FAUNA OF RAJASTHAN, INDIA

PART 3.—MOLLUSCA

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(With 2 Text-figures and 3 Plates)

CONTENTS

I—INTRODUCTION

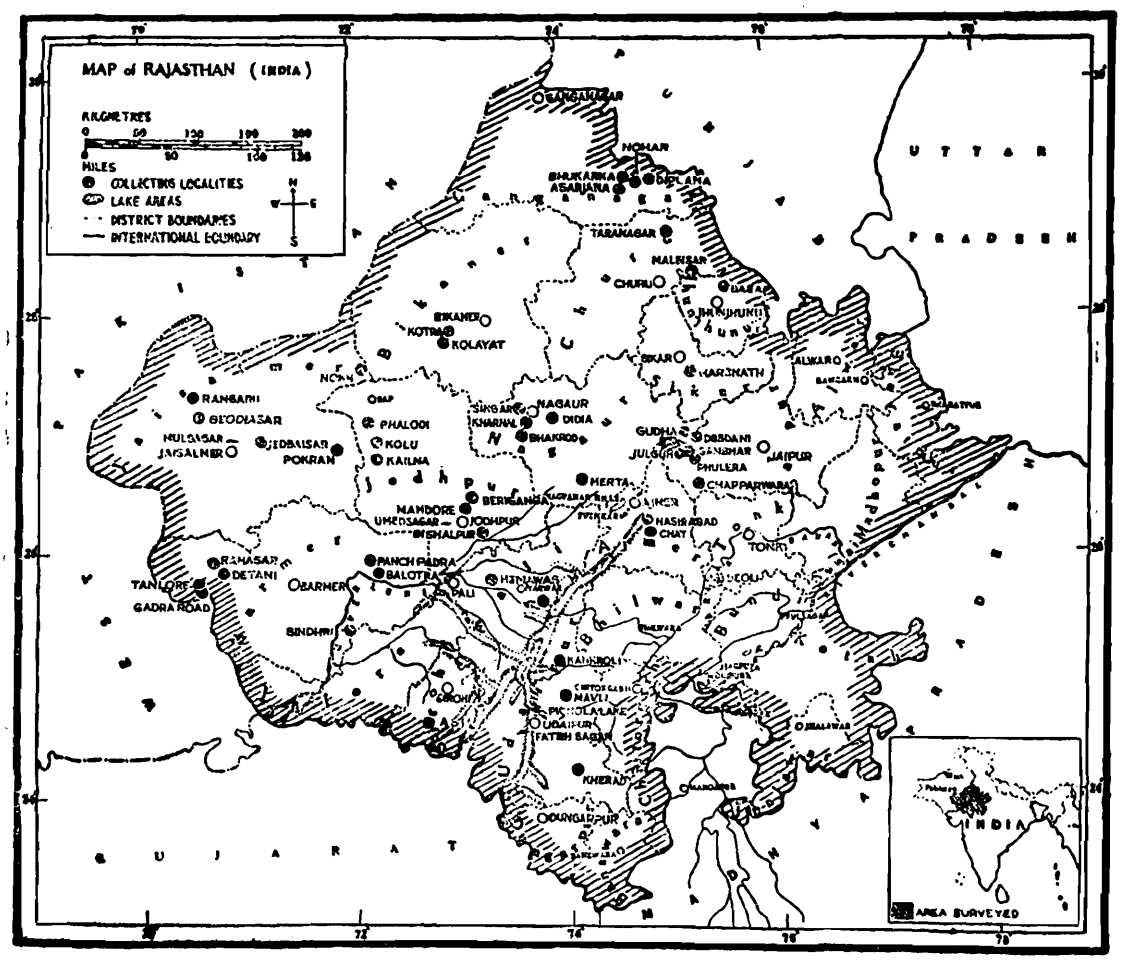
(a) *General*

The collection dealt with here includes mainly specimens of land and freshwater Mollusca and a few shell-remains of marine origin from excavations of a mound near Sambhar Lake. They were obtained from various localities of Rajasthan (from the districts of Ajmer, Barmer, Bikaner, Chittorgarh, Churu, Dungarpur, Ganganagar, Jaipur, Jaisalmer, Jhunjhunu, Jodhpur, Nagaur, Pali, Sikar, Sirohi, Tonk and Udaipur) mostly by different survey parties of the Zoological Survey of India during the years 1941-61, and a few by other institutions and individuals.

For an account of the topography, climate, vegetation, etc. of Rajasthan, *see* Part I (General Introduction) of this series of paper (Roonwal, 1968, *Rec. Zool. Surv. India*, Vol. 61 (3 & 4), pp. 291-375).

Since very little is known about the molluscan fauna of Rajasthan save some casual references by Hanley & Theobald (1876), Theobald (1876), Nevill (1878, 1884), Preston (1912, 1915), Gude (1914), Germain (1921), Annandale & Rao (1925) and Prashad (1925), an attempt is made

here to place on record the varied forms available in that area. Published records were also carefully examined. As a result, only one species, *Boysia boysil* (a tiny land snail), was added which was not available in the collection examined by us.



TEXT-FIG. 1.—Map showing the important collecting localities of Rajasthan Mollusca.

Out of the 36 forms listed here, only 11 were recorded earlier from Rajasthan, the remaining 25 (marked with an asterisk (*) in the text) being new records from that area. The localities noted in the case of many of the forms studied are mostly new.

We have examined in the course of our study a large number of specimens (about 3,760) representing 21 genera and 15 families. In the case of some species, excellent series were available showing different stages of growth and development of the shells. The paucity of species in the area may possibly be due to the influence of the arid climate in which moisture loving animals of all groups do not thrive.

Abbreviations used :—

D. & G. P. R. S., Survey Parties of the Desert and Gangetic Plains Regional Station (of the Zoological Survey of India), Jodhpur.

Dist., District.

Ex., Exs., Example, Examples.

Nr., Near.

Sta., Field Collecting Station.

Z.S.I., Zoological Survey of India, Calcutta.

(b) *Acknowledgements*

We are grateful to Dr. M. L. Roonwal, Director, Zoological Survey of India, Calcutta, for providing the necessary help and facilities throughout the work and also for his valuable suggestions. Our best thanks are also due to Shri R. C. Bagchi, Head Artist, and Shri G. C. Saha, Photographer, for their care in taking the shell photographs.

II—LIST OF SPECIES ARRANGED PHYLOGENETICALLY

Class I. GASTROPODA

Order (i) MESOGASTROPODA

Family 1. VIVIPARIDAE

1. **Viviparus bengalensis* (Lamarck).
   - (i) *Form *typica* (Lamarck).
   - (ii) *Race *mandiensis* Kobelt.
   - (iii) *Race *gigantea* (Reeve).
   - (iv) *Phase *annandalei* Kobelt.
2. **Viviparus variatus* (Frauenfeld).

Family 2. PILIDAE

3. *Pila globosa* (Swainson).

Family 3. AMNICOLIDAE

4. **Digoniostoma pulchella* (Benson).
5. *Digoniostoma cerameopoma* (Benson).
6. *Alocinma orcula* var. *products* (Nevill).

Family 4. MELANIIDAE

7. *Melanoides* (*Melanoides*) *tuberculatus* (Müller).
8. **Melanoides* (*Melanoides*) *pyramis* (Hutton).

Family 5. CYPRAEIDAE

9. **Erosaria lamarckii* (Gray).
   - (i) *Race *redimita* (Melvill).

Family 6. OLIVIDAE

10. **Olivancillaria* (*Olivancillaria*) *acuminata* (Lamarck).

Family 7. XANCIDAE

11. *Xancus pyrum* (Linnaeus)
    - *(i) Form *pyrum* (Linnaeus).

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*First records from Rajasthan.

Order (ii) BASOMMATOPHORA

Family 8. LYMNAEIDAE

12. *Lymnaea* (*Pseudosuccinea*) *acuminata* Lamarck.
    (i) Form *typica* Lamarck.
    (ii) *Form *patula* Troschel.
    (iii) *Form *chlamys* Benson.
    (iv) *Form *rufescens* (Gray).
13. **Lymnaea* (*Pseudosuccinea*) *luteola* Lamarck.
    (i) *Form *typica* Lamarck.
    (ii) *Form *australis* Annandale & Rao.
    (iii) *Form *impura* Troschel.

Family 9. PLANORBIDAE

14. **Indoplanorbis exustus* (Deshayes).
15. *Gyraulus convexiusculus* (Hutton).

Order (iii) STYLOMMATOPHORA

Family 10. VERONICELLIDAE

16. **Laevicaulis alte* (Ferussac).

Family 11. VERTIGINIDAE

17. *Boysia boysii* (Pfeiffer).
18. **Pupoides coenopictus* (Hutton).

Family 12. SUBULINIDAE

19. **Opeas gracile* (Hutton).
20. *Zootecus insularies* (Ehrenberg).
21. *Zootecus estellus* (Benson).

Class II. BIVALVIA (-PELECYPODA)

Order (iv) ANISOMYARIA

Family 13. PTERIIDAE

22. **Pinctada margaritifera* (Linnaeus).

Order (v) EULAMELLIBRANCHIATA

Family 14. UNIONIDAE

23. *Parreysia favidens* (Benson).
24. **Parreysia corrugata* (Müller) var. *nagpoorensis* (Lea).
25. *Indonaia caerulea* (Lea).
26. **Indonaia occata* (Lea).
27. **Lamellidens corrianus* (Lea).

Family 15. CORBICULIDAE

28. **Corbicula striatella* Deshayes.

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*First records from Rajasthan.

III—KEY TO IDENTIFICATION OF RAJASTHAN MOLLUSCA

1. Land slug without a shell ; anus rounded and situated submedially ; penis smooth, slender and free to its extremity ; pedal ganglion having shape of a spiral tube.

...*Laevicaulis* Simroth

(*a*) Penis long, cylindrical, acrocaulous and has a sub-basal collar.

... *L. alte*

2. Shell small, globose-conoid ; aperture edentulate and lying on same level as penultimate whorl forming an acute angle.

.. *Baysia* Pfeiffer (the only species *boysii* representing this genus is not found in the collection studied)

3. Shell small, elongate-ovate ; aperture with one parietal tooth only ; peristome expanded, reflexed and edentulous, but not continuous.

... *Pupoides* Pfeiffern

(*a*) Shell cylindro-pyramidal ; parietal denticle rudimentary or absent.

... *P. coenopictus*

4 Shell small, many-whorled ; spire slender or broader ; umbilicus narrow or closed ; columellar lip straight or concave, reflexed but not toothed or truncate below.

...*Opeas* Albers

(*a*) Spire slender and crenulated near suture ; aperture longer than broad, with pillar lip straight and slightly reflexed ; umbilicus narrow.

... *O. gracile*

5 Shell rather small, many-whorled, cylindrical or oblong-cylindrical ; aperture widely ovate or sometimes very oblique ; peristome thick or thin.

... *Zootecus* Westerlund

(*a*) Shell subcylindrical ; aperture semi-ovate, with inner lip slightly dilated and reflexed over small umbilicus and outer lip somewhat thickened inside.

... *Z. insularis*

(*b*) Shell oblong-cylindrical, stouter than in *insularis* ; last whorl ascending near aperture which is angulate-oval ; inner lip vertical ; peristome obtuse.

... *Z. estelus*

6. Shell small or large (sometimes gigantic), ovate-conic or globose-conic ; whorls smooth or variously sculptured or banded and lineated with dark green ; umbilicus narrow or wide ; operculum shortly ovate, but not retractile ; lining of stomach without folds or chitinous thickenings.

... *Viviparus* Montfort

(*a*)(i) Shell large, about 1⅔ times as high as broad ; surface conspicuously banded and lineated with dark green ; mouth sub-circular with margin narrow and black (when full-grown) ; umbilicus narrow.

... *V. bengalensis* f. *typica*

(ii) Shell sometimes translucent like opal glass ; spire more conical and sharply pointed ; aperture not quite so broad as in form *typica*, but more projecting ; umbilicus slightly more broader.

