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OF THE
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(A Journal of Indian Zoology¹)

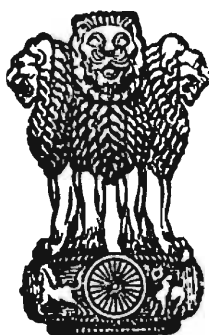
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**A new species of *Pullus* Mulsant (Coleoptera, Coccinellidae),
predaceous on the aphid, *Rhopalosiphum nymphaeae* (Linn.),
in Calcutta**

By

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Zoological Survey of India, Calcutta

(With 1 Plate)

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I—INTRODUCTION

During the course of general insect survey of Calcutta and its environs, a number of Lady-beetles (Coleoptera, Coccinellidae) were collected over the past several years. In this paper one of the hitherto unnamed species of the genus *Pullus* Mulsant is described. It was found feeding on the aphid, *Rhopalosiphum nymphaeae* (Linn.) (Hemipt., Aphididae), on the water-plant, *Pistia stratiotes* L. (Araceae), in certain ponds in the Eden Garden, Calcutta. During November-December, 1957, when both the water-plants and the aphids mentioned above were quite common in the ponds, the Lady-beetles were found to be freely breeding among the aphid colonies. Subsequently some more examples of the beetle were collected from the same locality. Two examples of the beetles were also obtained from Bansdhani, a suburban area, some 10 km. south of Calcutta.

Thanks are due to Shri S. K. David for the identification of the aphids and to Dr. M. L. Roonwal, for his encouragement.

II—DESCRIPTION OF THE SPECIES

***Pullus nymphaeus* sp. n.**

♂, ♀. Body oval, moderately convex with fairly distinct humeral calli ; pubescence mostly greyish, on the whole long and sparse ; dorsal surface piceous except towards the apex where it gradually becomes dark brown (Fig. 1, left half) ; the frons, mouth-parts and antennae also dark brown. In some of the examples the colour at the apex of the elytra, frons, antennae, mouth-parts, etc. may be a little lighter than is the case in the majority of examples, described above. Underside piceous except for the dark brown pronotal epipleurae, the legs and the apical two abdominal sternites.

Head with rather coarse, impressed and generally sparse punctation ; pubescence also sparse, moderately long, sub-depressed, directed

anteriorly, rather pale grey ; eyes finely faceted ; antennae (Fig. 2) club-shaped, the 1st, 3rd and 9th segments long, the 4th, 5th and 6th short and subequal, and the remainder segments of intermediate length. *Pronotum* convex, a little more than twice as broad as long, slightly narrowed and rounded laterally, a little emarginate anteriorly ; narrowly but distinctly margined at the median two-thirds the width of the base ; the anterior angles subacute, the posterior ones rather rounded and obtuse ; punctuation uniform, moderately coarse, relatively less impressed and sparse than that on the head ; pubescence longer than that on the head, sparse and suberect, mostly directed antero-medially except in the median basal area where it is more inclined towards the longitudinal median line and rather irregularly directed near the posterior angles. *Scutellum* small, subtriangular, with a few fine punctures and sparse pubescence. *Elytra* a little longer than the width of the two together, moderately convex, rather vertically inclined from the humeral callus to the lateral margin especially for the anterior half of the length ; humeral angles rounded, the lateral margins narrowly bordered from the base to a little distance beyond the middle ; apical angles narrowly rounded ; punctuation coarse, rather sparse, and impressed more distinctly than that on the pronotum and head ; interspaces moderately smooth ; pubescence nearly as long as that on the pronotum but relatively more stout, sparse, suberect and greyish, and also different in that the hairs are directed backwards, in a longitudinally wavy fashion especially in the basal three-fourths of the elytron (Fig. 1, right half). *Underside* with mostly short and depressed pubescence and with fine to coarse and impressed punctuation ; the prosternal carinae (Fig. 3) almost straight and convergent towards the anterior margin where these come very close to each other ; punctuation on the pro- and mesosternum fine and impressed that on the metasternum coarse and impressed and fairly close. The abdominal lines complete, semicircular, extending beyond the middle of the first abdominal segment ; the pubescence on the terminal sternites of the abdomen relatively long, depressed and directed posteriorly. *Male genitalia* with a sub-transverse and well-developed basal piece (Fig. 4 and 5, *bp*), the long trabes (*t*), the elongate oval parameres (*pm*), each bearing a number of long and delicate setae ; the median lobe (*ml*) conical, about one-and-a-half times as long as wide, a little longer than parameres and acutely pointed at the apex ; the siphon (Fig. 6) distinctly long and narrow except for a short, expanded part (*s*) in the middle which is quite characteristic of the species, the siphonal capsule (*sc*) also elongate, its inner arm narrower than the outer one, the terminal part of the siphon with a thin, short and weakly chitinised filament which is usually projecting out. *Female genitalia* with sub-elongate genital plates (ix sternite) (Fig. 7, *gp*), each bearing a distinct papilla at the apex ; the spermatheca (Fig. 8, *st*) almost kidney-shaped, constricted a little beyond the median part ; the narrow, rather tubular, infundibulum (*i*) with an oblong membranous projection at the apex of the cornu (*cn*) which is quite rounded at the base near the ramus. The outlines of the paramera, the median lobe and the siphon in the male, and of the spermatheca in the female, are typical of the species and greatly helpful in its recognition.

Length 1.85—2.0 mm ; breadth 1.3--1.4 mm.

Holotype.—♂, INDIA ; Calcutta (West Bengal), Eden Garden, 6.--xii. 1957, feeding on *Rhopalosiphum nymphaeae* (L.), on water-plant,

(*A. P. Kapur* Coll.) in the Zoological Survey of India, Calcutta, Regd. No. 1308/H4A. (The genitalia dissected and mounted in Canada Balsam between two coverslips and pinned with the specimen). *Paratypes*: *Allotype*.—♀, with the same data as the holotype; in the Z.S.I. Collection. (The genitalia dissected and mounted as above). Other Paratypes.—♂, ♀, several examples as follows : INDIA : Calcutta, Eden Garden, feeding on *R. nymphaeae* (L.), on water-plants, 29.xi.1957 (1 ex.) ; 3-, 4-, 6-, 19, and 24.xii.1957 (4, 5, 28, 3 and 1 ex., respectively); 22.i.1959 (1 ex.) ; 4.xii.1959 (1 ex.) (all *A. P. Kapur* Coll.) ; 25.xi.1960 (2 exs.) (*S. Ali*) ; 30.xi.1962 (3 exs.) (*S. Ali* and *P. Singh*) ; Bansdhani, ca. 10 km. south of Calcutta, 14.i.1960 (2 exs.) (*A. R. Bhaumik*) ; mostly in Z.S.I. Collection ; Calcutta. (1 ex.), (no further data) in Riksmuseum, Stockholm. (In some cases the genitalia are dissected and mounted in the same manner as stated earlier.)

Remarks.—*Pullus pallidicollis* (Mulsant)¹ and *Pullus pyrocheilus* (Mulsant)² are two other species of the genus *Pullus* Mulsant that are quite commonly found in Calcutta but these are easily distinguishable from the presently described species by their colouration, especially on the pronotum which is light brown in the former species, and reddish-testaceous with a black, semi-circular median spot at the base in the latter species. There are also further differences in their colouration, and in the punctation and pubescence which are on the whole finer and shorter than is the case in *P. nymphaeus*. The only other species of the genus which comes close to the latter is *Pullus brunnescens* (Motschulsky)³, originally described from Ceylon but later recorded from other parts of Asia. This species is larger (2.54 mm. long), much lighter and uniformly reddish-testaceous to testaceous in colour. The two species are further distinguishable externally by the character of their pubescence, punctation and the shape of humeral calli. The pubescence in *P. brunnescens* is shorter, closer and relatively depressed ; the punctation is finer and the humeral calli less prominent than is the case in *P. nymphaeus*. In respect of the genitalic structure also there are some important differences between the two species. In the male, the paramera are narrow, the median lobe relatively wider and the siphon not expanded in the middle in *P. brunnescens* ; in the female of the latter the spermatheca is different in outline, its nodulus is narrow and emarginate at the base, whereas in the case of *P. nymphaeus* it is rounded. *Scymnus picescens* Gorham⁴ is another species (found in southern India) which, on account of its piceous colouration, resembles *P. nymphaeus* to some extent but which can be distinguished from the latter by its smaller size (1.2 mm. long), close and strong punctation and short pubescence.

III—SUMMARY

A new species of Lady-beetle, namely, *Pullus nymphaeus* Kapur and Munshi, is described from Calcutta. It was found feeding on the aphid, *Rhopalosiphum nymphaeae* (Linn.), on water-plants.

¹ & ² Mulsant, M. E. *Ann. Soc. Linn. Lyon*, 1, pp. 280-282 (1853).

³ Motschulsky, V. *Bull. Soc. Nat. Mosco*, 39, p. 425 (1866).

⁴ Gorham. H. S. *Ann. Soc. ent. Belg.*, 38, p. 207 (1894).

PLATE 1

FIG. 1.—Outline of *Pullus nymphaeus* sp. n., left half showing the colour-pattern ; the right half showing the arrangement of pubescence.

FIG. 2.—The antenna.

FIG. 3.—Prosternum ; showing the carinae.

FIG. 4.—Lateral view of the male genitalia except siphon (*bp*, basal plate ; *pm*, parameres ; *ml*, median lobe ; *t*, trabes).

FIG. 5.—Front view of the above.

FIG. 6.—The siphon (*s*, expanded part of the siphon ; *sc*, siphonal capsule).

FIG. 7.—Terminal segments of the female (*gp*, genital plates).

FIG. 8.—The spermatheca of the same (*st*, spermatheca ; *cn*, cornu ; *i*, infundibulum).

2.0 mm. scale for fig. 1 ; 0.2 mm. scale for figs. 2, 3, 4, and 5 ; 0.4 mm. scale for fig. 6. ; 0.1 mm. scale for figs. 7 and 8.)

Field Observations on habits of Indian Langur, *Presbytis entellus* (Dufresne) in Gir Forest, Gujarat

By

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(With 1 Text-figure)

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I—INTRODUCTION

During October-November, 1962 a party from Zoological Survey of India conducted a general faunistic survey of certain areas of the Gir forest in Saurashtra region of the Gujarat State famed for its lions. While engaged in the survey, I had numerous occasions to observe the habits of the common Indian Langur, *Presbytis entellus* (Dufresne) in these forests. Incidentally it may be mentioned here that the other Indian monkey, the Macaques (*Macaca* spp.) were never observed in these forests and I was told that they are totally absent in this region, the only monkey commonly met with being the langur.

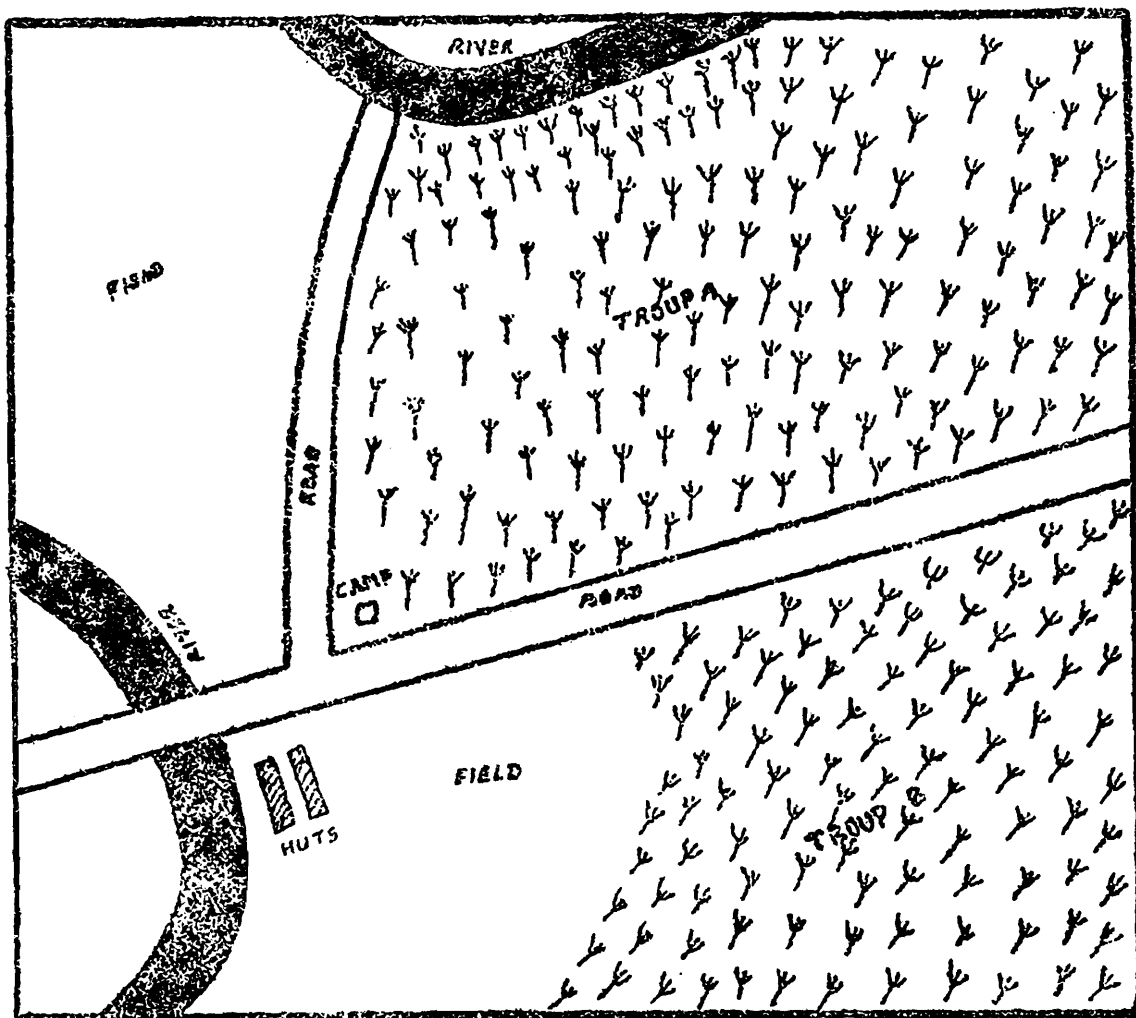
Observations were mostly made on two troupes of langurs inhabiting the forest near Sirwan, about 14 Km. from Sasan Gir.

II—TERRITORY AND TROUP-COMPOSITION

Territory.—Each troupe was found to have distinctive territory with certain conspicuous land marks as the boundary. The place Sirwan is a small forest village with a cluster of tribal (“Siddi”) hamlets. A forest stream winds its course through the outskirts of this village which is crossed by the forest road from Sasan. Before crossing the stream, when approached from Sasan, there are a few strips of cultivated fields on either side, that of right side being more extensive, and also two or three “pukka” buildings of the Forest Department, of which one, intended as the forest guard’s quarters, served us as our camp (Text-fig. 1). This road and the strips of cultivated fields differentiated the territory of the two groups, serving as the boundary line. As the stream was almost semicircular in its course at this place both the troupes had ready recourse to water. In fact riverine jungle seems to be the favourite haunts of these monkeys and generally they never frequent jungles remote from any water course. The fact that they often rest in shade near water courses was reported by earlier workers like McCann (1928) and Prater (1948). This preference has been consistently observed by me in other places also where I have watched troupes of langurs.

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Each troupe confined itself to its earmarked territory and this adherence was rather obvious by its strict application. Although the members scattered rather widely during their wanderings, they invariably stopped at the edge of the road not venturing further on to the other side. A few young individuals with their characteristic delinquency crossed the road sometimes, but they immediately retreated to their side on sight of any intruder (sometimes the observer) or the members of the opposite troupe, even if running into the alien territory was easier and quicker. Their sense of territorial possession is strong, a fact which Hughes (1884) testifies by reporting two troupes fighting for a territory the larger group evicting the smaller by attacking and killing the latter's leader. Such territorial adherence is in marked contrast to the case of Macaques, where according to Nolte (1955) who studied the Bonnet Monkey (*M. radiata*), there was no marked parochialism.



TEXT-FIG. 1.—Map of camp site where two troupes of Lungurs were studied.

Troup-composition.—There were 18 members in one troupe and about 22 in the other. Obviously the size of the troupe varies to a great extent as Nolte (1955) observed troupes of 50 or more at Sikandra near Akbar's Tomb and in western Himalayas near Chakrata as well as smaller troupes from 4-5 to 17 members, elsewhere. Each troupe had a leader, a large male. In addition to the leader, I could count 3 males, 10 females and 4 juveniles in the first group. The second group did not readily lend itself to counting as the jungle here was more thick and dark, but I

could count 2 males in addition to the leader and about 6 young ones. But the actual composition of this troupe may be different. There are many earlier reports about exclusively male troupes, (see Jerdon, 1867 ; Prater, 1948) but I have so far not observed anything like that. Carpenter (1935) has observed in the case of Red Spider Monkeys (*Atèles geoffroyi* Kuhl) that large groups in their wanderings tend to divide into smaller sub-groups of various composition one of which group is of males only and then regroup eventually in various composition during their progress through the forest. It is quite probable that what has been reported as exclusive male parties in the case of langurs may represent some such sub-groups belonging to a larger assemblage.

III—OBSERVATIONS ON DAILY ROUTINE ACTIVITIES

Daily routine.—The activity rhythm shows two peak periods, one from 6-30 to 9 a.m. and the other from 4 to 7 p.m. During this time they never alight to the ground, but move along tree tops. This is the real feeding time and the whole troupe is characteristically silent, busily foraging for food among the leaves, tender shoots and fruits of the trees. I never observed them eating insects or making any efforts to catch some. It seems that the diurnal routine of these langurs can be categorised into three periods : (1) feeding time, (2) recreation time, and (3) resting time. There is of course considerable overlap between the last two periods. But by and large this holds good.

The food seeking goes on in real earnest till about 9 or 9-30 a.m. Thereafter, some of them mostly juveniles and females alight to open ground especially agricultural fields. Nolte (1955) also reports similar postfeeding ground movements in *M. radiata*. Crops in the fields were harvested at this time, but the fallow lands were used by the monkeys for a sort of sun-bath by the older members and for frolicking play by the youngsters. By all accounts this seems to be the recreation time. It is at this time that the first vocal exercise of the morning, a loud resounding call or some short barks are uttered by some individuals. The loud call seems to be simply a manifestation of excess energy, whereas the short bark apparently signifies some irritation or annoyance.

By about 11-30 to 12 a.m. they retreat from these open places into the shades where it is more cool. This invariably will be among a group of shady trees near the bank of the forest stream. Some of them come to the very edge of water and dip their lips into it, supporting the forepart of their body by the outstretched arms applied to the ground. They drink only a little, perhaps being able to meet their water requirements from their succulent food. Those who have quenched their extra thirst now jump on to some branch of a tree overhanging the stream and may remain there motionless for a considerable time. This is also the time when the members engage in the act of grooming each other.

The resting time lasts till the afternoon heat is considerably dissipated. By about 4 p.m. (slightly earlier on cloudy days) the second period of peak activity begins. But this time the individuals are not so much in earnest about seeking out and consuming food as in the morning

as there are many apparently aimless leaps and bounces and frittering away of the time. They are also more vociferous at this time than in the morning. But towards dusk the whole troupe suddenly becomes silent and starts travelling in a definite direction. In all probability there must be some regular sleeping quarter which unfortunately I had no occasion to locate.

Leader's role.—It is often possible to identify a troupe by distinguishing the leader, as each troupe has a large male which by its authoritative demeanour gives no doubt about its unquestioned leadership. He is often bold and aggressive and may even hold his ground to watch the intruder with a malicious expression, when the rest of the troupe makes a big commotion among the tree branches by their prodigious leaps, while fleeing. The leader will be the last to bolt, and does so only after showing some boldness, threatening the intruder by a grimace of showing its teeth and growling at him, sometimes uttering some low gruttering barks. This behaviour serves to hold their object of fright at bay and to give time for other members to safely evacuate. But apart from this, the part played by the leader in the social organisation of the troupe appears to be limited. In the daily troupe movement at best only the general direction is set by the leader, and within that direction the members are quite free to scatter in a wide area. Often other members go well in advance of the leader. But as soon as the troupe is disturbed by any sign of alarm the leader comes into his own as described above.

Play.—As stated in describing daily routine the time of play is immediately after the early morning feeding time. By and large, young and old alike indulge in some sort of play. This may take the form of grappling, tumbling, chasing each other, or merely running to the edge of the clearing, remain squatting for a brief while and suddenly running back. Some members at this time give vent to their playful mood by a resounding call which may be taken up by many others.

Nursing and maternal instinct.—As there were no infants with the troupe I could not make any observations on this aspect. But I would like to append here an observation which was made at another place. Here the troupe, which was small, consisted of among others a mother and its suckling infant. Other female members of the troupe evinced a keen interest in the infant which appeared to be the common object of affection and concern. Often one of the females would take away the suckling infant from its mother's breast and put it to her own, or fondle it, the mother silently yielding to such behaviour. But the infant apparently possessed power of recognition of its mother, as it not only refused to suckle at the dry teats of such aspiring mothers but showed its unhappiness by trying to get out and reach its own mother. This display of maternal instinct and family cohesion is touchingly humane and of much interest.

IV—SUMMARY

Field observations on the habits of the Indian Langur, *Presbytis entellus* (Dufresne) were conducted in the Gir Forest, Gujarat. Two troupes of langurs were studied and it was found that each troupe had

its distinctive territory with clear territorial adherence. The troupe consisted of 18-22 members of both sexes and young ones. Activity rhythm showed two peak periods, morning and evening. Daily routine can be categorised into (1) feeding time (peak activity periods), (2) recreation time, and (3) resting time. Recreation follows the morning feeding when members indulge in playful antics. This is followed by resting on shady trees near river bank till the evening feeding starts. Each troupe has a leader whose authority is conspicuous only when the troupe faces danger or disturbance. An interesting observation regarding common concern and care of infants by females other than the mother observed elsewhere is also appended.

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Nidification of some common Indian Birds. No. 8.*
The Shikra, *Accipiter badius* (Gmelin)

By

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(With 2 Tables)

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I—INTRODUCTION

The Shikra, *Accipiter badius* (Gmelin), is undoubtedly one of the commonest Indian Raptors. It is resident throughout India up to about 1,520 metres in the Himalaya, and is known to breed throughout its range. In spite of its wide range and abundance very little seems to be known about its breeding habits in India. Hume (1873, pp. 24-25) was, apparently, the first ornithologist ever to collect the data then available on the subject. The information compiled by him dealt mostly with the breeding season; situation, location, description of nests; time taken for the construction of nest; clutch size; description and measurement of eggs. Many interesting aspects like courtship, mating, territory, nest building, laying pattern, incubation, description of young, care of young and nestling periods, etc., were completely left out presum-

*No.1.—*J. Bombay nat. Hist. Soc.*, Bombay, 60, pp. 121-133, 1963.
 No. 2.—*J. Bombay nat. Hist. Soc.*, Bombay (in press).
 Nos. 3-5.—*Res. Bull. Punjab Univ.*, Chandigarh, 14, pp. 1-28, 1967.
 No. 6.—*Pavo*, Baroda, 1, pp. 35-43, 1963.
 No. 7.—*Pavo*, Baroda, 1, pp. 110-119, 1963.
Rcc. Zool. Surv. India, 62 (1 & 2), 1970.

ably because not much was then known about them. Most of these aspects were omitted not only in his later (Hume, 1890, pp. 119-120), comprehensive collation, but also in Baker's (1935, pp. 103-105) comparatively recent and more elaborate compilation. Although many ornithologists and naturalists (Anderson, 1871, 1875, 1876; Marshal, 1877; Jerdon, 1877; Cripps, 1878; Davidson and Wenden, 1878; Doig, 1879; Vidal, 1880; Davidson, 1882; Swinhoe and Barnes, 1885; Barnes, 1885, 1886, 1888; Beavan, 1886; Munn, 1894; Jesse, 1896; 1903; Inglis, 1903; Whistler, 1910, 1916, 1922, 1928; Currie, 1916; Donald, 1920; Field, 1922; Baker, 1928; Dewar, 1928, 1929; Williams, 1929; Baker and Inglis, 1930; Phillips, 1933; Biddulph, 1937; Ali, 1946; Aitken, 1947; Lowther, 1948, 1949; Betts, 1953; Hutson, 1954 to mention a few) have, from time to time augmented our knowledge on the subject, yet large lacunae exist in our knowledge of the breeding habits of this bird.

II—BREEDING SEASON

The Shikra has been recorded to breed from January to June in Kerala, January to April (Ali, 1953, p. 316), March to June (Ferguson, 1904, p. 671), March to April in the rest of South India (Baker and Inglis, 1930, p. 265; Biddulph, 1937, p. 406; Betts, 1953, p. 250), March to August in Ceylon (Henry, 1955, p. 227; Legge, 1880, p. 25; Waite, 1925, p. 283), March to May in Western India and Deccan (Barnes, 1888, p. 287; Davidson and Wenden, 1878, p. 73; Vidal, 1880, p. 30), March to May in Eastern India and Burma (Cripps, 1878, p. 343; Inglis, 1903, p. 559; Munn, 1894, p. 62; Oates, 1883, p. 179; Smythies, 1940, p. 349), April to May in Uttar Pradesh and Rajasthan (Anderson, 1871, p. 682; Barnes, 1886, p. 39; Jesse, 1903, p. 77; Ried, 1881, p. 6), and April to July in Delhi and Punjab (Currie, 1916, p. 572; Donald, 1920, p. 136; Field, 1922, p. 766; Whistler, 1910, p. 704; Huston, 1954, p. 141).

At Hoshiarpur (Punjab), where this study was first undertaken in 1951, nests of this species with eggs and young were located during April to June in the years 1951 and 1952; around Poona (Maharashtra) breeding activity was noticed in April and May 1954 and at Vellore (North Arcot, Madras) a few nests were kept under observation in March and April, 1956.

III—MATING

With the approach of breeding season the Shikra, normally a quiet bird, becomes very noisy. Its two-note call can be very frequently heard throughout the day, particularly in the calm of the mornings. The sexes are apparently attracted to each others' calls resulting in pair formation. The paired birds appear to indulge often in a rather peculiar nuptial flight in which the wings are held well above the level of the back, slightly bent and the beats are low and leisurely. The courtship seems to consist chiefly of these nuptial flights and general chasing of each other (mostly male chasing the female) through and around tree tops. The male may sometimes bring in a tidbit like a lizard or a small bird to share with his mate. The copulation is a noisy affair and invariably takes place on branches of trees. The male utters his mating call a number of times in quick succession, The female answers it. The

male then flies up to or advances towards her. On his approach she crouches low, spreads her wings and lowers her head often uttering her mating call. The male mounts her in this position, balancing himself chiefly by flapping his wings, keeps on uttering his mating call intermittently throughout the act. The copulation is most frequent when the nest is under construction and may, during the peak of building activity, take place as frequently as three times in four hours.

IV—NEST BUILDING

After pairing off the birds devote their attention to the task of selecting a suitable site for their nest. The Shikras are apparently very selective about the breeding locality as well as the nesting site. "This little Hawk eschews extremes and never breeds in evergreen humid forests or, on the other hand, in actual deserts or the driest areas such as occur in Rajputana and elsewhere. It frequents for preference well-wooded country, both cultivated and waste land and it ascends the hills in suitable places upto about 5,000 ft. or rather higher" (Baker, 1935, p. 103). A well screened, three—or more pronged fork in a shady tree of a considerable size gets the first preference as the site select. Such a site is invariably provided by the sideways and upwards radiating branches of the parasitic shrub (*Loranthus* spp.) which often grows on sizeable trees. Such sites have often been recorded by the previous workers (Anderson, 1875, p. 19 ; Field, 1922, p. 766 ; Inglis, 1903, p. 559) also. In the absence of such a coveted fork, any well-concealed fork near the top or on the outside of a large shady tree growing solitary or in a grove, in a garden, on the outskirts of villages or in open deciduous forest is made use of. Exposed forks and forks offered by palm leaf bases are also occasionally occupied in the absence of something better. With such a flexible range of requirement, obviously the birds do not experience much difficulty in securing an appropriate nesting site. After having selected the site they do not exhibit much hurry or anxiety towards starting the construction of the nest. They usually hang around for a few days indulging in their conspicuous and noisy love-making thereby announcing their intentions to all and sundry. Even when they decide to go ahead with the construction they do not exhibit much enthusiasm or industry. Both partners collect the nesting materials in their own leisurely fashion, managing between themselves a few twigs a day. Normally dry twigs are wrenched off dead trees or branches with the beak. If the dry ones are not easily available the green ones are broken off. During transportation to the nest the bigger or the heavier twigs are transferred to the talons where as the smaller ones are carried in the beak itself. The female appears comparatively more concerned about the progress of nest construction. She not only makes greater number of material collecting trips but also does the major part of construction work. The male normally passes on his contribution of twigs to the female if she happens to be at work in the nest. In her absence he may try his hand (rather beak and breast) at the construction. The female, the chief architect, shows great hesitation while fixing a twig, often changing its position a number of times. There are long intervals of rest, love-making and food hunting in between the spurts of building activity. In the beginning the twigs are deposited in the fork in a haphazard manner. When the pile is about 7—10 cm. high the female starts applying her breast to shape the

egg cavity. Hume (1873, p. 24) and many of the subsequent workers have recorded the Shikra to take upwards of a month to complete a nest. Six pairs observed during the course of this study took 15-25 days to complete their nests.

The finished nest resembles that of a House Crow (*see* Lamba, 1963, pp. 124-126 for description of House Crow's nest) and is, generally speaking a shallow cup, 18-24 cm. in diameter and 8-12 cm. deep made of twigs roughly and loosely put together ; the egg chamber is 8-10 cm. across and 6-8 cm. in depth, occasionally lined with grass blades and roots.

At times a pair of Shikras may decide to skip the drudgery of making a nest of their own and may utilise an old or abandoned nest of other birds. Baker (1935, pp. 103-104) records Benjamin Aitken having taken a clutch of Shikras' eggs from an old crow's nest. Lowther (1944, pp.5-6) noticed a pair of Shikras in occupation of a nest made entirely out of pieces of wire (obviously an old and abandoned nest of House Crow), Hutson (1954, p. 141) found a pair of Shikras in occupation of a nest built and deserted by a pair of Honey Buzzards.

V—TERRITORY

Each pair of nesting Shikras appears to have a well defined territory. It is rare to find two pairs nesting within a mile of each other. Apparently the territorial claims of others of the species are well respected. No special territory announcing call or note was noticed, presumably the loud mating calls serve this purpose. Smaller birds in the vicinity of the nesting tree are greatly alarmed in the beginning but gradually get used to their presence and may even venture to visit the nesting tree itself. Drongos and crows, if nesting in vicinity, put up a stiff resistance towards the establishment of Shikra's claim and may at times (especially when the Shikras have not started the construction of the nest), even succeed in chasing the Shikras out of a fancied site. Crows, tree-pies and similar other egg-and-young stealers usually keep clear of the Shikra's nest. Any impudent ones that dare approach the nest are obliged to beat an hasty retreat as a result of the hot chase given by one or both of the owners. Even larger raptors do not appear to bother these little brave ones

VI—LAYING AND CLUTCH SIZE

Laying may start as soon as the nest is complete or there may be a gap of a couple of days between the cessation of the building activity and the laying of the first egg. The subsequent eggs are laid at intervals of forty-eight hours (Table 1). No particular time of the day appears to be preferred for laying. The normal clutch consists of three to four eggs. Bigger clutches of five have also been recorded (Anderson, 1876, p.780 ; Whistler, 1910, p. 704 ; Lowther, 1944, p. 6).

The eggs are broad ovals, slightly pointed at one end. The texture is fine and smooth. They are devoid of gloss. They are very faint bluish white in colour. No marked eggs were met with during the course of this study, but speckled, spotted and partially or fully blotched eggs clutches have often been recorded by previous workers [“freely marked with minute specks of reddish brown” (Anderson, 1876, p. 780); “lightly speckled at larger end with blackish pin-pricks or with rather larger sub-shell blotches of pale grey or lavender” (Baker, 1935, p. 104); “indistinctly spotted with very faint grey” (Barnes, 1885, p. 23); “few small greyish specks and spots” (Donald, 1920, p. 136); “thinly sprinkled all over with very faint greyish specks and spots” (Hume, 1890, p. 121); “much blotched with reddish brown” (Jerdon, 1877, p. 50); “slightly marked with large faint blotches of brownish yellow” (Jesse, 1903, p. 77); “very faint bluish spots” (Swinhoe & Barnes, 1885, p. 56); “slightly speckled with grey, (Whistler, 1928, p. 291)]. Twenty-one eggs measured 38-40 cm. (average 39.6 cm.) × 30-32 cm. (average 31.8 cm.).

VII—INCUBATION

1. *General*

The female starts sitting as soon as the first egg is laid. She alone appears to do all the incubation. In the beginning she is a loose sitter and may often be found missing from the nest though always present somewhere in the vicinity keeping a watchful eye. During the night she alone covers the clutch, the male roosting in the nesting-tree or in an adjoining one. As the incubation advances she spends most of her time in the nest. Food is invariably brought to her by her mate who alights on a near by branch or tree with food, calls her and flies away after passing the food on to her.

The Shikra is a brave bird as a rule. It tries to put up a gallant defence when the eggs (or young) are threatened. The owners swoop menacingly on the intruders but seldom inflict injury on human ones. There are, however, some timid exceptions who prefer to desert the nest with eggs rather than swoop on human intruders day after day. On two occasions when full clutches were removed, fresh ones were laid after seven and ten days. Partial loss of a clutch does not induce the birds to lay more eggs to complete the clutch. Once the first egg that was laid in the nest was removed on the same day in the hope to find out the maximum number of eggs that would be laid if the eggs went on thus disappearing, but the female out-manoeuvred the move by refusing to lay any more eggs for the next eight days. On the ninth day she laid again. This time the egg was not removed and she was observed to complete her clutch of four. Once a fresh clutch was laid when the single freshly hatched young was removed from the nest. The youngs were often heard hammering at the shell from within, even twenty-four hours before emergence.

2. *Period of incubation*

By period of incubation, I mean, the time elapsed between the laying of the first egg and appearance of the first hatchling. Although a number

of nests were kept under observation during the study ; the period of incubation could be ascertained only in five cases. In all the five cases it turned out to be eighteen days (Table 1).

TABLE 1.—*Laying pattern and period of incubation.*

Nest No.	1st egg laid on	2nd egg laid on	3rd egg laid on	4th egg laid on	1st nestling hatched on	Period in days
5	May 2	May 6	May 6		May 20	18
7	Apr. 5	Apr. 7	Apr. 9	Apr. 11	Apr. 23	18
8	Apr. 21	Apr. 23	Apr. 25	Apr. 27	May 9	18
12	Mar. 28	Mar. 30	Apr. 1		Apr. 15	18
14	May 7	May 9	May 11	May 13	May 25	18

VIII—YOUNG IN THE NEST

1. *Description, growth and behaviour*

The young can be heard tapping the shell from within about twenty-four hours before the emergence. They hatch out one after the other at intervals of twenty-four to forty-eight hours (usually twenty-four in the case of first two), more or less in the sequence in which they are laid. The freshly hatched young are covered with short white down, comprising of preplumulae and prepinnae, all over the body. The eyes are open and are dark in colour. The tips of beak and claws are black and hard. The freshly hatched young cannot stand on their legs till they are four to five days old. Within a week the down on the dorsal side and head turns buffy. As the young grows the preplumulae and prepinnae are gradually replaced by plumulae and teleoptiles, respectively. The teleoptiles start cutting through the skin by the end of the first week. By the end of the second week the wing quills burst from their sheaths. The teleoptiles appear first on the scapulars, back and tail ; next on the flanks and breast, and finally on the head. The nestling down is more or less completely replaced by teleoptiles by the time nestlings are about a month old. The plumage of the young at this stage is brownish above ; white below boldly streaked with dark brown ; tail brownish and barred. The job of feeding the young is mostly left to the female, the male being mainly engaged in procuring the food, which consists of small birds, mice, lizards, frogs, and the like. Pieces of flesh are torn out by the female and deposited in the gaping mouth of the nestlings. The young are fed at irregular intervals and not very frequently, usually three to five times a day.

About a week old nestlings raise their necks when approached and demand food by opening their mouths, spreading the wings and twittering. They show no sign of fear although the parent utters the warning call every time the nest is threatened. The fear complex appears to set in by the end of the second week. At this stage on hearing the warning call of the parent they instantaneously become alert and try to escape

capture (by the human investigator) by moving out of the nest into the adjoining branches. If caught, they express their resentment by biting. When more than two weeks old the nestlings prefer to sit on the edge of or outside the nest. They can fly small distances when three to four weeks old. The fledglings leave the nest when four to five weeks old but remain in the vicinity of the nesting tree for another fortnight or so. During this time they are usually fed by the parents.

2. *Mortality in the young*

The mortality in the young of Shikra does not appear to be very high. There appear to be two main causes of death, namely, starvation and accidents. In spite of the best efforts of the brave parents enough food is not always provided for the full brood. Deaths due to starvation occur mostly in the first or second week. Usually the nestling last to hatch is the one who meets this fate. Being the youngest and hence the weakest of all the brood, it often fails to receive his rightful share which is devoured by the greedy elders. As a result such a nestling goes on becoming weaker with the passage of each day and finally succumbs to hunger. Occasionally a part of the loose nest may give way resulting in a fatal fall of a nestling or a young nestling may lose balance while moving on the fringes of the flimsy nest and die as a result of the fall. A few deaths due to disease and natural calamities cannot, however, be ruled out. The dead nestlings are thrown out of the nest by the parents. During the present study it was observed that out of twenty-one nestlings that hatched in seven nests four failed to leave the nest alive.

3. *Nesting success*

By nesting success, I mean, the ratio of nestlings that flew out of the nest to the number of eggs laid. The nesting success in the Shikra apparently depends upon a number of factors. The important ones being the fertility of eggs laid, accidents to fledglings, amount of food available at nesting stage and deaths due to disease and natural calamities. In the seven nests kept under observation during the course of this study, twenty-five eggs were laid, four eggs did not hatch out, four nestlings died as a result of starvation and fall, and seventeen flew out of the nest (Table 2). The ratio works out to 68 per cent.

TABLE 2.—*Nesting success.*

Nest No.	Total eggs laid	Eggs not hatched	Total hatch	Fledglings died	Fledglings survived
3	4	1	3	1	2
5	3	—	3	—	3
7	4	1	3	1	2
8	4	—	4	1	3
10	4	1	3	—	3
12	3	—	3	1	2
14	3	1	2	—	2
TOTAL	25	4	21	4	17

$17/25=68$ per cent,

IX—SUMMARY

Breeding habits of Shikra, *Accipiter badius* (Gmelin) were studied at Hoshiarpur (Punjab), Poona (Maharashtra), and Vellore (North Arcot, Madras). April to June was found to be the main breeding season. The breeding season commences a little early in southern India, *i.e.*, in March, and lasts a little longer in the northern India. A crow-like, loosely put together nest of twigs, occasionally lined with grass or roots is usually made in a well-screened fork (preferably three or more pronged), in a shady tree. Both sexes take part in the construction of the nest, but the female appears to accomplish the major portion. Three or four very faint bluish-white eggs are laid. Female alone incubates. The period of incubation is eighteen days. The nestlings are nidicolous. Female does most of the feeding whereas male does most of the food hunting. The nestlings leave the nest when they are four to five weeks old. Nesting success in seven nests was observed to be 68 per cent.

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Field ecology of some marine borers (Mollusca : Teredinidae) of mangroves in Sundarbans, India

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(With 1 Table and 1 Text-fig.)

