotica*) is distinctly south-eastern Palaearctic in range. It is common in Egypt, and in many parts of the Mediterranean basin, but is not known from within the limits of the Indian Empire except in the extreme west of British Baluchistan. The aquatic Oligochaeta are essentially Northern Indian. Two of the three species recorded are known only from India proper, while the third form is an Indian race of a cosmopolitan species.

Four species of Polyzoa have been found in Seistan. Two of these, both species of *Plumatella*, are apparently endemic. One of these [*P. (Hyalinella) bigemmis*] belongs to a cosmopolitan subgenus, the other [*P. (Afrindella) persica*] to one of tropical range and strictly Oriental so far as Asia is concerned. Of the other two representatives of the group, one (*Fredericella sultana jordanica*) is a race of a cosmopolitan species, formerly known only from Palestine and the Volga system, while the other is identical with the Indian race of a species (*Lophopodella carteri*) known from India, China and Japan, but represented in the two last countries by a distinct race (*davenporti*).

The only Coelenterate collected is a cosmopolitan species (*Hydra vulgaris*) common in the plains of India.

Three species of sponge were found, viz. *Spongilla alba*, *S. carteri* and *Ephydatia fluviatilis*. The last is a cosmopolitan species common in most parts of the Holarctic Zone but represented by distinct races in the Himalayas and Upper Burma and replaced in Peninsular India by an allied species (*E. meyeri*). *S. carteri* is the commonest of the Indian freshwater sponges and has also been taken in Hungary, Mauritius and the Malay Archipelago. *S. alba* is known from Egypt and from India, where it is usually

found in slightly brackish water. The Seistan form belongs to a distinct race or variety (*rhadinæa*) not found elsewhere.

Our knowledge of the aquatic insects of Seistan is quite fragmentary, being based on a collection made in the middle of winter and only partially worked out. We obtained specimens of a considerable number of water-beetles, but have not succeeded in persuading any coleopterist to name them and our collection of Diptera met with more than one misfortune. The aquatic Rhynchota, as I have already pointed out, belong exclusively to the families Corixidae and Notonectidae. The genera represented (*Micronecta*, *Corixa*, *Microcorisa*, *Anisops* and *Notonecta*) are cosmopolitan and most of the species are known to be Palaearctic. How small our true knowledge about the range of the less conspicuous water-bugs really is, is, however, illustrated by the fact that one of the Seistan species is otherwise known only from an oasis in the Algerian desert. What I have said about the Rhynchota also applies to the Diptera. One species of Tipulid (*Symplecta elongata*) is recorded as Persian and one Ephydrid (*Halmopota viridescens*) has been described from Seistan as new; the other flies are well known European species. So probably is also the May-fly (*Palingenia*) abundant in its larval state on the banks of the Randa stream.

The aquatic fauna of Seistan is thus, as might be expected from its geographical habitat, mainly Palaearctic. Particularly in the fish, it has affinities with that of the highlands of Central Asia, but the molluscs belong to the geographical association I have recently called the Afghan type—not true Eurasian but belonging to species with both Palaearctic and Oriental relationships. They have, indeed, been introduced, with part of the fish-fauna, into Seistan recently, from the lower mountainous districts of Afghanistan and Baluchistan. It is among the less highly organized invertebrates that the tropical Indian element is most clearly manifest, but although this element is apparently absent in the fish, it appears (to go beyond the groups discussed in this paper) among the birds, of which Mr. Stuart Baker writes:—"The geographical affinities are Indo-Palaearctic, the races of resident birds nearly all belonging to the Palaearctic rather than to the Indian forms... On the other hand a few sub-species, apparently resident, are typically tropical Indian."

LIST OF THE AQUATIC FAUNA OF SEISTAN.