... *V. bengalensis* race *mandeinsis*

(iii) Shell of gigantic size, with spire short and stout, but sometimes narrow and elongate ; bodywhorl very large, obtusely swollen round upper part and then rounded ; aperture very large and almost circular, with outer margin much thickened and partially covering wide umbilicus.

... *V. bengalensis* race ***gigantea***

(iv) Shell very thin, usually small and translucent ; satures shallow ; dark spiral bands on whorls sometimes a little incrassated ; aperture distinctly subrhomboidal and subangulate at its inner extremity.

... *V. bengalensis* phase *annandalei*

(*b*) Shell somewhat ovate-conical and deeply umbilicate ; bodywhorl descending behind aperture which is rather pyriform ; an obscure but constant whitish band running round periphery of bodywhorl.

... *V. variatus*

7. Shell large or very large, usually dextral (very rarely sinistral) ; spire depressed or sometimes conical ; umbilicus perforate or broadly open, rarely vestigial ; columella not thickened ; operculum thick and internally calcareous.

... *Pila* Röding

(*a*) Shell large, globose, with spire usually depressed but sometimes abnormally long and exserted giving shell a somewhat ovate appearance ; aperture large and its thickened outer margin often lined with a band of orange or pale yellow ; umbilicus wide.

... *P. globosa*

8. Shell small, narrowly umbilicate or sub-umbilicate ; outer lip slightly thickened, produced and angulate or subangulate at its inner extremity ; operculum showing no spiral on surface and its nucleus almost central ; columellar lip forming a sharp and prominent ridge.

... *Digoniostoma* Annandale

(*a*) Columellar margin less projecting below and blunt ; umbilicus practically closed and groove running forward from it not so deep or well defined.

... *D. pulchella*

(*b*) Columellar margin more acutely angled below ; umbilicus moderately narrow, deep and slightly covered by peristome.

... *D. cerameopoma*

9. Shell with umbilicus closed or rimate and without an oblique channel running forward on lower surface of shell ; operculum with spirals on both surfaces and its nucleus eccentric ; columellar fold ridge-like, but not prominent ; peristome continuous, but not thickened.

... *Alocinma* Annandale & Prashad

(*a*) Shell much narrower and more elongate than in typical *orcula*.

... *A. orcula* var. *producta*

10. Shell slender and imperforate ; spire much longer than bodywhorl and evenly descending ; surface smooth or sculptured with axial and spiral ridges sometimes becoming spinose round upper part of whorls ; operculum ovate, with uncleus near lower margin ; aperture ovate, but never produced above.

... *Melanoides* Olivier

(*a*) Shell bearing numerous fine tubercles all over ; bodywhorl comparatively small in size ; umbilical region marked with a brown spiral band ; aperture less than $\frac{1}{3}$ the total length of shell.

... *M. tuberculatus*

(*b*) Bodywhorl relatively large and much more swollen ; aperture tapering more abruptly and at least more than ½ as long as shell.

... *M. pyramis*

11. Shell relatively large and thick, discoidal ; whorls rounded but without peripheral keel ; penial stylet absent.

... *Indoplanorbis* Annandale & Prashad

(*a*) Shell corneous or olive (rarely black) ; aperture broad and sickle-shaped.

...*I. exustus*

12. Shell small, thin and fragile, with whorls convex both above and below ; periphery often carinate (carina, when present, lies in middle of whorl) ; penial stylet present.

... *Gyraulus* Charpentier

(*a*) Whorls not much compressed ; periphery mostly subangular in middle ; aperture small and lunate-oval.

... *G. convexiusculus*

Shell small or large with bodywhorl generally very large, but spire short or produced and sharply pointed ; columellar fold conspicuously twisted longitudinally ; aperture wide (ovate or rotund) with fragile peristome ; umbilicus closed.

... *Lymnaea* Lamarck

(*a*)(i) Shell always fairly large, with a regularly ovate outline ; spire short narrow and gradually tapering ; aperture more than twice as long as broad.

... *L. acuminata* f. *typica*

(ii) Shell with a relatively much larger spire ; bodywhorl nearly four-fifth as broad as long ; mouth less expanded especially towards anterior extremity.

... *L. acuminata* f. *patula*

(iii) Form intermediate between *typica* and *patula*, with spire narrower than in either and columella a little more twisted ; outer lip obscurely angled near upper end.

... *L. acuminata* f. *chlamys*

(iv) Spire more large, attenuate and acuminate ; surface sometimes tinged with red ; mouth of shell relatively shorter and less expanded.

... *L. acuminata* f. *rufescens*

(*b*)(i) Shell of large or larger size and rather thicker texture ; bodywhorl a little compressed and cpire short, broad and conical ; sutures more oblique ; aperture twice as long as broad, with outer lip slightly dilated.

... *L. luteola* f. *typica*

(ii) Shell small, with much narrower and elongate spire ; bodywhorl showing no compression ; outer margin of aperture nearly straight for greater part of its length and inner lip rather straight and obliquely angled below.

... *L. luteola* f. *australis*

(iii) Shell of smaller size, with rather narrower bodywhorl which is sometimes slightly angular on the back ; surface usually, covered with a black deposit ; mouth pyriform ; sutures more impressed but sometimes shallow.

... *L. luteola* f. *impura*

14. Shell large, thick and heavy, with spire obtuse ; canal long, narrow and straight ; columella 2 to 5 plaited and outer lip thin and simple.
... *Xancus* Röding

(*a*) Columella distinctly triplicate.
... *X. pyrum pyrum*

(In female shell upper part of columella is calloused when full-grown and outer lip slightly more thickened).

15. Cowry with back sometimes slightly gibbous and copiously sprinkled with small rounded white specks sometimes ocellated with brown ; extremities distinctly pitted, crenated and lineated with brown.
... *Erosaria* Troschel

(*a*) Shell ochraceous, with dorsal specks purely white, indistinct and lacking in pupils ; margins less broad, but thickened and angular.
... *E. lamarckii redimita*

16. Shell somewhat large, with spire raised, exserted and sharply acuminate ; surface mostly marked with interrupted zigzag streaks and a delicate net work pattern next sutures; columella bearing numerous and sometimes close-set plications.
... *Olivancillaria* d'Orbigny

(*a*) Spire more acuminate and surface frequently adorned with faint, close, orange-red strigations and suture beneath with fasciculaticus frequently reduced to a row of white spots ; base marked with a spiral fawn zone interrupted with light flashes.
... *O. acuminata*

17. True mother-of-pearl oysters, with valves as high as long ; hind angle slightly produced ; surface marked with more conspicuous and scaly layers.
... *Pinctada* Röding

(*a*) Hinge toothless and hinge margin shorter ; outer surface marked with radial rows of white or yellow spots running from umbo to margin ; margin of nacre usually dark of smoky.
... *P. margaritifera*

18. Shell small or large, subtrigonal to cordiform ; umbones prominent and concentrically grooved ; lateral teeth well-developed in both valves, long and finely crenulate ; pallial sinus entire.
... *Corbicula* Megerle V. Mühlfeld

(*a*) Shell triangular-ovate (when young) and almost ovate rounded (when fully mature) ; posterior side distinctly truncated in adult ; raised concentric ridges on surface becoming indistinct with age in posterior part ; anterior cardinals longer and more arched than posterior ones.
... *C. striatella*

19. Shell small or large, oval to subrhomboidal and thick, with full, high, zigzag, radially sculptured beaks (sculpture mostly extending over disk); left valve with two irregular pseudocardinals which are more or less broken into ragged denticles or strongly vertically striate, and two laterals, while right valve with one or sometimes two pseudocardinals (upper one small and compressed) and two laterals (upper one larger) ; gills three to five times as long as broad and inner pair of gills nearly as broad as outer except in anterior part.
... *Parreysia* Conrad

(*a*) Shell very thick and triangularly wedge-shaped ; zigzag sculpture on beaks not extending over disk ; posterior ridge well-marked ; pseudocardinals strong and very much split up ; all four gills marsupials
... *P. favidens*

(*b*) Shell subtriangular and subinflated, with anterior side more produced and rounded, while posterior side obliquely biangular ; central zigzag ridges on disk generally united at their lower points to form chevroy-shaped markings ; outer left gill filled with embryos, while outer right gill with a few only.
... *P. corrugata* var. *nagpoorensis*

20. Shell rather thin, transverse, elliptical and slightly compressed in middle; cicatrices shallow ; inner pair of gills broader than outer throughout its length.

.. *Indonaia* Prashad

(*a*) Shell elongate-elliptical, pointed about midway up behind ; beaks sculptured with numerous fine radiating riblets which are sometimes zigzagged ; teeth lamellar and delicate.

.. *I. carerulea*

(*b*) Shell subrhomboidal ; surface covered throughout with granular concentric ridges and traces of zigzag sculpture.

.. *I. occata*

21. Shell elongate-oval or elongate-elliptical or rhomboidal, with dorsal slope nearly straight or alittle curved, posterior ridge often biangulate with two sharp radiating lirae above it ; left valve with two compressed pseudocardi nals (front one roughened) and two laterals, while right valve with two parallel lamellar pseudocardinals and one lateral ; entire length of outer pair of gills marsupial.

.....*Lamellidens* Simpson

(*a*) Shell very thin and elongate-elliptical, with dorsal slope comparatively long and stright and posterior wing much broader ; upper pseudocardinals in right valve rather small and thin, while those in left valve feebly developed.

.....L. *corrianus*

IV—SYSTEMATIC ACCOUNT

It is convenient, from the point of view of the field worker, to divide this Systematic Account under three ecological categories, *viz.*, land, molluscs, fresh-water molluscs and marine molluscs (from excavations).

(a) LAND MOLLUSCS

Family VERONICELLIDAE

1. *Laevicaulis alta (Férussac)

(Pl.18, Figs. 1, 1*a*)

1821. *Vaginulus alte* Férussac, *Tabl. Syst. Anim. Moll.*, Paris, p. 14.

1925. *Meisenheimeria alte. Hoffmann. Jena. Z. Naturw.*, Jena, **61**, pp. 226-228. Pl. V, Fig. 45b' (penis).

1953. *Laevicaulis alte*, Forcart, *Ann. Mus. Congo, Zool. Wet. Sci. Zool.* Tervuren, 23 : 13, 15, 17, 22, 63-68, Pl. II, Fig. 4, Pl. IV, Fig. 7, Map 6 (p. 65), Table 14 (p. 64).

Material.—Udaipur District : Coll. *R. K. Kaushik* : 1 ex., Udaipur 28.x.57.

Distribution.—Rajasthan (first record) : Udaipur (Udaipur Dist.), is above. *Elsewhere* : Extremely wide : Africa to Asia (India, Ceylon, Malay Peninsula and Archipelago, Hong Kong, Formosa, Philippines, China) and Australia (Queensland), Loyalty Islands and New Caledonia (*See* Ray, 1961, p. 275 ; Benthem Jutting, 1952, pp. 330, 331).

Remarks.—Specimen young, but skin colour and genitalia suggest its close identity with the species *alte*. Length 35.5 mm., diameter 14 mm.

Family VERTIGINIDAE

2. Boysia boysii (Pfeiffer)

1846. *Tomogeres boysii* Pfeiffer, *Symb. Hist. Helic.*, Cassel, 3, p. 82 : Also *Z. Malak.*, Cassel, 6, p. 105 (1849).

1914. *Boysia boysi* Gude, *Faun. Brit. India, Moll.*, London, 2 (*Trochomorphidae-Janellidal*) pp. 297, 298.

Material.—None. Recorded from Chittorgarh and Ajmer (Rajasthan) by Hanley & Theobald (1876, p. 4), Theobald (1876, p. 31) and Gude (1914, p. 298).

Distribution.—Rajasthan : Chittorgarh (Chittorgarh Dist.) and Ajmer (Ajmer District), as above. *Elsewhere :* India : West Bengal and Nerbada Valley.