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I—INTRODUCTION

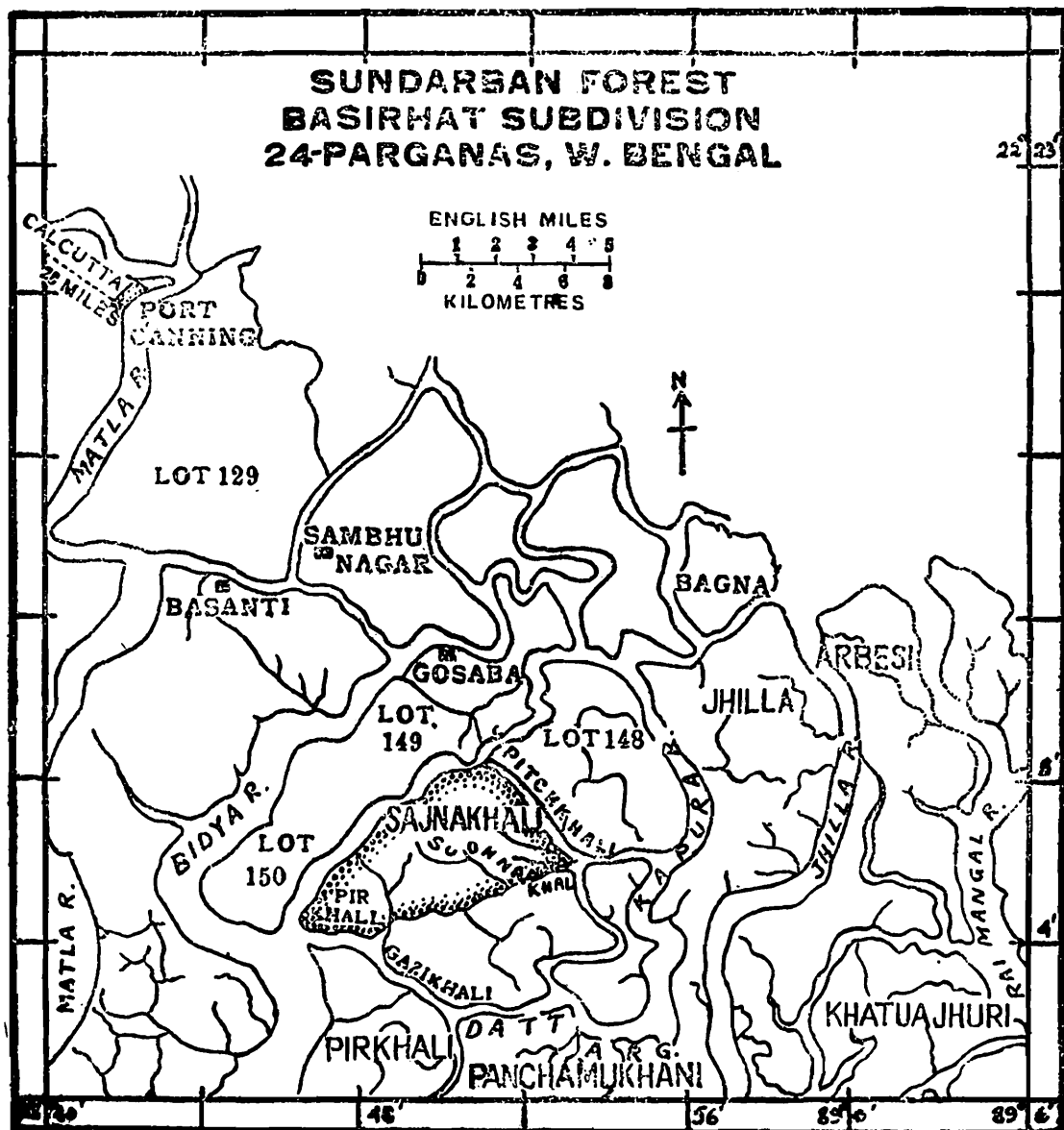
This paper is a report on the marine molluscan borers, collected in 1958 and 1961 from Port Canning and Sajnakhali, in the Sunderbans, West Bengal.

About 600 examples representing altogether four genera and six species were collected. The great majority of them were extracted from living mangrove trees which were lining the edges of khals, creeks and streams intersecting one another and subdividing the Gangetic delta ; others were obtained from dead stems or trunks of mangrove trees and other infested logs of wood, like piles of jetty. During high tide the mangrove trees at the edges of canals, creeks, etc., are partially or completely submerged, and when the tide ebbs they are again exposed. Thus, these trees under intermittent tidal influence become vulnerable to borer attack.

Rec. Zool. Surv. India, 62 (182), 1970.

The first study of the Teredinid borers of Sundarbans was by Roonwal (1954). He traced the destructive role of *Bactronophorus thoracites* (Gould) on living mangrove trees. Ganapati and Rao (1959) studied the borers from mangroves of Godavari estuary and reported the occurrence of four species. Three new species have been reported by Rajagopalaiengar (1961) and Rajagopal (1964) based on a study of a part of the above material. Three more species which were not accounted for earlier are dealt with here associating some remarks on field observations on each species.

My grateful thanks are due to Dr. M.L. Roonwal, Director, Zoological Survey of India, for kindly going through the paper and giving valuable suggestions.



TEXT-FIG. 1.—Map of Sundarbans, Basirhat Subdivision, 24-Parganas, W. Bengal, indicating the area surveyed: Sajnakhali Reserve Forest (Shaded portion).

II—ECOLOGICAL ACCOUNT

1. *Teredo (Kuphus) manni* Wright

1866. *Kuphus manni* Wright, *Trans. Linn. Soc. Lond.*, London, 25(3), p 565, pl. 65, figs. 1-8.

Material.—LOT A.—(i) Coll. A. S. Rajagopalaiengar, 87 examples, Edge of Matla R. at low tide, Port Canning, 24-Parganas, 9-17 January, 1958, ex. a trunk of a dead tree. LOT B.—Coll. H. C. Ray, Sajnakhali. lat. 28° 7' N., long. 88° 50' E., 24-Parganas, 21-28. iii. 1958, as follows :—(ii) 4 examples, Forest Ghat, 21. iii. 1958, ex. a log of damaged wood. (iii) 40 examples, S. bank of Sajnakhali Khal, c. 2.5 Km. E. of Forest Office, 22-24 and 28. iii. 1958, ex. pieces of living mangrove trees. (iv) 3 examples, S. Bank of Sajnakhali Khal, W. of Forest Office, 24. iii. 1958, ex. pieces of living mangrove tree. (v) 10 examples, bank of Gomdi Khal near Pakhirala village, N. W. of Forest Office, 25. iii. 1958, ex. pieces of living mangrove trees. (vi) 2 examples, Tetulbaria camp area c. 13-18 Km. S. W. of Forest Office, 25-26. iii. 1958, ex. pieces of living mangrove trees. LOT C.—Coll. A. S. Rajagopalaiengar, Sajnakhali, lat. 28° 7' N., long. 88° 50' E., 24-Parganas, April-May, 1961, as follows :—(vii) 2 examples, Baentolla-Bharani, a creek c. 1 Km. W. of Forest Office, 26. iv. 1961, ex. a piece of *sundari* tree. (viii) 1 example, Baentolla-Bharani, a creek c. 1 Km. W. of Forest Office, 27. iv. 1961, ex. a piece of *baen* tree. (ix) 3 examples, Baentolla-Bharani, a creek c. 1 Km. W. of Forest Office, 27. iv. 1961, ex. a piece of *gengwa* tree. (x) 5 examples, S. bank of Sajnakhali Khal and Gomdi Khal c. 1.6 Km. W. of Forest Office, 28. iv. 1961, ex. a piece of *gengwa* tree. (xi) 4 examples, S. bank of Sajnakhali Khal and Gomdi Khal c. 1.6 Km. W. of Forest Office, 28. iv. 1961, ex. a piece of *dhundal* tree. (xii) 13 examples, S. bank of Sajnakhali Khal c. 3 Km. E. of Forest Office, 29. iv. 1961, ex. a piece of *gengwa* tree. (xiii) 1 example, S. bank of Sajnakhali Khal c. 3 Km. E. of Forest Office, 29. iv. 1961, ex. a piece of *goran* tree. (xiv) 6 examples, bank of Gomdi R. c. 5 Km. W. of Forest Office, 30. iv. 1961, ex. a piece of *khalshi* tree. (xv) 11 examples, bank of Pichkhal c. 6 Km. E. of Forest Office, 1. vi. 1961, ex. a piece of *gengwa* tree. (xvi) 6 examples, Sajnakhali Forest Office jetty, 2. v. 1961, ex. a piece of *pussur* wood. (xvii) 4 examples, Sudhanyakhali c. 13 Km. S. of Forest Office, 2. v. 1961, ex. a piece of *sundari* tree. (xviii) 10 examples, Sudhanyakhali c. 13 Km. S. of Forest Office, 3. v. 1961, ex. a piece of *baen* tree.

Observations.—This is by far the commonest species. For its attack it seems to favour *baen* and *gengwa* in preference to other trees. When freshly extracted from the trees, the borer in living condition is dull bluish in its anterior third. When occurring in other kinds of trees it generally acquires the same colour as of the wood infested. It usually attains great length—an example measuring 91.44 cm. (ca. 3 feet) in living condition was obtained. The burrow or tunnel is lined with a thick calcareous shell-tube which is extra hard posteriorly. At the posterior end the aperture of the shell-tube is, as a rule, divided by a horizontal septum into upper and lower compartments for the projection of exhalent and inhalent siphons.

TABLE 1.—Measurements (in mm.) of some Teredinid borers from Sundarbans, West Bengal.

Body-part	<i>Teredo</i> (<i>Kuphus</i>) <i>mannii</i>	<i>Bankia</i> (<i>Liliobankia</i>) <i>campenellata</i>	<i>Bactronophorus</i> <i>thoracites</i>
	(15 exs.)	(12 exs.)	(2 exs.)
1. Total length	25-405 (in spirit) 91.44 (living)	33-80 (in spirit)	180-215 (in spirit)
2. Length of shell	4-12 (in spirit)	4-8 „	11.5-13.0 „
3. Height of shell	4-12 „	4-8 „	11.5-13.0 „
4. Length of pallet	3-9 „	5-20.5 „	17-21 „
5. Length of stalk	1.5-5.0 „	3-7 „	6.0-7.50 „
6. Length of blade	1.5-6.0 „	2.5-14.0 „	11.0-13.50 „
7. Diameter of blade	1-3 „	—	—

Distribution.—Indian Ocean (East African Coast, Kerimba Islands, Madagascar, Reunion) ; Malaya : Singapore ; Cochin-China ; Tonkin ; Indonesia : Sumatra : Bebalan, Belawan Deli, Pantai Tjermin, Soengsang ; Rhiouw-Archipelago : Tandjoeng Balei, Tandjoeng Pinang ; Moena (South Celebes), Ambonia ; New Guinea ; Bismarck Archipelago ; Philippines ; Australia (Brisbane).

2. *Bankia* (*Liliobankia*) *campenellata* Moll and Roch

(Table 1)

1931. *Bankia campenellata* Moll and Roch, *Proc. malac. Soc. Lond.*, London, 19 (4), p. 215.

1955. *Bankia* (*Liliobankia*) *campenellata* Roch, *Zool. Meded.*, Leiden, 34 (8), p. 140, figs. 7-j&k.

Material.—LOT A.—(i) Coll. A. S. Rajagopalaiengar, 15 examples, edge of Matla R. at low tide, Port Canning, 24-Parganas, 12-16 January, 1958, ex. a trunk of a dead tree. LOT B.—H. C. Ray, Sajnakhali, lat. 28° 7' N., long. 88° 50' E., 24-Parganas, 23-25. iii. 1958 as follows :—(ii) 2 examples, S. bank of Sajnakhali Khal, c. 2.5 Km. E. of Forest Office, 23. iii. 1958, ex. pieces of living mangrove trees. (iii) 4 examples and 2 pallets, Tetulbaria camp, c. 17 Km. S. W. of Forest Office, 25. iii. 1958, ex. pieces of living mangrove trees. LOT C.—Coll. A. S. Rajagopalaiengar, Sajnakhali, lat. 28° 7' N., long. 88° 50' E., 24-Parganas, April-May, 1961, as follows :—(iv) 14 examples and 9 pallets, Baentolla-Bharani, a creek c. 1 Km. W. of Forest Office, 26-27. iv. 1961. ex. a piece of *gengwa* tree. (v) 12 examples, bank of Gomdi R., c. 5 Km. W. of Forest Office, 30. iv. 1961, ex. a piece of *goran* tree. (vi) 15 examples, Sajnakhali Forest Office jetty, 1-3. v. 1961, ex. pieces of *pussur* wood. (vii) 2 examples, Sudhanya Khal c. 13 Km. S. of Forest Office, 3. v. 1961, ex. a piece of *baen* tree.

Observations.—Clench and Turner (1946) traced in detail the extent of confusion that prevails under the old name *Bankia campanulata* and

hinted that the present species may possibly be their *B. katherinae*. Roch (1955), while relegating it to subgenus *Liliobankia*, regards it as distinct from *katherinae*.

This species is less common than the previous one. It does not attain great length. Full-grown borers of more than 100 mm. in length are rare. The species seems to prefer *gengwa* tree, and occasionally *goran* and *pussur*. Its occurrence in *baen* was met with only once. When freshly extracted, the anterior half of the body is bright red in the living condition. Also, the rhythmic functioning of the heart is visible clearly through the almost transparent mantle. The burrow is lined with a thin tube of shell-material which is flimsy and often comes off when the borer is extracted. The posterior end of the tube is more or less conical and the aperture is without a septum.

Distribution.—Reunion Is., India ; Malaya Archipelago ; Indonesia : Sumatra.

3. *Bactronophorus thoracites* (Gould)

1856. *Teredo thoracites* Gould, *Proc. Boston Soc. nat. Hist.*, Boston, 6, p. 15.

Material.—Coll. H. C. Ray, Sajnakhali, lat. 28° 7' N., long. 88° 50' E., 24-Parganas, 23-24. iii. 1958, as follows :—(i) 1 example, S. bank of Sajnakhali Khal, E. of Forest Office, 23. iii. 1958, ex. pieces of living mangrove trees. (ii) 1 example, S. bank of Sajnakhali Khal, W. of Forest Office, 24. iii. 1958, ex. pieces of living mangrove trees.

Observations.—This is the least common species in the area as can be judged from the number of examples (only two) obtained. It seems to grow to a fairly large size and has large and stout shells. The siphons are rather short and conjoined almost to the tip. The shell-lining of the tunnel, though quite thick, is fragile.

Distribution.—India (Bombay, Visakhapatnam) ; Burma (Mergui Archipelago) ; Cochin-China ; Singapore ; Indonesia (Sumatra : Belawan Deli ; Rhiouw Archipelago : Tandjoeng Balei ; Borneo, Moluccas) ; New Guinea ; Philippines ; Australia (North Australia, Queensland).

III—FIELD OBSERVATIONS

In the Sundarbans, West Bengal, the following mangrove trees were observed to be commonly attacked by the Teredinid borers :—

<i>Popular name (Bengali)</i>	<i>Scientific name</i>	<i>Family</i>
1. Baen	<i>Avicennia officinalis</i> L.	} Verbenaceae
	„ <i>alba</i> Blume	
	„ <i>marina</i> Vier- happer	
2. Dhundal	<i>Carapa obovata</i> Blume	Meliaceae
3. Gengwa	<i>Excoecaria agallocha</i> L.	Euphorbiaceae

<i>Popular name (Bengali)</i>	<i>Scientific name</i>	<i>Family</i>
4. Goran	<i>Ceriops decandra</i> Ding Hou (= <i>C. roxburghiana</i> Arn.)	} Rhizophoraceae
	<i>Ceriops taqal</i> (Perry) Robin- son (= <i>C. candolleana</i> Arn.)	
5. Khalsi	<i>Aegiceras corniculatus</i> (L.)	Myrsinaceae
6. Pussur	<i>Xylocarpus molluccensis</i> Roemer (= <i>Carapa molluccensis</i> Lam.)	} Meliaceae
7. Sundari	<i>Heretiera fomes</i> Buchnan- Hamilton	Sterculiaceae

It was noticed that none of the Monocot plants showed any sign of attack.

Four genera namely *Teredo*, *Bankia*, *Nausitora* and *Bactronophorus*, altogether comprising six species occur in this area. *Teredo* and *Bactronophorus* are represented by a single species each, while the other two genera by two each. The following is the complete list of species occurring here :—

1. *Teredo (Kuphus) manni* Wright.
2. *Bankia (Liliobankia) campenellata* Moll & Roch.
3. *Bankia (Neobankia) roonwali* Rajagopalaiengar.
4. *Nausitora lanceolata* Rajagopal.
5. „ *sajnakhaliensis* Rajagopal.
6. *Bactronophorus thoracites* (Gould).

There seems to be a degree of preference on the part of these borers to the kind of trees they attack. *Teredo (Kuphus) manni* seems to favour *baen* and *gengwa* in which it occurs in larger numbers than in other trees. *Bankia (Neobankia) roonwali* and *Nausitora lanceolata* appear to prefer *goran*, *pussur* and *sundari*. *Bankia (Liliobankia) campenellata* occurs commonly in soft woods like *gengwa*, and less commonly in *goran*, *pussur* and *sundari* and rarely in *baen*. All the three examples of *Nausitora sajnakhaliensis* were obtained from *goran*. Whether this indicates any preference cannot be conclusively stated. No observation was possible regarding *Bactronophorus thoracites* since only two examples were obtained.

The most dominant species in respect of numbers and size is *T (K.) manni* and the rarest are *N. sajnakhaliensis* and *B. thoracites*. Of the remaining three species, *B.(L.) campenellata* is the least common and the other two occur in more or less equal numbers.

The Isopod borer, *Sphaeroma* sp., was also found to attack wood infested by the Teredinid borers in one or two instances. However, *Maresin* (family Pholadidae) was conspicuous by its absence.

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Fauna of Rajasthan, India. Part 5. Aquatic beetles (Insecta : Coleoptera : Dytiscidae)

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(With 4 Text-figures)

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I—INTRODUCTION

This is a report on the collection of aquatic beetles of the family Dytiscidae from Rajasthan, collected by the Zoological Survey of India parties as indicated below during the years 1941-1960; the author himself was a member of the collecting parties in 1956 and 1958. Recently Baid (1959) recorded three species, namely, *Cybister tripunctatus asiaticus* Sharp, *Eretes sticticus* (Linn.) and *Hyphoporus severini* Regimbart from the Sambhar Lake proper. There does not appear to be any other record of these beetles from Rajasthan. Altogether 22 species belonging to 13 genera are recorded here. Of these, 19 species are recorded from Rajasthan for the first time.

For an account of the topography, climate, vegetation, etc. of Rajasthan, see Part 1 (General Introduction) of this series of papers (Roonwal, 1969, *Rec. Zool. Surv. India*, Vol. 61 (3 & 4), pp. 291—375.

The abbreviation 'ex.' has been used for example or examples as the case may be.

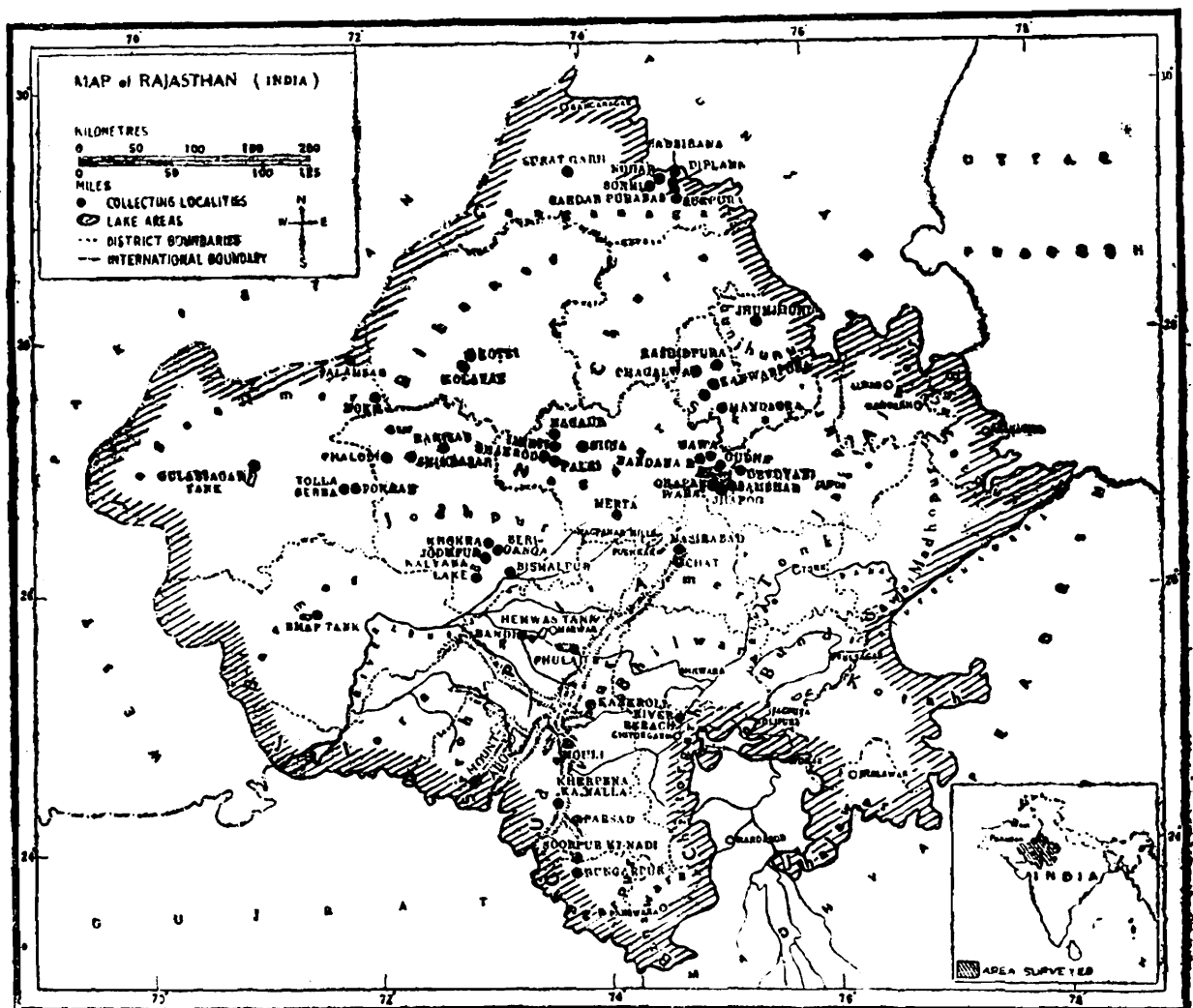
Rec. Zool. Surv. India. 62 (1 & 2) 1970.

(29)

I am grateful to Dr. M. L. Roonwal, Director, Zoological Survey of India, for giving me an opportunity to study the above collections and for his valuable suggestions. My sincere thanks are also due to Dr. A. P. Kapur for his kind encouragement and to my senior colleague Shri K. S. Pradhan for his valuable help in the preparation of the manuscript.

The present account is based on the following collections(Text-fig. 1.) :—

Places visited	Name of Collector and Year of Collection
1. Udaipur and Dungarpur State (Chittorgarh, Barapal, Dungar)	B. N. Chopra and M. L. Roonwal (Oct., 1941).
2. Udaipur, Sirohi and Palanpur States (Mavli, Phulad, Mount Abu, Deesa, Palanpur)	K. S. Pradhan, (Feb.-Mar., 1948).
3. Sambhar Lake, Nawa, Nasirabad, Pali, Merta city	Z. S. I. Party (B. Biswas and T. G. Vazirani) (Nov.-Dec., 1956).
4. Sambhar Lake, within a radius of 16 Km. (ten miles) (Nawa, Jhapog, Phulera, Bahadurpur, Koni)	T. G. Vazirani (Jan.-June, 1958).
5. Sikar District (Rampura, Singaran, Gangara, Malosi, Rashidpura, Dasaki Dhani, Charaubos, Piparali, Choklakabos).	J. S. Bhatti (Nov., 1960).



TEXT-FIG. 1.—Map of Rajasthan, showing the collecting localities for Dytiscid beetles.

II—LIST OF SPECIES

The following species are known from Rajasthan and are discussed in this paper.

Family DYTISCIDAE

Subfamily (i) NOTERINAE

1. *Canthydrus laetabilis* (Walker)

Subfamily (ii) LACCOPHILINAE

2. *Laccophilus chinensis inefficiens* Walker
3. *L. parvulus* Aube
4. *L. flexuosus* Aube
5. *L. sharpi* Regimbart

Subfamily (iii) HYDROPORINAE

6. *Hyphydrus flavicans* Regimbart
7. *Herophydrus musicus* (Klug)
8. *Hydrovatus confertus* Sharp
9. *Guignotus flammulatus* (Sharp)
10. *G. inconstans* (Regimbart)
11. *G. pendjabensis* Guignot
12. *G. pusillus* (Fabricius)
13. *Hyphoporus severni* Regimbart
14. *H. kempi* Gschwendtner
15. *H. nilghiricus* Regimbart

Subfamily (iv) COLYMBETINAE

16. *Rhantus taprobanicus* Sharp

Subfamily (v) DYTISCIANAE

17. *Eretes sticticus* (Linnaeus)
18. *Hydaticus fabricii* Macleay
19. *H. luczonicus* Aube
20. *Rhantaticus congestus* (Klug)
21. *Sandracottus dejeani* (Aube)
22. *Cybister tripunctatus asiaticus* Sharp

III—SYSTEMATIC ACCOUNT

Key to subfamilies of family Dytiscidae

- | | |
|--|---------------|
| 1. Scutellum invisible | 2 |
| Scutellum visible | 4 |
| 2. Fourth segment of the pro-and meso-tarsi much reduced, hardly visible. Prosternal process arched and oblique | Hydroporinae |
| Fourth segment of the pro-and meso-tarsi not reduced, subequal to the third tarsal segment. Prosternal process straight, occasionally a little depressed | 3 |
| 3. Posterior legs with two tarsal claws of equal length ; sides of the pronotum rebordered | Noterinae |
| Posterior legs with a single(thick) tarsal claw ; sides of the pronotum not rebordered | Laccophilinae |
| 4. Anterior border of the eyes excised ; three basal segments of the pro-tarsi enlarged but not forming a large palette | Colymbetinae |
| Anterior border of the eyes not excised ; three basal segments of the pro-tarsi enlarged into rounded, oval or sub-triangular palette | Dytiscinae |

Subfamily NOTERINAE

Key to the tribes and Indian genera

- | | |
|--|------------------------------------|
| 1. No curved spurs on the apex of the pro-tibiae | Notomicrini (<i>Hydrocoptus</i>) |
| Curved spurs on the apex of the pro-tibiae present | 2 |
| 2. Prosternal process rounded behind ; meta-femora usually without ciliae | Noterini (<i>Neterus</i>) |
| Prosternal process truncate behind ; meta-femora with long ciliae ; meta-coxal cavities contiguous | 3 Hydrocantini |
| 3. Prosternal process very broad ; meta-tibiae also very broad, size 4- 7mm. | <i>Hydrocanthus</i> |
| Prosternal process moderately broad ; meta-tibiae rather slender ; size less than 4 mm. | <i>Canthydrus</i> |

Genus 1. *Canthydrus*1. *Canthydrus laetabilis* (Walker)

1858. *Hydroporus laetabilis* Walker, *Ann. Mag. nat. Hist.*, London, 2(3), p. 205.

1920. *Canthydrus laetabilis* : Zimmermann, *Coleopt. Catal. Junk.*, Berlin, 4, p. 11.

Material.—39 ex. as follows :—Nasirabad, 28. xi. 1956, 1 ex. ; Pali 6. xii. 1956, Stn. 20, 20 ex. ; Bahadurpur, 27. iv. 1958, 2 ex. ; Sambhar Lake, 28. iii. 1958, 6 ex. ; 27. iv. 1958, 2 ex. ; On road to Naraina from Sambhar Lake, 23. iii. 1958, 7 ex.

Remarks.—The species has been previously recorded in India from Madras, Konbir and Mandar (Bihar) and also from Ceylon (Colombo) and Burma. It generally occurs along with *C. luctuosus* (Aube).

Subfamily LACCOPHILINAE

Key to the Indian Genera

1. Prosternal process simple ; posterior angles of the pronotum not directed backwards . *Laccophilus*
- Prosternal process tridentate ; posterior angles of the pronotum acute, directed backwards and closely fitting the elytra . *Neptosternus*

Genus 2. *Laccophilus*

Key to the species known from Rajasthan

1. Elytral markings consisting of small irrotations in the form of checker board ; sub-basal fascia of the elytra with six pallid radiating lines towards the base *chinensis inefficiens*
- Elytral markings consisting of longitudinal undulating lines 2
2. Elytral markings flexuosus, excessively irregular covering the whole surface, except the lateral margins *flexuosus*
- Elytral markings with zig-zag double clear lines, some times becoming thick and coalescent 3
3. Elytra with zig-zag double lines, markings generally thick and coalescent ; penis as seen in fig. 1a *parvulus*
- Elytra with zig-zag lines not coalescent ; penis as seen in fig. 1b *sharpi*

2. *Laccophilus chinensis inefficiens* Walker

(Text-fig. 2d)

1858. *Laccophilus chinensis* Boheman, *K. Sv. Fregatten Eugenies Resa, ... Zoologi*, 1, Insecta, Stockholm, 2, p. 21.
1859. *Laccophilus inefficiens* Walker, *Ann. Mag. nat. Hist.*, London, 3(3), p. 51.
1920. *Laccophilus chinensis* var. *inefficiens* : Zinnemann, *Coelopt. Catal*, Junk, Berlin, 4, p. 17.

Material.—3 ex. as follows :—Pali, 6. xii. 1956, 1 ex. ; Nawa, 15. xi. 1956, 2 ex.

Remarks.—*L. inefficiens* was described by Walker (*t.c.*) from Ceylon. Regimbert (1899) considered it to be a variety of *L. chinensis* (type-locality : China). The nominotypical form has so far been recorded only from China and the var. *inefficiens* is confined to Ceylon, India and Burma. *L. inefficiens* is considered here as a subspecies on the basis of geographical isolation from the nominotypical form. The penis is figured here (Text-fig. 2*d*). In India it has been previously recorded from Mandar and Konbir (Bihar) and the Ghats.

3. *Laccophilus parvulus* Aube

(Text-fig. 2*a*)

1838. *Laccophilus parvulus* Aube, in Dejean's *Species Coleopteres*, Paris, 6, p. 429.

1920. *Laccophilus parvulus* : Zimmermann, *Coleopt. Catal. Junk*, Berlin, 4, p. 24.

Material.—35 ex. as follows :—Pali, 6. xii. 1956, 4 ex. ; Nawa, 15. xi. 1956, 20 ex. ; Sikar Dist., 8. xi. 1956, 1 ex. ; Sikar Dist., 13. xi. 1960, 3 ex. ; Sikar Dist., 13. xi. 1960, 1 ex. ; Sambhar Lake, Gudha, 30. i. 1958, 2 ex. ; Nasirabad, 28. xi. 1956, 4 ex.

Remarks.—The species was originally described from Sumatra and is very variable in the character of the elytral markings. The penis (Text-fig. 2*a*), however, affords a more reliable character for identification. It is widely distributed in Ceylon, India, Burma, Thailand, Sumatra, Malaya (Singapore), Cochin-China, Annam and Celebes. In India it has been recorded from Pondicherry, Tetara, Mandar and Konbir.

4. *Laccophilus flexuosus* Aube

(Text-fig. 2*c*)

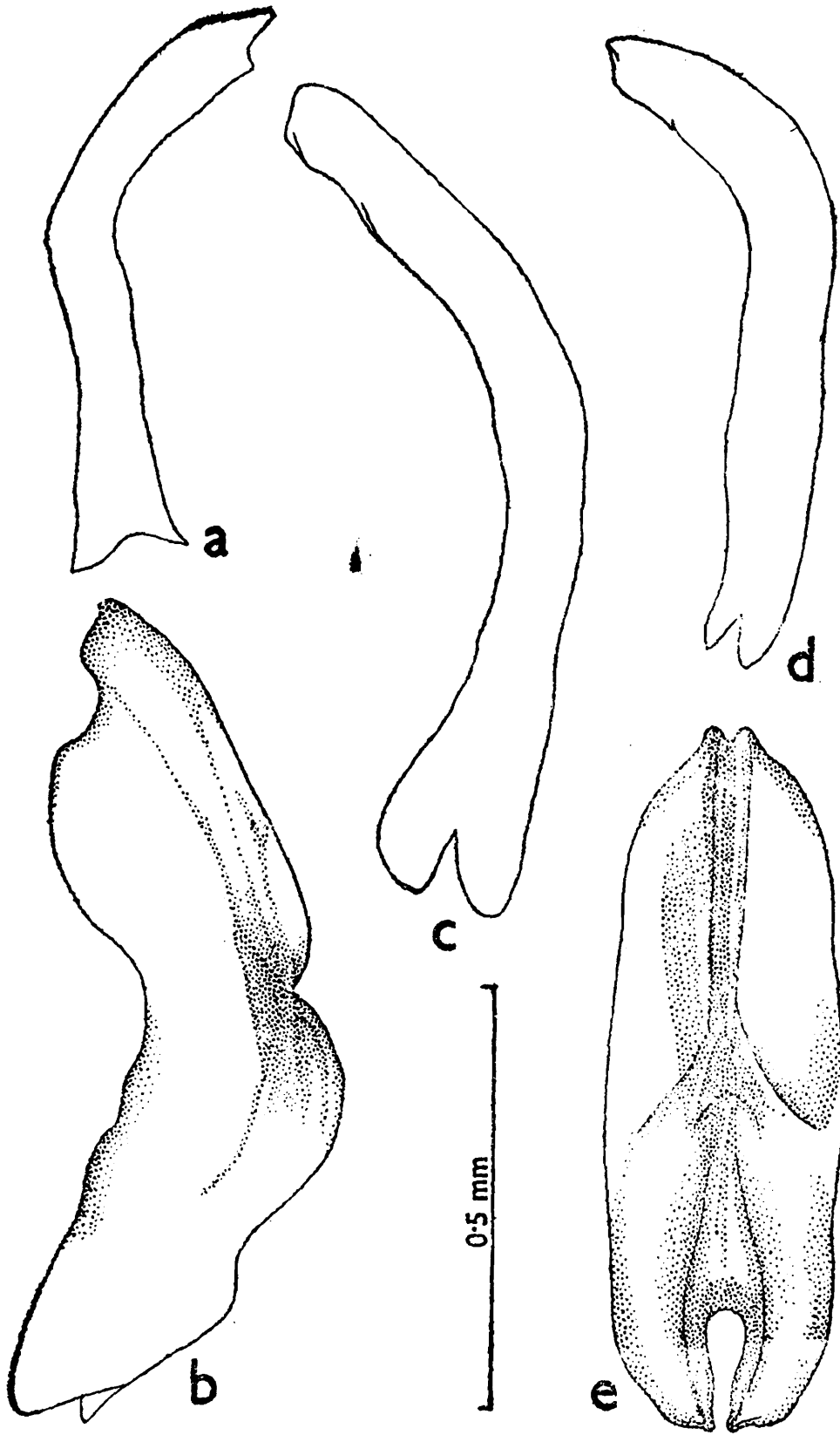
1838. *Laccophilus flexuosus* Aube, in Dejean's *Species Cloeopteres*, 6, p. 430.

1920. *Laccophilus flexuosus* : Zimmermann, *Coleopt. Catal. Junk*, Berlin, 4, p. 18.

1959. *Laccophilus flexuosus* : Guignot, *Bull. mens. Soc. Linn., Lyon*, Lyon, 28, p. 11.

Material.—49 ex. as follows :—Sambhar Lake, 12. xii. 1956, 5 ex. ; 22. xi. 1956, 5 ex. ; Nasirabad, 28. xi. 1956, 6 ex. ; Pali, 6. xii. 1956, 3 ex. ; Merta City, 26. xii. 1956, 1 ex. ; 27. xii. 1956, 3 ex. ; 28. xii. 1956, 16 ex. ; 31. xii. 1956, 6 ex. ; Phulera, 11. iii. 1958, 1 ex. ; Bahadurpur, 27. iv. 1958, 2 ex. ; Gudha, 30. i. 1958, 1 ex.

Remarks.—It inhabits all places, viz., ponds, tanks, pools, river beds, etc. Its known distribution is, India (Bombay, Konbir, Mandar, Tetara, Mettur Dam) ; W. Pakistan ; Burma. The penis (Text-fig. 2c) is more evenly curved from the base to the apex than in *L. parvulus* or *L. chinensis inefficiens*.



TEXT-FIG. 2.—Lateral view of penis of : (a) *Laccophilus parvulus* ; (b) *L. sharpi* ; (c) *L. flexuosus* ; (d) *L. chinensis inefficiens*, and (e) *Rhantaticus congestus* (Dorsal view).

5. *Laccophilus sharpi* Regimbart

(Text-fig. 2b)

1882. *Laccophilus flexuosus* Sharp *nec* Aube, *Sci. Trans. R. Dublin Soc.* Dublin, 2, p. 310. (In part.)
1889. *Laccophilus sharpi* Regimbart, *Ann. Soc. ent. Fr.*, Paris, (6)9, p. 151.
1920. *Laccophilus sharpi*: Zimmermann, *Coleopt. Catal. Junk.*, Berlin, 4, p. 26.
1959. *Laccophilus sharpi*: Guignot, *Bull. mens. Soc. Linn. Lyon.* Lyon, 28, p. 11.

Material.—50 ex., as follows :—Sambhar Lake, 12. xi. 1956, 7 ex. ; 22. xi. 1956, 5 ex. ; Nawa, 15. xi. 1956, 10 ex. ; Nasirabad, 28. xi. 1956, 1 ex. ; Pali, 5. xii. 1956, 1 ex. ; 6. xii. 1956, 5 ex. ; Merta-city, 31. xii. 1956, 1 ex. ; 27. xii. 1956, 1 ex. ; Gudha, 30. i. 1958, 2 ex. ; Bangadh, -. iii. 1958, 3 ex. ; On road to Naraina from Sambhar Lake, 23. iii. 1958, 1 ex. ; Phulera, 11. iii. 1958, 2 ex. ; On road to Dudu from Sambhar Lake, 11. iv. 1958, 5 ex. ; Bahadurpur, 27. vi. 1958, 6 ex.

Remarks.—This species is widely distributed in W. Pakistan, India, Burma, China, Cochin-China, Japan, Sumatra, Java, New Guinea and Australia. The elytral markings being quite variable, the structure of the penis (Text-fig. 2b) helps considerably in the identification.

Subfamily *HYDROPORINAE**Key to the tribes and genera known from India*

- | | |
|--|-----------------------------------|
| 1. Prosternal process much deflected from the general direction of the prosternum ; protarsi usually with 4 segments | 2 |
| Prosternal process little deflected from the general direction, protarsi with 5 segments | Methlini (<i>Methles</i>) |
| 2. Claws of the metatarsi mostly unequal, the external claw nearly invisible | 5 Hyphidriini |
| Claws of the metatarsi equal | 3 |
| 3. Prosternal process broadened at the apex ; sutural angles of the elytra acuminate | Hydrovatini (<i>Hydrovatus</i>) |
| Prosternal process not broadened at the apex | 4 |
| 4. Pronotum marked with a latero-basal striae on both the sides, pronotal striae generally continued on the elytra | 6 Bidessini |
| Pronotum not marked with any striae on both the sides | 9 Hydroporini |
| 5. Prosternal process oblong ; size more than 2 mm. | <i>Hyphydrus</i> |
| Prosternal process lanceolate lobate, the apex rounded, not acuminate ; size approx. 2 mm. | <i>Microdytes</i> |

6. Head with a fine* transverse cervical stria	7
Head without a transverse cervical stria	9
7. Epipleurae excavated at base, forming a cavity delimited by a margin, more rarely a simple ridge. Epistome with front edge raised. Pronotal striae well developed	<i>Clypeodytes</i>
Epipleurae at base not excavated and without a ridge delimiting a basal cavity	8
8. Elytra with longitudinal costae, rarely indistinct	<i>Yola</i>
Elytra without longitudinal costae, but with a sutural striae	<i>Bidessus</i>
9. Elytra with sutural striae	<i>Guignotus</i>
Elytra without a sutural striae	<i>Uvarus</i>
10. Base of the epipleurae with an oblique cavity	11
Base of the epipleurae without any oblique cavity	14
11. Clypeus not rebordered in front	<i>Coelambus</i>
Clypeus rebordered in front	12
12. The rebordered clypeus not interrupted in the middle	<i>Hygrotus**</i>
The rebordered clypeus interrupted in the middle	13
13. Basal portion of the epipleurae very narrow, humeral area limited behind by a well marked raised line ; metacoxal cavities approximate	<i>Herophydrus</i>
Basal portion of the epipleurae not so narrow, humeral area not limited behind by a well marked raised line ; metacoxal cavities well separated	<i>Hyphoporus</i>
14. Posterior border of the metacoxal processes straight lined	15
Posterior border of the metacoxal processes notched in the middle or on the sides	16
15. Elytra with longitudinal carina	<i>Peschetius</i>
Elytra without longitudinal carina	<i>Hydroporus</i>
16. Punctuation of the elytra double	<i>Deronectes</i>
Punctuation of the elytra simple	<i>Potamonectes</i>

*This cervical stria runs completely across the vertex of the head from the hind edge of the compound eye to the hind edge of the other.

**Not known from India.

Genus 3. **Hyphydrus**6. **Hyphydrus flavicans** Regimbart

1892. *Hyphydrus flavicans* Regimbart, *Ann. Soc. ent. Bclg.*, Brussels **36**, p. 115.

1920. *Hyphydrus flavicans* : Zimmermann, *Coleopt. Catal. Junk*, Berlin, **4**, p. 40.

Material.—14 ex. as follows :—Palanpur, Banas river, 15. iii. 1948, 1 ex. ; Sambhar Lake, 20. xi. 1956, 1 ex. ; 22. xi. 1956, 1 ex. ; Merta-city, 31. xii. 1956, 1 ex. ; Phulera, 11. iii. 1948, 1 ex. ; Bahadurpur, 27. iv. 1958, 3 ex. ; Bangadh, 1958, 2 ex. ; Gudha, 15. v. 1958, 3 ex. ; Jhapog, 15. v. 1958, 1 ex. ; Koni, 24. v. 1958, 1 ex.