Name.	Habitat in Seistan.	Geographical range.	Remarks.
BATRACHIA.			
<i>Rana cyanophlyctis seistanica</i> , Nik. ¹	Reed-beds of Hamún	Seistan	<i>Forma typica</i> extends from S. Arabia to Malay Peninsula.
<i>Rana esculenta ridibunda</i> (Pallas)	Probably all over the country ..	S. and E. Europe; S. W. Asia; Central Asia.	Species almost throughout Palae-arctic Region.
<i>Bufo viridis</i> , Laur. ..	In winter under lumps of clay and debris at edge of Hamún, etc.	Greater part of Palaearctic Region	....
PISCES.			
<i>Discognathus adiscus</i> , Annand.	Water channels and pools in drying river.	Seistan .. ..	....
<i>Discognathus phryne</i> , Annand.	Water channels and reed-beds of Hamun.	Mountains of Baluchistan; Seistan	....
<i>Scaphiodon macmahoni</i> , Regan.	Delta of Helmand ..	Seistan .. ..	....
<i>Schizothorax zarudnyi</i> (Nik.) ..	Delta of Helmand, Hamun, etc. ..	Seistan	Closely allied to <i>Sch. intermedius</i> from Hindu-Kush, etc.
<i>Schizopygopsis stoliczkae</i> , Steind.	Delta of the Helmand ..	Northern water-sheds of the Himalayas and the Hindu-Kush.	....
<i>Schizocypris brucei</i> , Regan. ..	Pools connected with rivers and streams in flood-season.	Waziristan, N.-W. Frontier of India; Seistan.	....
<i>Nemachilus stoliczkae</i> (Steind.)	Delta of the Helmand.. ..	Similar to that of <i>Sch. stoliczkae</i> but extending further east.	....
<i>Adiposia macmahoni</i> (Chaudh.)	Delta of the Helmand and muddy pools in drying stream-bed.	Seistan .. ..	....
<i>Adiposia rhadinaea</i> (Regan) ..	Delta of the Helmand ..	Seistan	...
MOLLUSCA.			
Gastropoda.			
<i>Amnicola sistanica</i> , Annand. and Prashad.	Reed-beds of the Hamun and flooded country generally.	Seistan	...

¹ "A forma typica oculo parvo, oculi diametro longitudinali distincte quam rostri longitudo minore, tympani diametro 4/5 oculi diametri aequante, differt. Habitat in Seistano." Nikolsky, *Ann. Mus. Zool. Ac. Sci. St. Petersburg*, IV, p. 406 (1889).

LIST OF THE AQUATIC FAUNA OF SEISTAN.

250

Records of the Indian Museum.

[Vol. XVIII,

Name.	Habitat in Seistan.	Geographical range.	Remarks.
<i>Vivipara helmandica</i> , Annand. ¹	Helmand river and effluents ..	Seistan . ..	...
<i>Limnaea bactriana</i> , Hutton ..	Water-courses and pools with much vegetation.	Afghanistan, Baluchistan, Seistan and Lower Mesopotamia.	..
<i>Limnaea gedrosiana</i> , Annand. and Prashad.	Reed-beds of Hamun	Same as last species	...
<i>Limnaea gedrosiana</i> var. <i>rectilabrum</i> , Annand. and Prashad.	Pools liable to complete dessication.	N. Baluchistan, Seistan .	...
<i>Limnaea hordeum</i> , Mousson	Only dead specimens found	Seistan, Afghan desert; Lower Mesopotamia.	Only known from empty and possibly sub-fossil shells.
<i>Gyraulus convexiusculus</i> (Hutton).	All bodies of water with abundant vegetation.	Mesopotamia to China and Malay Archipelago.	....
<i>Gyraulus euphraticus</i> , Mousson	Similar to last species ..	Similar to last species ..	..
<i>Segmentina calathus</i> (Benson)	Only dead specimens found	Seistan; India; Burma and Sumatra.	..
PELECYPODA.			
<i>Lamellidens marginalis rhadi-naeus</i> , Annand. and Prashad.	In all larger bodies of water	Seistan and adjacent part of Afghan desert.	<i>Forma typica</i> all over the Indian Empire and Ceylon.
<i>Corbicula fluminalis</i> (Müller)	Hamun, pools, water-courses and desert springs.	Greater part of Asia and Africa	Fossil (Tertiary) in N. Europe.
INSECTA.			
Ephemeroptera.			
<i>Palmigenia?</i> <i>longicauda</i> , Oliver	Edge of flooded country on banks of river.	Continental Europe and S.-W. Asia.	The identity of Seistan specimens with European specimens is not completely confirmed.
ODONATA.			
<i>Ischnura elegans</i> , Lind.	Reed-beds of the Hamun	Europe and S.-W. Asia as far east as Kashmir.	Adult among grass round desert springs in W. Baluchistan.
DIPTERA.			
<i>Chironomus pictulus</i> , Mg. ²	Garden at Nasratabad	Europe; Seistan	Larva probably in irrigation channel.
<i>Psychoda bengalensis</i> , Brun. ³	In garden at Nasratabad ..	Probably throughout Palaearctic, Nearctic and Oriental Regions.	...