3. ***Pupoides coenopictus** (Hutton)

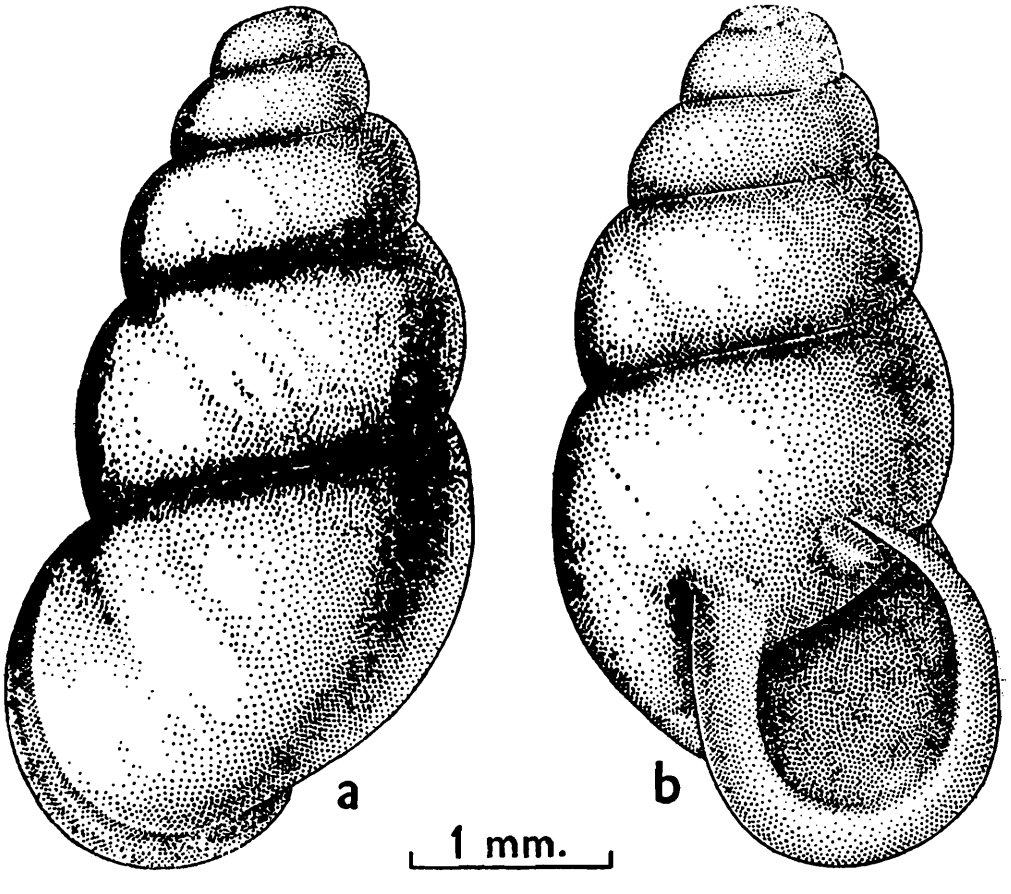
1834. *Pupa coenopicta* Hutton, *J. Asiat. Soc. Bengal*, Calcutta, 3, p. 85.

1878. *Pupa* (*Leucochila*) *coenopicta*, Nevill, *Handlist Moll. Indian Mus.*, Calcutt, 1, p. 193.

Material.—Nagaur District : Coll. *S. Biswas :* 1 ex., Sta. 13, Kuchaman Road, 5.ix.58.

Distribution.—Rajasthan (first record) : Kuchaman Road (Nagaur Dist.), as above. *Elsewhere :* India : Bihar, Madras, Kerala, Gujarat, Delhi, Maharashtra, Punjab, Kashmir. Also Afghanistan, Ceylon, Upper Burma and Abyssinia (*See* Blanford, 1865, p. 94 ; Hanley & Theobald, 1876, p. 12 ; Annandale & Rao, 1925, pp. 388, 393 ; Gude, 1914, pp. 259, 260).

TEXT-FIG. 2.—Shell of *Pupoides coenopictus* (Hutton). Kuchaman Road; Nagaur District, Rajasthan, (*a*) Dorsal view. (*b*) Ventral view.



Remarks.—Shell tiny, fragile and pale brown, with the parietal denticle rudimentary ; spire obtuse and peristome well-developed and recurved. Height 4.4 mm., diameter (round bodywhorl) 2.2 mm., whorls 5 ; aperture : length 1.8 mm., breadth 1.6 mm.

Family SUBULINIDAE

4. *Opeas gracile (Hutton)

1834. *Bulimus Gracilis* Hutton, *J. Asiat. Soc. Bengal, Calcutta*, 3, p. 84.

1878. *Opeas gracile*, Theobald, *J. Asiat. Soc. Bengal, Calcutta*, 47 (3), p. 146.

1914. *Opeas gracile*, Gude, *Faun. Brit. India, Moll.*, London, 2 (Trochomorphidae-Janellidae), pp. 355-357.

Material.—Jaipur District : (i) Coll. *A. K. Mukherjee :* 1 ex., Sta. 22, Ratan *tālāb* nr. Sambhar Lake, 9.i.58. (ii) Coll. *S. Biswas :* 2 exs., Debdani Temple tank nr. Sambhar town, 13.xii.58.

Nagaur District : Coll. *S. Biswas :* 1 ex., Sta. 13, Kuchaman Road, 5.ix.58.

Distribution.—Rajasthan (first record) : Ratan *tālāb* and Debdani Temple tank (Jaipur Dist.) ; Kuchaman Road (Nagaur Dist.) *Elsewhere :* Widespread : East Africa to Asia (Aden, India, Ceylon Burma, East and West Pakistan, Malay Peninsula and Archipelago, Annam, Indo-China, China, Papua, Philippines, Japan) and Polynesia.

Remarks.—The largest example (Pl. 18, Fig. 2) is from Ratan *tālāb* (tank) (height 11 mm., diameter 3 mm., whorls 8½) and agrees with the Fig. 4 in Pl. xxiii of Hanley & Theobald (1876).

This snail, though small, is known to cause (like *Achatina fulica*, the Giant African Land Snail) considerable damage to potted plants and other garden crops.

5. **Zootecus insularis** (Ehrenberg)

(Plate 18, Fig. 3)

1831. *Pupa insularis* Ehrenberg, *Symb. Phys. Anim. Avert. Moll.*, Berlin' 1, p. 3.

1923. *Zootecus insularis*, Annandale & Rao, *Rec. Indian Mus.*, Calcutta, 25, p. 394, pl. IX, figs. 8, 9 (shells).

Material.—Bikaner District : Coll. *B. Biswas :* (i) 4 exs., Kolayat, 10.ix.60. (ii) 5 exs., Kotra, *ca.* 2 km. N. of Kolayat, 15.ix.60.

Ganganagar District : Coll. *B. Biswas :* 14 exs., Suratgarh, 9.x.60.

Jaipur District : Coll. *C. A. Hackett :* 7 exs., Sambhar Lake,no date.

Jaisalmer District : Coll. *B. Biswas :* 1 ex., Nokh, 25.viii.60.

Jhunjhunu District : Coll. *B. Biswas :* (i) 5 exs., Sta. 51, Municipal tank, Jhunjhunu, 3.xi.60. (ii) 7 exs., Sta. 52, Samas *tālāb* (tank), Jhunjhunu, 3.xi.60.

Nagaur District : Coll. *B. Biswas :* (i) 28 exs., stony waste land between Indana and Didia, *ca.* 16 km. S.E. of Nagaur, 4.ix.60. (ii) 5 exs., Kharnal, *ca.* 17 km. S.W. of Nagaur, 6.ix.60.

Distribution.—Rajasthan : Sambhar Lake (Jaipur Dist., Nevill, 1878, p. 195 ; Gude, 1914, p. 368). The other localities as mentioned above (districts of Bikaner, Ganganagar, Jaisalmer, Jhunjhunu and Nagaur) are new records. *Elsewhere :* Very widespread : Africa to Arabia, India, Ceylon, Burma and West Pakistan (Baluchistan). Prashad's record (1936) from excavations at Harappa in the Punjab shows that the species lived in the prehistoric times also.

Remarks.—Shells are of different sizes and in different stages of growth, and agree well with the figures of *insularis* given by Annandale & Rao (1923) on specimens from the Salt Range, Punjab. The largest example (Pl. 18, Fig. 3) is from Sambhar Lake (height 16.5 mm., diameter 5.5 mm., whorls $8\frac{1}{2}$).

6. Zootecus estellus (Benson)

(Plate 18, Fig. 4)

1857. *Bulimus estellus* Benson, *Ann, & Mag. Nat. Hist.*, London, (2) **19**, p. 327.

Material.—Barmer District : Coll. *K. K. Tiwari and S. Biswas :* (i) 120 exs., Sta. 6, rocky hill, S.W. of Barmer town, 26.i.58. (ii) 15 exs., Sta. 7, on way to Detani, *ca.* 21 km. N.E. of Gadra Road, 30.i.58. (iii) 11 exs., Sta. 7, *ca.* 2 km. W. of Afforestation Nursery, Gadra Road, 31.i.58. (iv) 5 exs., nr. Ranasar village, *ca.* 26 km. N.E. of Gadra Road, 1.ii.58. (v) 2 exs., Sta. 7, nr. Tamlore village, *ca.* 21 km. W. of Gadra Road, 3.ii.58. (vi) 2 exs., Sta. 8, bank of Luni R. at Syndhri, *ca.* 58 km. from Balotra, 10.ii.58. (vii) 3 exs., salt pits, N.E. side of the Circuit House, Panchpadra, 12.ii.58.

Jaipur District : Coll. *B. Biswas :* (i) 8 exs., Japog nr. Sambhar Lake, 12.xi.56. Coll. *A. K. Mukherjee :* 130 exs., bank of Sambhar Lake, 25.iv.57. Coll. *S. Biswas :* (i) 1 ex., a ditch nr. Sambhar Lake, Gudha, 9.x.58. (ii) 24 exs., Sambhar Lake nr. Gudha *kyars*, 30.viii.59.

Jaisalmer District : Coll. *K. K. Tiwari & S. Biswas :* (i) 50 exs., Sta. 3, Badabagh, Jaisalmer, 25.xii.57. (ii) 3 exs., Sta. 3, Mulsagar nr. Jaisalmer, 27.xii.57. (iii) 9 exs., Sta. 3, W. of Dak Bungalow, Jaisalmer, 31.xii.57. (iv) 10 exs., Sta. 4, Ramgarh, *ca.* 5 km. W. of Ramgarh, low scrub vegetation, 3.i.58. (v) 2 exs., Sta. 3, on way to Jaisalmer, *ca.* 7 km. from Dak Bungalow, Jaisalmer, 9.i.58. (vi) 2 exs., Jedbaiser, *ca.* 21 km. E. of Jaisalmer, 21.i.58.

Jodhpur District : Coll. *F. Stoliczka :* 30 exs., Balmir, no date. Coll. *K. K. Tiwari & S. Biswas :* (i) 1 ex., on land nr. Shivasagar, Phalodi, 16.xii.57. (ii) 10 exs., Kolu, *ca.* 21 km. from Phalodi on Jodhpur Road, 17.xii.57. Coll. *R. K. Bhatnagar :* 9 exs., bush nr. dried up canal, Bishalpur, 14.xii.61.

Nagaur District : Coll. *S. Biswas :* 10 exs., Sta. 13, Kuchaman Road, 5.ix.58.

Distribution.—Rajasthan : Balmir (Jodhpur Dist., Nevill, 1878, p. 195 ; Gude, 1914, p. 369). The other localities mentioned above (districts of Barmer, Jaipur, Jaisalmer, Jodhpur and Nagaur) are new records. *Elsewhere :* India : Andhra Pradesh. Also West Pakistan (Sind).

Remarks.—Like *Zootecus insularis*, this species isalso very variable though not so widely distributed. It is represented by a good series of specimens, of which the largest one (Pl. 18, Fig. 4) is from Balmir (Jodhpur Dist.) (height 16.5 mm., diameter 6.5 mm., whorls 8) and very closely resembles the Fig. 4 in Pl. xxii of Hanley & Theobald (1876).