Remarks.—This species was originally described from Konbir-Nowatoli, Chota-Nagpur (Bihar), and subsequently recorded by Regimbart (1899) from Vedantagal, South Arcot and Pondicherry. The present record from Rajasthan extends its distribution westwards. The species is closely related to *H. lyratus* Swartz (a widely distributed species in South-East Asia) in having a small spine on the first abdominal sternite directed backwards and two small tubercles on the apical sternite (in males). The two species also resemble each other in having elongate depression in the middle of the lateral side of each elytron. Apart from the range of distribution, *flavicans* is smaller in size and more oval ; the colouration is entirely reddish, being darker in *lyratus*. The clypeus is also less rounded and more finely rebordered and the contour of the sides of the pronotum is more continued with the elytral shoulders.

Genus 4. **Herophydrus**7. **Herophydrus musicus** (Klug)

1833. *Hydroporus musicus* Klug, *Symbolae Physicae*, Berlin, **4**, p. 33, fig. 12.

1920. *Herophydrus musicus* : Zimmermann, *Coleopt. Catal. Junk*, Berlin, **4**, p. 74.

Material.—22 ex. as follows :—Sambhar Lake, 12. xi. 1956, 1 ex. ; 20. xi. 1956, 3 ex. ; 22. xi. 1956, 1 ex. ; 30. i. 1958, 1 ex. ; Nawa, 15. xi. 1956, 3 ex. ; Nasirabad, 28. xi. 1956, 1 ex. ; Pali, 5. xii. 1956, 1 ex. ; 6. xii. 1956, 2 ex. ; Merta-city, 27. xii. 1956, 1 ex. ; 31. xii. 1956, 4 ex. ; Phulera, 11. iii. 1958, 2 ex. ; Jhapog, 1 iii. 1958, 1 ex. ; Mount Abu, 7. iii. 1948, 1 ex.

Remarks.—This species has been recorded from Mandar (Bihar), by Regimbart (1899), and from Nepal by Gschwendtner (1935). The world distribution extends westwards to Turkistan, Egypt and Iraq. The elytral pattern, which according to Regimbart (1899) consists of five longitudinal black lines, is variable in that the lateral-most line is occasionally wanting in some examples while in others the fourth line is often abridged and represented by a small lateral line in the middle.

Genus 5. **Hydrovatus**

8. **Hydrovatus confertus** Sharp

1882. *Hydrovatus confertus* Sharp, *Sci. Trans. R. Dublin Soc.*, Dublin, 2, p. 329.

1920. *Hydrovatus confertus* : Zimmermann, *Coleopt. Catal. Junk*, Berlin, 4, p. 32.

Material.—2 ex. as follows :—Pali, 5. xii. 1956, 1 ex. ; 6. xii. 1956, 1 ex.

Remarks.—Originally described from Siam, the species has been recorded in India from Konbir-Nowatoli, Tetara, Pondicherry and Mettur Dam. Its range of distribution includes Ceylon, Burma, Siam, Cochin-China, Java, Sumatra and Borneo. This species is often confused with *fractus* Sharp in which the sides of the pronotum are more parallel and thus the humeral region of the elytra bulges out a little in contour ; further, in the male the antennal segments in the middle are slightly dilated in this species.

Genus 6. **Guignotus**

Key to the species known from Rajasthan

- | | |
|--|---------------------|
| 1. Species without any elytral markings | <i>inconstans</i> |
| Species with elytral markings | 2 |
| 2. Each elytron with two longitudinal brown markings terminating at the apex in the form of a crochet on the external side | <i>pendjabensis</i> |
| Elytral markings different | 3 |
| 3. Pronotal striae oblique, not continued on the elytra | <i>flammulatus</i> |
| Pronotal striae oblique, continued on the elytra | <i>pusillus</i> |

9. **Guignotus flammulatus** (Sharp)

1882. *Bidessus flammulatus* Sharp, *Sci. Trans. R. Dublin Soc.*, Dublin, 2, p. 359.

1892. *Bidessus antennatus* : Regimbart, *Ann. Soc. ent. Belg.*, Brussels, 36, p. 118.

1920. *Bidessus flammulatus* : Zimmermann, *Coleopt. Catal. Junk*, Berlin, 4, p. 51.

1959. *Guignotus flammulatus* : Guignot, *Bull. mens. Soc. Linn. Lyon*, Lyon, 28, p. 9.

Material.—37 ex. as follows :—Sambhar Lake, 10. xi. 1956, 1 ex. 12. xi. 1956, 5 ex. ; Nawa, 15. xi. 1956, 5 ex. ; 16. xi. 1956, 2 ex. ; Nasirabad, 29. xi. 1956, 17 ex. ; Pali, 6. xii. 1956, 4 ex. ; Merta-city, 31. xii. 1956, 1 ex. ; Bahadurpur, 27. iv. 1958, 1 ex. ; Sikar Dist., 15. xi. 1960, 1 ex.

Remarks.—This species was described from China. Till recently the Indian specimens were referred *antennatus* Regimbart, but Guignot (1959) synonymised it with *flammulatus*. In India it has been so far recorded from Konbir-Nowatoli, Mandar. It also occurs in W Pakistan, Tonkin and China.

10. *Guignotus inconstans* (Regimbart)

1882. *Bidessus intermixtus* Sharp, *Sci. Trans. R. Dublin Soc.*, Dublin, **2**, p. 358 (nec. *Hydroporus intermixtus* Walker, 1858, p. 204).
 1892. *Bidessus inconstans* : Regimbart, *Ann. Soc. ent. Belg.*, Brussels, **36**, p. 119.
 1895. *Bidessus inconstans* : Regimbart, *Ann. Soc. ent. Fr.*, Paris, **64**, p. 344.

Material.—3 ex. as follows :—Nasirabad, 29. xi. 1956, 2 ex. ; Pali, 1 ex. ; Stn. 24, 24. xii. 1956, Merta-city, 31. xii. 1956, 1 ex.

Remarks.—The present specimens have been determined by comparison with the specimens from Rambha (Ganjam Dist., Orissa) and determined by Gschwendtner. They are distinctly though sparsely pubescent, a point not mentioned in the description. The discal striae are subequal to the pronotal striae, while Regimbart (1899) described it as most briefly continued on the elytra. The species has been recorded from Ceylon, India (Ghates, Konbir-Nowatoli, Mandar) and doubtfully from Sumatra (*vide* Sharp, 1882).

There has been an error in some earlier identification of this species. Sharp, 1882, p. 358, wrongly believed *Hydroporus intermixtus* Walker, 1858, to be a *Bidessus*. Regimbart, 1899 followed Sharp, 1882, in placing his own *inconstans* of 1892 and 1895 as a synonym of *intermixtus* Walker, *sensu* Sharp. Balfour-Browne, 1936 has pointed out that *Hydroporus intermixtus* Walker is in fact a *Hyphydrus*. It followed logically that *inconstans* Regimbart, 1892, is both available and valid.

11. *Guignotus pendjabensis* Guignot

1954. *Guignotus pendjabensis* Guignot, *Opusc ent.*, Lund., **19**, p. 22.

Material.—20 ex. as follows :—Sambhar Lake, 21. xi. 1956, 1 ex. ; 22. xi. 1956, 1 ex. ; 12. xi. 1956, 3 ex. ; Nawa, 15. xi. 1956, 5 ex. ; 16. xi. 1956, 2 ex. ; Nasirabad, 28. xi. 1956, 2 ex. ; Pali, 6. xii. 1956, 4 ex. ; Bahadurpur, 27. iv. 1958, 1 ex. ; Gudha, 19. v. 1958, 1 ex.

Remarks.—This species extends from W Pakistan to India. In India it is now being reported from Rajasthan from the areas mentioned above.

12. *Guignotus pusillus* (Fabricius)

1781. *Dytiscus pusillus* Fabricius, *Species Insectorum*, Hamburgi & Kilonii, **1**, p. 297.
 1792. *Dytiscus geminus* Fabricius, *Entomologia Systematica*. Hafniae, **1**, p. 199.
 1935. *Bidessus geminus* : Gschwendtner, *Rec. Indian Mus.*, Delhi, **37**, p. 374.
 1947. *Guignotus pusillus* : Guignot, *Faune de France*, Coleopteres, Hydrocanthares, Paris, **48**, pp. 66-67.

Material.—44. ex. as follows :—Sambhar Lake, 12. xi. 1956, 4 ex. ; 20. xi. 1956, 1 ex. ; 21. xi. 1956, 1 ex. ; 22. xi. 1956, 1 ex. ; 27. iv. 1958, 1 ex. ; Nawa, 15. xi. 1956, 6 ex. ; 16. xi. 1956, 4 ex. ; Nasirabad, 29. xi. 1956, 2 ex. ; Pali, 6. xii. 1956, 6 ex. ; 5. xii. 1956, 1 ex. ; Merta-city, 31.1 xii. 956, 13 ex. ; Bahadurpur, 27. iv. 1958, 1 ex.

Remarks.—This is a predominantly palaeartic species, being distributed in India in Kashmir and Simla hills. Various forms have been described on the basis of size and elytral markings. The elytral markings present in the above collection vary from the obsolete pattern to the very distinct ones of the forma *typica* and forma *geminus*.

Genus 7. *Hyphoporus*

Key to the species known from Rajasthan

1. Punctuation on the head moderately strong and close, on the pronotum stronger than on the head and elongately confluent on the posterior-half of the pronotum in males *nilghiricus*

- Punctuation on the head fine and remote, on the pronotum a little stronger than on the head but not confluent in males 2

2. Size 5-5.5 mm. long. Elytra rather irregularly punctate, interstices between punctures without any fine punctures, penis as seen in fig. 3a *severini*

- Size 4.5-4.75 mm. long. Elytra rather irregularly punctate, penis as seen in fig. 3c. *kempi*

13. *Hyphoporus severini* Regimbart

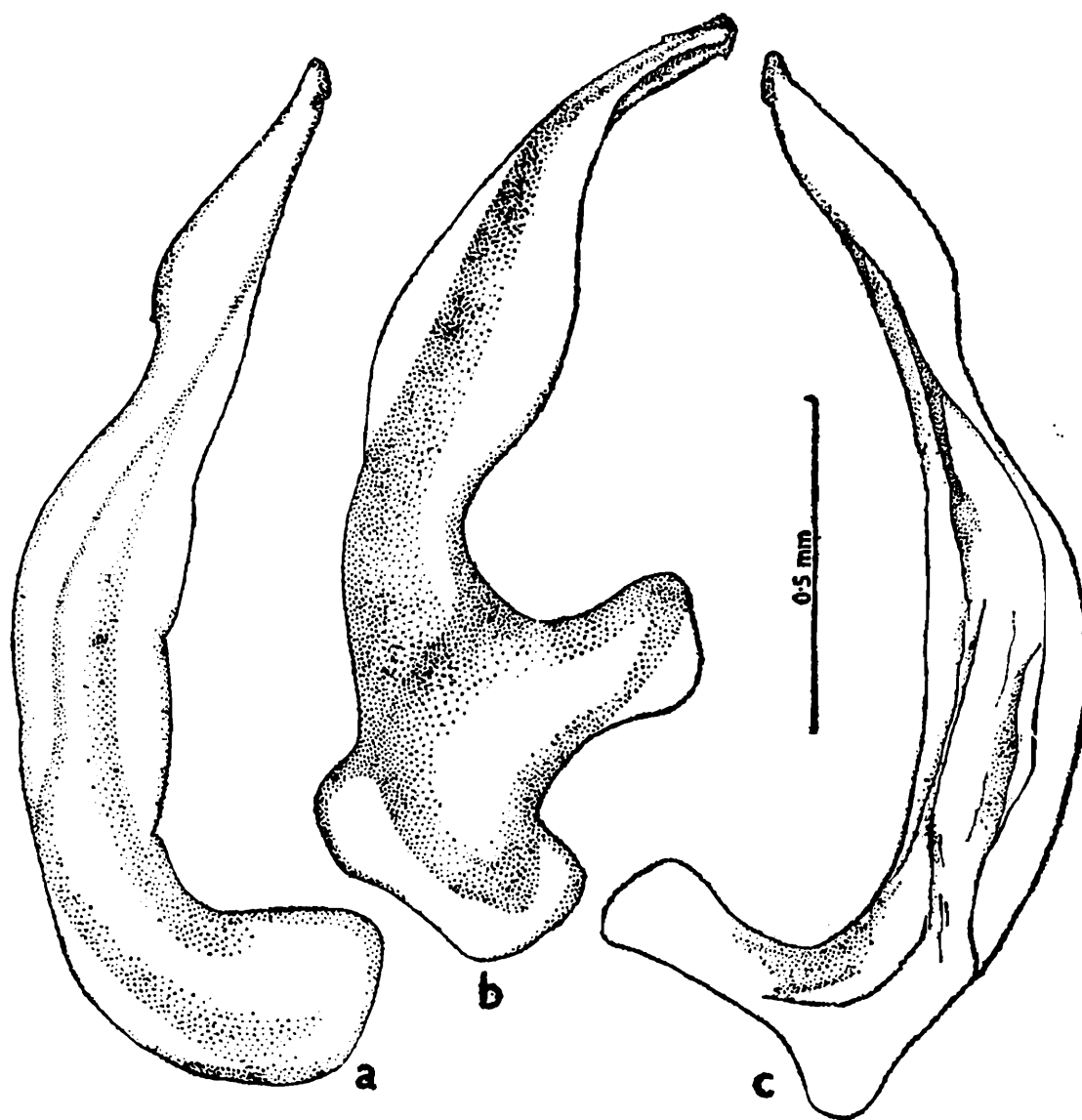
(Text-fig. 3a)

1892. *Hyphoporus severini* Regimbart, *Ann. Soc. ent. Belg.*, Brussels, 36, p. 115.

1920. *Hyphoporus severini* : Zimmermann, *Coleopt. Catal. Junk*, Berlin, 4, p. 73.

Material.—41 ex. as follows :—Sambhar Lake, 20. xi. 1956, 3 ex. ; Nawa, 15. xi. 1956, 1 ex. ; Jhapog, 1. iii. 1958, 1 ex. ; Bangadh, 1958, 4 ex. ; Sambhar Lake, 10. iii. 1958, 2 ex. ; Phulera, 11. iii. 1958, 5 ex. ; On road to Dudu from Sambhar Lake, 11. iv. 1958, 4 ex. ; 6. vi. 1958, 1 ex. ; Bahadurpur, 27. iv. 1958, 8 ex. ; Gudha, 13. v. 1958, 1 ex. ; Nawa, 19. v. 1958, 1 ex. ; Koni, 24. v. 1958, 5 ex. ; Mount Abu, 8. iii. 1948, 3 ex. ; 7. iii. 1948, 2 ex.

Remarks.—It has been previously recorded from Konbir (Bihar), Moradabad (U. P.), Assam and Sylhet (E. Pakistan). The species is closely related to *H. kempi* Gschw. in the structure of the male genitalia (Text-fig. 3c) but can be easily distinguished by its larger size and more oval body.



TEXT-FIG. 3.—Lateral view of penis of : (a) *Hyphoporus severini* ; (b) *H. nilghiricus* ; and (c) *H. kempi*.

14. *Hyphoporus kempi* Gschwendtner

(Text-fig. 3c)

1935. *Hyphoporus kempi* Gschwendtner, *Rec. Indian Mus.*, Delhi, 37, pp. 368-369.

Material.—26 ex. as follows :—Sambhar Lake, 20. xi. 1956, 17 ex. Nawa, 15. xi. 1956, 1 ex. ; Pali, 6. xi. 1956, 2 ex. ; Sambhar Lake, 30. i. 1958, 2 ex. ; 11. iv. 1958, 1 ex. ; Phulera, 11. iii. 1958, 2 ex. ; Gudha, 19. v. 1958, 1 ex.

Remarks.—This species was described by Gschwendtner from specimens from Assam (4♂♂) and Lucknow (1♀). The present record extends its distribution westwards. In the structure of its penis (Text-fig. 3c) it comes close to *H. severini* but is slightly more curved and the two differ in the asymmetrical nature of the lateral sides of penis. This species is also a little smaller in size and less oval than *H. kempi*.

15. *Hyphoporus nilghiricus* Regimbart

(Text-fig. 3b)

1903. *Hyphoporus nilghiricus* Regimbart, *Ann. Soc. ent. Fr.*, Paris, 72, p. 331.

1920. *Hyphoporus nilghiricus* : Zimmermann, *Coleopt. Catal. Junk*, Berlin, 4, p. 72.

Material.—67 ex. as follows :—Nawa, 15. xi. 1956, 1 ex. ; -. iii. 1948, 45 ex. ; Jogmandi Jharna, 3. iii. 1948, 14 ex. ; Mount Abu, 8. iii. 1948, 6 ex. ; 10. iii. 1948, 1 ex.

Remarks.—This species has not been recorded since it was described by Regimbart (1903) from the Nilgiris. There is a single example, ♀, in the collection of the Zoological Survey of India, from Coonoor, Nilgiris, which was determined by Gschwendtner. The specimens before me agree fairly well with the description as given by Regimbart. The structure of the penis (Text-fig. 3b) is markedly different from the preceding two species.

Subfamily COLYMBETINAE

Key to the tribes and genera known from India

- | | |
|--|--------------------|
| 1. Claws of the metatarsi equal ; metatarsal segments not lobed on the outer side | 2 |
| Claws of the metatarsi unequal ; metatarsal segments lobed on the outer side | 3 (Colymbetini) |
| 2. Inferior face of the metafemora with a fringe of ciliae on the apical posterior angle | 5 (Agabini) |
| Inferior face of the metafemora without a fringe of ciliae on the apical posterior angle | 7 (Copelatini) |
| 3. Sides of the pronotum rebordered | 4 |
| Sides of the pronotum not rebordered | <i>Colymbetes</i> |
| 4. Inferior face of the metafemora with a fringe of ciliae on the posterior apical angle | <i>Ilybius</i> |
| Inferior face of the metafemora without a fringe of ciliae on the posterior apical angle | <i>Rhantus</i> |
| 5. Wings of the metasternum variable in size, but always distinctly wedge shaped, never linear | <i>Agabus</i> |
| Wings of the metasternum quite slender and linear | 6 |
| 6. Epipleurae continuing to be rather broad after the middle of the elytra | <i>Platambus</i> |
| Epipleurae after the middle of the elytra, quite narrow | <i>Platynectes</i> |
| 7. Elytra with dorsal striae | <i>Copelatus</i> |
| Elytra without dorsal striae | <i>Lacconectus</i> |

Genus 8. **Rhantus**16. **Rhantus taprobanicus** Sharp

1890. *Rhantus taprobanicus* Sharp, *Trans. R. ent. Soc. Lond.*, London, p. 346.

1920. *Rhantus taprobanicus* : Zimmermann, *Coleopt. Catal. Junk*, Berlin, 4, p. 207.

1935. *Rhantus taprobanicus* : Gschwendtner, *Rec. Indian Mus.*, Delhi, 37, p. 373.

Material.—11 ex., Mt. Abu,—,iii. 1948.

Remarks.—This species has been recorded from Ceylon and India (Kanara, Simla, Sangli, Kodaikanal, Bombay, Pedong, Sikkim, E. and W. Himalaya). Though the exact locality is not mentioned on the label, it is presumed that the specimens were collected around Mount Abu.

Subfamily *DYTISCINAE**Key to the tribes and genera known from India*

1. Hind margins of the four basal metatarsal segments on both the anterior and posterior faces fringed with elongate golden yellow ciliae overlapping the base of the next segment 2

Hind margins of the four basal metatarsal segments not fringed with any ciliae 6
2. Sides of the pronotum rebordered. Lateral borders of the elytra serrated in the posterior half Eretini (*Eretes*)

Sides of the pronotum not rebordered. Lateral borders of the elytra not serrated in the posterior half 3
3. Suture between the meta-episternum and metasternal wing straight ; apical spurs of the metatibiae simple, pointed 4 Hydatiini

Suture between the meta-episternum and the metasternal wing, curved ; apical spurs of the metatibiae blunt, more or less bifid 5 Thermonectini
4. Posterior tarsal claws nearly equal *Prodaticus*

Posterior tarsal claws unequal *Hydaticus*
5. Smaller, scarcely 10 mm. long ; meso-femora with short thorn like bristles usually reaching one-fourth the length of the trochanters *Rhantaticus*

- Larger, 13-15 mm. long ; meso-remora with few long ciliae not or scarcely shorter than the trochanters *Sandracottus*
6. Metatibiae much longer than broad ; its external spur slender, not much larger than the inner *Dytiscini**
- Metatibiae nearly always broader than long : its external spur broad, at least twice broader than the inner *Cybistrini (Cobister)*

Genus 9. Eretes

17. *Eretes sticticus* (Linnaeus)

1767. *Dyticus sticticus* Linnaeus, *Systema Naturae*, ed. 12, 1(2), Holmiae, p. 666.

1920. *Eretes sticticus* : Zimmermann, *Coleopt. Catal. Junk*, Berlin, 4, p. 216.

1947. *Eretes sticticus* : Guignot, *Faune de France*, Coleopteres Hydrocanthares, Paris, 48, pp. 223-224.

Material.—218 ex. as follows :—Gudha, 18. i. 1958, 22 ex. ; 20. i. 1958, 3 ex. ; 4. v. 1958, 3 ex. ; 5. ii. 1958, 2 ex. ; 21. i. 1958, 2 ex. ; 24. i. 1958, 2 ex. ; 10. iii. 1958, 1 ex. ; 7. vi. 1958, 1 ex. ; 30. i. 1958, 1 ex. ; 28. iv. 1958, 1 ex. ; 20. i. 1958, 1 ex. ; Sambhar Lake on road to Dudu, 20. i. 1958, 3 ex. ; Sambhar Lake, 20. xi. 1956, 3 ex. ; 12. xi. 1956, 52 ex. ; Nawa, 15. xi. 1956, 70 ex. ; Pali, 6. xii. 1956, 1 ex. ; Jhapog, 1958, 1 ex. ; Koni, 24. v. 1958, 1 ex. ; Bangadh, 5. vi. 1958, 8 ex. ; Sikar Dist., 8-15. xi. 1960, 40 ex.

Remarks.—This species is extremely variable in size, colour, form and sometimes in the shape of the posterior angles of the pronotum. It occurs throughout the world in tropical and subtropical regions. Baid (1959) stated that it is available in the Sambhar Lake proper upto September and October, at salinities 2.81—4.61 per cent. This species was, however, collected in the reservoirs and the pumping station at Jhapog at much higher salinities (11°-14°, B.E.) during the months of January to May 1958, and November 1956. During these months the approach to the water in the lake is very difficult on account of the nature of the soil surrounding the water making it almost impossible to reach the centre for making collections.

Genus 10. Hydaticus

18. *Hydaticus fabricii* Macleay

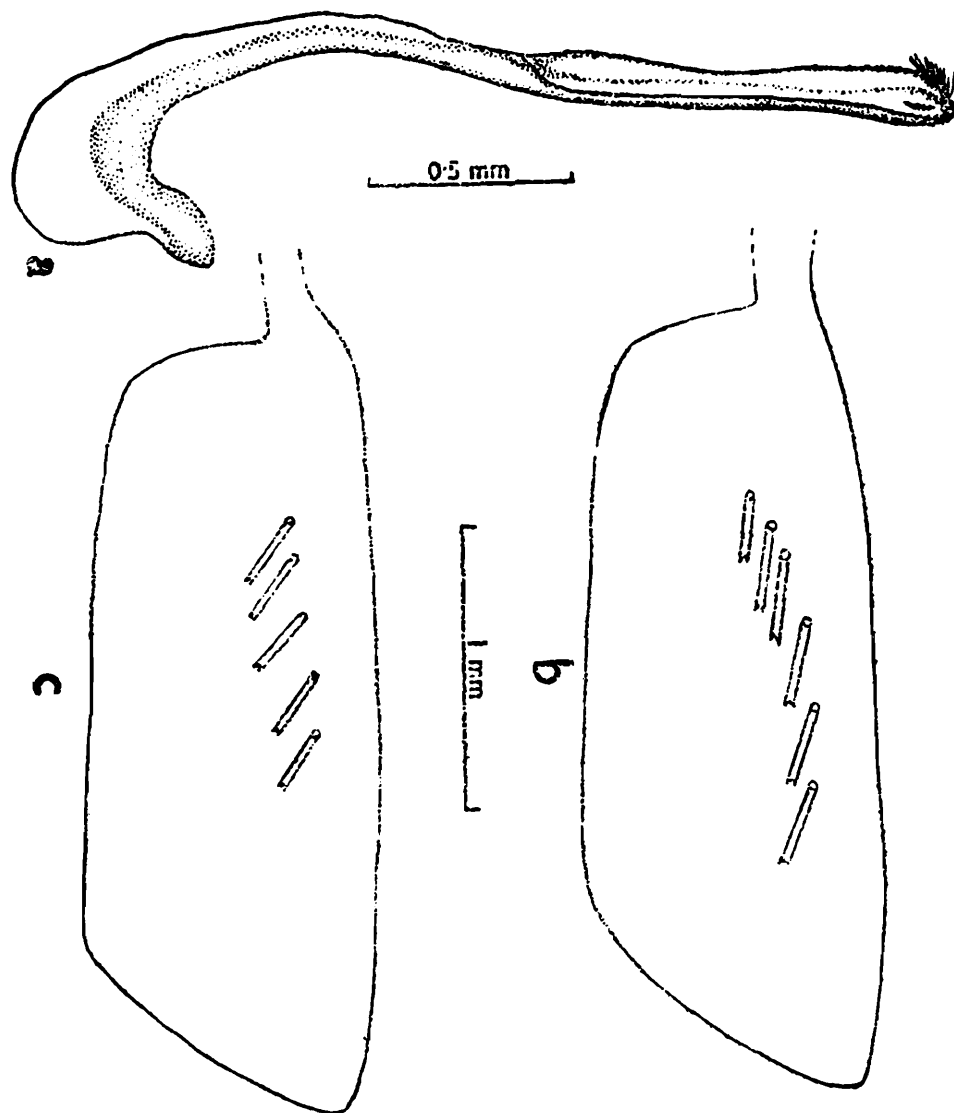
(Text-fig. 4a-c)

1833. *Hydaticus fabricii* Macleay, *Annulosa Javanica*, Paris, p. 131.

1920. *Hydaticus fabricii* : Zimmermann, *Coleopt. Catal. Junk*, Berlin, 4, p. 220.

*Not so far recorded from India.

Material.—4 ex. as follows :—Sambhar Lake, Bahadurpur, 27. iv. 1958, 1 ex. ; Phulad, Jogmandi stream, 3. iii. 1948, 1 ex. ; Mavli, Rajsa-
mand, 27. ii. 1948, 1 ex. ; iii. 1948, 1 ex.



TEXT-FIG. 4.—Diagrams of *Hydatiscus fabricii*. (a) Lateral view of penis of a specimen from " Rajasthan ". (b) Posterior face of metatibia, showing the bifid spines ; specimen from " Rajasthan " (same as in Fig. a). (c) Ditto, specimen from Bahadurpur, Sambhar Lake.

Remarks.—This species has often been confused with *leander* Rossi, *ponticus* Sharp and *incertus* Regimbart. Balfour-Browne (1950) has discussed the disposition of the bifid spines on the posterior face of the meta-tibiae but it appears that this character is of doubtful value. The bifid spines on posterior face of meta-tibiae of two of the specimens mentioned above are figured here (Text-figs. 4b, c.). The male genitalia, penis (Text-fig. 4a) of one of the specimens is also figured.

19. *Hydatiscus luczonicus* Aube

1838. *Hydatiscus luczonicus* Aube in Dejean's *Species Coleopteres*, Paris, 6, p. 179.

1920, *Hydatiscus luczonicus* : Zimmermann. *Coleopt. Catal. Junk*, Berlin, 4, p. 222.

Material.—2 ex. as follows :—Phulad, Jogmandi Stream, 3. iii. 1948, 1 ex. ; —x. 1941, 1 ex.

Remarks.—This species has been recorded from India (Parishalt, Ragnore, Konbir-Nowatoli, Sangli), Ceylon ; Tonkin ; and the Philippines.

Genus 11. *Rhantaticus*

20. *Rhantaticus congestus* (Klug)

(Text-fig. 2e)

1832. *Hydaticus congestus* Klug, *Symbolae Physicae, Insectes Madagascar*, Berlin, 3, p. 136.

1920. *Rhantaticus congestus* : Zimmermann, *Coleop. Catal. Junk*, Berlin, 4, p. 232.

Material.—16 ex. as follows :—Bangadh,—vi. 1958, 4 ex. ; On road to Dudu from Sambhar Lake, 11. iv. 1958, 4 ex. ; 6. vi. 1958, 2 ex. ; Bahadurpur, 27. iv. 1958, 1 ex. ; Sambhar Lake, 10. iii. 1958, 1 ex. ; Gudha, 7. vi. 1958, 4 ex.

Remarks.—This species is very widely distributed from Madagascar to Australia. The present specimens conform to the typical form (from tropical Asia) as described by Sharp (1882) in his monograph on the family. The black marks on the head and pronotum and the condensation of black spots on the elytra are variable. The locality records from India are rather vague, viz., 'Inde' and 'Himalaya' by Regimbart (1899). It is now recorded from Rajasthan for the first time.

Genus 12. *Sandracottus*

21. *Sandracottus dejeani* (Aube)

1838. *Hydaticus dejeani* Aube in Dejean's *Species Coleopteres*, Paris, 6, p. 115.

1920. *Sandracottus dejeani* : Zimmermann, *Coleopt. Catal. Junk*, Berlin, 4, p. 234.

Material.—12 ex. as follows :—Sambhar Lake, on road to Dudu, 6. vi. 1958, 1 ex. ; 11. iv. 1958, 1 ex. ; Gudha, 4. v. 1958, 1 ex. ; Phulera, 11. iii. 1958, 8 ex. ; —x. 1941, 1 ex.

Remarks.—This is the commonest species of the genus occurring in India. It has been recorded from Murshidabad, Rajmahal, Sunderbans and Poona.

Genus 13. *Cybister*22. *Cybister tripunctatus asiaticus* Sharp

- 1882 *Cybister asiaticus* Sharp, *Sci. Trans. R. Dublin Soc.*, Dublin, 2, p. 731.
1920. *Cybister tripunctatus* var. *asiaticus* : Zimmermann, *Coleop. Catal. Junk.* Berlin, 4, p. 266.
1945. *Cybister tripunctatus asiaticus* : Balfour-Browne, *Occ. Pap. Bishop Mus.*, Honolulu, 28, No. 7, pp. 121-122.

Material.—28 ex. as follows :—Sambhar Lake, Main line salt Reservoir, 22. iii. 1958, 1 ex. ; 12. xi. 1956, Stn. 5, 2 ex. ; Nathela tank, 28. ii. 1948, 2 ex. ; Mount Abu, 8. iii. 1948, 1 ex. ; Phulad, 1. iii. 1948, 3 ex. ; Jogmandi Stream, 3. iii. 1948, 4 ex. ; Sikar Dist. : Rampura, 9. xi. 1960, 1 ex. ; Singaran, 10. xi. 1960, 1 ex. ; Gangara, 10. xi. 1960, 1 ex. ; Malosi, 12. xi. 1960, 3 ex. ; Rashidpura, 11. xi. 1960, 1 ex. ; Dasaki Dhani, 13. xi. 1960, 2 ex. ; Charaubos, 13. xi. 1960, 2 ex. ; Piparali, 13. xi. 1960, 3 ex. ; Chokla Kabas, 14. xi. 1960, 1 ex.

Remarks.—This is a very widely distributed species. Various subspecies and aberrations have been described with full specific rank. Balfour-browne (*t.c.*) considers that the subspecies *asiaticus* is confined to the Oriental Region and this view has been followed here. One example was taken alive on the brine solution of 11° B. E. in Sambhar Lake.

IV--SUMMARY

The paper deals with 22 species belonging to 13 genera of the family Dytiscidae. Previously only 3 species had been recorded from Rajasthan (from the Sambhar Lake). Thus, 19 species are being reported for the first time. Sixteen species have been collected within a radius of 16 km. from the Sambhar Lake. Keys to the genera recorded from India and to the species dealt with in this paper are provided. The figures of the male genitalia (penis only) of 9 species are given to facilitate identification.

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Fauna of Rajasthan, India. Part 6. Amphibia

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(With 1 Text-figure and 1 Plate)

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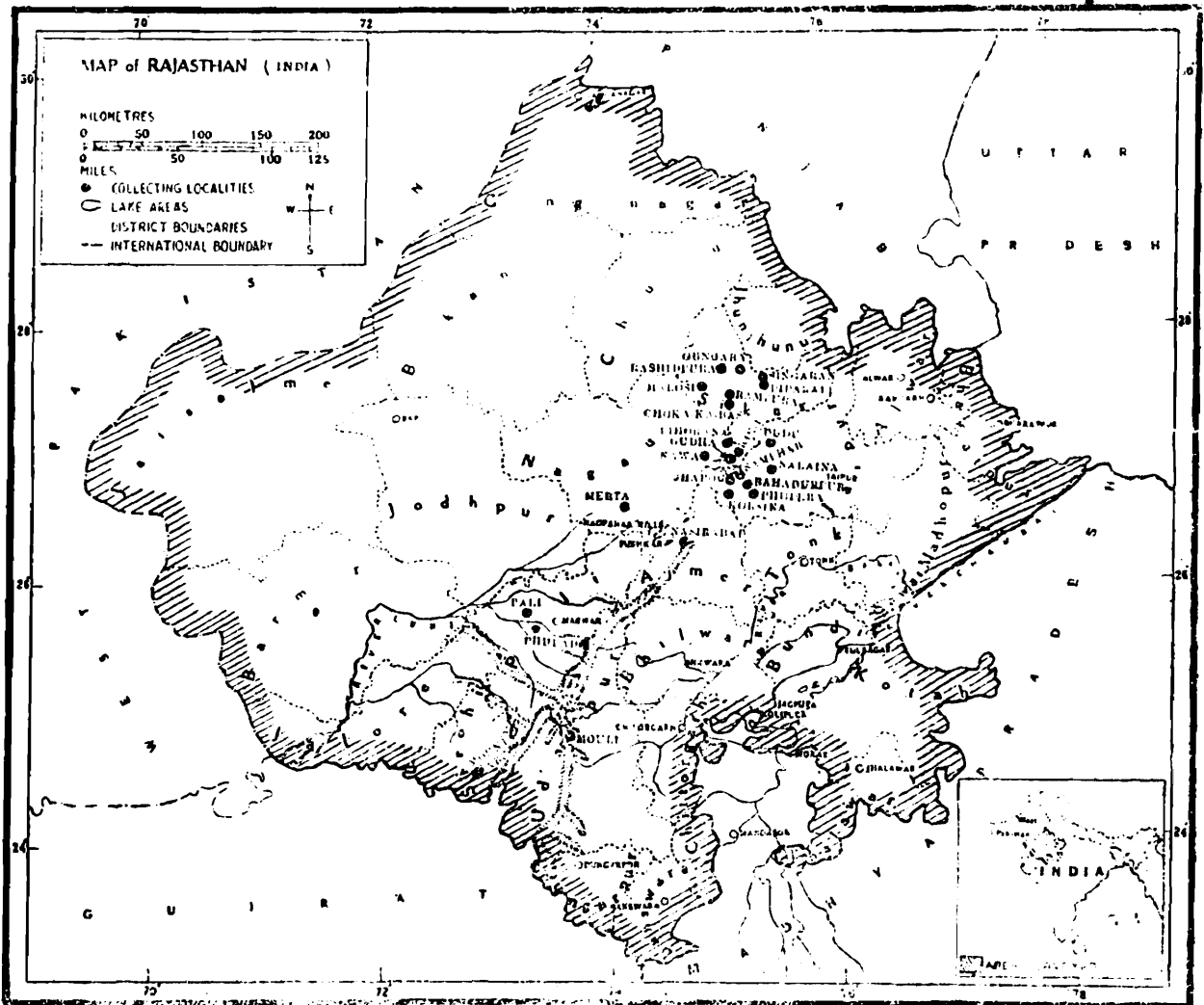
I.—INTRODUCTION

The amphibian fauna (frogs and toads) of the large tract of land known as Rajasthan (*ca.* 1,32,077 sq. miles), the western three-fifths of which form the great Indian Desert, has hitherto been hardly known except for McCann's (1943) short account of the fauna in the Abu Hills of Rajasthan. Lately the desert has been reported to be changing physiologically and climatically. It has, therefore, become imperative to study it from all points of view. The area has been systematically surveyed by various parties of the Zoological Survey of India during the last few years (1956-1961) although some surveys were done in earlier years also (1941 onwards). The present account is based on the following collections, but in addition a few specimens from earlier sources present in the Z.S.I. were also utilised.

1. Rajasthan Survey, 1941, by Drs. B. N. Chopra and M. L. Roonwal.
2. Rajasthan Survey, 1948, by Shri K. S. Pradhan.
3. Rajasthan Desert Survey, 1956-57, by Dr. B. Biswas.
4. Rajasthan Survey, 1957, by Dr. K. K. Tiwari and Shri S. Biswas.

Rec. Zool. Surv. India, 62 (1 & 2), 1970.

5. Rajasthan (Sambhar Lake) Survey, 1957-58, by Shri T. G. Vazirani, Shri A. K. Mukherjee and Shri S. Biswas.
6. Rajasthan (Jodhpur) Survey, 1960, by Shri R. K. Bhatnagar.
7. Rajasthan Desert Survey, 1960-61, by Dr. B. Biswas.



TEXT-FIG. 1.—Map of Rajasthan, showing the collecting localities for Amphibians.

As a result of these surveys, about 660 specimens have been accumulated, which have been studied. As a result of this study 8 species belonging to 3 families and 3 genera are recorded as follows. Keys for identification are given.

Family Ranidae

1. *Rana hexadactyla* Lesson
2. *R. cyanophlyctis* Schneider
3. *R. limnocharis* Wiegmann
4. *R. tigrina tigrina* Daudin
5. *R. breviceps* Schneider

Family Bufonidae

6. *Bufo melanostictus* Schneider
7. *B. andersoni* Boulenger

Family Microhylidae

8. *Microhyla ornata* (Dumeril & Bibron)

Of these 8 species, *R. hexadactyla* and *R. breviceps* are recorded here for the first time from Rajasthan. Two species, viz., *R. cyanophlyctis* and *B. andersoni*, are palaeartic, while the rest are Oriental. Out of these, *R. hexadactyla* is confined to India, while the rest extend eastwards to Burma, some of them further east up to Japan and Lombok.

For an account of the topography, climate, vegetation, etc. of Rajasthan, see Part 1 (General Introduction) of this series of papers (Roonwal, 1969, *Rec. zool. Surv. India*, Vol. 61 (3&4), pp. 291—375).

The following abbreviations have been used :—*Alt.*, altitude above mean sea-level ; *Coll.*, collected by ; collection ; *Coll. Stn.*, Collecting Station ; *Dist.*, district ; *ex.*, *exs.*, example, examples ; *lat.*, latitude ; *long.*, longitude ; *Z. S. I.*, Zoological Survey of India, Calcutta.

We wish to record our thanks to Dr. M. L. Roonwal, Director, Zoological Survey of India, for kindly going through the manuscript and offering valuable suggestions.

II.—SYSTEMATIC ACCOUNT

1. Key to the families and genera of Rajasthan Amphibia

- | | |
|---|-------------------------------------|
| 1. Upper jaw toothed, tongue bifid and notched behind | Ranidae (<i>Rana</i>) |
| Jaws toothless, tongue not bifid and not notched behind | 2 |
| 2. Skin rough with tubercles and spiny warts | ∴ Bufonidae (<i>Bufo</i>) |
| Skin smooth, without tubercles and warts | ∴ Microhylidae (<i>Microhyla</i>) |

2. Family RANIDAE

This family is represented in the collection by five species of *Rana* which can be distinguished by the following key.

Key to the species of genus *Rana* from Rajasthan

- | | | |
|---|---|---------------------------|
| 1. Outer metatarsals united | ∴ | <i>R. breviceps</i> |
| Outer metatarsals separated at least in the distal half | ∴ | 2 |
| 2. Inner metatarsal tubercle digitiform | ∴ | 3 |
| Inner metatarsal not so | ∴ | 4 |
| 3. First finger longer than second ; throat and belly with granules and small warts | ∴ | <i>R. hexadactyla</i> |
| First finger equals second ; throat and belly smooth | ∴ | <i>R. cyanophlyctis</i> |
| 4. Outer metatarsal tubercle absent | ∴ | <i>R. tigrina tigrina</i> |
| Outer metatarsal tubercle present | ∴ | <i>R. limnocharis</i> |

1. *Rana hexadactyla* Lesson

(Pl. 2, Fig. 1)

1834. *Rana hexadactyla* Lesson, *Béang. voy. Ind. Or. Rept.*, p. 33.