<i>Culex fatigans</i> , Wied. ⁴	In same garden as last species ..	Widely distributed in S. Asia; Africa; the warmer parts of America, etc.	(In Asia chiefly Oriental.)
<i>Theobaldia longiareolata</i> , Macq.	Larva common in desert springs and in water-courses.	Mediterranean basin; S. Africa; Seistan; W. Himalayas, etc.	....
<i>Symplecta punctipennis</i> , Mg. ..	Adult at edge of Hamun ..	Europe to Himalayas ..	....
<i>Symplecta elongata</i> , Lw.	Adult common on banks of irrigation channels.	Persia .. ..	....
<i>Halmopta viridescens</i> , Brun. ⁶ ..	Adult on surface of larger water-courses.	Seistan .. ..	....
RHYNCHOTA.			
<i>Notonecta glauca marmorea</i> , Fabr.	Village pond at Daulatabad ..	Palearctic Region; mountains of India.	....
<i>Anisops feberi</i> , Kirk. ..	.. ..	....	....
<i>Macrocorisa geffroyi</i> , Leach. ..	.. ..	....	....
<i>Corixa hieroglyphica</i> , Duf. ..	.. ..	....	....
<i>Corixa affinis</i> , Dist. ..	.. ..	..	....
<i>Corixa substriata</i> , Uhlet ..	.. ..	..	....
<i>Corixa seistanensis</i> , Dist. ..	Irrigation channels ..	Seistan .. ..	....
<i>Corixa randana</i> , Dist. ..	Pools in drying stream beds and reed-beds of the Hamun.	Seistan .. ..	....
<i>Micronecta desertana</i> , Dist. ..	Desert spring	Seistan .. ..	....
<i>Micronecta biskrensis</i> , Horv. ..	Same desert spring	N. Africa; Seistan .. ..	....
CRUSTACEA.			
Decapoda.			
<i>Potamon (Potamon) gedrosianum</i> , Alcock. ⁶	Pools in drying stream bed ..	Seistan; Baluchistan; N.-W. Frontier of India Punjab, Salt Range.	....

¹ Annandale, *Rec. Ind. Mus.* XIX, p. 114 (1920).

² Identified by Mr. F. W. Edwards.

³ "Only one wing left; but this agrees with *Ps. alternata*, Say, of which *Ps. bengalensis* is probably a synonym." F. W. Edwards. The specimen was identified when still complete by Mr. E. Brunetti.

⁴ This and the other Culicidae and Tipulidae identified by Mr. F. W. Edwards.

⁵ Brunetti, *Rec. Ind. Mus.* XVI, p. 300 (1919).

⁶ Alcock [*Cat. Ind. Dec. Crust.*, part I, fasc. II (Potamonidae), p. 23, 1910] refers this race to *P. fluviatile* with some doubt. This opinion was accepted by Dr. S. W. Kemp and myself in *Journ. As. Soc. Bengal* (N.S.) X, p. 250 (1913); but as Alcock refers the race to alternately to *fluviatile* or to *ibericum*, which elsewhere he also refers to *fluviatile* as a subspecies, it seems simpler to call it merely *gedrosianum*.

LIST OF THE AQUATIC FAUNA OF SEISTAN.

252

Records of the Indian Museum.