(b) FRESHWATER MOLLUSCS

Family VIVIPARIDAE

7. Viviparus bengalensis Lamarck

(i) *Form **typica** (Lamarck)

The Bengal Viviparus

(Plate 18, Fig. 5)

1822. *Paludina bengalensis* Lamarck, *Hist. Nat. Anim. sans Verteb.*, Paris, 6 (2), p. 174.

1921. *Vivipara bengalensis* f. *typica*, Annandale, *Rec. Indian Mus.*, Calcutta, 22, pp. 267, 270, 271, Pl. I, Figs. 1-5.

Material.—Pali District : Coll. *K. S. Pradhan :* 2 exs., Jogmandi *jharnā* (stream) downstream, from a pool with stagnant water and rotten leaves, *ca.* 19 km. from Phulad Railway Station, 3.iii.48.

Distribution.—Rajasthan (first record) : Jogmandi *jharnā*, as above. *Elsewhere :* India : Common throughout. Also East Pakistan, Ceylon and Burma.

Remarks.—Though the colouration and the dark spiral bands on the surface are much faded, other characters of the shells agree well with those of the *forma typica.* The largest example (Pl. 18, Fig. 5) has height 26.5 mm., diameter 17.5 mm. and whorls $8\frac{1}{2}$.

(ii) *Race **mandiensis** Kobelt.

(Plate 18, Fig. 7)

1909. *Vivipara bengalensis* var, *mandiensis*, Kobelt, in Martini & Chemnitzs, *Syst. Conch-Cab.*, Nür-enberg, 1 (21), p. 414, Pl. LXXVII, Figs. 8-10.

1921. *Vivipara bengalensis* race *mandiensis*, Annandale, *Rec. Indian Mus.*, Calcutta, 22, pp. 271, 272, Pl. I, Figs. 4 and 10.

Material.—Chittorgarh District : Coll. *B. N. Chopra & M. L. Roonwal :* (i) 4 exs., R. Berach (Bedach) nr. Chittorgarh, 8-9.x.41. (ii) 33 exs., Sta. 10, a large tank, *ca.* 5 km. N. of Parsad (Palsad), 16-21.x. 41.

Dungarpur District : Coll. *B. N. Chopra & M. L. Roonwal* : 2 exs., Sta. 11, Surpur-ki-Nadi (stream), *ca.* 5 km. from Dungarpur town, 26.x.41.

Jodhpur District : Coll. *B. Biswas :* (i) 2 exs., Umedsagar Lake, *ca.* 10 km. W. of Jodhpur, 22.xii.56. (ii) 7 exs., vicinity of Umedsagar Lake, 23.xii.56. Coll. *D. & G. P. R. S.* : (i) 6 exs., Nagadari *kund*, (pool), Mandore, *ca.* 11 km. N. of Jodhpur, 25.x.60. (ii) 32 exs. Mandore Canal, *ca.* 10 km. N. of Patodi House, Patodi, Jodhpur, 27.x.60. and 19 & 22.ii.61.

Tonk District : Coll. *Indian Museum Collector :* 3 exs., Talow nr. Deoli, 16.v.1890.

Udaipur District : Coll. *D. & G. P. R. S. :* (i) 4 exs., Kherad village, Jaisamand Lake, *ca.* 60 km. S.E. of Udaipur, 23.xii.61. (ii) 6 exs., Fatehsagar Lake, *ca.* 7 km. N.W. of Udaipur Railway Station, 24.xii.61. (iii) 2 exs., Sarupsagar Lake, nr. Pichola Lake, *ca.* 7 km. W. of Udaipur Railway Station, 24.xii.61. (iv) 2 exs., Rajsamand Lake, *ca.* 1 km. N.W. of Udaipur, 24.xii.61.

Distribution.—Rajasthan (first record) : R. Berach (Chittorgarh Dist.) ; Surpur-ki-Nadi (stream) (Dungarpur Dist.) ; Umedsagar, Nagadari Kund and Mandore Canal (Jodhpur Dist.) ; Talow (Tonk Dist.) ; Kherad village, Fatehsagar, Sarupsagar and Rajsamand (Udaipur Dist.). *Elsewhere :* India : Bihar, Uttar Pradesh, Maharashtra and Punjab.

That this snail existed in the prehistoric days is known from the record by Prashad (1936, pp. 3, 10) from the ie excavatons at Harappa, Punjab. Ray (1960, p. 542) has recorded from the relatively recent excavations at Navasa (Maharashtra).

Remarks.—Specimens available are of various sizes and in various stages of growth, and form a good series. The largest example is from Talow (height 42.5 mm., diameter 33 mm., whorls 6), while that illustrated here (Pl. 18, Fig. 7) from Umedsagar has height 32 mm., diameter 24 mm. and whorls 6.

(iii) Race ***gigantea** (Reeve)

The Gigantic Viviparus

(Plate 18, Figs. 6, 6*a*)

1862. *Paludina gigantea* (von dem Busch MSS.) Reeve, *Conch. Icon.*, London, 14, Pl. II, Fig. 7.

1915. *Vivipara b:ngalensis* var. *gigantea*, Preston, *Faun. Brit. India, Moll.*, London, (*Gastr. & Pelec.*). p. 84.

Material.—Jaipur District : Coll. *A. K. Mukherjee :* 6 exs., Chapparwara Lake, 5.v.57.

Udaipur District : Coll. *B. N. Chopra & M. L. Roonwal :* 34 exs., Sta. 10, a large tank, *ca.* 5 km. N. of Parsad (Palsad), 26-27. x. 41.

Distribution.—Rajasthan (first record) : Chapparwara Lake (Jaipur Dist.) ; a tank in Udaipur (Udaipur Dist.). *Elsewhere :* India : West Bengal and Bihar.

Remarks.—Out of the 40 specimens in the lot, only 6 (dry) from the Chapparwara Lake appear good and full-grown, attaining even a gigantic size, with the colour yellow to cream, spire narrow and elongate to short and stout, sutures deep, spiral bands broad and conspicuous, umbilicus mostly wide, and aperture very large, sub-orbicular to almost circular, with thick outer margin. The remaining specimens (young) are olive green. The largest example (Pl. 18, Figs. 6, 6*a*) is from the Chapparwara Lake (height 50 mm., diameter 42 mm., with somewhat narrow and elongate spire, and whorls 6½).

(iv) *Phase **annandalei** Kobelt

(Plate 18, Figs. 10, 10*a*)

1908. *Vivipara annandalei* Kobelt, *Nachr, Malak. Gcscll.*, Frankfurt, **60**, pp. 161, 162.

1921. *Vivipara bengalensis* phase *annandalci*, Annandale, *Rcc. Indian Mus.* Calcutta, **22**, p. 276, Pl. II, Figs. 5-8.

Material.—Pali District : Coll. *K. S. Pradhan :* 1 ex., Jogmandi *jharnā* (stream) downstream, from a pool of stagnant water and rotten leaves, *ca.* 19 km. from Phulad Railway Station, 3.iii.48.

Distribution.—Rajasthan (first record) *:* Jogmandi *jharna* (stream) (Pali Dist.), as above. *Elsewhere* : India : West Bengal, Bihar and Andhra Pradesh.

Remarks.—The single shell (Pl. 18, Figs. 10, 10*a*) was found closely associated with specimens of typical *bengalensis.* It agrees well with the figures of *annandalei* given by Annandale (1921) and has height 22.5 mm., diameter 15.5 mm., whorls 6½.

8. ***Viviparus variatus*** (Frauenfeld)

The Varied Viviparus

(Plate 18, Fig. 11)

1862. *Paludina variata* Frauenfeld, *Verh. zool. bot. Ges. Wicn*, Vienna, p. 1163.

1915. *Vivipara variata*, Preston, *Faun. Brit. India, Moll.* (*Gastr. & Pelec.*), London, p. 89.

Material.—Barmer District *:* Coll. *S. Biswas* : 2 exs., bed of dried up Balu R., 7.i.59.

Tonk District : Coll. *Indian Museum Collector :* 6 exs., Talow nr. Deoli, 16.v.1890.

Udaipur District : Coll. *D. & G. P. R. S. :* 2 exs., Kherad village, Jaisamand Lake, *ca.* 60 km. S.E. of Udaipur, 23.xii.61.

Distribution.—Rajasthan (first record) : Balu R. (Barmer Dist.) ; Talow (Tonk Dist.) ; Kherad nr. Jaisamand Lake (Udaipur Dist.). *Elsewhere :* India : Orissa, Madras, Andhra Pradesh and Mysore State. Also Ceylon. It is more common in southern India than elsewhere.

Remarks.—Shells from Talow were found mixed with those of *V, bengalensis* race *mandiensis*, but are separable by their smaller size and ovately-conical shape, and a faint but constant whitish band running round the periphery of the bodywhorl. The largest example (Pl. 18 Fig. 11) is from the Balu R. bed (height 26 mm., diameter 20.5 mm., whorls 5).

Family PILIDAE

9. Pila globosa (Swainson)

The Indian Apple Snail

(Plate 20, Figs. 7, 7*a*)

1822, Ampullaria globosa Swainson, *Zool.*, London., *1Illustr, 1* (2), Pl, cxix.

1925, Pila globosa, Prashad, *Mem. Indiaen Mus.*, Delhi, 8, pp. 70, 73, Pl-XIII, Figs 1-7,

Material.—Jodhpur District : Coll. *B. Biswas* ; 2 exs., a dried up ditch at Rajlani; *ca.* 48 km. N. E. of Jodhpur, 22.iii.62.

Distribution.—Rajasthan : Prashad (1925) gave no exact locality. The locality 'Rajlani' (Jodhpur Dist.) as noted in the present paper is a new record. *Elsewhere :* India : Throughout, except southern India and Punjab. Also East Pakistan. Morelet's (1875) record of *globosa* from Siam is wrong. A detailed account of the Indian Apple Snails is given by Prashad.

Remarks.—Of the two specimens, one (Pl. 20, Figs, 7, 7*a*) is full-grown, more globose and olive-coloured, with the spire depressed, peristome thickened and lined with a band of orange or pale yellow ; it has height 64 mm., diameter 68 mm. (aperture 46 mm. long, 26 mm. wide) and whorls 6. The other specimen is lemon yellow and has a slightly raised spire.

Family AMNICOLIDAE

10. *Digoniostoma pulchella (Benson)

(Plate 18, Figs. 8, 8*a*)

1836. *Paludina pulchella* Benson, *J. Asiat. Soc. Bengal*, Calcutta, 5, p. 746.

Material.—Ajmer District : Coll. *B. Biswas :* 6 exs., Sta. 17, Chat, *ca.* 6 km. S. of Nasirabad, 28. xii. 56.

Barmer District : Coll. *K. K. Tiwari & S. Biswas :* 5 exs., salt pits, N. E. of Circuit House, Panchpadra, 12. ii. 58.

Jaipur District : Coll. *T G. Vazirani* : 2 exs., Ratan *tālāb* (tank) nr. Gudha and Japog, 3. ii. 58. Coll. *A. K. Mukherjee* : 10 exs., Sta. 23, Chapparwara Lake, 20. vii. 58. Coll. *S. Biswas* : (i) 5 exs., a ditch at Barbaryan in Narayana, 1. iii. 58. (ii) 14 exs., Ratan *tālāb* (tank), *ca.* 3 km. S. W. of Japog, 2. ix. 58. (iii) 26 exs., a ditch adjacent to Sambhar Lake nr. Gudha, 17. ix. 58. (iv) 1 ex., Chapparwara Bund Reservoir, *ca.* 40 km. from Sambhar Lake, 30. ix. 58. (v) 148 exs., Gudha *tālāb* (tank), *ca.* 2 km. N. W. of Gudha, 23. x. 58. (vi) 3 exs., Dhobala tank at Narayana, 31. x. 58. (vii) 4 exs., Narayana *tālāb* (tank) at Narayana, 2. xi. 58. (viii) 6 exs., Bala *tālāb* (tank), *ca.* 5 km. S. E. of Julguh, 24. xi. 58. (ix) 8 exs., a ditch, *ca.* 2 km. W. of Phulera, 3-4. xii. 58.