1920. *Rana hexadactyla* : Boulenger, *Rec. Indian Mus.*, Calcutta. 20, p. 10.

1933. *Rana hexadactyla* : Bhaduri, *J. Bombay nat. Hist. Soc.*, Bombay, 36, pp. 514-516.

Material.—Jaipur Dist., Jaipur : Coll., R. H. Beddome, 2 exs. (juveniles) (Z.S.I. Reg. No. 9432, 9433).

Distribution.—RAJASTHAN (first record): Jaipur Dist. *Elsewhere* : West Bengal, southern India and Ceylon.

Remarks.—The specimens measure 32 mm. and 47 mm. in length. They have pointed toes and an inner metatarsal tubercle which is digitiform. Head broader than long. Colour dark brown. Lower parts granulate, with enlarged porous warts under the thighs and along each side of belly ; skin smooth above, with small porous warts on sides.

2. *Rana cyanophlyctis* Schneider

(Pl. 2, Fig. 2)

1799. *Rana cyanophlyctis* Schneider, *Hist. Amph.*, Jena, 1, p. 157.
 1920. *Rana cyanophlyctis* : Boulenger, *Rec. Indian Mus.*, Calcutta, 12, p. 30.
 1943. *Rana cyanophlyctis* : McCarr, *J. Bombay nat. Hist. Soc.*, Bombay, 43, p. 206 (Mt. Abu).

Material.—(a) Adults : exs. Ajmer Dist. : Coll. B. Biswas, 2 exs., Stn. 17, Chat, 28.xi. 1956 ; 3 exs., Stn. 19, Nasirabad, 29. xi. 1956. Barmer Dist. Coll. K. K. Tiwari and S. Biswas, 5 exs., Bhap, 25.i.1958. Bikaner Dist. : Coll. B. Biswas, 1 ex., Stn. 19, Kolayat, 11.x.1960 ; 2 exs., Stn. 19, Kolayat, 14.ix.1960 ; 2 exs., Kotri, 15.ix.1960. Ganganagar Dist. : Coll. B. Biswas, 9 exs., Stn. 31, Badbirana, 14.x.1960 ; 4 exs., Sardarpurabas, 14.x.1960 ; 8 exs., Stn. 35, Sonri, 15.x.1960 ; 9 exs., Stn. 43, Surpura, 18.x.1960. Jaipur Dist. : Coll. B. Biswas, 1 ex., Stn. 5, Jhapog, 16.xi.1956 ; 2 exs., a pool in Sambhar Lake, 28.xi. 1956 ; Coll. A. K. Mukherjee, 11 exs., Jalga Lake, 13.xi.1957. Jhunjhunu Dist. : Coll. B. Biswas, 6 exs., Stn. 51, Jhunjhunu, 3.xi.1960. Jodhpur Dist. : Coll. B. Biswas, 3 exs., Stn. 24, Kaylana, 14.xi.1956 ; 7 exs., Bariganga, 18.xi.1956 ; Coll. K. K. Tiwari and S. Biswas, 2 exs., Stn. 1, Shivrasar, 13.xii.1957 ; Coll. R. K. Bhatnagar, 3 exs., Bishalpur, 4.vii.1960 ; 4 exs., Bishalpur, 6.vii.1960 ; 3 exs., Ajit Singh Farm, 5.vii.1960 ; 1 ex., Khokhra, 3.viii.1960. Nagaur Dist. : Coll. B. Biswas, 6 exs., Stn. 9, Nandana River, 15.xi.1956 ; 1 ex., Stn. 13, Nawa, 16.xi.1956 ; 2 exs., Stn. 29, Merta, 27.xii.1956 ; 1 ex., Stn. 28, Merta, 27.xii.1956 ; 10 exs., Stn. 15, Bhakrod, 6.ix.1960 ; 3 exs., Didia, 4.ix.1960 ; 9 exs., Stn. 13, Imirti, 6.ix.1960. Coll. A. K. Mukherjee, 1 ex., Gudha, 5.iv.1958 ; Coll. S. Biswas, 1 ex., Gudha Talav ; 8 exs., Gudha Talav. Pali Dist. : Coll. B. Biswas, 4 exs., Stn. 20, 4.xii.1956 ; 2 exs., Stn. 22, Hemawas Tank, 5.xii.1956 ; 4 exs., 5.xii.1956 ; Stn. 20, Bandi River, 6.xii.1956 ; 6 exs., Stn. 23, Pali, 6.xii.1956. Sikar Dist. : Coll. B. Biswas, 12 exs., Stn. 61, Kanwarpura, 8.ix.1960 ; 6 exs., Stn. 60, Kosli, 8.xi.1960 ; 14 exs., Phagalwa, 12.xi.1960 ; 3 exs., Rashidpura, 11.xi.1960 ; 4 exs., Stn. 67, Sikav, 10.xi.1960. Sirohi Dist. : Coll. K. S. Pradhan, 3 exs., Kundra Nalla, 9.iii.1948 ; 1 ex., Gorachapra Nalla, 10.iii.1948. Udaipur Dist. : Coll. B. N. Chopra and M. L. Roonwal, 9 exs., Stn. 1, River Berach, 8-9.x.1941 ; 2 exs., Stn. 5, Kherpena-ka-Nalla, 13-15.x.

1941 ; 12 exs., Stn. 13, Barapal-ka-Nalla, 14.x.1941 ; 7 exs., Stn. 7, Parai River, 17-13.x.1941 ; 7 exs., Stn. 8, Parshad (Palsad)-ka-Nalla, 18-21.x.1941 ; 2 exs., Stn. 40, Parshad, 16-21.x.1941 ; 7 exs., Stn. 11, Soorpur-ki-Nadi, 26.x.1941 ; 6 exs. Stn. 13, Barapal-ka-Nalla, 28.x.1941 ; 5 exs., Rajas-mand, 27.ii.1948 ; 1 ex., Nalhela tank, 28.ii.1948 ; 2 exs., Pipli, 2.ii. 1948 ; 3 exs., Kundra Nalla, 9.iii.1948.

(b) Tadpoles : 62 exs. as follows :—Ganganagar Dist. : Coll. *B. Biswas*, 2 exs., Stn. 25, Diplana, 13.x.1960 ; 3 exs., Stn. 42, Surpura, 18.x.1960. Jaipur Dist. : Coll. *A. K. Mukherjee*, 1 ex., Stn. 23, Chapparwara, 20.iii.1958. Jaisalmer Dist. : Coll. *K. K. Tiwari* and *S. Biswas*, 1 ex., Stn. 2, Salamsar, 20.xii.1957. Jodhpur Dist. : Coll. *K. K. Tiwari* and *S. Biswas*, 3 exs., Stn. 2, Ranisar, 20.xii.1957. Nagaur Dist. : Coll. *B. Biswas*, 4 exs., Stn. 27, Merta, 19.xii.1956 ; 2 exs., Stn. 29, Merta, 26.xii.1956 ; 3 exs., Stn. 15, Bhakrod, 6.ix.1960 ; 2 exs. Stn. 13, Imirti, 6.ix.1960 ; 1 ex. Stn. 2 ; Nagaur, 2.ix.1960 ; Coll. *S. Biswas*, 3 exs., Gudha, 9.x.1958. Sikar Dist. : Coll. *B. Biswas*, 1 ex., Stn. 78, Hanumansagar Tank, 14.xi.1960 ; 1 ex., Stn. 80, Mandaora, 14.xi.1960 ; 4 exs., Rashidpura, 11.xi.1960 ; 1 ex., Stn. 60, Sikar, 8.xi.1960. Udaipur Dist. : Coll. *B. N. Chopra* and *M. L. Roonwal*, 18 exs., Stn. 5, Kherpena-ka-Nalla, 13.15.x.1948 ; 1 ex., Stn. 5, Barapal, 15.x.1941 ; 4 exs., Stn. 3, Barapal-ka-Nalla, 14.x.1941 ; Coll. *K. S. Pradhan*, 7 exs., Rajasmand, 27.ii.1948.

Distribution.—RAJASTHAN.—Districts of Ajmer, Barmer, Ganganagar, Jaipur, Jaisalmer, Jodhpur, Nagaur, Pali, Sikar, Sirohi and Udaipur (new records). Earlier known only from Sirohi Dist. (McCann, 1943). *Elsewhere* : S. W. Asia, Ceylon, India (generally), Thailand and Malay peninsula.

Remarks.—Length 52-61 mm. in males and 50-70 mm. in females. Form moderately robust. All specimens have separated outer metatarsals, fully webbed toes, pointed fingers and toes, and distinct tympanum. Head broader than long. Sexes distinct, males with swollen thumbs and a pair of external vocal sacs. Colour usually greyish above. Skin of upper surface with dark olive rounded spots. Specimens from Udaipur Dist. (E. Rajasthan) are reddish brown ; those from Nagaur Dist. (W. Rajasthan) are olive.

This species is clearly distinguished from *Rana hexadactyla*, its closest ally, by the absence of series of small porous warts on lower parts.

Tadpoles : Largest one *ca.* 11 mm. long. Tadpole with the tail twice as long as body. Horny teeth arranged in two rows—one marginal series in front and two series behind beak.

3. *Rana tigrina tigrina* Daudin

(Pl. 2, Fig. 3)

1803. *Rana tigrina* Daudin, *Hist. Rain. Gren. Crap.*, p. 64, pl. 20.

1920. *Rana tigrina* : Boulenger, *Rec. Indian Mus.*, Calcutta, 20, pp. 17-23.

1943. *Rana tigrina* : McCann, *J. Bombay nat. Hist. Soc.*, Bombay, 43, p. 206.

Material.—(a) Adults : 15 exs. as follows : Ganganagar Dist. : Coll. *B. Biswas*, 3 exs., Stn. 24, Suratgarh, 9.x.1960. Jaipur Dist. : Coll. *A. K. Mukherjee*, 2 exs., Jaipur, 13.xi.1957 ; 2 exs., Stn. 28, Chapparwara Lake, 28.vii.1958. Nagaur Dist. : Coll. *T. G. Vazirani*, 4 exs., Gudha, 29.iii.1958 ; Coll. *B. Biswas*, 1 ex., Stn. 28, Merta, 27.xi.1956. Udaipur Dist. : Coll. *B. N. Chopra* and *M. L. Roonwal*, 1 ex., Stn. 3, Barapal, 14.x.1941 ; 2 exs., Stn. 4, Barapal, 13-14. x. 1941.

(b) Tadpoles. : 5 exs. as follows : Jaipur Dist. : Coll. *A. K. Mukherjee*, 5 exs., Stn. 23, Chapparwara, 20.vii.1958.

Distribution.—RAJASTHAN.—Districts of Ganganagar, Jaipur, Nagaur and Udaipur (new records) ; also Sirohi (McCann 1943). *Elsewhere* : Ceylon, India from the base of the Himalayas through Punjab, Uttar Pradesh to south India, Assam, Burma, Siam, Southern Yunnan and Nepal.

Remarks.—Length 178-188 mm. in males and 133-152 mm. in females. Toes entirely webbed ; inner metatarsal tubercle not digitiform but compressed and large ; head broader than long. Sexes distinct ; male with a pair of external vocal sacs and a strong pad on the inner side of first finger. Colour yellowish in some specimens, green in others. Skin with dark spots disposed in longitudinal series on back ; lower parts white.

Largest tadpole *ca.* 44 mm. long. Tadpoles with tail ending in fine point and about twice as long as body. Teeth in 4 upper and 5 lower series—the outer upper long and uninterrupted the outer lower short and uninterrupted.

4. *Rana limnocharis* Weigmann

(Pl. 2, Fig. 4)

1835. *Rana limnocharia* Weigmann, *N. Acta Ac. Leop.*, Carol, 17, (1), p. 255.
 1920. *Rana limnocharia* : Boulenger, *Rec. Indian Mus.*, Calcutta, 20, pp. 28-35.
 1943. *Rana limnocharia* : McCann, *J. Bombay nat. Hist. Soc.*, Bombay, 43, p. 206 (Abu hills).

Material.—(a) Adults : 11 exs. as follows : Nagaur District : Coll. *S. Biswas*, 1 ex., Gudha, 4.ix.1958 ; Pali District : Coll. *K. S. Pradhan*, 4 exs., Phulad River, 1.iii.1948 ; Sirohi District : Coll. *K. S. Pradhan*, 4 exs., Kundra Nalla, 9. iii.1948 ; 1 ex., Gorachapra Nalla, 10.iii.1948 : Udaipur District : Coll. *K. S. Pradhan*, 1 ex., Mavli, 10.iii.1948.

(b) Tadpoles : 127 exs. as follows : Jaipur District : Coll. *A. K. Mukherjee*, 5 exs., Stn. 23, Chapparwara, 20.vii. 1958 ; Nagaur District ; Coll. *S. Biswas*, 63 exs., Gudha, 2. ix. 1958 ; 53 exs., Gudha, 4.ix.1958 ; 6 exs. Stn. 13, Gudha, 5.ix.1958.

Distribution.—RAJASTHAN.—Districts of Jaipur, Nagaur, Pali, Sirohi (McCann, 1943) and Udaipur. *Elsewhere* : Eastern Asia from Japan and China to India (generally), Ceylon, Malay Peninsula and Archipelago, eastward to the Philippines, Borneo and Lombok.

Remarks.—Tadpoles : Largest *ca.* 24 mm. ; with tail about twice as long as body. Teeth in six rows—or long marginal series of upper labial teeth with a short series on each side and three long uninterrupted series of lower labial teeth.

5. *Rana breviceps* Schneider

(Pl. 2, Fig. 5).

1799. *Rana breviceps* Schneider, *Hist. Amph.*, Jena, 1, p. 140.

1920. *Rana breviceps* : Boulenger, *Rec. Indian Mus.*, Calcutta, 20, pp. 103-105.

Material.—Jodhpur District : Coll. *R. K. Bhatnagar*, 1 ex., Campus of the Regional Stn. (ZSI), 17.vii.1960 ; Nagaur District : Coll. *B. Biswas*, 7 exs., Stn. 11, Nagaur, 15.ix.1960 ; Udaipur District : Coll. *B. N. Chopra* and *M. L. Roonwal*, 1 ex., Stn. 5, Kherpena-ka-Nalla, 13-15.x.1941.

Distribution.—RAJASTHAN (first record) : Jodhpur, Nagaur and Udaipur Districts. *Elsewhere* : India, Ceylon and Upper Burma. Mostly found in the plains of the southern India. Known also from U. P. and Assam.

Remarks.—Length of the male and female specimens, 63 mm. and 44 mm. respectively. Body stout, toad like. Both the specimens have united outer metatarsals, small subarticular tubercles and half webbed toes. Head broader than long. Sexes are distinct. Male with a vocal sac forming folds on sides of throat. Colour usually yellowish or brownish above. The specimen from Jodhpur (W Rajasthan) is greenish above whereas the one from Udaipur (E. Rajasthan) is brownish. A yellow vertebral streak is present in the specimen from Jodhpur. Skin with longitudinal folds in both the specimens. This species is distinguished clearly from *Rana limnocharis*, its closest ally, by the presence of large and shovel-shaped inner metatarsal tubercle which is used for burrowing.

3. Family BUFONIDAE

Genus *Bufo* Laurenti

Key to the species of genus *Bufo* Laurenti from Rajasthan

Head without bony ridges.

A tarsal fold.

Parotid glands flat

B. andersoni

Head with bony ridges.

No tarsal fold.

Parotid glands elongate.

B. melanostictus

6. *Bufo melanostictus* Schneider

(Pl. 2, Fig. 6)

1799. *Bufo melanostictus* Schneider, *Hist. Amph.*, Jena, 1, p. 216.
 1890. *Bufo melanostictus* : Boulenger, *Fauna Brit. Ind.*, London, p. 50.
 1923. *Bufo melanostictus* : Nieden, *Das Tierreich, Anura.*, Berlin, 1, p. 116, fig. 167.
 1943. *Bufo melanostictus* : McCann, *J. Bombay nat. Hist. Soc.*, 43, p. 206 (Mt. Abu).

Material.—Jaipur District : Coll. A. K. Mukherjee, 10 exs., Jalga Lake, 25.vii.1958 ; Sirohi District : Coll. K. S. Pradhan, 1 ex., Mt. Abu, 7.iii.1948 ; Udaipur District : Coll. B. N. Chopra and M. L. Roonwal, 1 ex., Kherpena-ka-Nallah, 13-15.x.1941.

Distribution.—RAJASTHAN.—Districts of Jaipur, Sirohi (McCann, 1943) and Udaipur. *Elsewhere* : Commonest throughout India, Ceylon and Burma. Its range extends to Southern China, Malaya peninsula and Archipelago.

Remarks.—All specimens are juveniles. Length 22–24 mm. All have prominent spiny warts on upper surface. Parotids prominent and kidney-shaped. Colour brownish above, spines of warts black ; lower surface spotted.

7. *Bufo andersoni* Boulenger

(Pl. 2, Fig. 7)

1883. *Bufo andersoni* Boulenger, *Ann. mag. nat. Hist.*, London, (5) 12, p. 163.
 1890. *Bufo andersoni* : Boulenger, *Fauna Brit. Ind.*, London, p. 504.
 1923. *Bufo andersoni* : Nieden, *Das Tierreich, Anura*, Berlin, 1, p. 86, figs. 136 & 137.
 1943. *Bufo andersoni* : McCann, *J. Bombay nat. Hist., Soc.*, Bombay, 43, pp. 215-216.

Material.—Bikaner District : Coll. B. Biswas, 2 exs., Kolayat, 2.ix.1960 ; 72 exs., Kotri, 15.ix.1960 ; Ganganagar District : Coll. B. Biswas, 1 ex., Nohar, 13.x.1960 ; Jaipur District : Coll. A. K. Mukherjee, 3 exs., Stn. 1, Devdyani, 26.iv.1957 ; 2 exs., Stn. 3, Jhapog, 29.iv.1957 ; Jaisalmer District : Coll. K. K. Tiwari and S. Biswas, 2 exs., Stn. 2, Tolla berra, 21.xii.1957 ; 1 ex., Stn. 2, Salamsar, 23.xii.1957 ; 1 ex., Stn. 3, Tolla Berra, 25.xii.1957 ; Jodhpur District : Coll. B. Biswas, 1 ex., Kaylana afforestation, 12.xii.1956 ; 1 ex., Jodhpur, 29.viii.1960 ; Coll. R. K. Bhatnagar, 3 exs., Khowkhra, 3.viii.1960 ; Nagaur District : Coll. A. K. Mukherjee, 7 exs., Stn. 17, Gudha, 4.yiii.1958 ; 4 exs., Stn. 10, Nandana River, 28.vii.1958 ; Coll. B. Biswas, 2 exs., Nagaur, 2.ix.1960 ; Udaipur District : Coll. K. S. Pradhan, 1 ex., Mavli, 25.ii.1948 ; 1 ex., Mavli, 26.ii.1948.

Distribution.—RAJASTHAN.—Districts of Bikaner, Ganganagar, Jaipur, Jaisalmer, Jodhpur, Nagaur and Udaipur. *Elsewhere.*—Northern India (Agra, Rajasthan and Sind) to Arabia.

Remarks.—Length 35-78 mm. in males and 39-91 mm. in females. All specimens have a crown without bony ridges and a tarsal fold. The parotids are large and flat. Sexes are distinct, males with a subgular vocal sac. Colour olive grey in some specimens and brownish in others. Some specimens from Nagaur (W. Rajasthan) are olive grey whereas those from Jaipur and Udaipur (E. Rajasthan) are brownish. Skin of upper surface with regular flat warts but without spines. It is clearly distinguished from its ally, *B. melanostictus* by absence of bony ridges on head and presence of a tarsal fold.

The species is already known from Rajasthan in Ajmer and Sirohi districts.

4. Family MICROHYLIDAE

Genus *Microhyla* Tschudi

8. *Microhyla ornata* (Dumeril & Bibron)

(Pl. 2, Fig. 8)

1841. *Engystoma ornatum* Dumeril and Bibron, *Erpet. Gen.*, Paris, 8, p. 745.
 1934. *Microhyla ornata* : Parker, *A monograph of the frogs of the family Microhylidae*, London, pp. 139-141.
 1943. *Microhyla ornata* : McCann, *J. Bombay nat. Hist. Soc.*, Bombay, 43, p. 206. (Mt. Abu).

Material.—Pali District : Coll. K. S. Pradhan, 2 exs., Phulad River, 1.iii.1948.

Distribution.—RAJASTHAN.—Districts of Pali and Sirohi (McCann, 1943). *Elsewhere* : Ceylon, India, Burma, Malay peninsula, Thailand, Formosa, Tonkin and Hainan. Occurs generally in India.

Remarks.—Length of the specimens are 21 mm. and 18 mm. In both specimens toes are webbed at base and metatarsal tubercles are very small. Both specimens are males with black pigmented throats. Skin smooth, greyish olive above with characteristic dark marking.

III—SUMMARY

1. The paper deals with the Amphibian fauna of Rajasthan based on several recent collections made by the Zoological Survey of India parties, and consists of about 660 specimens. Eight species belonging to three families and three genera, viz., 1. *Rana hexadactyla* Lesson, 2. *R. cyanophlyctis* Schneider, 3. *R. tigrina tigrina* Daudin, 4. *R. limnocharis* Weigmann, 5. *R. breviceps* Schneider, 6. *Bufo melanostictus* Schneider, 7. *B. andersoni* Boulenger, and 8. *Microhyla ornata* (Dumeril and Bibron), are recorded.

2. *Rana hexadactyla* and *R. breviceps* are recorded from Rajasthan for the first time.

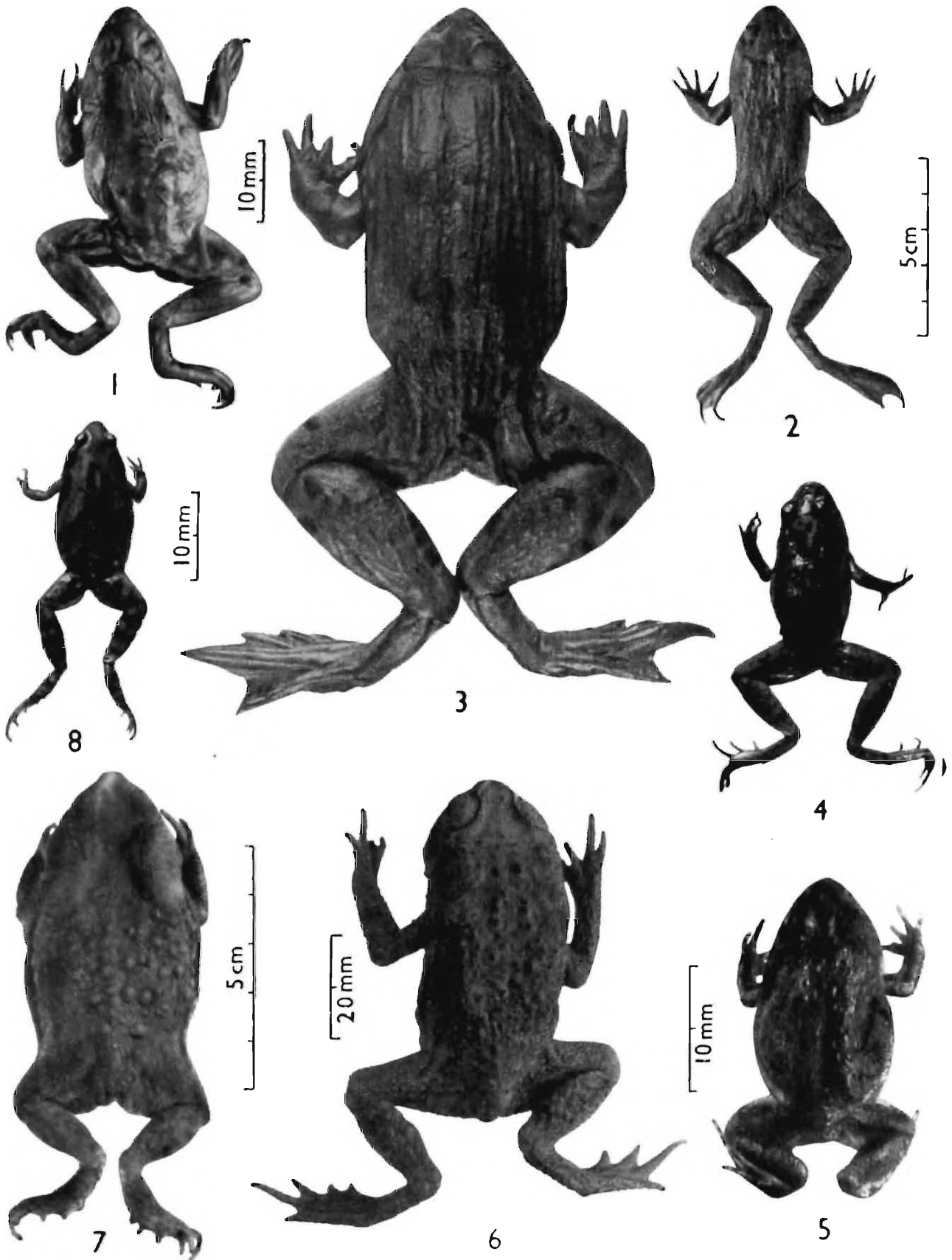
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PLATE 2

Photographs of Amphibia (Frogs & Toads) from Rajasthan

- FIG. 1.—*Rana hexadactyla* Lesson. (Z. S. I. No. 9432 ; Jaipur, Jaipur Dist.).
- FIG. 2.—*Rana cyanophlyctis* Schneider. (Z. S. I. No. A 67 ; ♀, Golab-sagar Tank, Jaisalmer Dist.).
- FIG. 3.—*Rana tigrina tigrina* Daudin. (Z. S. I. No. A 211 ; ♀, Gudha, Nagaur Dist.).
- FIG. 4.—*Rana limnocharis* Wiegmann. (Z. S. I. No. A 178 ; ♂, River Phulad, Pali Dist.).
- FIG. 5.—*Rana breviceps* Schneider. (Z. S. I. No. A 1282 ; Nagaur, Nagaur Dist.).
- FIG. 6.—*Bufo melanostictus* Schneider. (Z. S. I. No. 9935 ; Mt. Abu, Sirohi Dist.).
- FIG. 7.—*Bufo andersoni* Boulenger. (Z. S. I. No. A 1283 ; Nagaur, Nagaur Dist.).
- FIG. 8.—*Microhyla ornata* (Dumeril & Bibron). (Z. S. I. No. A 189 ; ♂, River phulad, Pali Dist.).



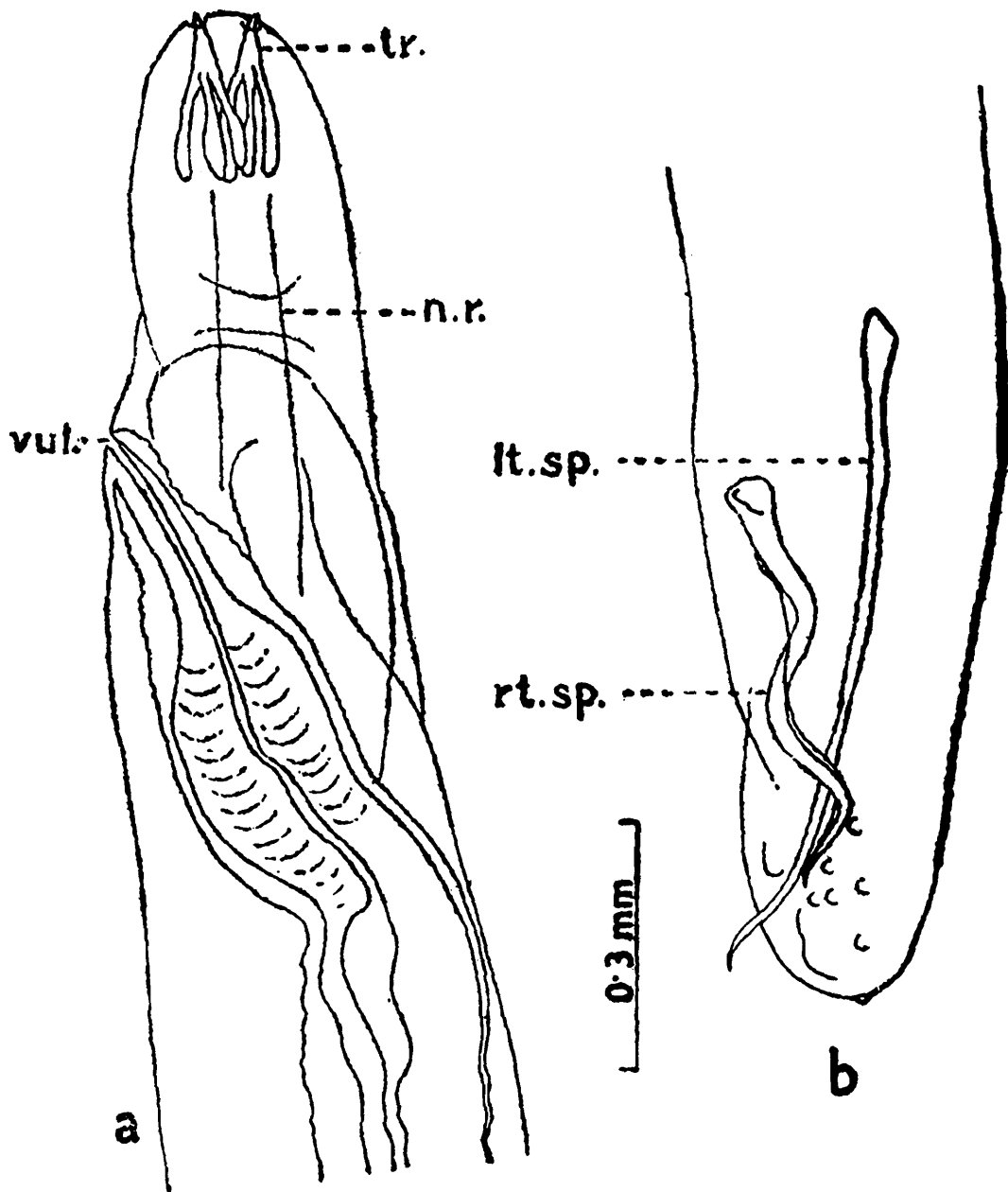
***Diplotriaena singhi* sp. n. from a Pied Bushchat, *Saxicola caprata bicolor* (Sykes) from India**

By

T. D. SOOTA
Zoological Survey of India, Calcutta

(With 1 Text-figure)

Diplotriaena singhi sp. n.*



TEXT-FIG. 1.—*Diplotriaena singhi* sp. n. (a) Female, anterior region; (b) Male, posterior region. *lt. sp.*, left spicule; *n.r.*, nerve ring; *rt. sp.*, right spicule; *tr.*, trident; *vul.*, vulva

Material.—3♂♂ and 1♀, all from the host-bird (*vide infra*) from Hissar (Punjab).

*Named after Dr. Kunwar Suresh Singh, Professor of Parasitology, Post Graduate College of Animal Sciences, Indian Veterinary Research Institute, Izatnagar, for his help in various ways.

Rec. Zool. Surv. India, 62 (1&2), 1970

(61)

Diagnosis.—A pair of cuticularised tridents present on sides of oesophagus in anterior end ; spicules unequal and dissimilar, the left longer and nearly straight, the right shorter and spirally twisted.

Description : Male : Total body-length 11·57-19·4 mm. (holotype 19 mm.), maximum width of holotype 0·61 mm. Tridents two in number, length 0·18mm. Nerve-ring 0·31mm. from anterior end. Spicules dissimilar and unequal. Left spicule more or less straight ; length 0·65-0·77mm. (holotype 0·77mm.). Right spicule spirally twisted, with about two turns ; straight line distance between the two points 0·40-0·53mm. (holotype 0·5 mm.). Cloaca subterminal ; 0·11-0·13 mm. (holotype 0·12mm.) from posterior end. Seven pairs of caudal papillae (5 pairs postanal, 1 pair adanal and 1 pair preanal), all very small and difficult to see.

Female : Total body-length 34·8 mm. ; maximum breadth 0·59 mm. Tridents 0·2 mm. in length. Nerve-ring 0·34 mm. from anterior end. Vulva anterior 0·53 mm. from anterior end. Embryonated eggs in uterus 0·046-0·050×0·030-0·032 mm.

Type-specimens.—*Holotype :* ♂, deposited with Zoological Survey of India, Calcutta, Registered No. W 6695/1. *Allotype :* ♀ ; Reg. No. W. 6696/1. *Paratypes :* Two ♂♂, in a poor state of preservation ; Reg. No. W. 6697/1.

Type-locality.—Hissar, Punjab (India).

Type-host.—From the abdominal cavity of the Pied Bushchat, *Saxicola caprata bicolor* (Sykes) (Aves : Passeriformes, Muscicapidae).

Remarks.—The new species differs from all the known species of the genus in the number and position of caudal papillae and size of both the spicules.

SUMMARY

A new species of an avian nematode is described from a Pied Bushchat, *Saxicola caprata bicolor* (Sykes). The present is the first record of the genus from this host.

Fauna of Rajasthan, India. Part 7. Fishes

By

A. K. DATTA AND N. MAJUMDAR

Zoological Survey of India, Calcutta

(With 2 Text-figures and 7 Plates)

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I—INTRODUCTION

The present account is based on the collections made by the field-parties of the Zoological Survey of India during the years 1941-63, as follows :—(i) In 1941, by Drs. B. N. Chopra and M. L. Roonwal. (ii) In 1948, by Shri K. S. Pradhan. (iii) In 1956, by Dr. B. Biswas. (iv) In 1957, by Shri A. K. Mukherjee. (v) In 1958, by Shri S. Biswas. (vi) In 1961-62, by Dr. A. K. Datta. (vii) In 1963, by Shri K. K. Mahajan, Shri N. Majumdar and Shri R. N. Bhargava.

A total of 75 species of fishes are known from Rajasthan and are listed in the next section. Three of these, namely *Carassius carassius* (Linn.), *Gambusia affinis* (Baird & Giard) and *Osphronemus goramy* Lacépède, are introduced species from foreign countries, but are now well established. We have been able to examine 63 species (marked with an asterisk *) belonging to 36 genera and 16 families. Of these, the following 11 species are recorded for the first time from Rajasthan :—

1. *Gudusia chapra* (Hamilton)
2. *Barilius barila* Hamilton
3. *Danio* (*Brachydanio*) *rerio* Hamilton
4. *Amblypharyngodon mola* (Hamilton)

**Rec. Zool. Surv. India*, 62 (122), 1970.

5. *Aspidoparia morar* (Hamilton)
6. *Cherynius chagunio* (Hamilton)
7. *Labeo dyocheilus* (McClelland)
8. *Botia lohachata* Chaudhuri
9. *Puntius vittatus* Day
10. *Mystus vittatus* (Bloch)
11. *Mastocembelus pancalus* (Hamilton)

A new species of fish, *Labeo rajasthanicus* (family Cyprinidae), from Jaisamand Lake, Udaipur District, is also described here.

The following 12 species of fish are included from the published literature :—

1. *Oxygaster phulo* (Hamilton)
2. *Barilius bendelisis* (Hamilton)
3. *Barilius vagra* (Hamilton)
4. *Labeo angra* (Hamilton)
5. *Labeo nigripinnis* Day
6. *Puntius conchoniis* (Hamilton)
7. *Puntius dorsalis* (Jerdon)
8. *Silonia silondia* (Hamilton)
9. *Bagarius bagarius* (Hamilton)
10. *Channa striatus* (Bloch.)
11. *Ambassis baculis* (Hamilton)
12. *Osphronemus goramy* Lacèpède

Our knowledge about the fish fauna of Rajasthan and its zoogeographical relationships is due mainly to Misra (1950), Mathur (1952), Hora & Mathur (1952), Krishna & Menon (1958), Dutta Gupta, Menon, Nair & Das (1961) and, Moona (1963). A comprehensive taxonomic key and illustrations are not, however, available ; these are provided in the present account. Regarding the zoogeography of the fishes of Rajasthan, Mathur (1952) traced the affinities of the fish fauna of Rajasthan, to that of Peninsular India on the one hand, and the Sind Hills on the other, and drew the following conclusions :—

“ The Aravallis during the more recent geological epochs tilted to the north and in this process carried the fauna of the Peninsula, more particularly of the Satpuras, northwards. Owing to the foredeep in front of the Himalayas and the possibility of a large river flowing through it, this Peninsular fauna could not extend to the Himalayas, and, for the same reason, the Himalayan fauna could not spread to the Aravallis. The absence of any characteristic Himalayan species in the Aravallis is very significant in this connection.”

“ There is a sunken ridge below the desert areas of Rajasthan and Sind which once connected the Aravalli Hills with the Sind Hills through the Sangla Hills in the Punjab (Auden), 1950, 18). The occurrence of *Labeo nigripinnis* in such widely separated areas as the Sind Hills and the Aravalli Hills to-day indicated that once its range would have been continuous over the sunken ridge.”

We are grateful to Dr. M. L. Roonwal, Director, Zoological Survey of India, for offering us the opportunity to work out the material and also for reading the manuscript and suggesting improvements.

II—LIST OF COLLECTING STATIONS IN RAJASTHAN FOR FISHES

A total of 93 collecting stations in 14 district of Rajasthan from which the fishes were obtained are listed below. These serial numbers will also be found in the map (Text-fig. 1).

1. *Ajmer District*

1. Anasagar Lake, *ca.* 2 km. from Public Garden, Ajmer.
2. Chat, *ca.* 6 km. S. of Nasirabad, Ajmer District.

2. *Alwar District*

3. Jeysagar, Alwar.
4. Mangalsar, Alwar.
5. Mansarovar, Alwar.
6. Siliserh Bund, Alwar.

3. *Bharatpur District*

7. Pucca tank near Multipurpose School, Bharatpur.
8. Aghapur, *ca.* 22 km. from Bharatpur.
9. Kharna village, *ca.* 20 km. S. of Bharatpur.
10. Kila-ki-Khai, *ca.* 3 km. from Deeg town.
11. Ghana Bird Sanctuary, *ca.* 20 km. from Bharatpur town.
12. Roopsagar, *ca.* 35 km. from Bharatpur town.
13. Tank near Ajan village, *ca.* 20 km. N.E. of Bharatpur town.
14. Tank, *ca.* 5 km. N. E. of Bharatpur Fort.
15. Danaduch-ki-Diggi (tank) *ca.* 6 km. N. E. of Bharatpur Fort.
16. Tank inside Ghana Bird sanctuary.
17. Tank, *ca.* 15 km. N. W. of Kama Tehsil, near Akata village.
18. Tank at Kherli village, *ca.* 16 km. from Nagar.
19. Tank *ca.* 10 km. N. E. of Khumbher village.

4. *Bikaner District*

20. Kolayat.

5. *Dungarpur District*

21. Dungarpur town.
22. River Sone, near Piparidia village, *ca.* 14 km. N. of Dungarpur town.
23. Soorpur-ki-Nadi, *ca.* 6 km. from Dungarpur town.