[Vol. XVII I,

Name.	Habitat in Seistan.	Geographical range.	Remarks.
OSTRACODA.			
<i>Eucypris clavata</i> , Baird ..	Pools of foul water, amongst <i>Zannichellia</i> .		
<i>Ilyocypris bradyi</i> , Sars.	Same pools; also in spring in Baluch desert.		
<i>Potamocypris villosa</i> , Jur.	In same pools		
<i>Herpetocypris reptans</i> , Baird ..	In pools of clear water in Hamun, amongst <i>Potamogeton pectinatus</i> .		
CLADOCERA.			
<i>Daphnia magna</i> , Straus.	In pools of foul water with <i>E. clavata</i> .	All these are probably cosmopolitan species.	....
<i>Daphnia longispina</i> var. <i>rosea</i> , Sars.	In pools in reed-beds with <i>H. reptans</i> .		
<i>Simocephalus vetulus</i> , O. F. M.	In pools of both types already mentioned.		
<i>Ceriodaphnia pulchella</i> , Sars.	In pools in reed-beds with <i>D. longispina</i> var. <i>rosea</i> , etc.		
<i>Ceriodaphnia reticulata</i> , Jur. .	In same habitat as the last ..		
<i>Bosmina longirostris</i> , O. F. M.	In same habitat as the last ..		
COPEPODA.			
<i>Cyclops strenuus</i> , Fischer-Sars.	In foul-water pools ..		
<i>Cyclops leuckarti</i> , Claus. ..	With the last ..		
<i>Cyclops viridis</i> , Jur.	In pools of reed-beds with <i>D. longispina</i> var. <i>rosea</i> , etc.		
CONCHOSTRACA.			
<i>Leptestheria tenuis</i> , Sars.	In irrigation channel	Palaeartic Region.	....
ANNELIDA.			
Oligochaeta.			
<i>Chaetogaster bengalensis</i> , Annd.	In <i>Limnaea gedrosiana</i> var. <i>rectilabrum</i> in flood-pool.	Northern and Peninsular India; Seistan.	....

<i>Chaetogaster punjabensis</i> , Stephenson?	In irrigation channel amongst filamentous algae.	N.-W. India; Seistan ..	..	....
<i>Nais communis punjabensis</i> , Stephenson.	In same channel associated with the Poyzoon <i>Lophopodella</i> ; also in pools in reed-beds.	....		....
HIRUDINEA.				
<i>Limnatis nilotica</i> (Sar.) ..	Desert springs .. ..	....		....
POLYZOA.				
<i>Fredericella sultana jordanica</i> , Annand.	In reed-beds and at bare margin of the Hamun.	Volga system; Palestine; Seistan.		....
<i>Plumatella (Afrindella) persica</i> , Annand.	In muddy pools in drying stream-bed.	Seistan	..	..
<i>Plumatella (Hyalinella) bigemmis</i> , Annand.	In reed-beds of the Hamun ..	Seistan .. ..	..	....
<i>Lophopodella carteri</i> (Hyatt) ..	Amongst filamentous algae in irrigation channel.	Seistan to Japan	..	The Chinese and Japanese race is subspecifically distinct (<i>davenporti</i> , Oka).
TREMATODA.				
<i>Fasciola gigantea</i> , Cobbold	In sheef from edge of Hamun	Probably all over Africa and S. Asia; S. America (? introduced).		Found in Rangoon by Dr. H. H. Marshall, in cattle imported from Calcutta.
HYDROZOA.				
<i>Hydra vulgaris</i> , Pallas. ..	In irrigation channel with <i>L. carteri</i>	Cosmopolitan	..	The common Indian species.
PORIFERA.				
<i>Spongilla alba</i> var. <i>rhadinæa</i> , Annand.	In reed-beds of the Hamun ..	Seistan	..	The <i>forma typica</i> known from Egypt and India.
<i>Spongilla (Eunapius) carteri</i> , Carter.	Gemmules amongst flotsam in flooded country.	E. Europe; (?) Central Africa; Mauritius; Malaysia, India.		....
<i>Ephydatia fluviatilis</i> , auct. ..	In same habitats as <i>F. sultana jordanica</i> .	Holarctic, including W. Himalayas		....

[1921.]

N. ANNANDALE: *Fauna of Seistan*.