Jaisalmer District : Coll. *K. K. Tiwari & S. Biswas* : (i) 3 exs., Sta. 2, Ramsar (a large tank), *ca.* 1 km. S. W. of Rest House at Pokran, 20. xii. 57. (ii) 300 exs., Ramdeora, Pokran, 20. xii. 57. (iii) 6 exs., Sta. 3, Golabsagar tank, Jaisalmer, 26. xii. 57. (iv) 16 exs., Gadisar, E. of Dak Bungalow, Jaisalmer, 28. xii. 57. (v) 6 exs., Sta. 4, Geodiasar, *ca.* 19 km. S. of Ramgarh, 7. i. 58. (vi) 40 exs., Jedbaiser, *ca.* 21 km. E. of Jaisalmer, 21. i. 58.

Jhunjhunu District : Coll. *B. Biswas* : 100 exs., Sta. 45, Bagar, *ca.* 16 km. N. E. of Jhunjhunu, 3 xi. 60.

Jodhpur District : Coll. *B. Biswas* : 5 exs., Beriganga, *ca.* 16 km. N. of Jodhpur, 2. xii. 56. Coll. *K. K. Tiwari & S. Biswas* : (i) 5 exs., Ramsar, Phalodi, 14. xii. 57. (ii) 9 exs., on land at Shivasagar, Phalodi, 16. xii. 57. (iii) 3 exs., a tank at Ekar, *ca.* 3 km. N. W. of Phalodi, 17. xii. 57.

Nagaur District : Coll. *B. Biswas* : (i) 10 exs., Sta. 27, Merta, 26. xii. 56. (ii) 7 exs., Sta. 31, a pond at Merta, 31. xii. 56. (iii) 2 exs., Sta. 13, Kuchaman Road, 5. ix. 58. (iv) 28 exs., Sta. 2, a tank N. of Singar, *ca.* 16 km. W. of Nagaur, 2. ix. 60. (v) 3 exs., Sta. 9, a tank at Rol, *ca.* 20 km. E. of Nagaur, 4. ix. 60. (vi) 4 exs., Sta. 13, a tank at Imirti, *ca.* 16 km. S. W. of Nagaur, 6. ix. 60.

Pali District : Coll. *B. Biswas* : (i) 6 exs., Sta. 21, Hemawas tank, *ca.* 8 km. S. of Pali, 5. xii. 56. (ii) 14 exs., Sta. 23, Pali, 6. xii. 56.

Sikar District : Coll. *B. Biswas* : (i) 12 exs., Sta. 31, Harsnath tank, *ca.* 15 km. S. E. of Sikar, 14. ix. 60.

Sirohi District : Coll. *K. S. Pradhan* : (i) 3 exs., Nathela tank, *ca.* 1 km. from Mavli Camp, 28. ii. 48. (ii) 1 ex., Jaivilas Palace, Mount Abu, 7. iii. 48.

Udaipur District : Coll. *B. N. Chopra & M. L. Roonwal* : (i) 100 exs. Sta. 6, a large tank close to Dak Bungalow at Barapal village, *ca.* 24 km. S. of Udaipur, 15. x. 41. (ii) 4 exs., a large tank, *ca.* 5 km. N. of Parsad (Palsad), 26-27. x. 41. Coll. *D. & G. P. R. S.* : 2 exs., a pond, *ca.* 1 km. N. of Fatehsagar Lake, Udaipur, 24. xii. 61.

Distribution.—Rajasthan (first record) : Localities mentioned above (districts of Ajmer, Barmer, Jaipur, Jaisalmer, Jhunjhunu, Jodhpur, Nagaur, Pali, Sikar, Sirohi and Udaipur). *Elsewhere* : India : Common throughout. Also Burma and Malay Peninsula.

Remarks.—Ghose's *Paludomus baccula* var. *minuta* from the Batu Cave, Selangor (1929), is a synonym (*see* Laidlaw, 1940).

This large collection has specimens ranging from the very young to adults. The largest example (pl. 18, Figs. 8, 8*a*) is from Merta (height 8·5 mm., diameter 5·5 mm., whorls 5).

11. **Digoniostoma cerameopoma** (Benson)

(Plate 18, Figs. 9, 9*a*)

1830. *Plaudina cerameopoma* Benson, *Gleanings in Sci.*, Calcutta, **2**, p. 125.
1929. *Bithynia* (*Digoniostoma*) *cerameopoma*, Thiele, *Handb. Syst. Wsichtierk.*, Jena, **1**, p. 155.

Material.—Jaipur Dist. : Coll. *F. Stoliczka* : 4 exs., Sambhar Lake, no date.

Distribution.—Rajasthan : Sambhar Lake (Jaipur Dist.), as above, (*vide* Nevill, 1884, p. 34). *Elsewhere* : India : West Bengal, Bihar, Assam and Punjab. Also West Pakistan (Sind).

Remarks.—The largest example (Pl. 18, Figs. 9, 9*a*) has the following particulars : height 11·5 mm., diameter 7 mm., whorls 5½.

12. **Alocinma orcula** var. **producta** (Nevill)

(Plate 19, Figs. 1, 1*a*)

1884. *Bythinia orcula* var. *producta* Nevill, *Hand list Moll. Indian Mus*, Calcutta, **2**, p. 37.
1921. *Amnicola* (*Alocinma*) *orcula* var. *producta*, Annandale, *Rec. Indian Mus.*, Calcutta, **22**, p. 540.

Material.—Jaipur District : Coll. *F. Stoliczka* : 3 exs., Sambhar Lake, no date.

Distribution.—Rajasthan : Sambhar Lake (Jaipur Dist.), as above (*vide* Nevill, 1884). *Elsewhere* : India : West Bengal, Assam, Bihar and Punjab.

Remarks.—This form often occurs along with the *forma typica*. Shells are very small and delicate, the largest one (Pl. 19, Figs. 1, 1*a*) with height 5 mm., diameter 4 mm., whorls 4.

Family MELANIDAE

13. **Melanoides (Melanoides) tuberculatus** (Müller)

The Tubercled Melania

(Plate 19, Figs. 2, 2*a*)

1774. *Nerita tuberculata* Müller, *Verm. Terr. Fluv. Testacea*, Havniae & Lipsiae, **2**, p. 191.
1906. *Melanis tuberculatus*, Comber, *J. Bombay nat. Hist. Soc.*, **17**(1), p. 216,
1919. *Melanoidss tuberculatus*, Annandale & Prashad, *Rec. Indian Mus* Calcutta, **18**, pp. 31, 32, Pl. IV, Fig. 1.

Material.—Rajasthan : Coll. *C A. Hackett* : 6 exs., no exact locality, no date.

Barmer District : Coll. *K. K. Tiwari & S. Biswas* : 475 exs., Sta. 8, Luni R. at Syndhri, *ca.* 58 km. from Balotra, 10. ii. 58.

Chittorgarh District : Coll. *B. N. Chopra & M. L. Roonwal* : 5 exs ; Sta. 1, R. Berach (Bedach) nr. Chittorgarh, 8-9. x. 41.

Jaipur District : Coll. *T G. Vazirani* : 5 exs., Sambhar Lake nr. new *kyārs*, 29. v. 58. Coll. *A. K. Mukherjee* : 4 exs., Sta. 17, Gudha nr. Sambhar Lake, 10. vii. 58.

Pali District : Coll. *K. S. Pradhan* : 10 exs., Jogmandi *jharna* (waterfall) *ca.* 19 km. from Phulad, 3, iii. 48.

Sirohi District : Coll. *K. S. Pradhan* : (i) 18 exs., Kudra Dam, Mount Abu, 8. iii. 48. (ii) 8 exs., Gora Chapra *nullāh* (stream), *ca.* 3 km. E. of Abu Dak Bungalow, Mount Abu, 10. iii. 48.

Udaipur District : Coll. *B. N. Chopra & M. L. Roonwal* : 6 exs., Sta 10, a large tank, *ca.* 5 km. N. of Parsad (Palsad), 26-27. x. 41. Coll *K. S. Pradhan* : 1 ex., Rajsamand Lake, *ca.* 32 km. N. of Mavli (in water rich in aquatic vegetation), 27. ii. 48.

Distribution.—Rajasthan : Nevill (1884, p. 239) gave no exact locality Other localities as mentioned above (districts of Barmer, Chittorgarh Jaipur, Pali, Sirohi and Udaipur) are new records. *Elsewhere* : Very widespread : From southern and eastern shores of the Mediterranean and Africa to Asia (India, Ceylon, Burma, East and West Pakistan, Iran, Afghanistan, Malay Peninsula and Archipelago, China) and Philippines and Australia (*see* Annandale, 1918*a*, pp. 114, 115, 157 ; 1918*b*, p. 163 ; Benthem Jutting, 1956, pp. 412-418).

The occurrence of this species in prehistoric Jericho, Jordan (dating back to 5,000—7,000 years), is indicated by Biggs (1960).

Remarks.—Specimens are greatly variable in shape, size, etc., of their shells. The largest example (Pl. 19, Figs. 2, 2*a*) is from Jogmandi *jharnā* (height 22 mm., diameter 7·5 mm., whorls 6).

14. *Melanoides (Melanoides) pyramis (Hutton)

The Pyramid Melania

(Plate 19, Figs. 3, 3*a*)

1850. *Melania pyramis* Hutton, *J. Asiat. Soc. Bengal*, Calcutta, 18(2), p. 658.

1919. *Melanoides pyramis*, Annandale & Prashad, *Rec. Indian Mus.*, Calcutta, 18, p. 32, Pl. IV, Fig. 3.

Material.—Jodhpur District : Coll. *D. & G. P. R. S.* : 1 ex., Mandore Canal, *ca.* 10 km. N. of Jodhpur, 22. ii. 61.

Distribution.—Rajasthan (first record) : Mandore Canal (Jodhpur Dist.), as above. *Elsewhere* : India : Quite common in the Gangetic plains. Also West Pakistan (Baluchistan), Iran and Iraq.

Remarks.—The single shell shows the typical features of ***pyramis*** and has height 23·5 mm., diameter 8 mm., whorls 9.

Family PLANORBIDAE

15. *Indoplanorbis exustus (Deshayes)

(Plate 19, Fig. 5)

1834. *Planorbis exustus* Deshayes, *Belang. Voy. Ind.-Orient. Zool. Moll.*, Paris, p. 417, Pl. 1, Figs. 11-13.

1921. *Planorbis (Panorbis) cxustus.*, Germain, *Rec. Indian Mus.*, Calcutta, **21**, pp. 26-33, Pl. 1, Figs. 4-9.

1921. *Indoplanorbis exustus*, Annandale & Prashad, *Rcc. Indian Mus.*, Calcutta, **22**, pp. 578-582, Figs. 14A, B, genitalia (p. 579).

Material.—Ajmer District : Coll. *B. Biswas* : (i) exs., Sta. 18, Nasirabad, 29. xi. 56. (ii) 2 exs., Sta. 17, Chat, *ca.* 6 km. S. of Nasirabad, 28. xii. 56.

Barmer District : Coll. *K. K. Tiwari & S. Biswas* : (i) 1 ex., Sta. 6, rocky hill, S. W. of Barmer town, 26. i. 58. (ii) 4 exs., Sta. 9, nr. Circuit House, Panchpadra Salt Depot, 11. ii. 58. (iii) 18 exs., Sta. 9, salt pits, N. E. of Circuit House, Panchpadra Salt Depot, 12. ii. 58. (iv) 12 exs., Sta. 9, E. of Circuit House, Panchpadra Salt Depot, 14. ii. 58. Coll. *S. Biswas* : 2 exs., Balu R. bed, 7. i. 59.

Bikaner District : Coll. *B. Biswas* : 7 exs., Kotra, *ca.* 3 km. N. of Kolayat, 15. x. 60.

Churu District : Coll. *B. Biswas* : 55 exs., Sta. 43, a tank, S. of Taranagar, 26. x. 60.