6. *Jaipur District*

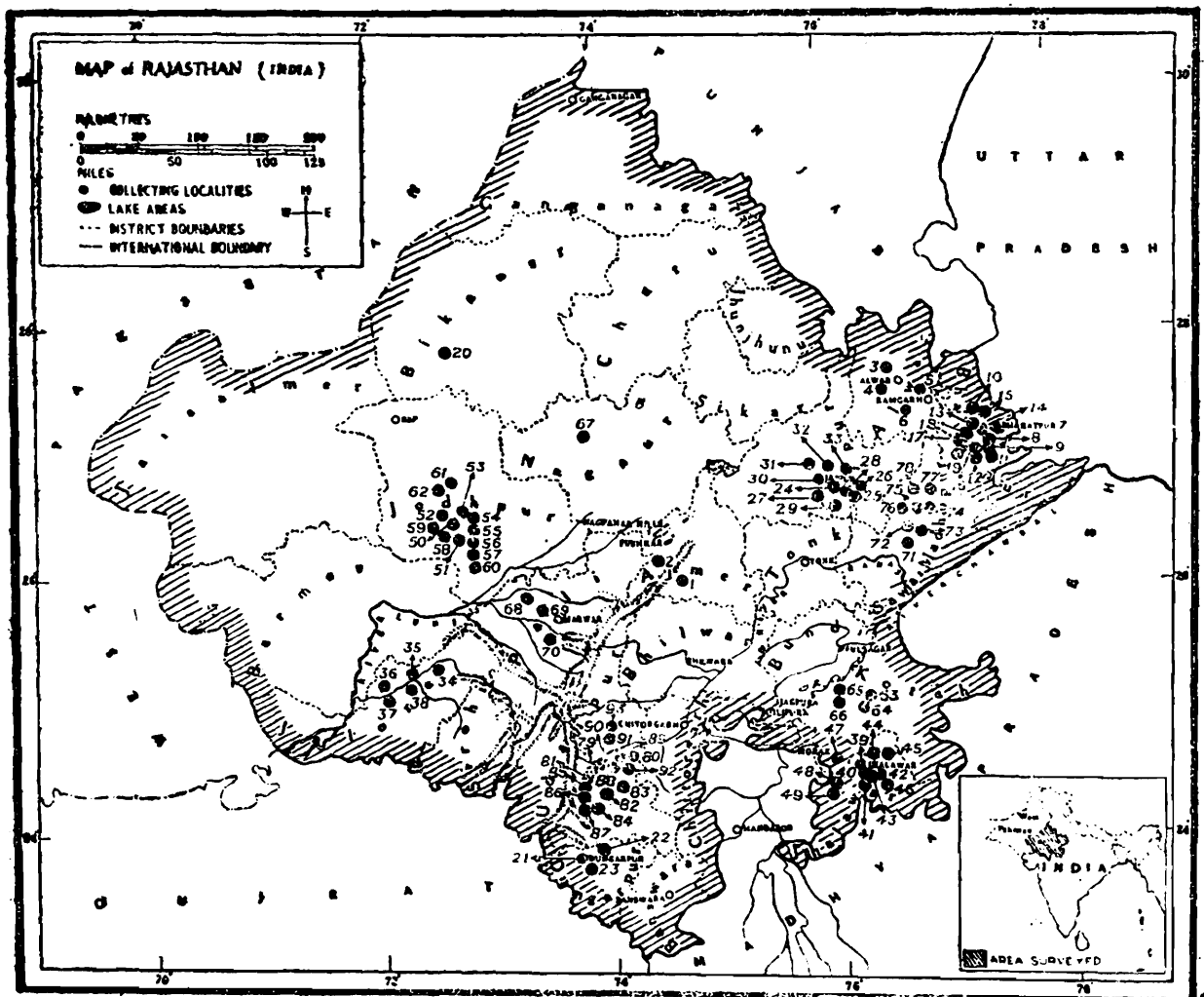
24. A nulla (stream) from Mapdori-ka-Bund, *ca.* 7 km. S. W. of Manoharpur Bus Stand, Manoharpur.
25. Pond, in bed of a tributary of Sabi river, *ca.* 5 km. W. of Manoharpur Bus Stand, Manoharpur.
26. Bandi Nadi (R. Bandi) at Sanodia.
27. Chaparwara.
28. Chhitoli Bund, *ca.* 10 km. W. of Bairat village.
29. Datri Nadi (R. Datri).
30. Jaipur.
31. Jugla village.
32. Kala tank of Naraina.
33. Ratan talab (tank).

7. Jalor District

34. Dedeli-ka-Talao (tank), *ca.* 3 km. W. of Bhinmal Railway Station.
35. Jawai river, *ca.* 2 km. S. of Erinpura Bus station, Erinpura.
36. Nadi, *ca.* 3 km. N. of Jawai Dam Railway Station, Erinpura.
37. Sagi river, *ca.* 17 km. W. of Jaswantpura.
38. Talbi (tank) *ca.* 2 km. N. of Bhinmal Railway Station.

8. Jhalawar District

39. Ahu river, *ca.* 2.5 km. N. E. of Sunel village.
40. Chandra Sarovar (tank), *ca.* 2 km. W. of Jhalawar town.
41. Dhanwara-ka-Talao (tank) *ca.* 3 km. W. of Jhalawar Collectorate.
42. Gaduli talai (tank) *ca.* 1 km. W. of Shergarh village.
43. Gomti Sagar (tank), *ca.* 3 km. N. of Jhalarpatan.
44. Khandia tank, *ca.* 3 km. S. of Jhalawar town.
45. Mudlia Kheri, *ca.* 2 km. W. of Jhalarpatan.
46. Parwan river, *ca.* 5 km. E. of Aklera village.
47. Parwan river, *ca.* 1 km. S. of Shergarh village.
48. Shukla talai, *ca.* 1 km. S. of Jhalawar town.
49. Tributary of Parwan river, *ca.* 2 km. N. W. of Aklera village.



TEXT-FIG. 1.—Map of Rajasthan, showing the collecting localities for fishes. The Arabic numerals against the localities correspond to the numbers given in the text under the collecting localities.

9. *Jodhpur District*

50. Bowri (tank), *ca.* 2 km. N. of Kailana bridge, near Jodhpur.
51. Luni river, *ca.* 39 km. S. W. Jodhpur town.
52. Kailana tank, *ca.* 12 km. W. of Jodhpur town.
53. Mandore Canal.
54. Namdari tank, *ca.* 14 km. from Jodhpur town.
55. Nagadari, Mandore Gardens, near Jodhpur.
56. Padam Sagar (tank), Jodhpur town.
57. Parlora talab (tank), at Darasane village, *ca.* 46 km. S. of Jodhpur.
58. Ranibagh garden, Mandore, near Jodhpur.
59. Ranisagar, Jodhpur town.
60. Sardarsamand tank, *ca.* 47 km. S. of Jodhpur.
61. Takhtsagar tank, Jodhpur.
62. Umedsagar tank, *ca.* 12 km. N. W. of Jodhpur town.

10. *Kotah District*

63. Bewara tank, *ca.* 2 km. N. of Dara Game Sanctuary.
64. Nanta tank, *ca.* 12 km. N. W. of Kotah town.
65. Alani river, *ca.* 20 km. E. of Kotah town.
66. Parwan river, *ca.* 3 km. E. of Palaita village.

11. *Nagaur District*

67. Nandana nadi (rivulet) at Nanta village.

12. *Pali District*

68. Chota Talao (tank), *ca.* 3 km. E. of Pali Railway Station.
69. Hemawas tank, *ca.* 8 km. S. of Pali town.
70. Bowri (tank) near Ghenari village, *ca.* 14 km. N. of Khimada village.

13. *Sawai Madhopur District*

71. Bhagwatigarh Bund, *ca.* 33 km. S. of Sawai Madhopur town.
72. Bhairu Dara, *ca.* 5 km. E. of Sawai Madhopur town.
73. Gambhir river, *ca.* 13 km. N. W. of Hindaun.
74. Gambhir river, *ca.* 5 km. N. of Karauli city.
75. Gambhir river, *ca.* 3 km. S. W. of Shri Mahabirji Railway Station.
76. Kiyard Bund, *ca.* 10 km. N. W. of Hindaun city.
77. Mui Bund, *ca.* 15 km. E. of Sawai Madhopur town.
78. Sarwal Bund, *ca.* 13 km. W. of Sawai Madhopur town.

14. Udaipur District

79. Ahar river, *ca.* 4 km. S. of Railway Bridge, Udaipur town.
80. Barapal village, *ca.* 22 km. N. of Udaipur town.
81. Dulev-ka-Nalla (R. Dulev) *ca.* 3 km. from Prasad village.
82. Fatehsagar, *ca.* 7 km. N. W. of Udaipur town.
83. Jaisamand tank, *ca.* 45 km. E. of Udaipur town.
84. Kharpena-ka-Nalla (river), *ca.* 3 km. N. of Barapal village.
85. Kherad village, Jaisamand, *ca.* 60 km. S. E. of Udaipur.
86. Kalaria tank, *ca.* 7 km. W. of Udaipur.
87. Parai-ki-Nadi (river), *ca.* 2 km. S. of Prasad village.
88. Pamri nadi (river), 1 km. E. of Kotra village.
89. Pichola Lake, *ca.* 7 km. W. of Udaipur town.
90. Rajsamand, *ca.* 40 km. from Mavli.
91. River Bearch (Bedach), near Chittorgarh.
92. River Phulad, *ca.* 2 km. S. E. of Phulad Railway Station.
93. Udaisagar Nalla, an out-flow from Udaisagar Lake, *ca.* 12 km. from Udaipur.

III—LIST OF FISHES KNOWN FROM RAJASTHAN

Note.—Out of the 75 species known from Rajasthan, 63 were examined by us from specimens and are marked with an asterisk(*). The remainder, Nos. 6, 9, 11, 20, 29, 39, 41, 58, 59, 67, 68 and 72, were taken from the published literature.

Class TELEOSTOMI

Order I. CLUPEIFORMES

Family (i) CLUPEIDAE

Genus (1) *Gudusia* Fowler

- *1. *Gudusia chapra* (Hamilton)

Family (ii) NOTOPTERIDAE

Genus (2) *Notopterus* Lacépède

- *2. *Notopterus notopterus* (Pallas)

Order II. CYPRINIFORMES

Family (iii) CYPRINIDAE

Genus (3) *Oxygaster* van Hasselt

- *3. *Oxygaster bacaila* (Hamilton)
 *4. *Oxygaster clupeoides* (Bloch)
 *5. *Oxygaster gora* (Hamilton)
 6. *Oxygaster phulo* (Hamilton)

Genus (4) **Barilius** Hamilton

- *7. *Barilius barila* Hamilton
- *8. *Barilius barna* (Hamilton)
- 9. *Barilius bendelisis* (Hamilton)
- *10. *Barilius bola* (Hamilton)
- 11. *Barilius vagra* (Hamilton)

Genus (5) **Danio** Hamilton

- *12. *Danio (Danio) aequipinnatus* (McClelland)
- *13. *Danio (Danio) devario* (Hamilton)
- *14. *Danio (Brachydanio) rerio* (Hamilton)

Genus (6) **Esomus** Swainson

- *15. *Esomus danrica* (Hamilton)

Genus (7) **Rasbora** Bleeker

- 16. *Rasbora daniconius* (Hamilton)

Genus (8) **Carassius** Nilsson

- *17. *Carassius carassius* (Linnaeus)

Genus (9) **Garra** Hamilton

- *18. *Garra gotyla* (Gray)
- *19. *Garra mullya* (Sykes)

Genus (10) **Labeo** Cuvier

- 20. *Labeo angra* (Hamilton)
- *21. *Labeo bata* (Hamilton)
- *22. *Labeo boga* (Hamilton)
- *23. *Labeo boggut* (Sykes)
- *24. *Labeo calbasu* (Hamilton)
- *25. *Labeo dero* (Hamilton)
- *26. *Labeo dyocheilus* (McClelland)
- *27. *Labeo fimbriatus* (Bloch)
- *28. *Labeo goniis* (Hamilton)
- 29. *Labeo nigripinnis* Day
- *30. *Labeo rohita* (Hamilton).
- *31. *Labeo rajasthanicus* sp. n.

Genus (11) **Aspidoparia** Heckel

- *32. *Aspidoparia morar* (Hamilton)

Genus (12) **Amblypharyngodon** Bleeker

- *33. *Amblypharyngodon mola* (Hamilton)

Genus (13) **Chagunius** Smith

- *34. *Chagunius chagunio* (Hamilton)

Genus (14) **Catla** Cuvier and Valenciennes

- *35. *Catla catla* (Hamilton)

Genus (15) **Cirrhinus** Cuvier*36. *Cirrhinus mrigala* (Hamilton)*37. *Cirrhinus reba* (Hamilton)Genus (16) **Puntius** Hamilton*38. *Puntius amphibia* (Valenciennes)39. *Puntius conchonius* (Hamilton)*40. *Puntius chola* (Hamilton)41. *Puntius dorsalis* (Jerdon)*42. *Puntius sarana* (Hamilton)*43. *Puntius sophore* (Hamilton)*44. *Puntius ticto* (Hamilton)*45. *Puntius vittatus* DayGenus (17) **Osteobrama** Cuvier*46. *Osteobrama cotio* (Hamilton)Genus (18) **Tor** Gray*47. *Tor khudree* (Sykes)

Family (iv) COBITIDAE

Genus (19) **Botia** Gray*48. *Botia lohachata* ChaudhuriGenus (20) **Lepidocephalichthys** Bleeker*49. *Lepidocephalichthys guntea* (Hamilton)Genus (21) **Noemacheilus** van Hasselt*50. *Noemacheilus botia* (Hamilton)*51. *Noemacheilus denisonii* Day

Family (v) BAGRIDAE

Genus (22) **Mystus** Scopoli*52. *Mystus bleekeri* (Day)*53. *Mystus cavasius* (Hamilton)*54. *Mystus seenghala* (Sykes)*55. *Mystus vittatus* (Bloch)

Family (vi) SILURIDAE

Genus (23) **Ompok** Lacèpède*56. *Ompok bimaculatus* (Bloch)Genus (24) **Wallago** Bleeker*57. *Wallago attu* (Schneider)Genus (25) **Silonia** Swainson58. *Silonia silondia* (Hamilton)

Family (vii) SISORIDAE

Genus (26) **Bagarius** Bleeker59. *Bagarius bagarius* (Hamilton)

Family (viii) SACCOBRANCHIDAE
Genus (21) **Heteropneustes** Müller

*60. *Heteropneustes fossilis* (Bloch)

Order III. BELONIFORMES

Family (ix) BELONIDAE

Genus (28) **Xenentodon** Regan

*61. *Xenentodon cancila* (Hamilton)

Order IV. CYPRINODONTIFORMES

Family (x) POECILIDAE

Genus (29) **Gambusia** Poey

*62. *Gambusia affinis* (Baird and Girard)

Genus (30) **Aplocheilus** McClelland

*63. *Aplocheilus lineatum* (Valenciennes)

Order V OPHICEPHALIFORMES

Family (xi) OPHICEPHALIDAE

Genus (31) **Channa** Gronov

*64. *Channa gachua* (Hamilton)

*65. *Channa marulius* (Hamilton)

*66. *Channa punctatus* (Bloch)

67. *Channa striatus* (Bloch)

Order (VI) PERCIFORMES

Family (xii) AMBASSIDAE

Genus (32) **Ambassis** Cuvier

*68. *Ambassis baculis* (Hamilton)

*69. *Ambassis nama* (Hamilton)

*70. *Ambassis ranga* (Hamilton)

Family (xiii) ANABANTIDAE

Genus (33) **Colisa** Cuvier and Valenciennes

*71. *Colisa fasciatus* (Bloch and Schneider)

Family (xiv) OSPHRONEMIDAE

Genus (34) **Osphronemus** Lacèpède

72. *Osphronemus goramy* Lacèpède

Family (xv) GOBIIDAE

Genus (35) **Glossogobius** Gill

*73. *Glossogobius giuris* (Hamilton)

Order VII. MASTOCEMBELIFORMES

Family (xvi) MASTOCEMBELIDAE

Genus (36) *Mastocembelus* Scopoli*74. *Mastocembelus armatus* (Lacépède)*75. *Mastocembelus pancalus* (Hamilton)

IV—FIELD KEY FOR IDENTIFICATION OF RAJASTHAN FISHES

- | | |
|---|----------------------------------|
| 1. Body eel-like | 2 |
| Body not eel-like | 3 |
| 2. Vertical fin confluent with caudal | <i>Mastocembelus armatus</i> |
| Vertical fin not confluent with caudal | <i>Mastocembelus pancalus</i> |
| 3. Jaws produced into a beak-like structure | <i>Xenentodon cancila</i> |
| Jaws not produced into a beak-like structure | 4 |
| 4. Body naked | 12 |
| Body scaly | 5 |
| 5. Suprabranchial organ present ; head snake-like | 58 |
| Suprabranchial organ absent ; head not snake-like | 6 |
| 6. One dorsal fin | 7 |
| Two dorsal fins | 17 |
| 7. Vertical fin with a viliform ray | <i>Colisa fasciatus</i> |
| Vertical fin without a viliform ray | <i>Osphronemus goramy</i> |
| 8. Gill membrane broadly united with isthmus ; jaws without teeth | 20 |
| Gill membrane free from isthmus ; jaws with teeth | 9 |
| 9. Head scaly and depressed ; abdomen not serrated | 11 |
| Head naked and compressed, abdomen serrated | 10 |
| 10. Anal with 21-24 rays | <i>Gudusia chapra</i> |
| Anal with 100-110 rays | <i>Notopterus notopterus</i> |
| 11. Vertical bands (8-10) on side of abdomen present | <i>Aplocheilichthys lineatum</i> |
| Vertical bands on side of abdomen absent | <i>Gambusia affinis</i> |
| 12. Four pairs of barbels present | <i>Heteropneustes fossilis</i> |
| One pair of barbels present | <i>Silonia silonia</i> |
| 13. Two pairs of barbels present | 14 |
| Barbels absent | 16 |
| 14. Dorsal with a spine | 15 |
| Dorsal without a spine | 23 |
| 15. Adipose dorsal 3 times the length of head | <i>Mystus cavasius</i> |
| Adipose dorsal not 3 times the length of head | <i>Mystus vittatus</i> |
| 16. Snout spatulate | <i>Mystus seenghala</i> |
| Snout not spatulate | <i>Mystus bleekeri</i> |
| 17. Anal with 15 rays | <i>Bagarius bagarius</i> |
| Anal with more than 15 rays | 18 |
| 18. Anal with 60-75 rays | <i>Ompok bimaculatus</i> |
| Anal with 86-93 rays | <i>Wallago attu</i> |

19. Pelvics united, forming a sucking disc	<i>Glossogobius giuris</i>
Pelvics separate;	20
20. Both edges of preorbital serrated	<i>Ambassis ranga</i>
Both edges of preorbital not serrated	21
21. Curved canines present in lower jaw	<i>Ambassis nama</i>
Curved canines absent in lower jaw	<i>Ambassis baculis</i>
22. Barbels 6 or more	60
Barbels less than 6	23
23. Abdomen sharp-edged	24
Abdomen rounded or flat	32
24. Maxilla extending up to front margin of orbit ; lateral line scales 80-87	<i>Oxygaster phulo</i>
Maxilla not extending up to the front margin of orbit ; lateral line scales more than 140	<i>Oxygaster gora</i>
25. Pectoral reach nearly to ventral ; lateral line scales 86-110	<i>Oxygaster bacaila</i>
Pectoral do not reach ventral ; lateral line scales 80-93	<i>Oxygaster clupeoides</i>
26. Lateral line close to ventral edge	27
Lateral line not close to ventral edge	29
27. Maxillary barbel long, reaching up to the pelvic Maxillary barbel short or absent	<i>Esomus danrica</i>
Maxillary barbel short or absent	28
28. Dorsal rays 9 or less	29
Dorsal rays more than 9	30
29. Anal rays not more than 7	<i>Rasbora daniconius</i>
Anal rays more than 7 (29-36)	<i>Osteobrama cotio</i>
30. Barbels present ; blue bands present on sides of body Barbels absent ; without blue bands on sides of body ; lateral line scales 41-48	31
Barbels absent ; without blue bands on sides of body ; lateral line scales 41-48	<i>Danio devario</i>
31. Rostral barbel short ; maxillary long, reaching end of the opercle	<i>Danio rerio</i>
Rostral barbel long, maxillary minute	<i>Danio aequipinnatus</i>
32. Mouth terminal or subterminal	33
Mouth markedly inferior	34
33. Post-labial groove continuous	<i>Tor khudree</i>
Post-labial groove interrupted in middle	34
34. Lower jaw with a post-symphyseal knob	36
Lower jaw without a post-symphyseal knob	38
35. Lower lip present ; lateral line complete	<i>Amblypharyngodon mola</i>
Lower lip absent ; lateral line incomplete	<i>Aspidoparia morar</i>
36. Cleft of mouth extending beyond anterior margin of eye ; lower jaw well developed	<i>Cirrhinus mrigala</i>
Cleft of mouth not extending beyond anterior margin of eye ; lower lip thin and deficient	<i>Cirrhinus reba</i>
37. Barbels absent	39
Barbels present	38
38. Barbels 2 ; anal 15-17	<i>Barilius bariv.</i>
Barbels 4 ; anal more than 17	40

39. Double row of blotches on body	<i>Barilius bola</i>
No double row of blotches on body	<i>Barilius barna</i>
40. Several (10) vertical bars on body	<i>Barilius vagra</i>
Vertical bars on the body absent	<i>Barilius bendelisis</i>
41. Anal spine serrated	<i>Carassius carassius</i>
Anal spine not serrated	<i>Catla catla</i>
42. With 4 barbels	43
With 2 barbels	44
43. Last anal ray elongated ; snout and cheek tuberculated	<i>Chagunius chagunio</i>
Last anal ray not elongated ; snout and cheek not tuberculated	<i>Puntius sarana</i>
44. Last undivided dorsal ray strong and serrated	45
Last undivided dorsal ray weak and not serrated	<i>Puntius amphibia</i>
45. Lateral line scales 26-28	<i>Puntius chola</i>
Lateral line scales 24-25	<i>Puntius dorsalis</i>
46. Last undivided dorsal ray entire	<i>Puntius sophore</i>
Last undivided dorsal ray articulated	<i>Puntius vittatus</i>
47. Two black spots at commencement of lateral line	<i>Puntius ticto</i>
One black spot at commencement of lateral line	<i>Puntius conchoniuis</i>
48. Chin with disc.	49
Chin without a disc.	50
49. A probosis on snout	<i>Garra gotyla</i>
No probosis on snout	<i>Garra mullya</i>
50. Scales along lateral line 60 or more	51
Scales along lateral line less than 60	52
51. Barbels 2 ; lateral line scales 60	<i>Labeo boggut</i>
Barbels 4 ; lateral line scales 74-84	<i>Labeo goniis</i>
52. Branched dorsal fin rays more than 18 ; lateral line scales 47	<i>Labeo fimbriatus</i>
Branched dorsal fin rays less than 18 ; lateral line scales 43	<i>Labeo dyocheilus</i>
53. A groove across snout	<i>Labeo dero</i>
No groove across snout	<i>Labeo angra</i>
54. Branched dorsal rays 14 ; lateral line scales 60	<i>Labeo rajasthanicus</i>
Branched dorsal rays less than 14 ; lateral line scales 42	<i>Labeo nigripinnis</i>
55. Height of the body 4-4½ in total length	<i>Labeo bata</i>
Height of the body 5-5½ in total length	<i>Labeo boga</i>
55. Branched dorsal rays 12-13 ; lateral line scales 40-42	<i>Labeo rohita</i>
Branched dorsal rays 13-15 ; lateral line scales 40-44	<i>Labeo calbasu</i>
57. Pectoral spotted	<i>Channa gachua</i>
Pectoral not spotted	58
58. Dorsal with more than 45 rays (45-55)	<i>Channa marulius</i>
Dorsal rays 45 or less	59
59. Dorsal rays 37-45	<i>Channa striatus</i>
Dorsal rays 29-32	<i>Channa punctatus</i>
60. A sharp prickle beneath eye	61
No sharp prickle beneath eye	62

- | | |
|--|-----------------------------------|
| 61. Body compressed (laterally) ; caudal forked | <i>Botia lohachata</i> |
| Body elongated, not compressed ; caudal truncate | <i>Lepidocephalichthys guntea</i> |
| 62. Body with 9-12 vertical bands | <i>Noemacheilus denisonii</i> |
| Body irregularly blotched | <i>Noemacheilus botia</i> |

V—SYSTEMATIC ACCOUNT

1. *Gudusia chapra* (Hamilton)

(Pl. 3, Fig. 4)

1822. *Clupanodon chapra* Hamilton, *Fishes of Ganges*, Edinburgh, pp. 248, 383. *Type-loc.* Upper parts of Ganges.

Material.—11 exs., Gaduli talai (tank), Jhalawar town, Jhalawar Dist., coll. *N. Majumdar* and *R. N. Bhargava*, 22. vi. 63.

Distribution.—RAJASTHAN : As above. *Elsewhere.*—INDIA : Assam, W. Bengal, Bihar, Orissa, Maharashtra, Andhra Pradesh, Madhya Pradesh. EXTRA-INDIAN : E. & W. Pakistan ; Malaya Peninsula.

2. *Notopterus notopterus* (Pallas)

(Pl. 3, Fig. 6)

1769. *Gymnotus notopterus* Pallas, *Spicil. Zool.*, Petersburg. 7, p.40, pl. 6, fig. 2. *Type-loc.* Indian Ocean.

Material. (i) 4 exs., Fatehsagar Lake, Udaipur Dist., coll. *R. N. Bhargava*. 11. iii. 61. (ii)-(v) Coll. *N. Majumdar* and *R. N. Bhargava* : (ii) 4 exs., Mangalsar, Alwar Dist., 7.vi.63. (iii) 4 exs., Siliserh Eurd, Alwar Dist., 8.vi.63. (iv) 2 exs., Jeysagar, Alwar Dist., 8.vi.63. (v) 1 ex., Khandia tank, Jhalawar Dist., 21.vi.63.

Distribution.—RAJASTHAN : As above. *Elsewhere* : INDIA : Punjab, Uttar Pradesh, Bihar, W. Bengal, Orissa, Assam, Madras, Madhya Pradesh, Andhra Pradesh, Maharashtra, Kerala. EXTRA-INDIAN : E. & W. Pakistan, Burma, Malaya Peninsula and Archipelago, Thailand.

3. *Oxygaster bacaila* (Hamilton)

(Pl. 3, Fig. 2)

1822. *Cyprinus bacaila* Hamilton, *Fishes of Ganges*, Edinburgh, pp. 265, 384, pl. 8, fig. 76. *Type-loc.* Freshwater rivers of all Gangetic Provinces.

Material.—(i) 4 exs., Chota Talao, Pali Dist., coll. *R. N. Bhargava*, 7.iii.61. (ii)-(iii) Coll. *N. Majumdar* and *R. N. Bhargava* : (ii) 16 exs., Jeysagar Bund, Alwar Dist., 7.vi.63. (iii) 27 exs., Khandia tank, Jhalawar Dist., 21.vi.63. (iv)-(vi) Coll. *A. K. Datta* : (iv) 2 exs., tank near Bharatpur Fort, Bharatpur Dist., 19.i.62. (v) 348 exs., Luni river, Jodhpur Dist., 12.xii.62. (vi) 22 exs., Kharala Dam, Jodhpur Dist., 8.i.63.

Distribution.—RAJASTHAN : As above. *Elsewhere* : INDIA : Throughout India (except Kerala, Mysore, Madras). EXTRA-INDIAN : E. & W. Pakistan and Burma.

4. *Oxygaster clupeioides* (Bloch)

(Pl. 3, Fig. 3)

1895. *Cyprinus clupeioides* Bloch, *Auslandische Fische*, Berlin, 12, p. 49, pl. 408, fig. 20. *Type-loc.* Tranquebar.

Material.—(i) 2 exs., Chaparwara, Jaipur Dist., coll. *A. K. Mukherjee*, 9.iii.57. (ii) 3 exs., Kherpena-ka-Nalla near Barapal, Udaipur Dist. coll. *B. N. Chopra* and *M. L. Roonwal*, 15. x. 41. (iii)-(vi) Coll. *N. Majumdar* and *R. N. Bhargava* : (iii) 3 exs., Surwal Bund, Sawai Madhopur Dist., 15.vi.63. (iv) 8 exs., Chandra Sarovar, Jhalawar Dist., 2.vi.63. (v) 36 exs., Shukla talai, Jhalawar Dist., 20.vi.63. (vi) 15 exs., Parwan river, Kota Dist., 26.vi.63. (vii)-(x) Coll. *A. K. Datta* : (vii) 10 exs., Pamri nadi, Udaipur Dist., 20.xii.61. (viii) 2 exs., Kailana Lake, Jodhpur Dist., 12.vii.62. (ix) 10 exs., Kharala Dam, Jodhpur Dist., 8.i.63. (x) 96 exs., Sardarsamand Lake, Jodhpur Dist., 19.iv.63.

Distribution.—RAJASTHAN : In addition to the above material, the following records (Mathur, 1952) are available : Tanks around Dungarpur town, Dungarpur Dist. Rajsamand near Kankroli, Udaipur Dist. ; R. Banas near Akhol and near Wadaval, Palanpur Dist. *Elsewhere* : INDIA : Gujarat, Madhya Pradesh, Andhra Pradesh, Mysore, Madras and Orissa. EXTRA-INDIAN : Burma.

5. *Oxygaster gora* (Hamilton)

(Pl. 3, Fig. 1)

1822. *Cyprinus gora* Hamilton, *Fishes of Ganges*, Edinburgh, pp. 263, 384. *Type-loc.* Brahmaputra near Goalpara.

Material.—1 ex., Fatehsagar Lake, ca. 3.5 km. from Udaipur town, coll. *R. N. Bhargava*, 11.iii.61.

Distribution.—RAJASTHAN : As above. *Elsewhere* : INDIA : Punjab, W. Bengal, Orissa and Assam. EXTRA-INDIAN : Nepal and E. & W. Pakistan.

6. *Oxygaster phulo* (Hamilton)

1822. *Cyprinus phulo* Hamilton, *Fishes of Ganges*, Edinburgh, pp. 262, 384. *Type-loc.* Rivers and ponds of the north-eastern parts of Bengal.

Material.—None. Reported from lakes in Jaipur and Udaipur Dists., and at Khetri (Jhunjhunu Dist.) by Dutta Gupta *et al* (1961).

Distribution.—RAJASTHAN : As above. *Elsewhere* : Throughout India.

7. *Barilius barila* Hamilton

(Pl. 3, Fig. 5)

1822. *Barilius barila* Hamilton, *Fishes of Ganges*, Edinburgh, pp. 267, 384. *Type-loc.* Rivers of northern Bengal.

Material.—2 exs., Ahu river, Jhalawar Dist., coll. *N. Majumdar* and *R. N. Bhargava*, 23.vi.63.

Distribution.—RAJASTHAN : As above. *Elsewhere* : INDIA : Freshwaters of Manipur, Assam, W. Bengal, Delhi, Uttar Pradesh, Bihar, Orissa, Madhya Pradesh and Mysore. EXTRA-INDIAN : E. Pakistan

8. **Barilius barna** (Hamilton)

(Pl. 5, Fig. 12)

1822. *Cyprinus barna* Hamilton, *Fishes of Ganges*, Edinburgh, pp. 268, 384.
Type-loc. Yamuna and Brahmaputra rivers.

Material.—(i) 1 ex., R. Ahu, Jhalawar Dist., coll. *N. Majumdar* and *R. N. Bhargava*, 23.vi.63. (ii)-(iii) coll. *A. K. Datta* : (ii) 1 ex., R. Wakal near Kotra village, Udaipur Dist., 20.xii.61. (iii) 1 ex., Sardarsamand Lake, Jodhpur Dist., 19.vi.63.

Distribution.—RAJASTHAN : As above. *Elsewhere* : INDIA : Assam, W. Bengal, Bihar, Uttar Pradesh and Orissa.

9. **Barilius bendelisis** (Hamilton)

1822. *Cyprinus bendelisis* Hamilton, *Fishes of Ganges*, Edinburgh, pp. 270, 385. *Type-loc.* Rivers of Mysore.

Material.—None. Reported from lakes in Jaipur Dist. and at Khetri (Jhunjhunu Dist.) by Dutta Gupta *et al* (1961).

Distribution.—RAJASTHAN : As above. *Elsewhere* : INDIA : Assam, W. Bengal, Bihar, Uttar Pradesh, Punjab, Madras, Mysore and Orissa. EXTRA-INDIAN : E. & W. Pakistan ; Ceylon.

10. **Barilius bola** (Hamilton)

(Pl. 4, Fig. 12)

1822. *Cyprinus bola* Hamilton, *Fishes of Ganges*, Edinburgh, pp. 274, 275.
Type-loc. Brahmaputra.

Material.—(i) 2 exs., Parsad-ka-Nalla, Udaipur Dist., coll. *B. N. Chopra* and *M. L. Roonwal*, 18.x.41. (ii) 1 ex., tributary of Parwan river near Aklera village, Jhalawar Dist., coll. *N. Majumdar* and *R. N. Bhargava*, 24.vi.63.

Distribution.—RAJASTHAN : As above. First record. *Elsewhere* : INDIA : The hill streams of Assam, West Bengal, Bihar, Uttar Pradesh, Punjab and Orissa. EXTRA-INDIAN : E. & W. Pakistan ; Burma.

11. **Barilius vagra** (Hamilton)

1822. *Cyprinus vagra* Hamilton, *Fishes of Ganges*, Edinburgh, pp. 269, 385.
Ganges at Patna.

Material.—None. Reported from lakes in Jaipur Dist. and at Khetri (Jhunjhunu Dist.) by Dutta Gupta *et al* (1961).

Distribution.—RAJASTHAN : As above. *Elsewhere* : INDIA : Throughout Northern India. EXTRA-INDIAN : W. Pakistan ; Ceylon.

12. **Danio (Danio) aequipinnatus** (McClelland)

(Pl. 4, Fig. 2)

1839. *Perilampus aequipinnatus* McClelland, *Asiatic Researches*, Calcutta, 19, p. 3, pl. 60, fig. 1. *Type-loc.* Assam.

Material.—(i) 6 exs., Dhulev-ka-Nalla near Prasad, Udaipur Dist., coll. *B. N. Chopra* and *M. L. Roonwal*, 18.x.41. (ii)-(iii) coll. *A. K. Datta* : (ii) 27 exs., Pamri nadi, Udaipur Dist., 22.xii.61. (iii) 5 exs., rocky pool, Pamri nadi, Udaipur Dist., 22.xii.61.

Distribution.—RAJASTHAN : As above. First record. *Elsewhere* INDIA : W Bengal, Assam, Manipur, Mysore, Madras and Andhra Pradesh. EXTRA-INDIAN : Ceylon, Burma, Thailand.

13. *Danio (Danio) devario* (Hamilton)

(Pl. 5, Fig. 4)

1822. *Cyprinus devario* Hamilton, *Fishes of Ganges*, Edinburgh, pp. 341-393, pl. 6, fig. 94. *Type-loc.* Rivers and ponds of Bengal.

Material.—(i)-(iii) Coll. *B. N. Chopra* and *M. L. Roonwal* : (i) 10 exs., tanks around Dungarpur town, 28.x.41. (ii) 6 exs., Udaisagar Nalla, Udaipur Dist., 11.x.41. (iii) 2 exs., R. Sone, Dungarpur Dist., 27.x.41. (iv)-(vi) Coll. *N. Majumdar* and *R. N. Bhargava* : (iv) 1 ex., Gomti Sagar, Jhalawar Dist., 21.vi.63. (v) 2 exs., Khandia tank, Jhalawar Dist., 21.vi.63. (vi) 8 exs., Sagi river, Jalor Dist., 1.vii.63.

Distribution.—RAJASTHAN : In addition to the above material, the following records (Mathur, 1952), are available :—Bundermere Lake and Gora Chapra Nalla, Mount Abu, Sirohi Dist. ; and Balsamand Lake, Jodhpur. *Elsewhere* : INDIA : Throughout Northern India. EXTRA-INDIAN : E. & W Pakistan ; Burma.

14. *Danio (Brachydanio) rerio* (Hamilton)

(Pl. 5, Fig. 14)

1822. *Cyprinus rerio* Hamilton, *Fishes of Ganges*, Edinburgh, pp. 323, 390. *Type-loc.* Kosi river.

Material.—Coll. *N. Majumdar* and *R. N. Bhargava* : (i) 2 exs., Siliserh Bund, Alwar Dist., 8.vi.63. (ii) 18 exs., Small nalla from Mapdori-ka-Bund near Manoharpur, Jaipur Dist., 9.vi.63. (iii) 1 ex., Mudlia Kheri, Jhalawar Dist., 21.vi.63. (iv) 1 ex., Khandia tank, Jhalawar Dist., 21.vi.63.

Distribution.—RAJASTHAN : As above. *Elsewhere* : Throughout India.

15. *Esomus danrica* (Hamilton)

(Pl. 4, Fig. 10)

1822. *Cyprinus danrica* Hamilton, *Fishes of Ganges*, Edinburgh, pp. 325, 327, pl. 16, fig. 88. *Type-loc.* Ponds and ditches of Bengal.

Material.—(i)-(ii) Coll. *A. K. Mukherjee* : (i) 16 exs., Ratan talab (tank), Jaipur Dist., 9.x.57. (ii) 5 exs., Chaparwara, Jaipur Dist., 9.xii.57. (iii) 20 exs., Kala tank, Naraina, Jaipur Dist., coll. *S. Biswas*, 1.xi.59. (iv)-(vi) Coll. *B. N. Chopra* and *M. L. Roonwal* : (iv) 8 exs., R. Sone near Pipradia, Dungarpur Dist., 27.x.41. (v) 3 exs., Parai-ki-Nadi, Prasad, Udaipur Dist., 11.x.41. (vi) 1 ex., Udaisagar Nalla, Udaipur Dist., 11.x.41. (vii)-(viii) Coll. *B. Biswas* : (vii) 8 exs., Hemwas tank, Pali Dist., 6.xii.56. (viii) 2 exs., Umedsagar Lake, Jodhpur Dist., 23.xii.56. (ix) 6 exs., Bewara tank, Kotah Dist., coll. *R. N. Bhargava*, 17.iii.61. (x)-(xv) Coll. *N. Majumdar* and *R. N. Bhargava* : (x) 2 exs., Mansarovar, Alwar Dist., 7.vi.63. (xi) 2 exs. Mapdori-ka-

Bund, Jaipur Dist., 9.vi.63. (xii) 2 exs., nalla of Mapdori-ka-Bund, Jaipur Dist., 9.vi.63. (xiii) 17 exs., Shukla talai, Jhalawar Dist., 20.vi.63. (xiv) 7 exs., Dhanwara-ka-Talao, Jhalawar Dist., 20.vi.63. (xv) 1 ex. Mudlia Kheri, Jhalawar Dist., 21.vi.63. (xvi)-(xxii) Coll. *A. K. Datta*: (xvi) 7 exs., Chota talao, Pali Dist., 7.iii.61. (xvii) 13 exs., Pamri Nadi, Udaipur Dist., 22.xii.61. (xviii) 1 ex., pond near Fatehsagar, Udaipur Dist., 23.xii.61. (xix) 2 exs., Umedsagar, Jodhpur Dist., 4.ii.62. (xx) 6 exs., Kharala Dam, Jodhpur Dist., 8.i.63. (xxi) 4 exs., Sardarsamand, Jodhpur Dist., 15.i.63. (xxii) 5 exs., Takhatsagar tank, Jodhpur Dist., 4.v.63. (xxiii) 6 exs., Dara Sanctuary, Kotah Dist., coll. *R. N. Bhargava*, 17.iii.60.

Distribution.—RAJASTHAN: In addition to the above material the following records (Mathur, 1952) are available:—R. Phulad near Phulad Railway Station. *Elsewhere*: INDIA: Throughout. EXTRA-INDIAN: E. & W. Pakistan, Burma, Ceylon, Malaya, Thailand.

16. *Rasbora daniconius* (Hamilton)

(Pl. 4, Fig. 1)

1822. *Cyprinus daniconius* Hamilton, *Fishes of Ganges*, Edinburgh, pp. 327, 329, pl. 15, fig. 89. *Type-loc.* Rivers of southern Bengal.

Material.—(i)-(iv) Coll. *B. N. Chopra* and *M. L. Roonwal*: (i) 66 exs. R. Bedach (Berach) near Chittorgarh, Udaipur Dist., 9.x.41. (ii) Kharpena-ka-Nalla, Udaipur Dist., 10.x.41. (iii) 15 exs., tanks and pools around Dungarpur Dist., 28.x.41. (iv) 40 exs., R. Sone near Pipradia village, Dungarpur Dist., 14.x.41. (v)-(viii) Coll. *R. N. Bhargava*: (v) 1 ex., Jaisamand, Udaipur Dist., 9.iii.61. (vi) 2 exs., Fatehsagar Lake, Udaipur Dist., 11.iii.61. (vii), (viii) 8 exs., Bewara tank, Kotah Dist., 17.ii.61. (ix) (xxi) Coll. *N. Majumdar* and *R. N. Bhargava*: (ix) 2 exs., Siliserh Bund, Alwar Dist., 8.vi.63. (x) 3 exs., Mapdori-ka-Bund, Jaipur Dist., 9.vi.63. (xi) 2 exs., small nalla from Mapdori-ka-Bund, Jaipur Dist., 9.vi.63. (xii) 3 exs., Surwal Bund, Sawai Madhopur Dist., 15.vi.63. (xiii) 45 exs., Chandra Sarovar, Jhalawar Dist., 20.vi.63. (xiv) 6 exs., Shukla talai, Jhalawar Dist., 20.vi.63. (xv) 6 exs., Dhanwara-ka-Talao, Jhalawar town, Jhalawar Dist., 20.vi.63. (xvi) 249 exs., Gomti Sagar, Jhalarpatan town, Jhalawar Dist., 21.vi.63. (xvii) 16 exs., Mudlia Kheri, Jhalarpatan town, Jhalawar Dist., 21.vi.63. (xviii) 1 ex., Khandia tank, Jhalawar town, Jhalawar Dist., 21.vi.63. (xix) 2 exs., Ahu river, Jhalawar Dist., 23.vi.63. (xx) 2 exs., tributary of Parwan river, Jhalawar Dist., 24.vi.63. (xxi) 2 exs., Jawai river, Jalor Dist., 2.vii.63. (xxii)-(xxix) Coll. *A. K. Datta*: (xxii) 1 ex., Wokal river, Udaipur, Udaipur Dist., 20.xii.61. (xxiii) 30 exs., Pamri nadi, Udaipur Dist., 20.xii.61. (xxiv) 7 exs., rocky pool, Pamri nadi, Udaipur Dist., 22.xii.61. (xxv) 27 exs., Fatehsagar, Udaipur Dist., 23.xii.61. (xxvi) 14 exs., pond near Fatehsagar, Udaipur Dist., 23.xii.61. (xxvii) 10 exs., Ahar river, Udaipur Dist., 24.xii.61. (xxviii) 36 exs., Pichola Lake, Udaipur Dist., 24.xii.61. (xxix) 22 exs., Kolaria tank, Udaipur Dist., 24.xii.61.

Distribution.—RAJASTHAN: In addition to the above material, the following records (Mathur, 1952) are available:—Rajsamand near Kankroli and R. Phulad, ca. 2 km. from Phulad Railway Station, Udaipur Dist. *Elsewhere*: INDIA: Throughout. EXTRA-INDIAN: E. & W. Pakistan, Ceylon, Malaya.

17. *Carassius carassius* (Linnaeus)

(Pl. 7, Fig. 7)

1758. *Cyprinus carassius* Linnaeus, *Syst. Nat.*, 10, p. 321, 322. *Type-loc* : China.

Material.—8 exs., Mandore canal, Jodhpur Dist., coll. J. S. Purohit, 2.v.61.

Distribution.—RAJASTHAN : As above. Introduced species. *Elsewhere* : INDIA : Maharashtra (introduced). Its original home is China and Japan.

18. *Garra gotyla* (Gray)

(Pl. 5, Fig. 1)

1832-33. *Cyprinus gotyla* Gray, *Ill. Indian Zoology*, 2, pl. 88, figs. 3, 3A. *Type-loc*. Northern India.

Material.—1 ex., R. Alani, Kotah Dist., coll. R. N. Bhargava, 17. iii. 61.

Distribution.—RAJASTHAN : As above. First record. *Elsewhere* : INDIA : Eastern and Western Himalayas, Uttar Pradesh, Punjab, Chota-Nagpur plateau, Vindhya and Satpura mountains. EXTRA-INDIAN : W. Pakistan (W. Punjab to Peshawar) ; Burma.

19. *Garra mullya* (Sykes)

(Pl. 5, Fig. 2)

1841. *Chondrostoma mullya* Sykes, *Trans. zool. Soc. Lond.*, London, 2, p. 359, pl. 62, fig. 3. *Type-loc*. Poona.

Material.—(i)-(v) Coll. N. Majumdar and R. N. Bhargava : (i) 2 exs., small nalla from Mapdori-ka-Bund, Jaipur Dist., 9. vi. 63. (ii) 11 exs., Bhairudara, Sawai Madhopur Dist., 16. vi. 63. (iii) 1 ex., Chandra Sarovar, Jhalawar Dist., 20. vi. 63. (iv) 5 exs., tributary of Prawan river, Jhalawar Dist., 24. vi. 63. (v) 2 exs., Jawai river, Jalore Dist., 2. vii. 63. (vi) 1 ex., Rocky pool, Pamri nadi, Udaipur Dist., coll. A. K. Datta, 22. xii. 61.

Distribution.—RAJASTHAN : As above. *Elsewhere* : INDIA : Maharashtra, Andhra Pradesh, Mysore, Madras and Kerala.

20. *Labeo angra* (Hamilton)

1822. *Cyprinus angra* Hamilton, *Fishes of Ganges*, Edinburgh, pp. 331, 391. *Type-loc*. Brahmaputra river.

Material.—None. Reported from lakes in Jaipur and Udaipur Dists., and at Khetri (Jhunjhunu Dist.), by Dutta Gupta *et al* (1961).

Distribution.—RAJASTHAN : As above. *Elsewhere* : INDIA : Assam, W. Bengal and Orissa. EXTRA-INDIAN : Burma.

21. *Labeo bata* (Hamilton)

(Pl. 9, Fig. 1)

1822. *Cyprinus bata* Hamilton, *Fishes of Ganges*, Edinburgh, pp. 283, 386.
Type-loc. Rivers and ponds of Bengal.

Material.—(i) 1 ex., Fatehsagar Lake, Udaipur Dist., coll. R. N. Bhargava, 11. iii. 61. (ii)-(iii) Coll. A. K. Datta : (ii) 4 exs., Dana-duch-ki-Diggi, Bharatpur Dist., 19. i. 62. (iii) 2 exs., Kailana Lake, Jodhpur Dist., 2. ii. 63.

Distribution.—RAJASTHAN : As above. *Elsewhere* : INDIA : Madras, Orissa, W. Bengal and Assam, Madhya Pradesh, Maharashtra. EXTRA INDIAN : W. Pakistan.

22. *Labeo boga* (Hamilton)

(Pl. 9, Fig. 4)

1822. *Cyprinus boga* Hamilton, *Fishes of Ganges*, Edinburgh, pp. 286, 386,
 pl. 28, fig. 80. *Type-loc.* Brahmaputra.

Material.—(i)-(ii) Coll. N. Majumdar and R. N. Bhargava : (i) 3 exs., Mui Bund, Sawai Madhopur Dist., 16. vi. 63. (ii) 1 ex., Jawai river, Jalor Dist., 2. vii. 63.

Distribution.—RAJASTHAN : As above. *Elsewhere* : INDIA : Throughout northern India and Andhra Pradesh. EXTRA-INDIAN : Burma.

23. *Labeo boggut* (Sykes)

(Pl. 6, Fig. 2)

1841. *Chondrostoma boggut* Sykes, *Trans. zool. Soc. Lond.*, London, 2,
 p. 359. *Type-loc.* Poona.

Material.—(i) 1 ex., Kherpena-ka-Nalla, ca. 3 km. N. of Barapal village, Udaipur Dist., coll. B. N. Chopra and M. L. Roonwal. (ii)-(xi) Coll. N. Majumdar and R. N. Bhargava : (ii) 23 exs., small pond in tributary of Sabi river, Jaipur Dist., 9. vi. 63. (iii) 46 exs., Bhairu Dara, Sawai Madhopur Dist., 16. vi. 63. (iv) 22 exs., Gambhir river near Karauli, Sawai Madhopur Dist., 17. vi. 63. (v) 31 exs., Gambhir river near Sri Mahabirji Rly. Station, Sawai Madhopur Dist., 18. vi. 63. (vi) 2 exs., Shukla talai, Jhalawar Dist., 20. vi. 63. (vii) 1 ex., Khandia tank, Jhalawar Dist., 21. vi. 63. (viii) 18 exs., Parwan river, Jhalawar Dist., 24. vi. 63. (ix) 3 exs., a tributary of Parwan river, Jhalawar Dist., 24. vi. 63. (x) 9 exs., Parwan river, Kotah Dist., 26. vi. 63. (xi) 27 exs., Jawai river, Jalor Dist., 2. vii. 63. (xii)-(xv) Coll. A. K. Datta : (xii) 1 ex., Pamri nadi, Udaipur Dist., 20. xii. 61. (xiii) 1 ex., Ki-aki-Khai, Bharatpur Dist., 22. i. 62. (xiv) 1 ex., Sardarsamand, Jodhpur Dist., 6. iii. 62. (xv) 2 exs., Kailana Lake, Jodhpur Dist., 2. ii. 63.

Distribution.—RAJASTHAN : In addition to the above material, the following records (Mathur, 1952) are available.—R. Phulad near Phulad Railway Station. *Elsewhere* : INDIA : Punjab, Uttar Pradesh, Bihar, W. Bengal, Gujarat, Madhya Pradesh and Madras. EXTRA-INDIAN E. & W. Pakistan and Malaya.

24. *Labeo calbasu* (Hamilton)

(Pl. 9, Fig. 6)

1822. *Cyprinus calbasu* Hamilton, *Fishes of Ganges*, Edinburg, pp. 297, 307, pl. 2, fig. 83. *Type-loc.* Rivers and ponds of Bengal and western Provinces.

Material.—(i)-(iii) Coll. N. Majumdar and R. N. Bhargava : (i) 2 exs., Jeysagar Bund, Alwar Dist., 7. vi. 63. (ii) 3 exs., Siliserh Bund, Alwar Dist., 8. vi. 63. (iii) 1 ex., Jai Samand, Alwar Dist., 8. vi. 63. (iv)-(vi) Coll. A. K. Datta : (iv) 2 exs., Danaduch-ki-Diggi, Bharatpur Dist., 19. i. 62. (v) 2 exs., Aghapur, Bharatpur Dist., 20. i. 60. (vi) 1 ex., Uttangan Nadi, Bharatpur Dist., 27. i. 63.

Distribution.—RAJASTHAN : As above. *Elsewhere* : INDIA : Throughout. EXTRA-INDIAN : E. & W. Pakistan, Burma, Thailand and Yunnan.

25. *Labeo dero* (Hamilton)

(Pl. 9, Fig. 5)

1822. *Cyprinus dero* Hamilton, *Fishes of Ganges*, Edinburg, pp. 277, 335, pl. 17, fig. 78. *Type-loc.* River Brahmaputra.

Material.—1 ex., Kharpena-ka-Nalla near Barapal village, Udaipur Dist., coll. B. N. Chopra and M. L. Roonwal, 15.x.41.

Distribution.—RAJASTHAN : As above. First record. *Elsewhere* : INDIA : Assam, W. Bengal, Uttar Pradesh and Punjab. EXTRA-INDIAN : E. & W. Pakistan and Burma.

26. *Labeo dyocheilus* (McClelland)

(Pl. 4, Fig. 13)

1839. *Cyprinus dyocheilus*, McClelland, *Asiatic Researches*, Calcutta, pp. 268, 330. *Type-loc.* Not given.

Material.—(i)-(ii) Coll. N. Majumdar and R. N. Bhargava : (i) 6 exs., Bhairu Dara, Sawai Madhopur Dist., 16.vi.63, (ii) 1 ex., Parwan river, Kotah Dist., 26. vi. 63. (iii)-(v) Coll. A. K. Datta : 2 exs., Danduchi-ki-Diggi, Bharatpur Dist., 19.i.62. (iv) 1 ex., Aghapur, Bharatpur Dist., 20.i.62. (v) 1 ex., Umran Lake, Alwar Dist., 25.i.62.

Distribution.—RAJASTHAN : As above. *Elsewhere* : INDIA : Assam ; Tarai region in W. Bengal, Bihar, Uttar Pradesh and Punjab. EXTRA-INDIAN : W. Pakistan.

27. *Labeo fimbriatus* (Bloch)

(Pl. 9, Fig. 3)

1797. *Cyprinus fimbriatus* Bloch, *Ausländische Fische*, Berlin, 12, p. 50, pl. 407. *Type-loc.* Madras.

Material.—2 exs., Soorpur-ki-Nadi, Dungarpur Dist., coll. B. N. Chopra and M. L. Roonwal, 26.x.41.

Distribution.—RAJASTHAN : As above. *Elsewhere* : INDIA : Throughout, except in W. Bengal and Malabar. EXTRA-INDIAN : W. Pakistan.

28. *Labeo goni* (Hamilton)

(Pl. 9, Fig. 2)

1822. *Cyprinus goni* Hamilton, *Fishes of Ganges* Edinburgh, pp. 292.
387. *Type-loc.* Freshwater rivers and ponds of Bengal.

Material.—(i) 2 exs., Fatehsagar Lake, Udaipur Dist., coll. R. N. Bhargava, 11. iii. 61. (ii)-(iii) Coll. N. Majumdar and R. N. Bhargava : (ii) 1 ex., Mui Bund, Sawai Madhopur Dist., 16.vi.63. (iii) 1 ex., Khandia tank, Jhalawar Dist., 21.vi.63. (iv) 1 ex., tank near Alahapur village, Alwar Dist., coll. A. K. Datta, 25. i. 62. (v) 1 ex., Sarup Sagar, Udaipur Dist., coll. K. K. Mahajan, 6. ii. 63.

Distribution.—RAJASTHAN : As above. *Elsewhere* : INDIA : Assam, W. Bengal, Uttar Pradesh and Punjab. EXTRA-INDIAN : Burma.

29. *Labeo nigripinnis* Day

1878. *Labeo nigripinnis* Day, *Fishes of India*, London, p. 544. pl. 132. fig. 81.
Type-loc. Not given.

Material.—None. Reported from Jaipur and Udaipur Dists. and at Khetri (Jhunjhunu Dist.) by Dutta Gupta *et al.* (1961).

Distribution.—RAJASTHAN : As above. *Elsewhere* : INDIA : Punjab, EXTRA-INDIAN : W. Pakistan.

30. *Labeo rohita* (Hamilton)

(Pl. 8, Fig. 6)

1822. *Cyprinus rohita* Hamilton, *Fishes of Ganges* Edinburgh, pp. 301, 388.
pl. 36, fig. 85. *Type-loc.* Freshwater rivers of Gangetic provinces.

Material.—(i) 1 ex., Fatehsagar Lake, Udaipur Dist. coll. R. N. Bhargava, 11. iii. 61. (ii) 2 exs., Mui Bund, Sawai Madhopur Dist., coll. N. Majumdar and R. N. Bhargava, 16. vi. 63. (iii)-(v) Coll. A. K. Datta : (iii) 2 exs., Kherad village, Jaisamand Lake, Udaipur Dist., 23. xii. 61. (iv) 2 exs., Danaduch-ki-Diggi, Bharatpur Dist., 19. i. 62 (v) 6 exs., Aghapur, Bharatpur Dist., 20. i. 62.

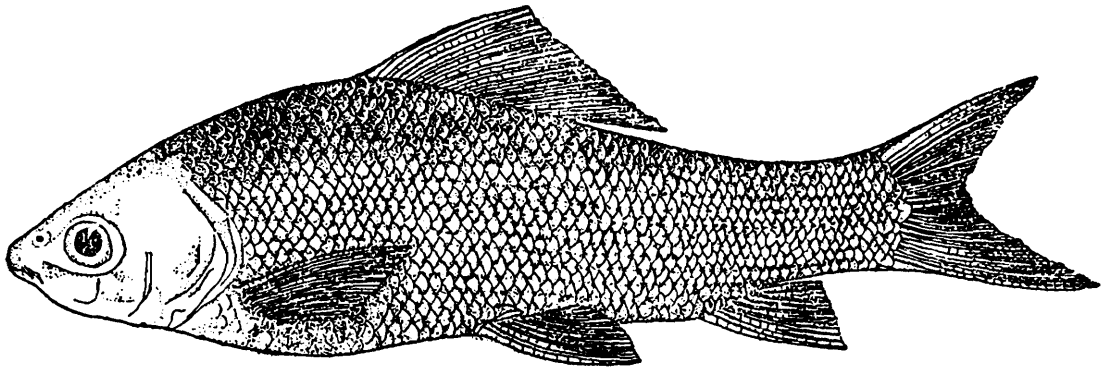
Distribution.—RAJASTHAN : As above. *Elsewhere* : INDIA : Assam, W. Bengal, Uttar Pradesh, Punjab and Madhya Pradesh. EXTRA-INDIAN : W. Pakistan : Burma.

31. *Labeo rajasthanicus* sp. n.

(Pl. 8, Fig. 3 ; Text-fig. 2)

Material.—1 ex., Jaisamand Lake, near Kherad village, ca. 61 km S. E. Udaipur, Udaipur Dist., Rajasthan, coll. A. K. Datta, 23.xii. 1961.

Diagnosis.—Standard length 231 mm.; with 16 rays in dorsal fin, the first 2 unbranched, other 14 branched ; with 60 scales along lateral line ; lateral transverse scales $11\frac{1}{2}$ from origin of dorsal to lateral line and $9\frac{1}{2}$ between lateral line and pelvic fin. Fin formula : D. 2/14, P.1/14, V.1/8, A.2/5, C. 19, L. L. 60, L. tr. $11\frac{1}{2}$, $9\frac{1}{2}$.



TEXT-FIG. 2.—*Labeo rajasthanicus* sp. n. Holotype.

Description.—Depth of body 3.4, length of head 3.9 in standard length. Width of head 1.6 in length of head. Height of head 1.8 in height of body, Diameter of eye 5.2 in length of head. Nares placed at upper margin of snout and separated by membranous flap ; snout smooth without any tubercles. Gape of mouth 4 in length of head. Barbels 4. Lips nonfimbriated, continuous, crescent-shaped, without horny covering inside. Lateral line scales 60, $9\frac{1}{2}$ between this and pelvic. Mid-dorsal streak in front of dorsal with 16 scales ; crest, belly and posterior pelvic region up to vent scaly. Dorsal fin with 16 rays, first 2 unbranched, other 14 branched ; distance between its anterior origin and tip of snout 2.2 in standard length ; situated before the origin of pelvic and nearer to snout than to caudal base ; height of dorsal fin shorter than depth of body below it, its free margin nearly straight. Pectoral fin with 14 rays, non-pedunculate, non-expanded and not bearing any tubercles. Pectoral fins placed vertically to body, shorter than head. Ventral fin inserted on ventral surface of body on a flat base ; with 9 rays, the first ray unbranched and other 8 branched. Margin of ventral fin not extending behind the anal opening. Anal fin with 7 rays, first 2 unbranched, rest branched. Anal opening away from origin of ventral and close to origin of anal fin. Distance from vent to anal fin 7 times in that between anterior origins of ventral and anal fin. Caudal fin with 19 rays, emarginate, with equal lobes. Length of caudal peduncle 2 times width and 1.2 times length of head. Posterior chamber of air bladder reduced : inner surface of peritonium black ; stomach thick-walled-lined with membranous fleshy, posteriorly directed papillae, arranged in spirial rows. The basipterygium and structure of pharyngeal bone

and teeth corresponding to those of *Labeo boggut* (Sykes). Colour, in alcohol, dark olive above, pale below ; fins dusky.

Measurements (mm.).—

Standard length	. . . . .	231
Head length	. . . . .	58
Head width	. . . . .	36
Head depth	. . . . .	42
Diameter of eye	. . . . .	11
Body depth	. . . . .	68
Predorsal length	. . . . .	105
Postdorsal length	. . . . .	30
Snout length	. . . . .	21
Gape of mouth	. . . . .	14
Height of caudal peduncle	. . . . .	49
Length of caudal peduncle	. . . . .	29
Lateral line scale	. . . . .	60
Lateral transverse scales	. . . . .	11½ and 9½

Holotype.—The specimen mentioned above under 'Material' Deposited in the Zoological Survey of India, Calcutta, Z. S. I. Reg. No. F. 4179/2.

Type-locality.—Jaisamand Lake, Udaipur District, Rajasthan.

Relationship.—*Labeo rajasthanicus* sp. n. is closely related to *Labeo boggut* (Sykes), a species found in W. Bengal, Orissa, Andhra Pradesh, Madhya Pradesh and Punjab, and resembles it in general facies and build, but differs as follows : (i) number of dorsal fins rays 16 vs. 12 ; (ii) number of lateral transverse scales in the body 11½ and 9½ vs. 12 and 14.

32. *Aspidoparia morar* (Hamilton)

(Pl. 4, Fig. 11)

1822. *Cyprinus morar* Hamilton, *Fishes of Ganges*, Edinburgh, pp. 264, 381, pl. 31, fig. 75. *Type-loc.* Rivers of Yamuna and Teesta, two large but distinct branches of Ganges.

Material.—(i) 13 exs., Gambhir river, Sawai Madhopur Dist., coll. N. Majumdar and R. N. Bhargava, 18. vi. 63. (ii) 1 ex., Maharaja's Agricultural Farm tank, Sardarsamand, Pali Dist., coll. K. K. Mahajan, 21. xi. 63.

Distribution.—RAJASTHAN : As above. *Elsewhere* : INDIA : Throughout, except western coast and in localities south of Kistna river. EXTRA-INDIAN : E. & W. Pakistan, Burma and Thailand.

33. *Amblypharyngodon mola* (Hamilton)

(Pl. 4, Fig. 15)

1822. *Cyprinus mola* Hamilton, *Fishes of Ganges*, Edinburgh, pp. 334, 392, pl. 38, fig. 92. *Type-loc.* Ponds and freshwater rivers in every part of the Gangetic provinces.

Material.—(i)-(vi) Coll. *N. Majumdar* and *R. N. Bhargava* : (i) 1 ex., Mansarovar, Alwar Dist., 7. vi. 63. (ii) 375 exs., Jeysagar Bund, Alwar Dist., 7. vi. 63. (iii) 1 ex., Gambhir river, Sawai Madhopur Dist., 18. vi. 63. (iv) 1 ex., Chandra Sarovar, Jhalawar Dist., 20. vi. 63. (v) 1 ex., Mudlia Kheri, Jhalawar Dist., 21. vi. 63. (vi) 2 exs., Jawai river, Jalor Dist., 2. vii. 63. (vii)-(viii) Coll. *A. K. Datta* : (vii) 3 exs., pool near Kailana Lake bridge, Jodhpur Dist., 7. vii. 62. (viii) 2 exs., Parlora talab, Dhrasani village, Jodhpur Dist., 19. vi. 63.

Distribution.—RAJASTHAN: As above. *Elsewhere* : INDIA : Throughout, except Kerala. EXTRA-INDIAN : E. & W. Pakistan ; Burma.

34. *Chagunius chagunio* (Hamilton)

(Pl. 5, Fig. 3)

1822. *Cyprinus chagunio* Hamilton, *Fishes of Ganges*, Edinburgh, pp. 295, 387. *Type-loc.* Yamuna and in the northern rivers of Bihar and Bengal.

Material.—4 exs., Parwan river, Kotah Dist., coll. *N. Majumdar* and *R. N. Bhargava*, 26. vi. 63.

Distribution.—RAJASTHAN : As above. *Elsewhere* : INDIA : Assam, W. Bengal, Punjab, Uttar Pradesh and Bihar, Orissa. EXTRA-INDIAN : E. & W. Pakistan, Burma and Thailand.

35. *Catla catla* (Hamilton)

(Pl. 5, Fig. 15)

1822. *Cyprinus catla* Hamilton, *Fishes of Ganges*, Edinburgh, pp. 287, 318, 387, pl. 13, fig. 81. *Type-loc.* Rivers and tanks of Bengal.

Material.—Coll. *A. K. Datta*, Bharatpur Dist.: (i) 1 ex., Danaduch-ki-Diggi, 19. i. 62 ; (ii) 1 ex., Aghapur, 20. i. 62.

Distribution.—RAJASTHAN : As above. *Elsewhere* : INDIA : Throughout. EXTRA-INDIAN : Burma and Thailand.

36. *Cirrhinus mrigala* (Hamilton)

(Pl. 8, Fig. 1)

1822. *Cyprinus mrigala* Hamilton, *Fishes of Ganges*, Edinburgh, pp. 279, 386, pl. 6, fig. *Type-loc.* Ponds and freshwater rivers of Gangetic province.

Material.—(i)-(iii) Coll. *N. Majumdar* and *R. N. Bhargava* : (i) 3 exs., Jeysagar Bund, Alwar Dist., 7. vi. 63. (ii) 4 exs., Siliserh Bund, Alwar Dist., 8. vi. 63 ; (iii) 7 exs., Mui Bund, Sawai Madhopur Dist., 16. vi. 63. (iv)-(vi) Coll. *A. K. Datta* : (iv) 1 ex., Kherad village, Jaisamand lake, Udaipur Dist., 23. xii. 61. (v) 2 exs., Danaduch-ki-Diggi, Bharatpur Dist., 19. i. 63. (vi) 4 exs., Aghapur, Bharatpur Dist., 20. i. 62.

Distribution.—RAJASTHAN : As above. *Elsewhere* : INDIA : Throughout. EXTRA-INDIAN : Burma.

37. *Cirrhinus reba* (Hamilton)

(Pl. 8, Fig. 5)

1822. *Cyprinus reba* Hamilton, *Fishes of Ganges*, Edinburgh, pp. 280, 386
Type-loc. Rivers and ponds of Bengal and Bihar.

Material.—(i)-(viii) Coll. *N. Majumdar* and *R. N. Bhargava* : (i) 1 ex., Jeysagar Bund, Alwar Dist., 7. vi. 63. (ii) 2 exs., Siliserh Bund, Alwar Dist., 8. vi. 63. (iii) 1 ex., Surwal Bund, Sawai Madhopur Dist., 15. vi. 63. (iv) 3 exs., Bhagwatigarh, Sawai Madhopur Dist., 18. vi. 63. (v) 4 exs., Gomti Sagar, Jhalawar Dist., 21. vi. 63. (vi) 2 exs., Mudlia kheri, Jhalawar Dist., 21. vi. 63. (vii) 2 exs., Ahu river, Jhalawar Dist., 23. vi. 63. (viii) 2 exs., Jawai river, Jalor Dist., 2. vii. 63. (ix)-(xvi) Coll. *A. K. Datta* : (ix) 6 exs., Pamri nadi, Udaipur Dist., 20. xii. 61. (x) 1 ex., Ahar river, Udaipur Dist., 24. xii. 61. (xi) 13 exs., Danaduch-ki-Diggi, Bharatpur Dist., 19.i.62. (xii) 2 exs., Ghanna Sanctuary, Bharatpur Dist., 20. i. 62. (xiii) 1 ex., Aghapur, Bharatpur Dist., 20. i. 62. (xiv) 3 exs., tank at Kherli village, Bharatpur Dist., 22. i. 62. (xv) 2 exs., tank, near Alahapur village, Alwar Dist., 25. i. 62. (xvi) 3 exs., Uttangan nadi, Bharatpur Dist., 27.i.62.

Distribution.—RAJASTHAN : As above. *Elsewhere* : INDIA : Throughout. EXTRA-INDIAN : E. & W. Pakistan.

38. *Puntius amphibia* (Valenciennes)

(Pl. 4, Fig. 9)

1842. *Capoeta amphibia* Valenciennes, *Hist. Nat. Poissons*, Paris., 16, p. 282, pl. 478. *Type-loc.* Bombay.

Material.—(i) 5 exs., Khandia tank, Jhalawar Dist., coll. *N. Majumdar* and *R. N. Bhargava*, 21. vi. 63. (ii) 2 exs., Kherad village, Udaipur Dist., Coll. *A. K. Datta*, 23. xii. 61.

Distribution.—RAJASTHAN : As above. *Elsewhere* : INDIA : Uttar Pradesh, Madhya Pradesh, Maharashtra and Madras. EXTRA-INDIAN : Ceylon.

39. *Puntius conchoni* (Hamilton)

1822. *Cyprinus conchoni* Hamilton, *Fishes of Ganges*, Edinburgh, pp. 317, 389. *Type-loc.* North-east of Bengal and in the rivers of Kosi and Ami.

Material.—None. Reported from lakes in Jaipur and Udaipur Dists. and at Khetri (Jhunjhunu Dist.) by Dutta Gupta *et al* (1961).

Distribution.—RAJASTHAN : As above. *Elsewhere* : INDIA : Assam, W Bengal, Orissa, Bihar, Uttar Pradesh, Punjab, Madhya Pradesh, Maharashtra. EXTRA-INDIAN E. & W Pakistan.

40. *Puntius chola* (Hamilton)

(Pl. 4, Fig. 4)

1822. *Cyprinus chola* Hamilton, *Fishes of Ganges*, Edinburgh, pp. 312, 389.
Type-loc. Ponds and other stagnant waters in northern parts of Bengal.

Material.—(i)-(iii) Coll. *B. N. Chopra* and *M. L. Roonwal* : (i) 2 exs., R. Bearch (Bedach) near Chittorgarh, Udaipur Dist., 8.x.41. (ii) 4 exs., Prasad (Palsad). Udaipur Dist., 17.x.41. (iii) 4 exs., tank near Barapal village. Udaipur Dist., 15.x.41. (iv) 1 ex., Fatehsagar Lake, Udaipur Dist. Coll. *R. N. Bhargava*, 11. iii. 61. (v)-(xi) Coll. *N. Majumdar* and *R. N. Bhargava* : (v) 64 exs., Manasarovar, Alwar Dist., 7. vi. 63. (vi) 1 ex., Jeysamand Bund, Alwar Dist., 7. vi. 63. (vii) 12 exs., Mui Bund, Sawai Madhopur Dist., 16. vi. 63. (viii) 12 exs., Shukla talai, Jhalawar Dist., 20. vi. 63. (ix) 22 exs., Gomti Sagar, Jhalawar Dist., 21. vi. 63. (x) 5 exs., Mudlia Kheri, Jhalawar Dist., 21. vi. 63. (xi) 14 exs., Gaduli talai, Jhalawar Dist., 22. vi. 63. (xii)-(xiii) Coll. *A. K. Datta* : 1 ex., tank (diggi) Bharatpur Dist., 19.i.62. (xiii) 2 exs., tank in Ghana Sanctuary, Bharatpur Dist., 20. i. 62.

Distribution.—RAJASTHAN : As above. *Elsewhere* : INDIAN : Throughout. EXTRA-INDIAN : E. & W. Pakistan.

41. *Puntius dorsalis* (Jerdon)

1849. *Systomus dorsalis* Jerdon, *Madras, J. Lit. & Sci. Madras*. pp. 314, 316.
Type-loc. Not given.

Material.—None. Reported from lakes in Jaipur and Udaipur Dists. and at Khetri (Jhunjhunu Dist.) by Dutta Gupta *et al* (1961).

Distribution.—RAJASTHAN : As above. *Elsewhere* : INDIA : Mysore, Madras, Andhra Pradesh. EXTRA-INDIAN : Ceylon.

42. *Puntius sarana* (Hamilton)

(Pl. 8, Fig. 2)

1822. *Cyprinus sarana* Hamilton, *Fishes of Ganges*, Edinburgh, pp. 307, 388. *Type-loc.* Ponds and rivers of India.

Material.—(i) 12 exs., Chaparwara, Jaipur Dist., coll. *A. K. Mukherjee*, 9. xii. 57. (ii) 1 ex., on the way to Chaparwara Bunda near Naraina Jaipur Dist., Coll. *S. Biswas*. 30. ix. 58. (iii) 21 exs., tanks and pools around Dungarpur town, coll. *B. N. Chopra* and *M. L. Roonwal*. 28.x.41. (iv) 4 exs., Rajsamand. Udaipur Dist., coll. *K. S. Pradhan*. 27.xi.48. (v) 1 ex., Parai-ka-Nadi, Udaipur Dist., coll. *B. N. Chopra* and *M. L. Roonwal*. 23. x. 41. (vi) 1 ex., Fatehsagar Lake, Udaipur Dist., coll. *R. N. Bhargava*, 11. iii. 61. (vii)-(xi) coll. *N. Majumdar* and *R. N. Bhargava* : (vii) 4 exs., Siliserh Bund, Alwar Dist. 8. vi. 63. (viii) 10 exs., Sawai Madhopur Dist., 16. vi. 63. (ix) 1 ex., Mui Bund, Sawai Madhopur Dist., 16. vi. 63. (x) 2 exs., Gambhir river, Sawai Madhopur Dist., 17. vi. 63. (xi) 3 exs., Gomti Sagar, Jhalawar Dist., 21. vi. 63. (xii)-(xiv) Coll. *A. K. Datta* : (xii) 5 exs., Pamri nadi, Udaipur Dist., 20. xii. 61. (xiii) 1 ex., Kila-ki-Khai, near Deeg town, Bharatpur Dist., 21. i. 62. (xiv) 2 exs., Sardarsamand, Jodhpur Dist., 6. iii. 62. (xv) 3 exs., Sarupsagar, Udaipur Dist., coll. *K. K. Mahajan*, 6. xi. 63.

Distribution.—RAJASTHAN : As above. *Elsewhere* : INDIA : Throughout. EXTRA-INDIAN : E. & W. Pakistan ; Malaya.

43. **Puntius sophore** (Hamilton)

(Pl. 4, Fig. 14)

1822. *Cyprinus sophore* Hamilton, *Fishes of Ganges*, Edinburgh, pp. 310, 389, pl. 19, fig. 86. *Type-loc.* Ponds of Bengal.

Material.—(i) 55 exs., Jaipur Dist., coll. *A. K. Mukherjee*, 9. xii. 57. (ii)-(iv) Coll. *B. N. Chopra* and *M. L. Roonwal* : (ii) 18 exs., a baori (well) near Barapal village, Udaipur Dist., 14. x. 41. (iii) 9 exs., R. Berach, near Chittorgarh, Udaipur Dist. 9. x. 41. (iv) 3 exs., Prasad-ka-Nalla near Udaipur Dist., 21. x. 41. (v)-(vi) Coll. *B. Biswas* : (v) 3 exs., Nandana nadi, Nawa, Nagaur Dist., 15. xi. 56. (vi) 4 exs., Chat, Nasirabad, Ajmer Dist., 28. xii. 56. (vii)-(x) Coll. *R. N. Bhargava* : (vii) 1 ex., Chhota Talao, Pali Dist., 7. iii. 61. (viii) 2 exs., Bewara tank, Kotah Dist., 17. iii. 61. (ix) 1 ex., Nanta tank No. 1, Kotah Dist., 18. iii. 61. (x) 4 exs., Anasagar Lake, Ajmer Dist., 14. iii. 61. (xi)-(xxii) Coll. *N. Majumdar* and *R. N. Bhargava* : (xi) 16 exs., Mangalsar, Alwar Dist., 7. vi. 63. (xii) 14 exs., small pond, Sabi river, Jaipur Dist., 9. vi. 63. (xiii) 4 exs., Mapdori-ka-Bund, Jaipur Dist., 9. vi. 63. (xiv) 4 exs., Bhairu Dara, Sawai Madhopur Dist., 16. vi. 63. (xv) 18 exs., Chandra Sarovar, Jhalawar Dist., 20. vi. 63. (xvi) 15 exs., Jhalawar Dist., 20. vi. 63. (xvii) 28 exs., Dhanwara-ka-Talao, Jhalawar Dist., 20. vi. 63. (xviii) 63 exs., Gomti Sagar, Jhalawar Dist., 21. vi. 63. (xix) 31 exs., Khandia tank, Jhalawar Dist., 21. vi. 63. (xx) 46 exs., Gaduli talai, Jhalawar Dist., 22. vi. 63. (xxi) 21 exs., Jalor Dist., 30. vi. 63. (xxii) 33 exs., Dadelika-Talao, Jalor Dist., 30. vi. 63. (xxiii)-(xxxiii) Coll. *A. K. Datta* : (xxiii) 51 exs., Tank, Kumbher village, Bharatpur Dist., 21. i. 62. (xxiv) 21 exs., Umedsagar, Jodhpur, Jodhpur Dist., 4. ii. 62. (xxv) 1 ex., Anasagar lake, Public Garden, Ajmer Dist., 14. iii. 61. (xxvi) 1 ex., Kailana Lake, Jodhpur Dist., 21. iv. 61. (xxvii) 20 exs., Pamri nadi, Udaipur Dist., 20. xii. 61. (xxviii) 1 ex., Aghapur, Bharatpur Dist., 20. i. 62. (xxix) 1 ex., tank at Kherli village, Bharatpur Dist., 22. i. 62. (xxx) 4 exs., Sardarsamand, Jodhpur Dist., 6. iii. 62. (xxxi) 14 exs., pool near Kailana lake bridge, Jodhpur Dist., 7. vii. 62. (xxxii) 196 exs., Sardarsamand, Jodhpur Dist., 15. i. 63. (xxxiii) 12 exs., Chota talab, Durasani village, Jodhpur Dist., 20. ii. 63. (xxxiv) 2 exs., Dara Sanctuary, Kotah Dist., coll. *R. N. Bhargava*, 17. iii. 61. (xxxv) 3 exs., Anasagar Lake, Ajmer Dist., coll. *K. K. Mahajan*, 19. x. 63.

Distribution.—RAJASTHAN : In addition to the above material the following records are available :—(a) Mathur (1952) : R. Phulad, near Phulad Railway Station ; Jai Vilas Palace Tank, and a stream near Dilwara temple, Bendermere Lake, Mount Abu, Sirohi Dist. ; (b) Krishna and Menon (1958) : Balsamand Lake, near Jodhpur. *Elsewhere* : INDIA : Throughout. EXTRA-INDIAN : E. & W Pakistan, Burma and Yunnan.

44. **Puntius ticto** (Hamilton)

(Pl. 4, Fig. 8)

1822. *Cyprinus ticto* Hamilton, *Fishes of Ganges*, Edinburgh, pp. 314, 389, pl. 8, fig. 87. *Type-loc.* South-east part of Bengal.

Material.—(i) 3 exs., Bandi Nadi at Sanodia, Jaipur Dist., coll. *B. Biswas*, 30. x. 58. (ii) 9 exs., Datra nadi, Jaipur Dist., 30. x. 58 (iii) 2

exs., Mandore canal, Jodhpur Dist., coll. *J. S. Purohit*, 2. v. 61. (iv)-(x) coll. *N. Majumdar* and *R. N. Bhargava* : (iv) 4 exs., Mapdori-ka-Bund, Jaipur Dist., 9. vi. 63. (v) 71 exs., small nulla from Mapdori-ka-Bund, Jaipur Dist., 9. vi. 63. (vi) 24 exs., Surwal Bund, Sawai Madhopur Dist., 15. vi. 63. (vii) 61 exs., Chandra Sarovar, Jhalawar Dist., 20. vi. 63. (viii) 4 exs., Gomti Sagar, Jhalawar Dist., 21. vi. 63. (ix) 4 exs., a tributary of Parwan river, Jhalawar Dist., 24. vi. 63. (x) 40 exs., Jawai river, Jalor Dist., 2. vii. 63. (xi)-(xviii) coll. *A. K. Datta* : (xi) 20 exs., Pamri nadi, Udaipur Dist., 20. vii. 61. (xii) 3 exs., rocky pool, Pamri nadi, Udaipur Dist., 22. x. 61. (xiii) 10 exs., pond near Fatehsagar, Udaipur Dist., 23. xii. 61. (xiv) 1 ex., tank near Ajan village, Bharatpur Dist., 19. i. 62. (xv) 3 exs., Kailana Lake, Jodhpur Dist., 12. vii. 62. (xvi) 1 ex., Luni river, Jodhpur Dist., 12. xii. 62. (xvii) 1 ex., Kharala Dam, Jodhpur Dist., 8. i. 63. (xviii) 5 exs., Sardarsamand, Jodhpur Dist., 15. i. 63. (xxix) 14 exs., lake in Ghana Sanctuary, Bharatpur Dist., coll. *R. N. Bhargava*, 20. i. 62.

Distribution.—RAJASTHAN : As above. *Elsewhere* : INDIA : Throughout. EXTRA-INDIAN : E. & W Pakistan, Ceylon, Burma, Siam and Thailand.

45. *Puntius vittatus* Day

(Pl. 5, Fig. 6)

1865. *Puntius vittatus* Day, *Proc. zool. Soc. Lond.*, London, 1865, p. 303. *Type-loc.* Madras.

Material.—Coll. *A. K. Datta* : (i) 118 exs., Pamri nadi, Udaipur Dist., 22. xii. 61. (ii) 1 ex., tank near Ajan village Bharatpur Dist., 19. i. 62. (iii) 20 exs., Luni river, Jodhpur Dist., 12. xii. 62. (iv) 45 exs., Kailana Lake, Jodhpur Dist., 25. ii. 62. (v) 11 exs., Sardarsamand, Jodhpur Dist., 15. i. 63.

Distribution.—RAJASTHAN : As above. *Elsewhere* : INDIA : Gujarat, Maharashtra, Mysore and Madras. EXTRA-INDIAN : Ceylon.

46. *Osteobrama cotio* (Hamilton)

(Pl. 5, Fig. 11)

1822. *Cyprinus cotio* Hamilton, *Fishes of Gorges*, Edinburgh, pp. 329, 393, pl. 39, fig. 93. *Type-loc.* Ponds and ditches of Bengal.

Material.—(i)-(v) Coll. *N. Majumdar* and *R. N. Bhargava* : (i) 19 exs., Gomti Sagar, Jhalawar Dist., 21. vi. 63. (ii) 4 exs., Mudlia Kheri, Jhalawar Dist., 21. vi. 63. (iii) 4 exs., Khandia tank, Jhalawar Dist., 21. vi. 63. (iv) 1 ex., Parwan river, Jhalawar Dist., 22. vi. 63. (v) 7 exs., Gaduli talai, Jhalawar Dist., 22. vi. 63. (vi)-(viii) Coll. *A. K. Datta* : (vi) 28 exs., tank near Mundaya, Bharatpur Dist., 23. i. 62. (vii) 25 exs., tank, Alwar Dist., 23. i. 62. (viii) 2 exs., tank, Bharatpur Dist., 26. i. 62.

Distribution.—RAJASTHAN : As above. *Elsewhere* : INDIA : Throughout, except Mysore, Kerala and Madras. EXTRA-INDIAN : Burma.

47. *Tor khudree* (Sykes)

(Pl. 8 Fig. 4)

1838. *Barbus khudree* Sykes, *Proc. zool. Soc. Lond.*, London, 1838, p. 159.
Type-loc. Mota-Mola river, 8 miles east of Poona.

Material.—(i) 3 exs., Fatehsagar Lake, Udaipur Dist., coll. R. N. Bhargava, 11. iii. 61. (ii) 7 exs., Parwan river, Kotah Dist., coll. N. Majumdar and R. N. Bhargava, 26. vi. 63. (iii) 3 exs., Kherat village, Jaisamand Lake, Udaipur Dist., coll. A. K. Datta, 23. xii. 61.