Dungarpur District : Coll. *B. N. Chopra & M. L. Roonwal* : 18 exs., Sta. 13, tank and pools around Dungarpur town, 28. x. 41.

Ganganagar District : Coll. *B. Biswas* : (i) 2 exs., Sta. 26, Diplana, *ca.* 13 km. E. of Nohar, 13. x. 60. (ii) 12 exs., Sta. 31, Badbirana, *ca.* 16 km. S. E. of Nohar, 15. x. 60. (iii) 2 exs., Sta. 34, Asarjana, *ca.* 18 km. N. W. of Nohar, 15. x. 60. (iv) 6 exs., Sta. 38, Bhukarka, *ca.* 10 km. N. W. of Nohar, 16. x. 60

Jaipur District : Coll. *B. Biswas* : (i) 9 exs., Bandi Nadi (river) at Sanodia, *ca.* 14 km. S. W. of Sambhar, 25. xi. 56. Coll. *S. Biswas* : (i) 6 exs., Sta. 3, Japog, Sambhar Lake, 12. xi. 56. (ii) 8 exs., Ratan *tālāb* (tank) (No. 5), *ca.* 3 km. S. of Japog, 2. ix. 58. (iii) 2 exs., a ditch nr. Sambhar Lake, Gudha, 9. x. 58. (iv) 36 exs., Gudha *tālāb* (tank) (No. 4), *ca.* 2 km. N. W. of Gudha village, 22. x. 58. (v) 3 exs., Dhobala tank, Narayana, 31. x. 58. (vi) 7 exs., Kalo *tālāb* (No. 5), Narayana, 1. xi. 58. (vii) 32 exs., Narayana *tālāb* (No. 4), Narayana, 2. xi. 58.

(viii) 3 exs., Gudha *tālāb* (No. 2), 20. ix. 58. (ix) 3 exs., Bala *tālāb* (No. 14), *ca.* 5 km. S. E. of Julguh, 24. xi. 58. (x) 28 exs., Dudu, on side of main road to Jaipur, 7. i. 59. (xi) 7 exs., Sambhar Lake nr. Gudha *kyārs*, 30. viii. 59. Coll. *A. K. Mukherjee* : (i) 10 exs., Sta. 22, Ratan *tālāb* (tank) nr. Sambhar Lake, 9. i. 58. (ii) 2 exs., Sta. 23, Chapparwara, 20. vii. 58. Coll. *T G. Vazirani* : (i) 5 exs., Ratan *tālāb* (tank), Gudha, 3. ii. 58. (ii) 1 ex., Gudha, 8. iii. 58.

Jaisalmer District : Coll. *K. K. Tiwari & S. Biswas* : (i) 16 exs., Sta. 2, Salamsar, S. W. of Rest House, Pokran, 20. xii. 57. (ii) 8 exs., Sta. 2, Ranisar a large tank, S. W. of Rest House at Pokran, 20. xii. 57. (iii) 13 exs., Sta. 2, Ramdesar at Ramdeora, Pokran, 20-21. xii. 57. (iv) 2 exs., Sta. 2, a dried up pond nr. Sati shrine, *ca.* 2 km. W. of Rest House, Pokran, 22. xii. 57. (v) 8 exs., Sta. 3, Didansagar, *ca.* 3 km. E. of Jaisalmer town, 25. xii. 57. (vi) 3 exs., Sta. 3, Golabsagar tank, Jaisalmer, 26. xii. 57. (vii) 1 ex., Sta. 3, Gadisar, E. of Dak Bungalow, Jaisalmer, 28. xii. 57. (ix) 18 exs., Sta. 3, W. of Gadisar, Jaisalmer, 30. xii. 57. (x) 4 exs., Sta. 4, Geodiasar, *ca.* 19 km. S. of Ramgarh, 7. i. 58. (xi) 18 exs., Jedbaisar, *ca.* 21 km. E. of Jaisalmer, 21. i. 58.

Jhunjhunu District : Coll. *B. Biswas* : (i) 11 exs., Sta. 56, Malsisar, *ca.* 35 km. N. W. of Jhunjhunu, 4. xi. 60.

Jodhpur District : Coll. *B. Biswas* : (i) 4 exs., Sta. 24, Kailna Lake, *ca.* 8 km. W. of Jodhpur, 14. xii. 56. (ii) 28 exs., Sta. 25, Beriganga R., *ca.* 16 km. N. of Jodhpur, 19-20. xii. 56. Coll. *Dr. K. K. Tiwari & S. Biswas* : (i) 74 exs., Sta. 1, Ranisar tank, Phalodi, 13 & 15. xii. 57. (ii) 30 exs., Sta. 1, Khetri *nullāh* (stream), Phalodi, 14. xii. 57 (iii) 3 exs., Sta. 1, Ramsar tank, Phalodi, 14. xii. 57 (iv) 60 exs., Sta. 1, Shivasagar tank, Phalodi, 15. xii. 57. (v) 84 exs., Sta. 2, Magdasar tank, Bap, *ca.* 30 km. N. of Phalodi, 15. xii. 57. (vi) 8 exs., Sta. 1, on land nr. Shivasagar, Phalodi, 16. xii. 57. Coll. *D. & G. P. R. S.* : 11 exs., Mandore Canal, *ca.* 10 km. N. of Jodhpur, 25. x. 60.

Nagaur District : Coll. *B. Biswas* : (i) 10 exs., Nawa nr. Sambhar Lake, 16. xi. 56. (ii) 14 exs., Sta. 27, Merta, 26. xii. 56. (iii) 11 exs., Sta. 30, a pond in Merta, 28. xii. 56. (iv) 25 exs., a tank, N. of Singar, *ca.* 16 km. W. of Nagaur, 3. ix. 60. (v) 28 exs., Sta. 6, a tank at Basni, *ca.* 8 km. W. of Nagaur, 3. ix. 60. (vi) 1 ex., Sta. 8, a tank at Didia, *ca.* 20 km. S. E. of Nagaur, 14. ix. 60. (vii) 8 exs., Sta. 11, a tank at Balwa, *ca.* 8 km. N. W. of Nagaur, 5. ix. 60. (viii) 14 exs., Sta. 13, a tank at Imirti, *ca.* 16 km. S. W. of Nagaur, 6. ix. 60. (ix) 11 exs., Sta. 14, a tank at Kharnal, *ca.* 17 km. S. W. of Nagaur, 16. ix. 60. (x) 25 exs., Sta. 14, a tank at Bhakrod, *ca.* 24 km. S. W. of Nagaur, 16. ix. 60. Coll. *A. K. Mukherjee* : 10 exs., Sta. 20, Julga nr. Sambhar Lake, 24. vii. 58. Coll. *S. Biswas* : 3 exs., Sta. 13, Kuchaman Road, 5. ix. 58.

Pali District : Coll. *K. S. Pradhan* : 2 exs., stagnant pool, *ca.* 19 km. from Phulad Railway Station nr. Jogmandi *jharnā* (stream), 3. iii. 48. Coll. *B. Biswas* : (i) 1 ex., Sta. 21, Hemawas tank, *ca.* 8 km. S. of Pali, 5. xii. 56.

Sikar District : Coll. *B. Biswas* : (i) 1 ex., Sta. 82, a tank, S. E. of Sikar, 15. xi. 60.

Udaipur District : Coll. *B. N. Chopra & M. L. Roonwal* : (i) 24 exs., Sta. 4, a *bāori* (tank) nr. Dak Bungalow, Barapal village, *ca.* 24 km. from Udaipur, 13-14. x. 41. (ii) 74 exs., Sta. 3, Barapal-ka-*nullah* (stream), nr. Barapal village, *ca.* 24 km. S. of Udaipur, 14. x. 41. (iii) 45 exs., Sta. 6, a large tank close to Dak Bungalow, Barapal village, *ca.* 24 km. S. of Udaipur, 15. x. 41. (iv) 12 exs., Sta. 10, a large tank, *ca.* 5 km. N. of Parsad (Palsad), 16 & 21. x. 41. (v) 2 exs., Sta. 7, Parai-ki-Nadi (Parai streamlet), *ca.* 2 km. S. of Parsad (palsad), 17 & 23. x. 41. Coll. *K. S. Pradhan* : 4 exs., Nathela tank, *ca.* 1 km. from Mavli, 28. ii. 48. Coll. *D. & G. P. R. S.* : 1 ex., Ahar R., *ca.* 4 km. S. of railway bridge, Udaipur, 24. xii. 61.

Distribution.—Rajasthan (first record) : Localities mentioned above (districts of Ajmer, Barmer, Bikaner, Churu, Dungarpur, Ganganagar, Jaipur, Jaisalmer, Jhunjhunu, Jodhpur, Nagaur, Pali, Sikar and Udaipur). *Elsewhere* : Very common throughout Asia (India, East and West Pakistan, Ceylon, Burma, Malay Peninsula and Archipelago, Indo-China, Thailand, China, Tibet, Iran).

Sewell (1931) recorded this giant Planorbid mollusc from the prehistoric excavations at Mohenjodaro, Sind.

Remarks.—This is a very common species and forms the largest series in the collection showing various stages of growth and development of the shells from the bulla stage to the adult form. The largest example is from Nasirabad (height 9 mm., diameter 18·5 mm.). The example illustrated here from Jaisalmer (Pl. 19, Fig. 5) measures : height 7 mm. and diameter 19 mm. This mollusc is the carrier of a serious cattle-pest, *Schistosoma spindalis.*

16. **Gyraulus convexiusculus** (Hutton)

(Plate 19, Fig. 4)

1849. *Planorbis convexiusculus* Hutton, *J. Asiat. Soc., Bengal,* Calcutta, **18**(2), p. 657.

1921. *Planorbis* (*Gyraulus*) *convexiusculus,* Germain, *Rec. Indian Mus.,* Calcutta, **21**, pp. 118-121.

Material.—Jaipur District : Coll. *F. Stoliczka* : (i) 9 exs., Sambhar Lake, no date. Coll. *A. K. Mukherjee* : (i) 8 exs., Sta. 22, Ratan *tālāb* (tank), 9. i. 58. (ii) 2 exs., Sta. 23, Chapparwara Lake, 20, vii. 58. Coll. *S. Biswas* : (i) 3 exs., Sta. 7, Chapparwara Bund Reservoir, *ca.* 40 km. from Sambhar, 30. ix. 58. (ii) 4 exs., Sta. 6, Debdani Temple tank nr. Sambhar, 13. xi. 58.

Jodhpur District : Coll. *D. & G. P. R. S.* : 2 exs., Mandore Canal, *ca.* 10 km. N. of Jodhpur, 25. x. 60.

Nagaur District : Coll. *S. Biswas* : 8 exs., Sta. 13, Kuchaman Road, 15. ix. 58.

Sirohi District : Coll. *K. S. Pradhan* : (i) 8 exs., Kudra Dam, Mount Abu, 8. iii. 48. (ii) 7 exs., Gora Chapra *nullāh* (stream), *ca.* 3 km. E. of Abu Dak Bungalow, Mount Abu, 10. iii. 48.

Udaipur District : Coll. *B. N. Chopra & M. L. Roonwal :* 4 exs., Sta. 10, a large tank, *ca.* 5 km. N. of Parsad (Palsad), 26-27. x. 41. Coll. *D. & G. P. R. S. :* 4 ex., Pichola Lake, *ca.* 7 km. W. of Udaipur Railway Station, 24. xii. 61.

Distribution.—Rajasthan : Sambhar Lake (Jaipur Dist., *vide* Nevill, 1878, p. 244 ; Germain, 1921, p. 121). Other localities as mentioned above (districts of Jaipur, Jodhpur, Nagaur, Sirohi and Udaipur) are new records. *Elsewhere :* Throughout Asia (India, Ceylon, Burma, East and West Pakistan, Iran, Afghanistan, Malay Peninsula and Archipelago, Indo-China, Thailand, China, Philippines and Japan) (*see* Annandale & Prashad, 1919, pp. 52-54 ; Benthem Jutting, 1956, pp. 463-466).