Distribution.—RAJASTHAN : In addition to the above material, the following record (Mathur, 1952) is available : — R. Surpur near Dungarpur. *Elsewhere* : INDIA : Uttar Pradesh, Orissa and Peninsular India.

48. *Botia lohachata* Chaudhuri

(Pl. 5, Fig. 13)

1912. *Botia lohachata* Chaudhuri, *Rec. Indian Mus.*, Calcutta, 7, pp. 441-442. *Type-loc.* Gandak river, Saran, Bihar.

Material.—(i)-(ii) Coll. N. Majumdar and R. N. Bhargava, Sawai Madhopur Dist. : (i) 1 ex., tributary of Gambhir river, 17. vi. 63. (ii) 1 ex., Gambhir river, 18. vi. 63. (iii)-(iv) Coll. A. K. Datta, Bharatpur Dist. : (iii) 1 ex., Danaduch-ki-Diggi, 19. i. 62. (iv) 1 ex., Kila-ki-Khai 21. i. 62.

Distribution.—RAJASTHAN : As above. *Elsewhere* : INDIA : Bihar and Uttar Pradesh.

49. *Lepidocephalichthys guntea* (Hamilton)

(Pl. 5, Fig. 8)

1822. *Cobitis guntea* Hamilton, *Fishes of Ganges*, Edinburg, pp. 353, 394. *Type-loc.* Ponds and freshwater rivers of Bengal.

Material.—(i)-(iv) Coll. B. N. Chopra and M. L. Roonwal : (i) 40 exs., Prasad-ka-Nalla, Udaipur Dist., 21. x. 41. (ii) 1 ex., tanks and pools around Dungarpur, Dungarpur Dist., 29. x. 41. (iii) R. Sone near Pipradia, Dungarpur Dist., 27. x. 41. (iv) 1 ex., large tank near Parsad, Udaipur Dist., 21. x. 41. (v)-(vii) Coll. N. Majumdar and R. N. Bhargava : (v) 1 ex., small nulla from Mapdori-ka-Bund, Jaipur Dist., 9. vi. 63. (vi) 1 ex., Chandra Sarovar, Jhalawar Dist., 20. vi. 63. (vii) 1 ex., Gomti Sagar, Jhalawar Dist., 21. vi. 63. (viii)-(ix) Coll. A. K. Datta : (vi) 1 ex., Chandra Sarovar, Jhalawar Dist., 20. vi. 63. (vii) 1 ex., Gomti Udaipur Dist. : (viii) 1 ex., Pamri nadi, 20. xii. 61. (ix) 2 exs., Ahar river, 24. xii. 61.

Distribution.—RAJASTHAN : As above. *Elsewhere* : INDIA : Throughout northern India. EXTRA-INDIAN : E. & W. Pakistan.

50. *Noemacheilus botia* (Hamilton)

(Pl. 4, Fig. 16)

1822. *Cobitis botia* Hamilton, *Fishes of Ganges*, Edinburg, pp. 350, 358, 394, 395. *Type-loc.* Rivers of north-eastern parts of Bengal.

Material.—Coll. N. Majumdar and R. N. Bhargava : (i) 1 ex., Chandra Sarovar, Jhalawar Dist., 20. vi. 63. (ii) 38 exs., Sagi river Jaswantpura, Garh village, Jalor Dist., 1. vi. 63.

Distribution.—RAJASTHAN : As above. *Elsewhere* : INDIA : Throughout. EXTRA-INDIAN : W. Pakistan and Ceylon.

51. *Noemacheilus denisonii* Day

(Pl. 5, Fig. 7)

1867. *Noemacheilus denisonii* Day, *Proc. zool. Soc. Lond.*, London, 1867, p. 287. *Type-loc.* Not given.

Material.—(i) 1 ex., Fatehsagar Lake, Udaipur Dist., coll. R. N. Bhargava, 11. iii. 62. (ii) 18 exs., Sagi river, Jalor Dist., coll. N. Majumdar and R. N. Bhargava, 1. vii. 63. (iii)-(vii) Coll. A. K. Datta. (iii) 1 ex., Nagadari, Mandore, Jodhpur Dist., 10. iv. 61. (iv) 1 ex., Kailana Lake, Jodhpur Dist., 21. iv. 61. (v) 1 ex., Bijolai tank, Jodhpur Dist., 7. xi. 62. (vi) 17 exs., Sardarsamand, Jodhpur Dist., 15. i. 63. (vii) 1 ex., Kharala Dam, Jodhpur Dist., 8. i. 63.

Distribution.—RAJASTHAN: In addition to the above material, the following records (Mathur, 1952) are available :—R. Phulad, a hill stream near Piple village 27 km. from Phulad; Jogmandi Jharna (waterfall) 18 km. E. of Phulad Railway Station; Trevor Tal (tank) and *nala* (stream) near Dilwara Temple, and Gora chapra *nala*, Mount Abu. Sirohi Dist.) *Elsewhere*: INDIA: Madras (Nilgiri Hills), Mysore, Maharashtra and Madhya Pradesh.

52. *Mystus bleekeri* (Day)

(Pl. 6, Fig. 6)

1877. *Macrones bleekeri* Day, *Fish. India*, p. 451, p. 101, fig. 1. *Type-loc.* Sind, Jamuna, upper waters of Ganges, Burma.

Material.—Coll. N. Majumdar and R. N. Bhargava: (i) 7 exs., Jeysagar Bund, Alwar Dist., 7. vi. 63. (ii) 1 ex., Bhairu Dara, Sawai Madhopur Dist., 16. vi. 63. (iii) 3 exs., Khandia tank, Jhalawar Dist., 21. vi. 63.

Distribution.—RAJASTHAN: As above. *Elsewhere*: INDIA: Throughout northern India. EXTRA-INDIAN: W. Pakistan, Burma and Malaya.

53. *Mystus cavasius* (Hamilton)

(Pl. 6, Fig. 3)

1822. *Pimelodus cavasius* Hamilton, *Fishes of Ganges*, Edinburgh, pp. 203, 379, pl. 11, fig. 67. *Type-loc.* Larger freshwater rivers of Gangetic Provinces.

Material.—(i)-(vii) Coll. N. Majumdar and R. N. Bhargava: (i) 3 exs., Surwal Bund, Sawai Madhopur Dist., 15. vi. 63. (ii) 5 exs., Mui Bund, Sawai Madhopur Dist., 16. vi. 63. (iii) 1 ex., Bhagwatigarh Bund, Sawai Madhopur Dist., 18. vi. 63. (iv) 3 exs., Shukla talai, Jhalawar Dist., 20. vi. 63. (v) 7 exs., Gomti Sagar, Jhalawar Dist., 21. vi. 63. (vi) 1 ex., Mudlia Kheri, Jhalawar Dist., 21. vi. 63. (vii)-(ix) Coll. A. K. Datta. (vii) 1 ex., Aghapur, Bharatpur Dist., 20. i. 62. (viii) 1 ex., tank, Kumbher village, Bharatpur Dist., 21. i. 62. (ix) 1 ex., Kila-ki-Khai, Deeg town, Bharatpur Dist., 21. i. 62.

Distribution.—RAJASTHAN: As above. *Elsewhere*: INDIA: Throughout. EXTRA-INDIAN: E. & W. Pakistan, Burma, Thailand, Malay-Archipelago and China.

54. *Mystus seenghala* (Sykes)

(Pl. 7, Fig. 5)

1839. *Platystomus seenghala* Sykes, *Trans. zool. Soc. Lond.*, London, 2, p. 371. *Type-loc.* Mola Mota River at Poona.

Material.—(i) 1 ex., Fatehsagar Lake, Udaipur, coll. R. N. Bhargava, 11. iii. 61. (ii) 1 ex., Mudlia Kheri, Jhalawar Dist., coll. N. Majumdar and R. N. Bhargava, 21. vi. 63.

Distribution.—RAJASTHAN : As above. *Elsewhere* : INDIA : Andhra Pradesh, Punjab, Uttar Pradesh, W. Bengal and Madhya Pradesh. EXTRA-INDIAN : Burma.

55. *Mystus vittatus* (Bloch)

(Pl. 4, Fig. 5)

1797. *Silurus vittatus* Bloch, *Ichth.*, Leyden, pl. 371, fig. 2. *Type-loc.* Tranquebar.

Material.—(i) 7 exs., Kiyard Bund, Sawai Madhopur Dist., coll. N. Majumdar and R. N. Bhargava, 17. vi. 63. (ii) 2 exs., Umran Lake, Alwar Dist., coll. A. K. Datta, 25. i. 62.

Distribution.—RAJASTHAN : As above. *Elsewhere* : INDIA : Punjab, Uttar Pradesh, Bihar, W. Bengal, Assam, Orissa, Madhya Pradesh, Madras and Kerala. EXTRA-INDIAN : E. & W. Pakistan, Burma, Ceylon and Thailand.

56. *Ompok bimaculatus* (Bloch)

(Pl. 6, Fig. 7)

1794. *Silurus bimaculatus* Bloch, *Ausländische Fische*, Berlin, 8, p. 24, pl. 364. *Type-loc.* Tranquebar.

Material.—(i) 1 ex., Fatehsagar Lake, Udaipur Dist., coll. R. N. Bhargava, 11. iii. 61. (ii)-(iv) Coll. N. Majumdar and R. N. Bhargava : (ii) 3 exs., Jeysagar Bund, Alwar Dist., 7. vi. 63. (iii) 10 exs., Mui Bund, Sawai Madhopur Dist., 16. vi. 63. (iv) 1 ex., Bhagwatigarh Bund, Sawai Madhopur Dist., 18. vi. 63.

Distribution.—RAJASTHAN : As above. *Elsewhere* : INDIA : Throughout. EXTRA-INDIAN : Ceylon, Burma, Malaya, Thailand and Yunnan.

57. *Wallago attu* (Schneider)

(Pl. 7, Fig. 4)

1801. *Silurus attu* Schneider, *Syst. Ichth. Bloch*, p. 338, pl. 75. *Type-loc.* Malabar.

Material.—(i)-(iii) Coll. N. Majumdar and R. N. Bhargava : (i) 1 ex., Siliserh Bund, Alwar Dist., 8. vi. 63. (ii) 1 ex., Bhairu Dara, Sawai Madhopur Dist., 16. vi. 63. (iii) 1 ex., Mui Bund, Sawai Madhopur Dist., 16. vi. 63. (iv)-(v) Coll. A. K. Datta, Bharatpur Dist. : (iv) 3 exs., Agharpur, 20. i. 62. (v) 6 exs., Danaduch-ki-Diggi, 19. i. 62.

Distribution.—RAJASTHAN : As above. *Elsewhere* : INDIA : Throughout. EXTRA-INDIAN : E. & W. Pakistan, Ceylon, Burma, Malay-
Archipelago, Thailand, Indo-China and W. Yunnan.

58. *Silonia silondia* (Hamilton)

1822. *Pimelodus silondia* Hamilton, *Fishes of Ganges*, Edinburg, pp. 160, 375, pl. 7, fig. 50. *Type-loc.* Gangetic estuaries.

Material.—None. Reported from lakes in Jaipur and Udaipur Dists. and at Khetri (Jhunjhunu Dist.) by Dutta Gupta *et al* (1961).

Distribution.—RAJASTHAN : As above. *Elsewhere* : INDIA : Uttar Pradesh, Bihar, Punjab, W. Bengal, Orissa, Andhra Pradesh and Maharashtra. EXTRA-INDIAN : Burma.

59. *Bagarius bagarius* (Hamilton)

1822. *Pimelodus bagarius* Hamilton, *Fishes of Ganges*, Edinburg, pp. 186, 378, pl. 7, fig. 62. *Type-loc.* Ganges.

Material.—None. Reported from lakes in Jaipur and Udaipur Dists. and at Khetri (Jhunjhunu Dist.) by Dutta Gupta *et al* (1961).

Distribution.—RAJASTHAN : As above. *Elsewhere* : INDIA : Throughout northern India, Orissa, Madhya Pradesh and Maharashtra. EXTRA-INDIAN : W. Pakistan, Burma, Malaya, Thailand and Indo-China.

60. *Heteropneustes fossilis* (Bloch)

(Pl. 7, Fig. 3)

1794. *Silurus fossilis* Bloch, *Auslandische Fische*, Berlin, 6, p. 370, text-fig. 2. *Type-loc.* Tranquebar.

Material.—(i) 1 ex., Julga, Jaipur Dist., coll. A. K. Mukherjee, 23. xi. 57. (ii) 1 ex., Datri Nadi at Naraina, Jaipur Dist., coll. S. Biswas, 30. x. 58. (iii)-(iv) Coll. N. Majumdar and R. N. Bhargava : (iii) 3 exs., Mangalsar, Alwar Dist., 7. vi. 63. (iv) 1 ex., Bhagwatigarh Bund, Sawai Madhopur Dist., 18. vi. 63. (v)-(xiii) Coll. A. K. Datta : (v) 1 ex., Takhatsagar tank, Jodhpur Dist., 21. vi. 61. (vi) 4 exs., bawari (tank) near Ghenari village, Pali Dist., 20. xi. 61. (vii) 1 ex., Nandri tank, Jodhpur Dist., 7. vii. 62. (viii) 3 exs., Umedsagar, Jodhpur Dist., 28. vi. 62. (ix) 2 exs., Kailana Lake, Jodhpur Dist., 12. vii. 62. (x) 5 exs., Kharala Dam, Jodhpur Dist., 8. i. 63. (xi) 3 exs., Sardarsamand, Jodhpur Dist., 15. i. 63. (xii) 9 exs., Gangani tank, Jodhpur Dist., 17. iii. 63. (xiii) 8 exs., well near Sapa Sarowar in Pipar, Jodhpur Dist., 23. v. 63.

Distribution.—RAJASTHAN : As above. Also : Kailana Lake, Jodhpur (Krishna and Menon, 1958) and Bharatpur Dist. (Moona, 1962). *Elsewhere* : INDIA : Throughout. EXTRA-INDIAN : E. & W. Pakistan, Ceylon, Nepal, Burma, Thailand and Indo-China.

61. *Xenentodon cancila* (Hamilton)

(Pl. 7, Fig. 6)

1822. *Belone cancila* Hamilton, *Fishes of Ganges*, Edinburg, pp. 213, 380, pl. 27, fig. 70. *Type-loc.* Ponds and smaller rivers of Gangetic Province.

Material.—(i) 5 exs., Chaparwara, Jaipur Dist., coll. A. K. Mukherjee, 9. iii. 57. (ii) 1 ex., Fatehsagar Lake, Udaipur Dist., coll. R. N. Bhargava, 11. iii. 61. (iii) 5 exs., Chandra Sarovar, Jhalawar Dist., coll. N. Majumdar and R. N. Bhargava, 20. vi. 63.

Distribution.—RAJASTHAN : As above. *Elsewhere* : INDIA : Throughout. EXTRA-INDIAN : E. & W. Pakistan, Ceylon, Burma and farther east,

62. *Gambusia affinis* (Baird & Girard)

(Pl. 4, Fig.6)

1853. *Heterandia patruelis* Baird & Girard, *Proc. Acad. nat. Sci. Philad.* Philadelphia, 6, p. 360. *Type-loc.* Rio Sabinal, Texas, U.S.A.

Material.—(i) 4 exs., Kherpena-ka-Nalla, Udaipur Dist., coll. B. N. Chopra and M. L. Roonwal, 15. x. 41. (ii) Many exs., Kailana Lake, Jodhpur Dist., coll. J. S. Purohit, 19. ii. 61. (iii)-(vi) Coll. A. K. Datta: (iii) 33 exs., Ranibag garden, Mandore, Jodhpur Dist., 27. x. 60. (iv) 55 exs., Kailana Lake, Jodhpur Dist., 19. ii. 61. (v) many exs., Nagadari, Mandore, Jodhpur Dist., 10. iv. 61. (vi) 23 exs., Takhatsagar tank, Jodhpur Dist., 21. iv. 61. (vii) 301 exs., Mandore canal, Jodhpur Dist., 17. v. 61. (viii) 61 exs., Dam, Jodhpur Dist., 23. ix. 61. (ix) 1 ex., Ahar river, Udaipur Dist., 24. xii. 61. (x) 25 exs., Main tank at Barli village, Jodhpur Dist., 4. ii. 62. (xi) 49 exs., Bhurd Bhaker, Jodhpur Dist., 28. iv. 62, (xii) 48 exs., tank, Jodhpur Dist., 28. iv. 62. (xiii) 36 exs., Sardarsamand Jodhpur Dist., 15. i. 63. (xiv) 1 ex., Luni river, Jodhpur Dist., 12. vii. 62. (xv) 94 exs., Padam Sagar, Jodhpur Dist., 21. iii. 63. (xvi) 8 exs., Ranisagar, Jodhpur Dist., 21. iii. 63. (xvii) 7 exs., Galta, Jaipur Dist., coll. K. K. Mahajan, 10. ix. 63.

Distribution.—RAJASTHAN : As above. Introduced species. *Elsewhere:* INDIA : Kashmir and Mysore. EXTRA-INDIAN : Ceylon, Malaya, Philippines, Formosa and Italy. Native to southern United States.

63. *Aplocheilus lineatum* (Valenciennes)

(Pl.4, Fig.7)

1846. *Panchax lineatum* Valenciennes, *Hist. Nat. Poissons*, Paris, 18, p. 381. *Type-loc.* Bombay.

Material.—(i) 3 exs., Ahar River, Udaipur Dist., coll. A. K. Datta and party, 24. xii. 61. (ii) 2 exs., Sardarsamand, Pali Dist., coll. K. K. Mahajan, 25. xi. 63.

Distribution.—RAJASTHAN : As above. *Elsewhere:* INDIA : Maharashtra, Kerala and Madras. EXTRA-INDIAN: Ceylon.

64. *Channa gachua* (Hamilton)

(Pl. 6, Fig. 1)

1822. *Ophiocephalus gachua* Hamilton, *Fishes of Ganges*, Edinburgh, pp. 68, 367, pl. 21, fig. 21. *Type-loc.* Ponds and ditches of Bengal.

Material.—(i)-(ii) Coll. B. Biswas : (i) 3 exs., Bandi nadi at Pali, Pali Dist., 6. xii. 56. (ii) 2 exs., Kolayat, Bikaner Dist., 5. xi. 56. (iii)-(iv) Coll. N. Majumdar and R. N. Bhargava : (iii) 11 exs., small pond in tributary of Sabi river, Jaipur Dist., 9. vi. 63. (iv) 3 exs., small nulla from Mapdori-ka-Bund, Jaipur Dist., 9. vi. 63. (v)-(viii) Coll. A. K. Datta : (v) 1 ex., Pamri nadi, 12 km. N. of Katra, Udaipur Dist., 22. xii. 61. (vi) 2 exs., Pamri nadi, 8 km. N. of Katra, Udaipur Dist., 20. xii. 61. (vii) 3 exs., Sardarsamand, Jodhpur Dist., 15. i. 63. (viii) 1 ex., Umedsagar, Jodhpur Dist., 11. iii. 63.

Distribution.—RAJASTHAN : As above. *Elsewhere:* INDIA : Throughout. EXTRA-INDIAN : E. & W. Pakistan, Afghanistan, Ceylon, Burma, Malaya, Thailand, Indo-China, Yunnan and, Haryana.

65. *Channa marulius* (Hamilton)

(Pl. 7, Fig. 2)

1822. *Ophiocephalus marulius* Hamilton, *Fishes of Ganges*, pp. 65, 367, pl. 17, fig. 19. *Type-loc.* Ponds and freshwater rivers of India.

Material.—(i) 1 ex., Jeysagar Bund, Alwar Dist., Coll. *N. Majumdar* and *R. N. Bhargava*, 7. vi. 63. (ii) 1 ex., Kailana Lake, Jodhpur Dist., coll. *A. K. Datta*, 2. ii. 63.

Distribution.—RAJASTHAN : As above. *Elsewhere* : INDIA : Throughout. EXTRA-INDIAN : E. & W. Pakistan, Ceylon and China.

66. *Channa punctatus* (Bloch)

(Pl. 6, Fig. 5)

1793. *Ophiocephalus punctatus* Bloch, *Auslandische Fische*, Berlin, 6, p. 139, pl. 358. *Type loc.* Malabar.

Material.—(i)-(vii) Coll. *B. N. Chopra* and *M. L. Roonwal* : (i) 3 exs., Soorpur-ka-Nadi, Dungarpur Dist., 26. x. 41. (ii) 2 exs., R. Sone near Pipradia village, Dungarpur Dist., 27. x. 41. (iii) 2 exs., tanks and pools around Dungarpur, Dungarpur Dist., 28. x. 41. (iv) 1 ex., Udaisagar nalla, Udaipur Dist., 10. iv. 41. (v) 1 ex., R. Berach near Chittorgarh, 8. x. 41. (vi) 2 exs., Parai-ka-Nadi near Prasad, Udaipur Dist., 17. x. 41. (vii) 1 ex., Dhulev-ka-Nadi, Prasad, Udaipur Dist., 20. x. 41. (viii) 1 ex., Chat, Ajmer Dist., coll. *B. Biswas*, 28. xi. 56. (ix) 1 ex., pond at Pali, Pali Dist., coll. *B. Biswas*, 6. xii. 56. (x) 4 exs., Julga, Jaipur Dist., coll. *A. K. Mukherjee*, 13.xi.57. (xi)-(xxii) Coll. *N. Majumdar* and *R. N. Bhargava* : (xi) 1 ex., Mansarovar, Alwar Dist., 7. vi. 63. (xii) 9 exs., Mangalsar, Alwar Dist., 7. vi. 63. (xiii) 1 ex., Siliserh Bund, Alwar Dist., 8. vi. 63. (xiv) 1 ex., Chhitoli Bund, Jaipur Dist., 11. vi. 63. (xv) 1 ex., Bhairu Dara, Sawai Madhopur Dist., 16. vi. 63. (xvi) 13 exs., Kiyard Bund, Sawai Madhopur Dist., 17. vi. 63. (xvii) 1 ex., pond in Gambhir river, Sawai Madhopur Dist., 17. vi. 63. (xviii) 1 ex., Shukla talai, Jhalawar Dist., 20. vi. 63. (xix) 6 exs., Gomti Sagar, Jhalawar Dist., 21. vi. 63. (xx) 1 ex., Mudlia kheri, Jhalawar Dist., 21. vi. 63. (xxi) 3 exs., Gaduli talai, Jhalawar Dist., 22. vi. 63. (xxii) 2 exs., Jawai river, Jalor Dist., 2. vii. 63. (xxiii)-(xxx) Coll. *A. K. Datta*. (xxiii) 2 exs., Ahar river, Udaipur Dist., 24. xii. 61. (xxiv) 16 exs., tank near Ajan village, Bharatpur Dist., 19. i. 62. (xxv) 2 exs., Umran Lake, Alwar Dist., 25. i. 62. (xxvi) 5 exs., Umedsagar, Jodhpur Dist., 4. ii. 62. (xxvii) 4 exs., Sardarsamand, Jodhpur Dist., 6. iii. 62. (xxviii) 1 ex., Kailana Lake, Jodhpur Dist., 12. vii. 62. (xxix) 11 exs., Kharala Dam, Jodhpur Dist., 8. i. 63. (xxx) 2 exs., Sardarsamand, Jodhpur Dist., 15. i. 63. (xxxi)-(xxxii) Coll. *K. K. Mahajan* : (xxxi) 3 exs., Maota tank, Amber, Jaipur Dist., 12. ix. 63. (xxxii) 1 ex., Sardarsamand, Jodhpur Dist., 26. xi. 63.

Distribution.—RAJASTHAN : In addition to the above material, the following records (Mathur, 1952) are available :—R. Phulad near Phulad Railway Station ; Jayvilas Palace tank, Mount Abu, Sirohi Dist. ; and Bharatpur Dist. *Elsewhere* : INDIA : Throughout. EXTRA-INDIAN : E. & W. Pakistan, Ceylon, Burma, Malaya, China and Polynesia.

67. *Channa striatus* (Bloch)

1793. *Ophiocephalus striatus* Bloch, *Auslandische Fische*, Berlin, 2, p. 141, pl. 359. *Type-loc.* Malabar.

Material.—None. Reported from lakes in Jaipur and Udaipur Dists., and at Khetri (Jhunjhunu Dist.) by Dutta Gupta *et al* (1961).

Distribution.—RAJASTHAN : As above. *Elsewhere* : INDIA : Throughout. EXTRA-INDIAN : E. & W. Pakistan, Ceylon, Burma, China and Polynesia.

68. *Ambassis baculis* (Hamilton)

1822. *Chanda baculis* Hamilton, *Fishes of Ganges*, Edinburgh, pp. 112, 371. *Type-loc.* North-eastern parts of Bengal.

Material.—None. Reported from lakes in Jaipur and Udaipur Dists. and at Khetri (Jhunjhunu Dist.) by Dutta Gupta *et al* (1961).

Distribution.—RAJASTHAN : As above. *Elsewhere* : INDIA : Throughout northern India ; EXTRA-INDIAN : E. & W. Pakistan, Burma and Thailand.

69. *Ambassis nama* (Hamilton)

(Pl. 4, Fig. 3)

1822. *Chanda nama* Hamilton, *Fishes of Ganges*, Edinburgh, pp. 109, 371, pl. 39, fig. 37. *Type-loc.* Ponds throughout Bengal.

Material.—(i)-(v) Coll. N. Majumdar and R. N. Bhargava : (i) 2 exs., Gambhir river, Sawai Madhopur Dist., 18. vi. 63. (ii) 63 exs., Chandra Sarovar, Jhalawar Dist., 20.vi.63. (iii) 2 exs., Khadia tank, Jhalawar Dist., 21.vi.63. (iv) 2 exs., Gaduli Talai, Jhalawar Dist., 22.vi.63. (v) 43 exs., Jawai river, Jalor Dist., 2.vii.63. (vi)-(ix) Coll. A. K. Datta : (vi) 45 exs., tank near Ajan village, Bharatpur Dist., 19.i.62. (vii) 9 exs., tank, Alwar Dist., 23.i.62. (viii) 19 exs., pucca tank in Bharatpur, Bharatpur Dist., 26.i.62. (ix) 1 ex., tank near Alahapur village, Alwar Dist., 25.i.62.

Distribution.—RAJASTHAN : As above. *Elsewhere* : INDIA : Throughout. EXTRA-INDIAN : E. & W. Pakistan and Burma.

70. *Ambassis ranga* (Hamilton)

(Pl. 5, Fig. 5)

1822. *Chanda ranga* Hamilton, *Fishes of Ganges*, Edinburgh, pp. 113, 371. pl. 16, fig. 38. *Type-loc.* Freshwater rivers of Gangetic Provinces

Material.—(i) 4 exs., Udaisagar nalla, Udaipur Dist., coll. B. N. Chopra and M. L. Roonwal, 11.x.41. (ii) 1 ex., Fatehsagar Lake, Udaipur Dist., coll. R. N. Bhargava, 11.iii.61. (iii)-(iv) Coll. N. Majumdar and R. N. Bhargava, Jhalawar Dist. (iii) 83 exs., Chandra Sarovar, 20.vi.63. (iv) 14 exs., Khandia tank, 21.vi.63. (v)-(xiii) Coll. A. K. Datta : (v) 20 exs., Ahar river, Udaipur Dist., 24.xii.61. (vi) 8 exs., Lake in Ghana Sanctuary, Bharatpur Dist. 20.i.62. (vii) 14 exs., tank Khumber village, Bharatpur Dist., 21.i.62. (viii) 6 exs., Roopsagar near Dreg

Palace, Bharatpur Dist., 21.i.62. (ix) 18 exs., Kila-ki-Khai, Deeg town, Bharatpur Dist., 21.i.62. (x) 11 exs., tank, Kherli village, Bharatpur Dist., 22.i.62. (xi) 19 exs., tank near Mohanpur Mundy, Bharatpur Dist., 23.i.62. (xii) 2 exs., tank, Alwar Dist. 23.i.62.

Distribution.—RAJASTHAN : As above. First record. *Elsewhere:* INDIA : Throughout. EXTRA-INDIAN : E. & W. Pakistan, Burma, Malaya and Thailand.

71. *Colisa fasciatus* (Bloch & Schneider)

(Pl. 5, Fig. 10)

1801. *Trichogaster fasciatus* Bloch and Schneider, *Ichthyologia*, Leyden, p. 164, text-fig. 36. *Type-loc.* Bengal.

Material.—(i) 3 exs., small nalla from Mapdori-ka-Bund, Jaipur Dist., coll. N. Majumdar and R. N. Bhargava, 9.vi.63. (ii)-(vii) coll. A. K. Datta : (ii) 5 exs., Ahar river, Udaipur Dist., 24.xii.61. (iii) 11 exs., Pichola Lake, Udaipur Dist., 24.xii.61. (iv) 66 exs., tank (diggi), Bharatpur Fort, Bharatpur Dist., 19.i.62. (v) 5 exs., Aghapur, Bharatpur Dist., 20.i.62, (vi) 21 exs., Kila-ki-Khai, Deeg, Bharatpur Dist., 21.i.62. (vii) 26 exs., tank near Akata village, Bharatpur Dist., 24.i.62.

Distribution.—RAJASTHAN : As above. *Elsewhere :* INDIA : Orissa, Andhra Pradesh, Madras, Assam, Bihar, Punjab and Uttar Pradesh. EXTRA-INDIAN : E. & W Pakistan ; and Burma.

72. *Osphronemus goramy* Lacèpède

1802. *Osphronemus gourami* Lacèpède, *Hist. Poissons*, Paris, 3, pp. 116, 117, pl. 8, fig. 2. *Type-loc.* Mauritius.

Material.—None. Reported from lakes in Jaipur and Udaipur Dists. and at Khetri (Jhunjhunu Dist.) by Dutta Gupta *et al* (1961).

Distribution.—RAJASTHAN : As above. Introduced species in India. *Elsewhere :* INDIA : W Bengal, Madras and Nilgiri Hills. EXTRA-INDIAN : Malaya, China, Mauritius, Philippines and Australia.

73. *Glossogobius giuris* (Hamilton)

(Pl. 5, Fig. 9)

1822. *Gobius giuris* Hamilton, *Fishes of Ganges*, Edinburgh, pp. 51, 366, pl. 33, fig. 15. *Type-loc.* Ponds and freshwater rivers of Gangetic Provinces.

Material.—(i) 2 exs., Gomti Sagar, Jhalawar Dist., coll. N. Majumdar and R. N. Bhargava, 21.vi.63. (ii) 1 ex., Kila-ki-Khai, Deeg, Bharatpur Dist., coll. A. K. Datta, 21.i.62.

Distribution.—RAJASTHAN : As above. *Elsewhere :* INDIA : Throughout. EXTRA-INDIAN : E. & W. Pakistan, Burma, Ceylon, Malaya, Thailand, China, Japan, Philippines, Melanesia, Polynesia, Australia ; also E. Africa.

74. *Mastocembelus armatus* (Lacépède)

(Pl. 6, Fig. 4)

1800. *Macrogathus armatus* Lacépède, *Hist. Poissons*, Paris, 2, 286, Type-loc. Bengal.

Material.—(i) 1 ex., Udaisagar nalla, Udaipur Dist., coll. B. N. Chopra and M. L. Roonwal, 25.x.41. (ii) 4 exs., R. Phulad, near Phulad Railway Station, Udaipur Dist., coll. K. S. Pradhan, 1.iii.48. (iii) 1 ex., Fatehsagar Lake, Udaipur Dist., coll. R. N. Bhargava, 11.iii.61. (iv)-(vii) Coll. N. Majumdar and R. N. Bhargava : (iv) 1 ex., Bhairu Dara, Sawai Madhopur Dist., 16.vi.63. (v) 1 ex., Mui Bund, Sawai Madhopur Dist., 16.vi.63. (vi) 1 ex., Gomti Sagar, Jhalawar Dist., 21.vi.63. (vii) 1 ex., Ahu River, Jhalawar Dist., 23.vi.63. (viii)-(ix) coll. A. K. Datta : (viii) 1 ex., Ahar river, Udaipur Dist., 24.xii.61. (ix) 2 exs., Kailana Lake, Jodhpur Dist., 11.iii.63.

Distribution.—RAJASTHAN : As above. Also R. Phulad, ca. 3 km. S. E. of Phulad stream (Mathur, 1952), and Bharatpur Dist. (Moona, 1963). *Elsewhere* : INDIA : Throughout. EXTRA-INDIAN : E. & W. Pakistan, Ceylon, Burma and Thailand.

75. *Mastocembelus pancalus* (Hamilton)

(Pl. 7, Fig. 1)

1822. *Macrogathus pancalus* Hamilton, *Fishes of Ganges*, Edinburgh, pp. 30, 364. Type-loc. Tanks of Gangetic Provinces.

Material.—Coll. A. K. Datta : (i) 2 exs., Kila-ki-Khai, Deeg, Bharatpur Dist., 21.i.62. (ii) 2 exs., Kailana Lake, Jodhpur Dist., 11.iii.63.

Distribution.—RAJASTHAN : As above. *Elsewhere* : INDIA : Throughout. EXTRA-INDIAN : E. & W. Pakistan.

VI—SUMMARY

1. A list of 75 species of fishes known to occur in Rajasthan is given and a field key to their identification provided.

2. Of these 75 species, 63 species belonging to 33 genera and 14 families were examined from specimens obtained largely from the collections made by the field parties of the Zoological Survey of India, during the years 1941-63, from 93 collecting stations in 14 districts of Rajasthan (Text-fig. 1).

3. The family Cyprinidae, with 44 species, forms the largest single group in the fish fauna of Rajasthan.

4. A new species, *Labeo rajasthanicus* (Cypriniformes : Cyprinidae), is described.

5. The following eleven species are recorded for the first time from Rajasthan :—(i) *Gudusia chapra* (Hamilton). (ii) *Barilius barila* Hamilton. (iii) *Danio* (*Brachydanio*) *rerio* (Hamilton).

(iv) *Amblypharyngodon mola* (Hamilton). (v) *Aspidoparia morar* (Hamilton). (vi) *Chagunius chagunio* (Hamilton). (vii) *Labeo dyocheilus* (McClelland). (viii) *Botia lohachata* Chaudhuri. (ix) *Puntius vittatus* Day. (x) *Mystus vittatus* (Bloch). (xi) *Mastocembelus pancalus* (Hamilton).

6. In the Systematic Account, the distribution, etc., of all the species is given.

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PLATE 3

Photographs of Rajasthan fishes, in lateral view. (Scale below Fig. 6 applies to all figures.)

Fig. 1.--*Oxygaster gora* (Hamilton). Fatehsagar Lake, Udaipur District.

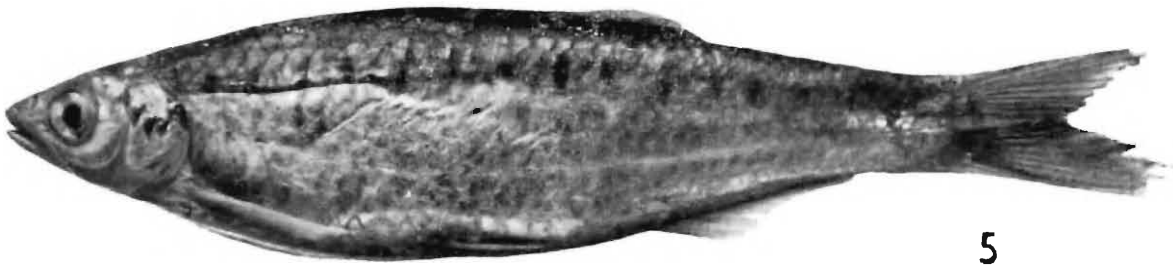
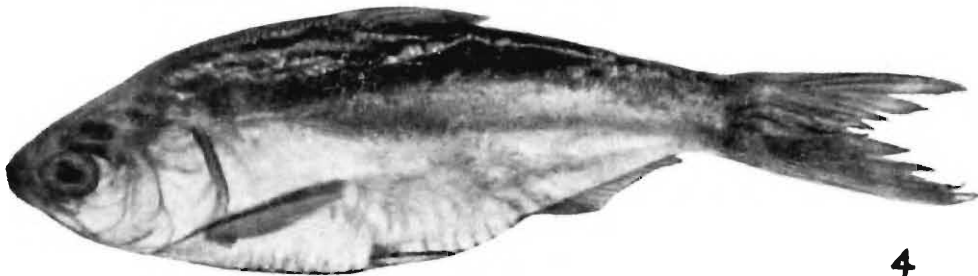
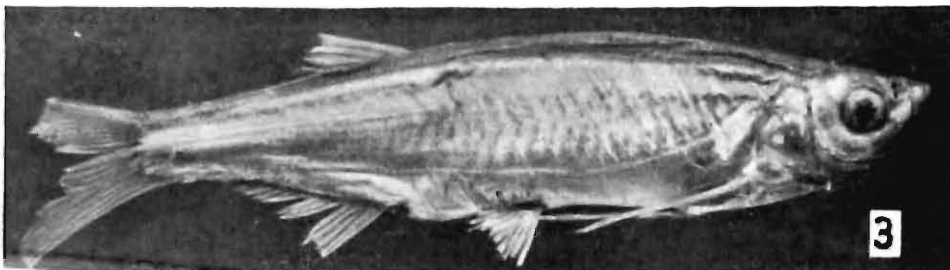
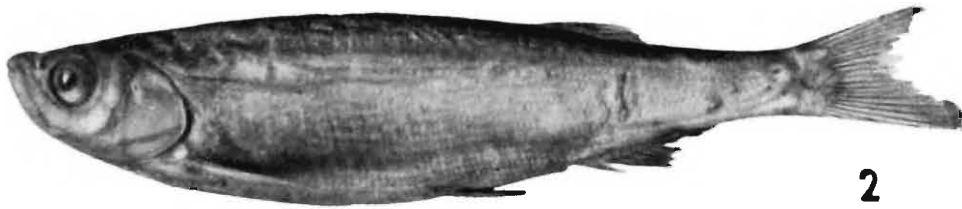
Fig. 2.—*Oxygaster bacaila* (Hamilton). Kharala Dam, Jodhpur District.

Fig. 3.—*Oxygaster clupeioides* (Bloch). Barapal, Udaipur District.

Fig. 4.—*Gudusia chapra* Hamilton. Gaduli tank, Jhalawar District.

Fig. 5.—*Barilius barila* Hamilton. Ahu River, Jhalawar District.

Fig. 6.—*Notopterus notopterus* (Pallas). Mangalsar, Alwar District.

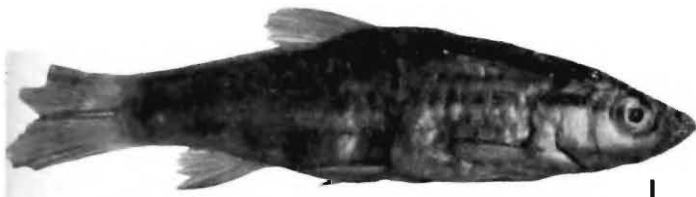


3 cm

PLATE 4

Photographs of Rajasthan fishes, in lateral view. (Scale below Fig. 16 applies to all figures.)

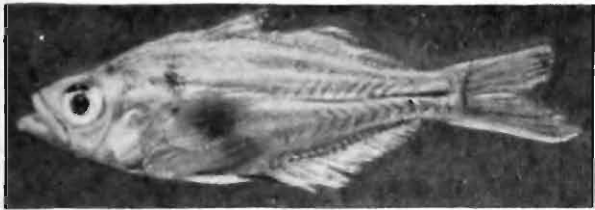
- Fig. 1.—*Rasbora daniconius* (Hamilton). Pamri nadi, Udaipur District.
- Fig. 2.—*Danio (Danio) aequipinnatus* (McClelland). Pamri nadi, Udaipur District.
- Fig. 3.—*Ambassis nama* (Hamilton). Khadia tank, Jhalawar District.
- Fig. 4.—*Puntius chola* (Hamilton). Mudlia Kheri, Jhalawar District.
- Fig. 5.—*Mystus vittatus* (Bloch). Kiyard Bund, Sawai Madhopur District.
- Fig. 6.—*Gambusia affinis* (Baird & Girard). Mandore, Jodhpur District.
- Fig. 7.—*Aplocheilus lineatum* (Valenciennes). Ahar River, Udaipur District.
- Fig. 8.—*Puntius ticto* (Hamilton). Ajan Village, Bharatpur District.
- Fig. 9.—*Puntius amphibia* (Valenciennes). Kherad village, Udaipur District.
- Fig. 10.—*Esomus danrica* (Hamilton). Pamri nadi, Udaipur District.
- Fig. 11.—*Aspidoparia morar* (Hamilton). Gambhir river, Sawai Madhopur District.
- Fig. 12.—*Barilius bola* (Hamilton). Aklera Village, Jhalawar District.
- Fig. 13.—*Labeo dyocheilus* (McClelland). Aghapur, Bharatpur District.
- Fig. 14.—*Puntius sophore* (Hamilton). Nandana nadi, Nagaur District.
- Fig. 15.—*Amblypharyngodon mola* (Hamilton), Kailana Lake, Jodhpur District.
- Fig. 16.—*Noemacheilus botia* (Hamilton). Sagi river, Jalore District.