Remarks.—The species is represented by a good series of typically flattened small shells of different sizes and in different phases of growth ; the periphery is subangular. The largest example (Pl. 19, Fig. 4) is from Chapparwara Lake (height 1·5 mm., diameter 5 mm.).

Family LYMNAEIDAE

17. *Lymnaea (Pseudosuccinea) acuminata Lamarck

The Acuminated Lymnaea

(i) Form **typica** Lamarck

(Plate 19, Figs. 6, 6*a*)

1822. *Limnaea acuminata* Lamarck, *Hist. Nat. Anim. sans Vertcb.*, Paris, 6(2), p. 160.

1925. *Limnaea* (*Pseudosuccinea*) *acuminata* f. *typica*, Annandale & Rao, *Rec. Indian Mus.*, Calcutta, **27**, p. 156, 180, 181, 189, fig. iii, nos. 3 & 5.

Material.—Jaipur District : Coll. *A. K. Mukherjee :* 3 exs., Sta. 23, Chapparwara nr. Sambhar Lake, 20. vii. 58. Coll. *S. Biswas :* 1 ex., Sta. 6, Chapparwara Bund Reservoir, *ca.* 4 km. from Sambhar, 30. ix. 58.

Jodhpur District : Coll. *D. & G. P. R. S. :* (i) 3 exs., Mandore Canal, *ca* .10 km. N. of Jodhpur, 19. ii. 61. (ii) 1 ex., Kailna Lake, *ca.* 1 km. N. W. of Jodhpur, 19. ii. 61.

Sirohi District : Coll. *K. S. Pradhan :* (i) 1 ex., a *nullāh* (streamlet) nr. Dilwara Temple, Mount Abu, 7. iii. 48.

Udaipur District : Coll. *K. S. Pradhan :* (i) 2 exs., a small pool nr. Rajsamand, *ca.* 32 km. N. of Mavli, Udaipur, 27. ii. 48. Coll. *D. &G. P. R. S. :* 1 ex., Pamri *Nadi*, a tributary of Wokal R., *ca.* 8 km. N. of Kotra ; Udaipur, 21. xii. 61.

Distribution.—Rajasthan : No exact locality (Nevill, 1878, p. 234 ; Annandale & Rao, 1925, p. 156). Other localities as mentioned above (district of Jaipur, Jodhpur, Sirohi and Udaipur) are new records. *Elsewhere :* India : Common throughout. Also East and West Pakistan and Burma.

Remarks.—The largest example (P. 19, Figs. 6, 6*a*) from a deep water pool nr. Trevor *tāl* (Mt. Abu) has height 17·5 mm., diameter 11·5 mm. and whorls 4.

(ii) *Form **patula** Troschel

(Plate 19, Figs. 7, 7*a*)

1837. *Limnaeus patulus* Troschel, in Wiegmann's *Arch. f. Naturges.*, Berlin, **3**, p. 167.

1925. *Limnaea* (*Pseudosuccinea*) *acuminata* f. *patula*, Annandale & Rao, *Rec. Indian Mus.*, Calcutta, **27**, p. 181, fig. iii, no. 9.

Material.—Pali District : Coll. *K. S. Pradhan :* 3 exs., a pond on sandy bed of Phulad R., *ca.* 2 km. S. of Phulad Railway Station. 1. iii. 48.

Udaipur District : Coll. *B. N. Chopra & M. L. Roonwal :* 3 exs., Sta. 8, Parsad-ka-*nullāh* (Parsad stream) nr. Dak Bungalow at Parsad (Palsad), 18-19. x. 41. Coll. *K. S. Pradhan :* 50 exs., Udaipur, 17. iii. 48. Coll. *D. & G. P. R. S. :* 1 ex., Pichola Lake, *ca.* 7 km. W. of Udaipur Railway Station, 24. xii. 61.

Distribution.—Rajasthan (first record) : Localities as mentioned above (districts of Pali and Udaipur). *Elsewhere :* India : As common as *forma typica*. Also West Pakistan, Nepal and Burma.

Remarks.—The largest example (Pl. 19, Figs. 7, 7*a*) is from Udaipur (height 26.5 mm., diameter 15 mm., whorls 3½).

(iii) *Form **chlamys** Benson

The Cloak Lymnaea

(Plate 19, Figs. 8, 8*a*)

1836. *Limnaea chlamys* Benson, *J. Asiat. Soc. Bengal*, Calcutta, **5**, p. 744.

1925. *Limnaea* (*Pseudosuccinea*) *acuminata* f. *chlamys*, Annandale & Rao, *Rec. Indian Mus.* Calcutta, **27**, p. 181. fig. iii, no. 6.

Material.—Rajasthan : 4 exs., no exact locality.

Pali District : Coll. *K. S. Pradhan :* (i) 10 exs., Phulad R. (with rocky and pebbly bottom and swift current), *ca.* 2 km. S. of Phulad Railway Station, 1. iii. 48.

Sirohi District : Coll. *K. S. Pradhan :* (i) 4 exs., a *nullāh* (stream), nr. Dilwara Temple, Mount Abu, 7. iii. 48. (ii) 84 exs., Gora Chapra *nullāh* (stream), *ca.* 3 km. E. of Abu Dak Bungalow, Mount Abu, 10. iii. 48.

Distribution.—Rajasthan (first record) : Localities mentioned above (districts of Pali and Sirohi). *Elsewhere :* India : As common as the form *patula.*

Remarks.—This form is represented by a good series. The largest example (Pl. 19, Figs, 8, 8*a*) is from " Rajasthan " (no exact locality) and has height 23 mm., diameter 13·5 mm., whorls 4½.

(iv) *Form **rufescens** (Gray)

The Reddish Lymnaea

(Plate 19, Figs. 9, 9*a*)

1820. *Limnaea rufescens* Gray, in Sowerby's *Genera of Shells*, London, 1, *Limnaea*, Fig. 2.

1925. *Limnaea* (*Pseudosuccinea*) *acuminata* f. *rufescens*, Annandale & Rao, *Rec. Indian Mus.*, Calcutta, 27, p. 181, Fig. iii, no. 10.

Material.—Jodhpur District : Coll. *D. & G.P.R.S. i* (i) 7 exs. Mandore Canal, *ca.* 8 km. N. of Jodhpur, 19. ii. 61. (ii) 14 exs., Mandore Canal, *ca.* 10 km. N. of Jodhpur, 22.ii.61.

Udaipur District : Coll. *B. N. Chepra & M. L. Roonwal :* 16 exs., Sta. 10, a large tank, *ca.* 5 km. N. of Parsad (Palsad), 16-21.x.41.

Distribution.—Rajasthan (first record) : Localities as mentioned above (districts of Jodhpur and Udaipur). *Elsewhere :* India : As common as the forms *chlamys* and *patula.* Also East Pakistan and Burma.

Remarks.—Though a reddish tinge is not visible in all the specimens, other peculiarities show beyond doubt that they belong to the form *rufescens.* The largest example (Pl. 19, Figs. 9. 9*a*) is from a large tank nr. Parsad, and has height 25 mm., diameter 12 mm., whorls 4½.

18. ***Lymnaea [Pseudosuccinea] luteola** Lamarck

(i) *Form **typica** Lamarck

The Yellowish Lymnaea

(Plate 19, Figs. 10, 10*a*)

1822 *Limnaea luteola* Lamarck, *Hist. Nat. Anim. sans Verteb.*, Paris, 6(2), p. 160.

1925. *Limnaea* (*Pseudosuccinea*) *luteola* f. *typica*, Annandale & Rao, *Rec. Indian Mus.*, Calcutta, 27 p. 184, fig. iv, no. 1.

Material.—Pali District : Coll. *K. S. Pradhan* 2 exs., Jogmandi *Jharna* (stream), *ca.* 19 km. from Phulad, 3.iii.48.

Sirohi District : Coll. *K. S. Pradhan :* 8 exs., Gora Chapra *nullāh* (stream), *ca.* 3 km.E. of Abu Dak Bungalow, Mount Abu, 10.iii.48.

Udaipur District : Coll. *D. & G. P. R. S. :* 6 exs., a channel, *ca.* 1 km. S. of Kankroli, Udaipur, 24.xii.61.

Distribution.—Rajasthan (first record) : Localities as mentioned above (districts of Pali, Sirohi and Udaipur). *Elsewhere :* India : More common throughout than *L. acuminata.* Also East and West Pakistan, Burma and Nepal (Pharping).

Remarks.—The few shells in the collection, though rather damaged, show the typical features of *luteola.* The largest example is from the Gota Chapra *nullāh*, and has height 22 mm., diameter 12 mm. and whorls 4½, while that illustrated here (Pl. 19, Figs. 10, 10*a*), from Kankroli, has height 19.5 mm., diameter 12 mm. and whorls 5.

(ii) Form australis Annandale & Rao, 1925

(Plate 19, Figs. 11, 11*a*)

1925. *Limnaea* (*Pseudosuccinea*) *luteola* f. *australis* Annandale & Rao, *Rec. Indian Mus.*, Calcutta, 27, p. 184, fig. iv, no. 3.

1943. *Lymnaea* (*Pseudosuccinea*) *luteola* f, *australis*, Ray, *J. Roy, Asiat, Soc. Bengal* (*Sci.*), Calcutta, 9, p. 64.

Material.—Jaipur District : Coll. *A. K. Mukherjee :* (i) 1 ex., Sta, 22, Ratan *tālāb* (tank) nr. Sambhar Lake, 9.i.58. (ii) 1 ex., Sta. 23, Chapparwara nr. Sambhar Lake, 20.vii.58.

Jodhpur District : Coll. *D. & G. P. R. S. :* 25 exs., Mandore Canal, *ca.* 8 km. N. of Jodhpur, 19.ii.61.

Sirohi District : Coll. *K. S. Pradhan :* 1 ex., a *nullāh* (stream) nr. Dilwara Temple, Mount Abu, 7.iii.48.

Udaipur District : Coll. *B. N. Chopra & M. L. Roonwal :* 2 exs., Sta. 10, a large tank, *ca.* 5 km. N. of Parsad (Palsad), 26-27.x.41. Coll. *K. S. Pradhan :* (i) 1 ex., a small pool nr. Rajsamand, *ca.* 32 km. N. of Mavli, 27.ii.48. (ii) 12 exs., Nathela tank, *ca.* 1 km. from Mavli, 28.ii.48. (iii) 34 exs., Nathela tank, *ca.* 2 km. from Mavli, 28.ii.48.

Distribution.—Rajasthan (first record) : Localities as mentioned above (districts of Jaipur, Jodhpur, Sirohi and Udaipur). *Elsewhere :* India : Common throughout. Also Ceylon, East and West Pakistan and Burma.

Remarks.—This form is represented by a good series. The largest example is from the Nathela tank nr. Mavli Camp, and has height 18 mm., diameter 11 mm. and whorls 4½, while that shown here (Pl. 19, Figs. 11, 11*a*) is from a pool nr. Rajsamand, and has height 17 mm., diameter 9.5 mm. and whorls 4½.

(iii) *Form **impura** Troschel

(Plate 19, Figs. 12, 12*a*)

1837. *Limnaeus impurus* Troschel, in Wiegmann s *Arch f. Naturges* Berlin, 3, p. 172.

1925. *Limnaea* (*Pseudosuccinea*) *luteola* f. *impura*, Annandale & Rao, *Rec. Indian Mus.*, Calcutta, 27, p. 185, fig. iv, no. 7.

Material.—Jodhpur District : Coll. *D. & G. P. R. S. :* 36 exs., Mandore Canal, *ca.* 10 km. N. of Jodhpur, 22.ii.61.

Nagaur District : Coll. *B. Biswas :* 11 exs., Sta. 17, a pond in Merta, 26.xii.56.

Distribution.—Rajasthan (first record) : Mandore Canal (Jodhpur Dist.) and pond in Merta (Nagaur District), as above. *Elsewhere :* India : Common throughout. Also Ceylon and Burma.

Remarks.—Though no black deposit is found on the surface of any shell, other important characters clearly indicate their close identity with the form *impura*. The largest example (Pl. 19, Figs. 12, 12*a*) is from Merta, and has height 18.5 mm., diameter 11 mm. and whorls 5.

Family UNIONIDAE

19. **Parreysia favidens** (Benson)

The Yellow-toothed Mussel

(Plate 20, Fig. 6)

1862. Unio favidens Benson, *Ann. & Mag. Nat. Hist.*, London, (3) 10, p. 188.

(1912 *Parreysia*, (*Parreysia*) *favidens*, Preston, *Rec. Indian Mus.*, Calcutta, 7. pp. 298, 299.

Material.—Chittorgarh District : 7 exs., Chittorgarh, 30.iv.1904.

Distribution.—Rajasthan : Preston (1912. p. 298; 1915, p. 159), no exact locality mentioned. The locality ' Chittorgarh ', as mentioned above, is a new record. *Elsewhere :* India : Common throughout. Also East and West Pakistan.

Remarks.—Shells small, pale olive-green to olive-yellow, with the umbones prominent in most cases. The largest example (Pl. 20, Fig. 6) has length 37.5 mm., thickness 10 mm., and height 38 mm. (umbones much eroded).

20. ***Parreysia corrugata** (Müller) **var. nagpoorensis** (Lea)

(Plate 20, Fig. 5)

1859. *Unio nagpoorensis* Lea, *Proc. Acad. Nat. Sci. Philad.*, Philadelphia, 3, p. 331.

1915. *Parreysia* (*Parreysia*) *corrugata* var. *nagpoorensis*, Preston, *Faun. Brit. India, Moll.*, London (Gastropoda & Pelecypoda), p. 157.

Material.—Chittorgarh District : Coll. *B. N. Chopra & M. L. Roonwal :* 10exs., Sta. 1, R. Berach (Bedach) nr. Chittorgarh, 8-9.x.41.

Distribution.—Rajasthan (first record) : R. Berach (Chittorgarh Dist.), as above. *Elsewhere :* India : West Bengal, Andhra Pradesh, Madras State and Maharashtra. Also recorded from the excavations of Navasa in Maharashtra (Ray, 1960, p. 547).

Remarks.—Shells mostly olive-yellow. The largest example (Pl. 20, Fig. 5) has length 33 mm., thickness 16 mm., height 25 mm.

21. **Indonaia caerulea** (Lea)

The Caeruleus Mussel

(Plate 20, Fig. 4)

1834. *Unio caeruleus* Lea, *Trans. Amer. Philos. Soc.*, Philadelphia, 4, p. 95, Pl. XIII, fig. 25.

1912. *Nodularia (Nodularia) caerulea*, Preston, *Rec. Indian Mus.*, Calcutta, 7, pp. 288, 289.

Material.—Rajasthan : 10 exs., no locality, 23.v.10.

Chittorgarh District : Coll. *B. N. Chopra & M. L. Roonwal :* 31 exs., Sta. 1, R. Berach (Bedach) nr. Chittorgarh, 8-9.x.41.

Pali District : Coll. *K. S. Pradhan :* 44 exs., a pool on sandy bed of R. Phulad, *ca.* 2 km. S. of Phulad Railway Station, 1.iii.48.

Udaipur District : Coll. *D. & G. P. R. S. :* 1 ex., Wokal R., *ca.* 2 km. E. of Kotra, Udaipur, 20.xii.61.

Distribution.—Rajasthan : Preston (1921, p. 289 ; 1915, p. 136) gave no locality except 'Rajputana'. Other localities as mentioned above (districts of Chittorgarh, Pali and Udaipur) are new records. *Elsewhere :* India : Quite common throughout. Also East and West Pakistan, Burma and Nepal. Also recorded from the exacavations of Navasa in Maharashtra (Ray, 1960, p. 546).

Remarks.—The largest example (Pl. 20, Fig. 4) in the series measures : length 50 mm., thickness 19 mm., height 29 mm.

22. **Indonaia occata** (Lea)

The Harrowed Mussel

(Plate 20, Fig. 3)

1860. *Unio occatus* Lea, *Proc. Acad. Nat. Sci. Philad.*, Philadelphia, 4, p. 307.

1921. *Indonaia occata*, Prashad, *Rec. Indian Mus.*, Calcutta, 22, p. 603.

Material.—Pali District : Coll. *K. S. Pradhan :* 2 exs., a pool on sandy bed of R. Phulad, *ca.* 2 km. S. of Phulad Railway Station, 1. iii.48.

Distribution.—Rajasthan (first record) : Phulad R. (Pali Dist.), as above. *Elsewhere :* India : West Bengal, Assam, Uttar Pradesh and Madhya Pradesh. Also Burma.

Remarks.—Both the specimens are small and found closely associated with those of *Indonaia caerulea*, but easily distinguishable from the latter by their surface being characteristically occated throughout.

The larger example (Pl. 20, Fig. 3) measures : length 11 mm., thickness 4 mm. and height 6 mm.

23. *Lamellidens corrianus (Lea)

The Corrie's Mussel

(Plate 20, Fig. 1)

1834. *Unio corrianus* Lea, *Trans. Amer. Philos. Soc.*, Philadelphia. 6, P. 65, Pl. IX, Fig. 25.

1921. *Lamellidens corrianus*, Prashad, *Rec. Indian Mus.*, Calcutta, 22, pp. 605-609, Fig. 29*c* (p. 607).

Material.—Raajasthan : 1 ex., no exact locality, 4.v.10.

Distribution.—Rajasthan (first record) : No exact locality mentioned except 'Rajputana' *Elsewhere :* India : Almost as widespread as *L. marginalis* which is the commonest freshwater mussel of India. Also East Pakistan and Burma (*see* Prashad, 1922 ; Marshall, 1922).

Remarks.—The single shell (Pl. 20, Fig. 1) was found in the Z.S.I. Collections labelled as " *Lamellidens marginalis* Lamarck, Loc. Rajputana" but it is actually *L. corrianus*. Measurements : length 78 mm., thickness 26 mm. and height 38 mm.

Family CORBICULIDAE

24. *Corbicula striatella Deshayes

The Small Striated Corbicula

(Plate 20, Fig. 2)

1854. *Corbicula striatella* Deshayes, *Proc. Zool. Soc. Lond.*, London, 22, p. 344.

1928. *Corbicula striatella*, Prashad, *Mem. Indian Mus.*, Delhi, 9, pp. 18-20, Pl. III, Figs. 9-11.

Material.—Chittorgarh District : Coll. *B. N. Chopra & M. L. Roonwal :* 2 exs., Sta. 1, R. Berach (Bedach) nr. Chittorgarh, 8-9.x.41.

Distribution.—Rajasthan (first record) : R. Berach (Chittorgarh Dist.), as above. *Elsewhere :* India : Quite common throughout. Also East and West Pakistan, Ceylon and Burma.

Remarks.—The two shells available were obtained along with specimens of *Indonaia caerulea*. A comprehensive account of the Indian Corbiculidae is given by Prashad (1928).

(C) MARINE MOLLUSCS (FROM EXCAVATIONS)

Since the four species included in this category were based on the study of shell-remains only which were unearthed in an ancient mound near Sambhar Lake, by the department of Archaeology and Historical Research, of the erstwhile Jaipur State, Jaipur, and returned to that department after identification, in 1938, by the Zoological Survey of India, it has not been possible to illustrate them here. The species are included here for the sake of completeness of this account.

It is presumed that these marine forms must have been imported into Rajasthan from the neighbouring sea coast.

Family XANCIDAE

25. *Xancus pyrum (Linnaeus)

(i) *Form pyrum (Linnaeus)

The Sacred Chank

1767. *Voluta pyrum* Linnaeus, *Syst. Nat.*, Holmiae, ed. 12, p. 1195, No. 438.

1960. *Xancus pyrum pyrum*, Ray, *Navasa Excavation Publication No. 1, University of Poona*, Poona, pp. 537, 538, 540, 549. Firs. 212 (Nos. 24, 25) and 213 (Nos. 3-5).

Distribution.—Rajasthan (first record) : An ancient mound near Sambhar Lake (Jaipur Dist.).

Elsewhere : India : Tranquebar Coast (Madras State) and Bombay (Maharashtra). For details regarding the economic importance of this Sacred Chank, *see* Ray (1960), and for other information, *see* Winckworth (1939).

Remarks.—Only the top portion of the shell was found.

Family CYPRAEIDAE

26. Erosaria lamarckii (Gray)

(i) *Race redimita (Melvill)

1888. *Cypraea lamarckii* var. *redimita* Melvill, *Mem. & Proc., Manch. Lit. & Philos. Soc.*, Manchester, (4) 1, pp. 226, 249, Pl. II, Fig. 16.

1938. *Erosaria (Erosaria) lamarckii* race *redimita*. Schilder & Schilder, *Proc. Malac. Soc. Lond.*, London, 23, p. 139, No. 33A.

Distribution.—Rajasthan (first record) : An ancient mound near Sambhar Lake (Jaipur Dist. .) *Elsewhere :* Very widespread : East Africa and Persian Gulf to West Pakistan (Karachi), India, Ceylon, Burma (Mergui) and Sumatra.

Remarks.—The shell, though worn out and damaged, appears to be identical with race *redimita*. This cowry is used as an amulet and also for decoration and ornaments.

Family OLIVIDAE

27. ***Olivancillaria (Olivancillaria) acuminata** (Lamarck)

The Acuminated Oliva

1811. *Oliva acuminata* Lamarck, *Ann. du. Mus.*, Paris, **16**, p. 323.

1883. *Oliva (Agaronia) acuminata*, Tryon, *Man. Conch.*, Philadelphia, **5**, pp. 88, 89, Pl. XXXV, Fig. 71.

Distribution.—Rajasthan (first record) : An ancient mound near Sambhar Lake (Jaipur Dist.). *Elsewhere :* Coast of West Africa (Senegal and Gambia) and Arabia (Aden) to India, East Indies and Philippines.

Remarks.—The shell is small and slender, with the spire elevated and acuminate but slightly damaged. This Oliva shell is used as an amulet and for ornaments.

Family PTERIIDAE

28. ***Pinctada margaritifera** (Linnaeus)

The Black-lip Oyster

1758. *Mytilus margaritiferus*, Linnaeus, *Syst. Nat.*, Holmiae, ed. 10, p. 704, No. 209.

1933. *Pinctada margaritifera*, Prashad & Bhaduri, *Rec. Indian Mus.*, Delhi, **35**, pp. 167-168.

Distribution.—Rajasthan (first record) : An ancient mound near Sambhar Lake (Jaipur Dist.). *Elsewhere :* More common in the Persian Gulf than in the Indian seas. This Oyster also occurs in the, Red Sea, East Africa, Ceylon, Burma (Mergui and its Archipelago), Cocos-Keeling Islands, Papua, Poulo-Condor, Solomon Islands, Philippines and Australia.

Remarks.—This large and 'Black-lip' mother-of-pearl oyster was represented only by a broken piece of shell. Hornell (1921) and Talavera & Faustino (1931) refer to its economic importance, while Prashad (1932) and Prashad & Bhaduri (1933) give other details about it.

V—SUMMARY

1. A comprehensive systematic account of the molluscan fauna of Rajasthan is given here for the first time, and is based mainly on extensive collections made by the survey parties of the Zoological Survey of India during the years 1941-61. The few earlier published accounts in the literature make only casual references to a few species.

2. The present account includes 36 forms, of which 6 are land molluscs, 26 freshwater molluscs and 4 marine molluscs (obtained as shell-remains from excavations of an ancient mound near Sambhar Lake). Specimens were available for all these species except one, *Boysia oysisi* (Pfeiffer), which is included on the basis of literature only.

3. Out of these 36 forms, 25 marked with an asterisk (*) in the text are new records from Rajasthan. Although the remaining 11 are not new records from this area, their earlier published references are sketchy and in many cases no exact locality is given, merely "Rajputana" being mentioned and the locality records given in the present account are in most cases new.

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