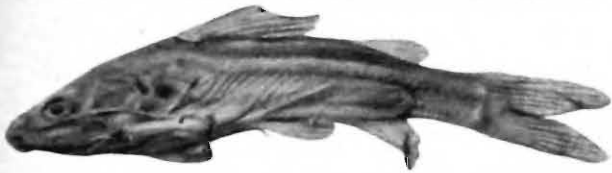
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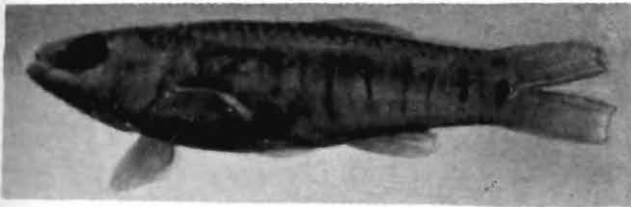
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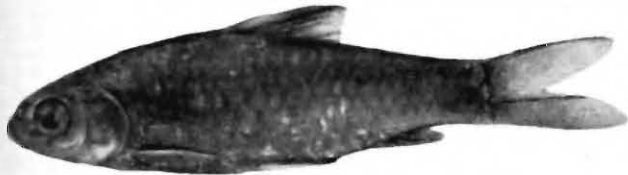
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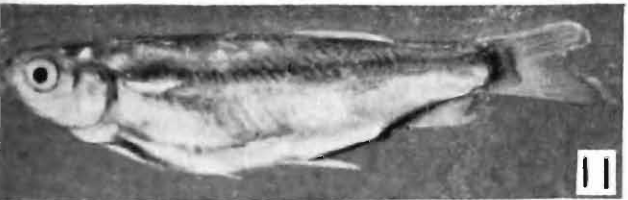
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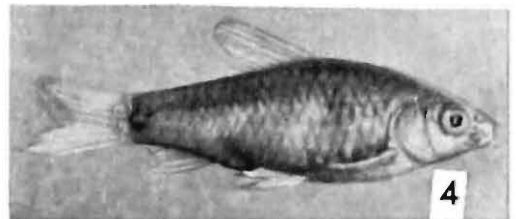
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13



15



4



6



8



10



12



14



16

3 cm

PLATE 5

Photographs of Rajasthan fishes, in lateral view. (Scale below Fig. 14 applies to all figures.)

- Fig. 1.—*Garra gotyla* (Gray). Alani river, Kotah District.
 Fig. 2.—*Garra mullya* (Sykes). Jawai river, Jalore District.
 Fig. 3.—*Chagunius chagunio* (Hamilton). Parwan river, Kotah District.
 Fig. 4.—*Danio (Danio) devario* (Hamilton). Gomti Sagar, Jhalawar District.
 Fig. 5.—*Ambassis ranga* (Hamilton). Chandra Sarovar, Jhalawar District.
 Fig. 6.—*Puntius vittatus* Day. Luni river, Jodhpur District.
 Fig. 7.—*Noemacheilus denisonii* Day. Sagi river, Jalore District.
 Fig. 8.—*Lepidocephalichthys guntea* (Hamilton). Pamri nadi, Udaipur District.
 Fig. 9.—*Glossogobius giuris* (Hamilton). Deeg, Bharatpur District.
 Fig. 10.—*Colisa fasciatus* (Bloch & Schneider). Pichola Lake, Udaipur District.
 Fig. 11.—*Osteobrama cotio* (Hamilton). Parwan river, Jhalawar District.
 Fig. 12.—*Barilius barna* (Hamilton). Wakal river, Udaipur District.
 Fig. 13.—*Botia lohachata* Chaudhuri, Gambhir river, Sawai Madhopur District.
 Fig. 14.—*Danio (Brachydanio) rerio* (Hamilton). Siliserh Bund, Alwar District.
 Fig. 15.—*Catla catla* (Hamilton). Danaduch-ki-Diggi, Bharatpur District.

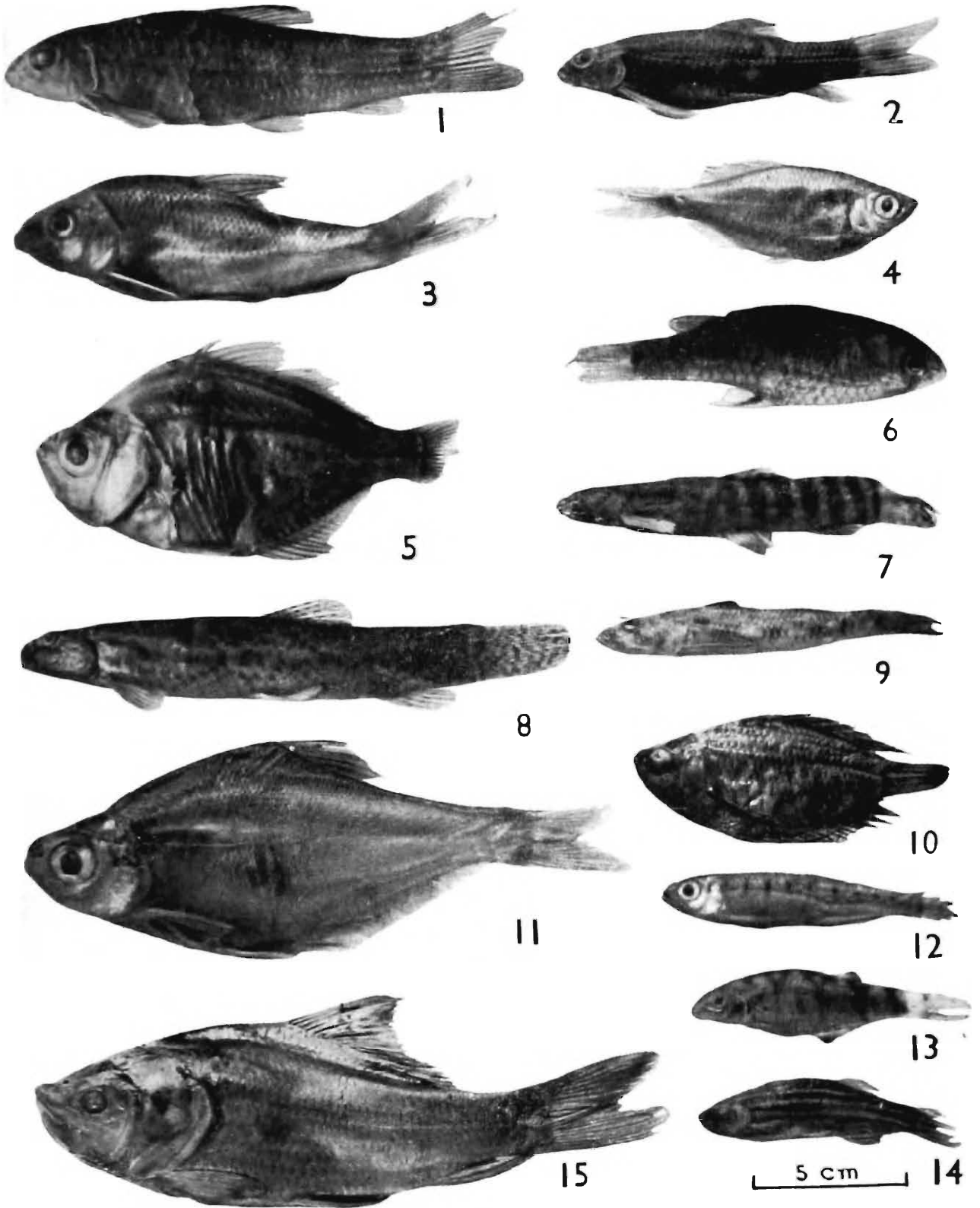


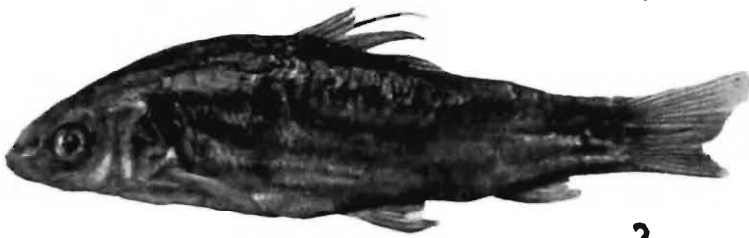
PLATE 6

Photographs of Rajasthan fishes, in lateral view. (Scale below Fig. 6 applies to all figures.)

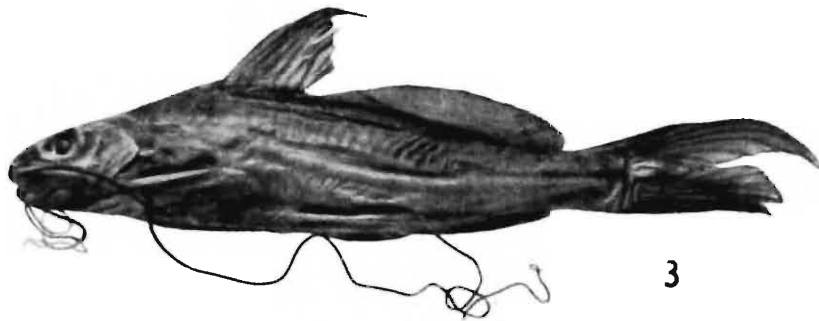
- Fig. 1.—*Channa gachua* (Hamilton). Mapdori-ka-Bund, Jaipur District.
Fig. 2.—*Labeo boggut* (Sykes). Karauli, Sawai Madhopur District.
Fig. 3.—*Mystus cavasius* (Hamilton). Kumbher village, Bharatpur District.
Fig. 4.—*Mastocembelus armatus* (Lecèpède). Kailana Lake, Jodhpur District.
Fig. 5.—*Channa punctatus* (Bloch). Mangalsar, Alwar District.
Fig. 6.—*Mystus bleekeri* (Day). Jeysagar, Alwar District.
Fig. 7.—*Ompok bimaculatus* (Bloch). Jeysagar, Alwar District.



1



2



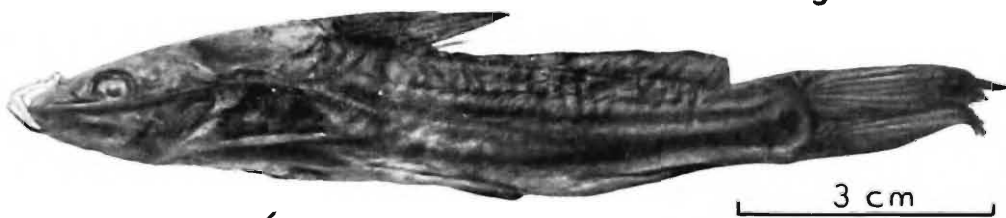
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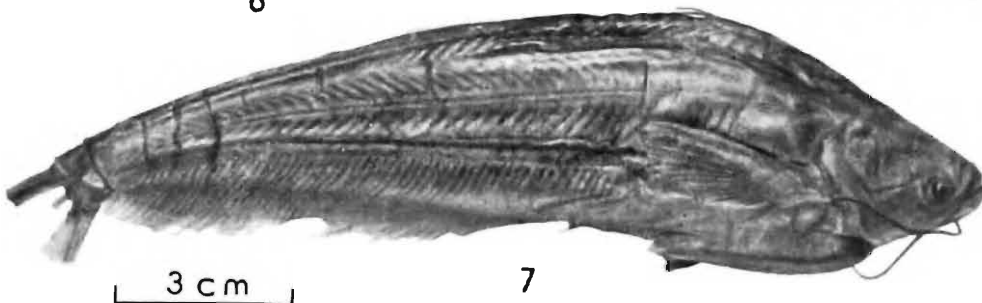
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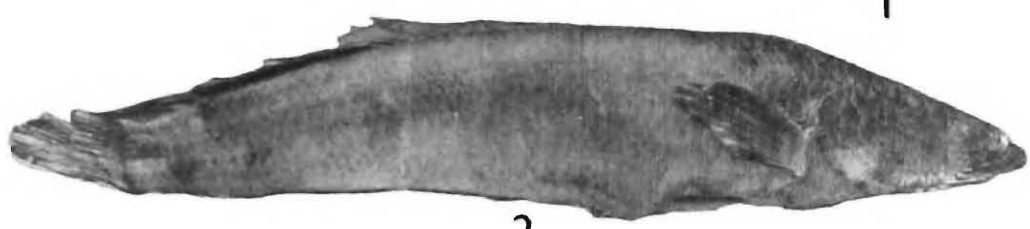
PLATE 7

Photographs of Rajasthan fishes, in lateral view. (Scale below Fig. 3 applies to Figs. 1-4 and 7.)

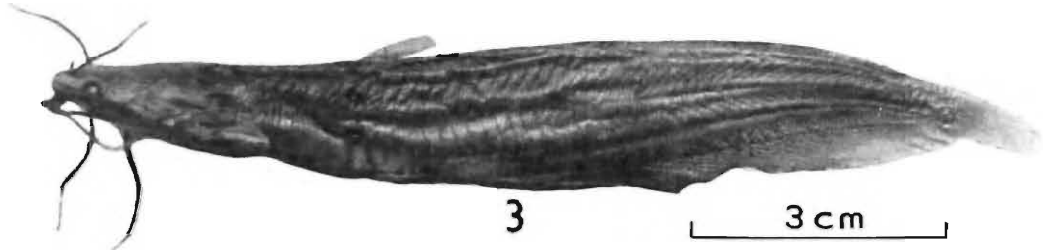
- Fig. 1.—*Mastocembelus pancalus* (Hamilton). Kailana Lake, Jodhpur District.
- Fig. 2.—*Channa marulius* (Hamilton). Jeysagar, Alwar District.
- Fig. 3.—*Heteropneustes fossilis* (Bloch). Kailana Lake, Jodhpur District.
- Fig. 4.—*Wallago attu* (Schneider). Siliserh Bund, Alwar District.
- Fig. 5.—*Mystus seenghala* (Sykes). Mudlia Kheri, Jhalawar District.
- Fig. 6.—*Xenentodon cancila* (Hamilton). Chandra Sarovar, Jhalawar District.
- Fig. 7.—*Carassius carassius* (Linnaeus). Mandore Canal, Jodhpur District.



1

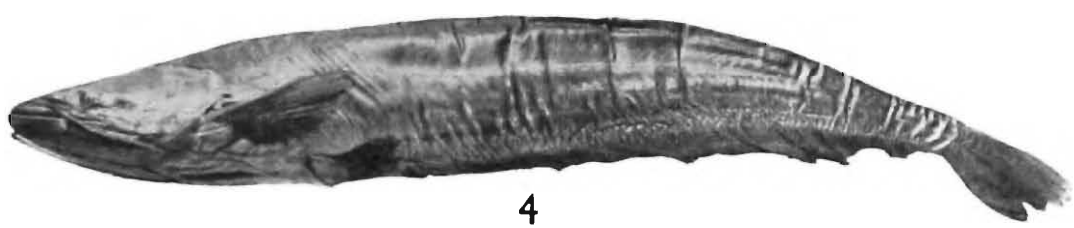


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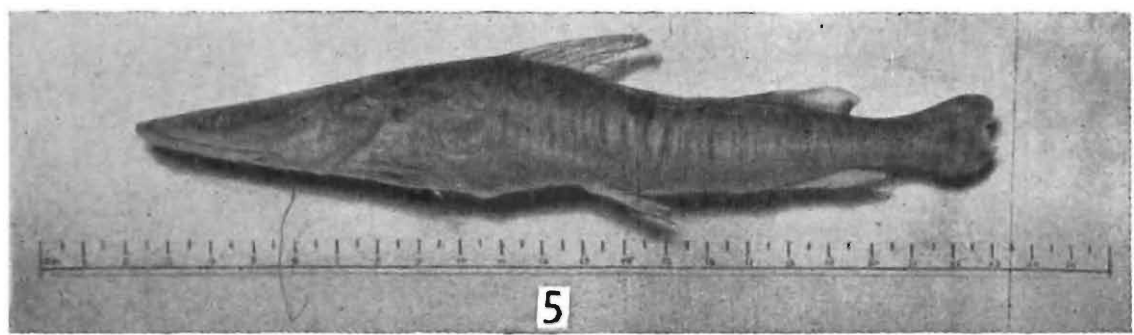


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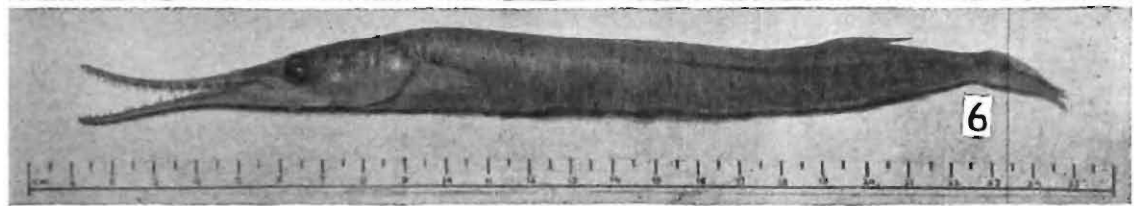
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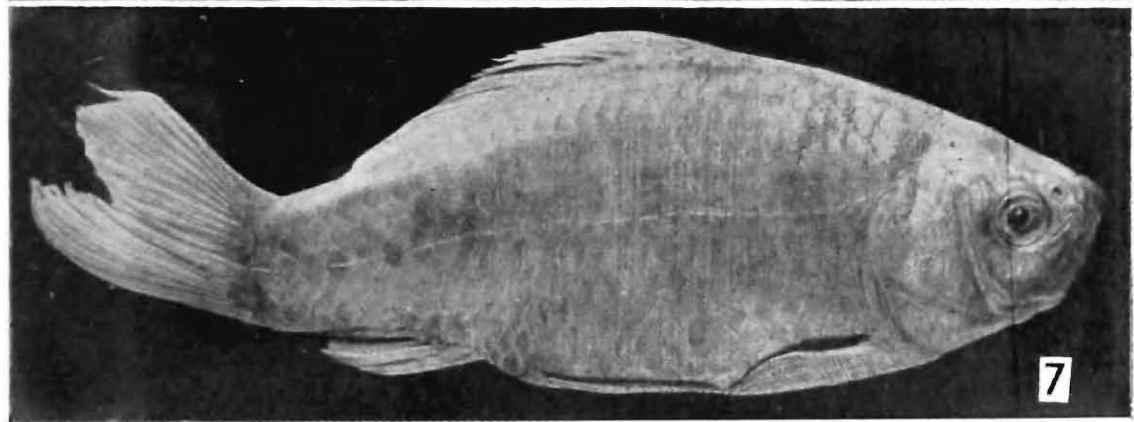
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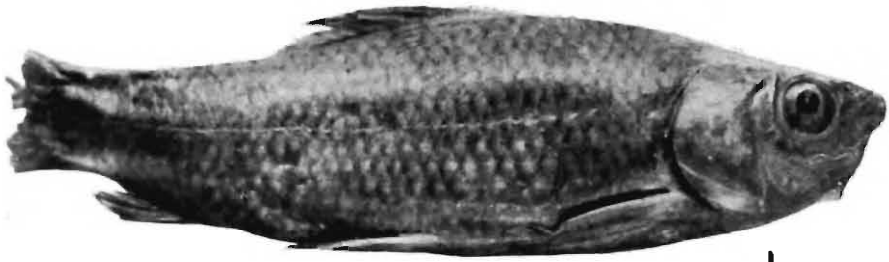


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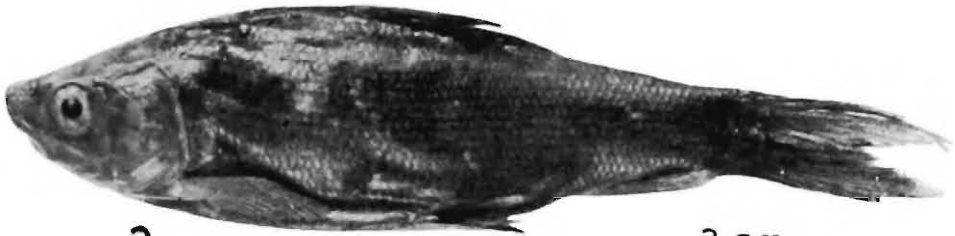
PLATE 8

Photographs of Rajasthan fishes, in lateral view. (Scale below Fig. 3 applies to Figs. 1-3 and 5).

- Fig. 1.—*Cirrhinus mrigala* (Hamilton). Jeysagar, Alwar District.
Fig. 2.—*Puntius sarana* (Hamilton). Pamri nadi, Udaipur District.
Fig. 3.—*Labeo rajasthanicus* sp. n. Jaisamand Lake, Udaipur District.
Fig. 4.—*Tor khudree* (Sykes). Jaisamand Lake, Udaipur District.
Fig. 5.—*Cirrhinus reba* (Hamilton). Siliserh, Alwar District.
Fig. 6.—*Labeo rohita* (Hamilton). Mui Bund, Sawai Madhopur District.

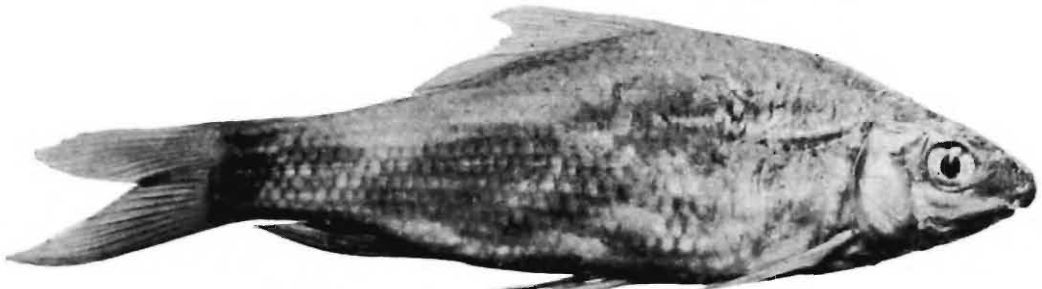


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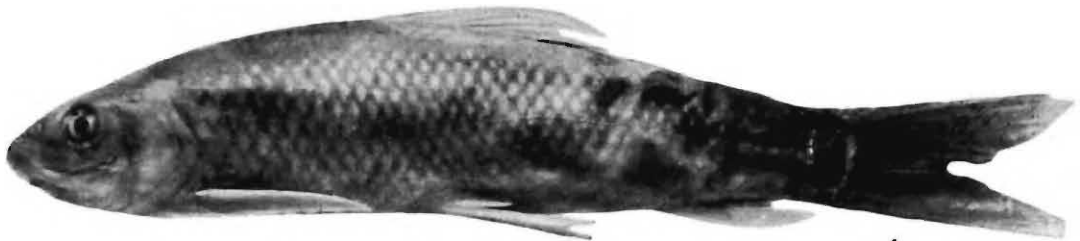
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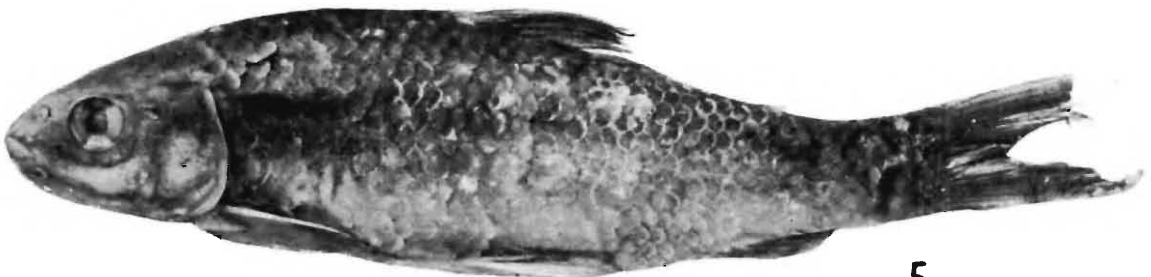


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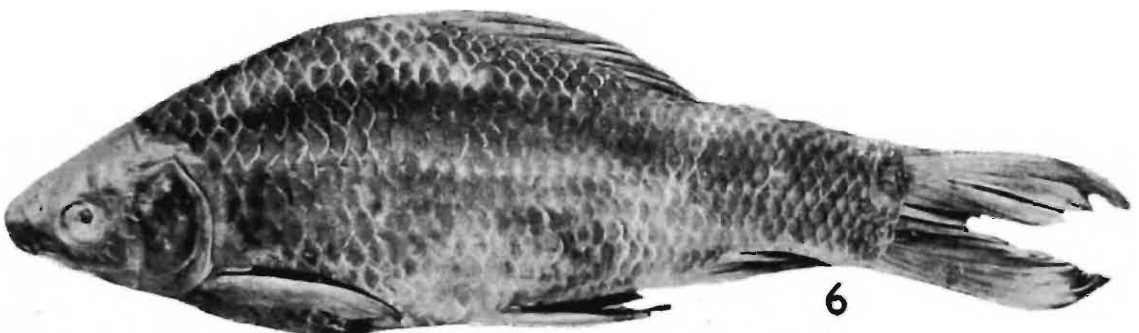
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5

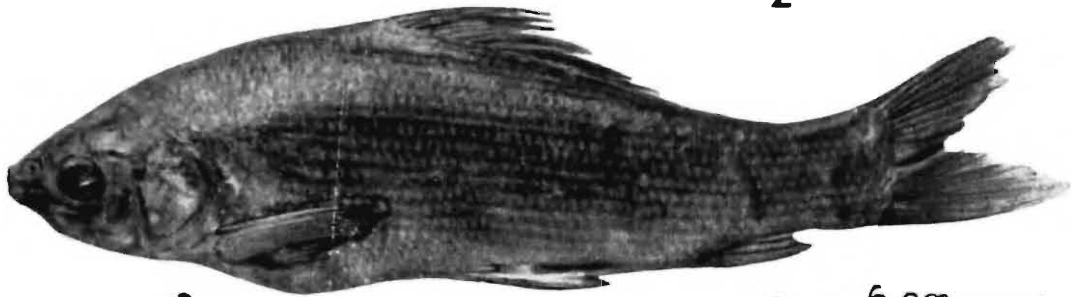
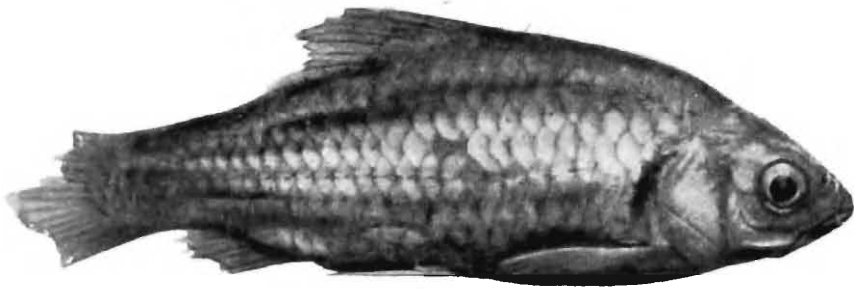
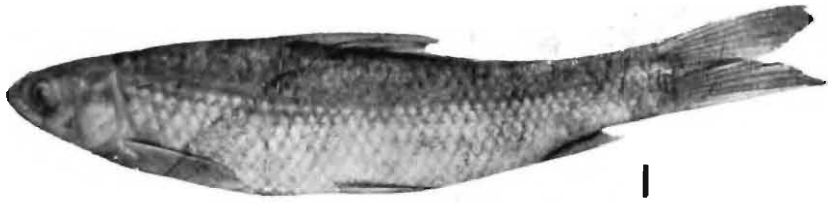


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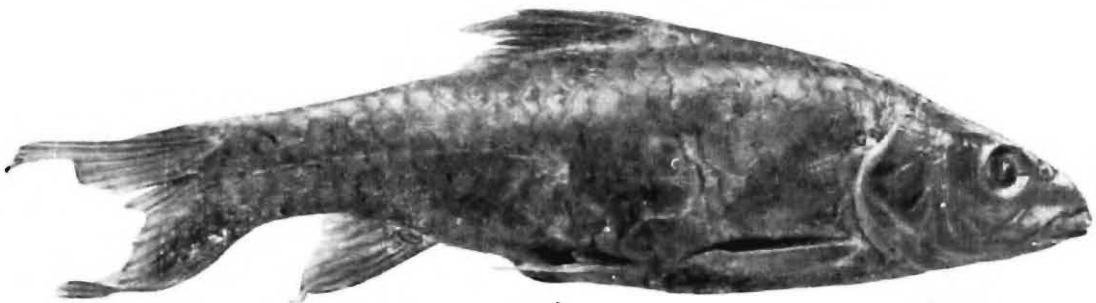
PLATE 9

Photographs of Rajasthan fishes, in lateral view. (Scale below Fig. 2 applies to Figs. 1, 2, and 4-6.)

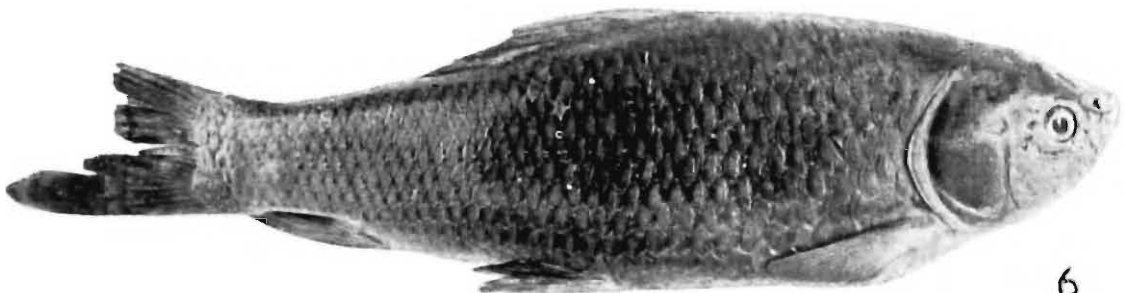
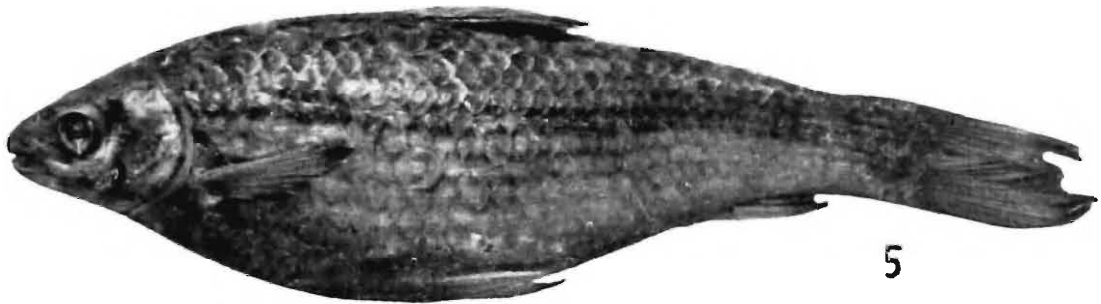
- Fig. 1.—*Labeo bata* (Hamilton). Kailana Lake, Jodhpur District.
 Fig. 2.—*Labeo gonius* (Hamilton). Alahapur, Alwar District.
 Fig. 3.—*Labeo fimbriatus* (Bloch). Soorpur-ki-Nadi, Dungarpur District.
 Fig. 4.—*Labeo boga* (Hamilton). Jawai river, Jalor District.
 Fig. 5.—*Labeo dero* (Hamilton). Kharpena-ka-Nalla, Udaipur District.
 Fig. 6.—*Labeo calbasu* (Hamilton). Uttangan nadi, Bharatpur District.



6 cm



3 cm



10 cm

The Neurosecretory system of the Pholad, *Diplothyra smithii* (Mollusca : Lamellibranchiata)

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(With 1 Text-figure)

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I—INTRODUCTION

While a great deal of information was gathered on the cytology, distribution and the role of the neurosecretory cells in the neuroendocrine regulation in both invertebrates and vertebrates, similar studies on the bivalve molluscs were started only in 1955. Gabe (1955) was the first investigator to report the occurrence of secretory neurons in 20 species of lamellibranchs. Lubet (1955, 1956) using the mussel, *Mytilus edulis* and the clam, *Chlamys varia*, showed a definite correlation between neurosecretion and sexual cycle. Fahrman (1961) reported two types of neurosecretory granules in the freshwater mussel, *Unio tumidus*, and Nagabhushanam (1962 a, b, c, 1964 a) observed two neurosecretory cell types in the oyster, *Crassostrea virginica*, the surf clam, *Spisula solidissima*, and the shipworm, *Bankia gouldi*, and one cell type in *Modiolus demissus*.

The present paper deals with the distribution and structure of the neurosecretory cells in the central nervous system of the pholad, *Diplothyra smithii*, with a view to extend our knowledge on the phenomenon of neurosecretion in the lamellibranchs.

The author wishes to express his sincere thanks to Dr. M. Fingerman, Professor of Zoology, Tulane University, New Orleans, U.S.A. for kindly providing facilities to carry out this investigation.

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II—MATERIAL AND METHODS

Freshly collected animals were used. They were frequently collected by breaking open the valves of the oysters obtained from Gulf Coast near New Orleans, U.S.A. The shell valves were carefully removed and the whole body was transferred to one of the following fixatives: formalin, Bouin's or Helly's fluid. The formalin-fixed material was post-chromated with 2-5 per cent Potassium dichromate to improve fixation. The material was then dehydrated in alcohol, cleared in xylol and embedded in Tissuemat. Serial sections were cut at 6-8 μ . The following staining techniques were employed :

1. Mallory's triple stain (MS),
2. Gomori's chromalum-hematoxylin-phloxin (CHP),
3. Periodic acid-Schiff (PAS) reaction for polysaccharides after diastase digestion (Pearse, 1960),
4. Sudan Black B, mounted in an aqueous medium, and
5. Einarson's gallocyanin-chromalum method for nucleic acids (Pearse, 1960).

III—OBSERVATIONS

General Description of the Nervous System.—The central nervous system of *Diplothyra smithii*, which conforms to that of *Martesia striata* (Nagabhushanam, 1962d), consists of three pairs of ganglia: cerebral, visceral and pedal. The cerebral ganglia are paired, situated one on each side near the epidermis, above the base of the labial palps and in front of the anterior end of the inner demibranch. The cerebral ganglia are smaller than the visceral ganglia. From each cerebral ganglion arises, besides the cerebral commissure, the anterior pallial nerve, anterior adductor nerve and a small labial nerve. Besides these 3 nerves, each cerebral ganglion gives off a cerebro-pedal connective and a cerebro-visceral connective.

The two pedal ganglia form a small cylindrical mass lying close to the mouth, a little below the antero-dorsal surface of the visceral mass. From the ventral surface of the pedal ganglia small nerves are given off into the foot.

The two visceral ganglia are enclosed in a fibrous capsule. Immediately in front of the visceral ganglia, the two cerebro-visceral connectives are joined by a transverse connective and this is slightly swollen centrally to form an accessory visceral ganglion. From each visceral ganglion arises the ctenidial nerve, renal nerve, posterior adductor nerve, posterior retractor nerve and a large nerve to the siphons.

Types of Neurosecretory Cells.—The distribution of the neurosecretory cells in the cerebral and visceral ganglia is shown in Text fig. 1a and b. Two types of neurosecretory cells, differing in size and staining ability with chromalum-hematoxylin-phloxin and Mallory's triple stains, were seen in the various ganglia (Table 1). These two types of neurons are designated as Cell Type I and Cell Type II.

Cell Type I.—The cells are somewhat pyriform in shape ; the cell bodies range from 18 to 22 μ in length and 12 to 15 μ in width. The nucleus is round or oval measuring 8 to 10 μ wide ; it may be either central or eccentric in position (Text-fig. 1c and d). The nucleus generally contains one large nucleolus but in certain instances two or three nucleolus-like bodies occur inside the nucleus. The secretory material stains red with Mallory's and blue-black with CHP. The granules always appear as very fine particles. Different Type I cells in the same animal are not always filled to the same extent with neurosecretory granules. For example, in several cerebral or visceral ganglia of some pholads, Type I cells which were packed with neurosecretory granules were found adjacent to cells which contained only a small number of granules. It is not improbable that this appearance is correlated with different phases of secretory activity. Vacuoles are generally absent. In certain cells the secretory material could be seen in the axons. This cell type is represented in all the ganglia.

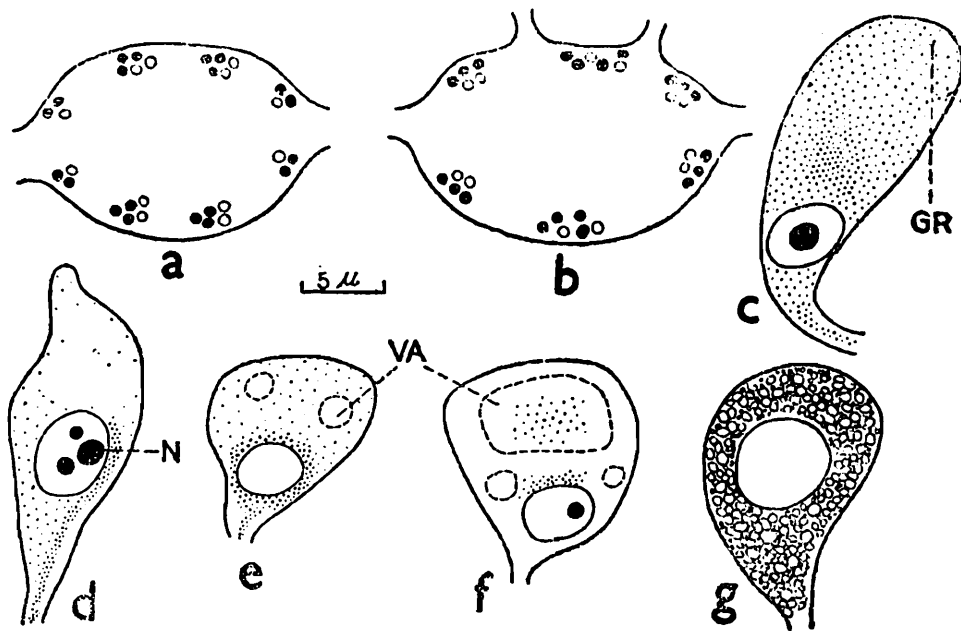
TABLE I.—*Characteristics of cells present in the central nervous system of Diplothyra smithii*

Description	Type I	Type II
Shape of the cell body	Pyriform	Oval
Size of the cell body	18—12 μ	12—18 μ
<i>Staining reaction :</i>		
Mallory's stain	Red	Pinkish
Gomori's technique	Blue-Black	Gray
Vacuoles	Absent	Abundant

Cell Type II.—These cells are smaller than the Type I Cells and restricted to the cerebral and visceral ganglia. The cell body is somewhat oval in shape, measuring 12-18 μ in diameter. Their nuclei are similar to those of Type I Cells and the fine granules in the cytoplasm stain pinkish with Mallory's and gray with CHP. In certain cells the neurosecretory granules are particularly concentrated around the nucleus. The vacuolisation of these cells is very striking ; the vacuoles do not possess a characteristic shape (Text-fig. 1e and f). Occasionally very fine particles are observed in the vacuoles. Just as in Type I Cells the secretory material leaves the perikaryon by way of the axons.

Observations on the living Type I Neurosecretory Cells.—Under the phase contrast microscope, the granules appeared as dark masses filling the cytoplasm. The nucleus is transparent with low refractive index. The nuclear membrane is distinctly visible. Towards the periphery

of the cell, the granules showed Brownian movements. Inside the cytoplasm small spheroids of different sizes are visible besides the granules (Text-fig. 1g).



TEXT-FIG. 1.—Cerebral and visceral ganglion of *Diplothyra smithii* Tryon, showing the distribution and location of neurosecretory cells.

(a) Cerebral ganglion, showing the distribution of the neurosecretory cells. (b) Visceral ganglion, showing the location of the neurosecretory cells. (c) and (d) Type I neurosecretory cells in the cerebral ganglion. (e) and (f) Type II neurosecretory cells in the visceral ganglion. (g) Living Type I neurosecretory cells showing the spheroids.

NOTE.—Dots represent Type I cells

Circles represent Type II cells

GR granules ; N., Nucleolus ; VA., Vacuole.

Cytochemistry of Type I Neurosecretory cells.—Type I neurosecretory material was poorly preserved by alcoholic fixatives. This loss of granules was appreciably prevented by post-fixing in 10 per cent formalin after initial fixation in 80 per cent ethanol prior to paraffin embedding. This loss of secretory material appears to be due to the solvent action of alcohol. Careful examination of Helly's fixed adjacent paraffin sections of the ganglia, one series stained with Mallory's and the other with Sudan Black B, revealed that the Type I neurosecretory material is strongly sudanophilic. The secretory material gave positive test with PAS after digestion with diastase. In sections fixed in Bouin's fluid and stained with gallocyanin-chromalum the cytoplasm of the neurosecretory cells showed blue colouration indicating a concentration of RNA.

IV—DISCUSSION

Among the molluscs several observations have been made concerning the neurosecretory cells of gastropods, but rather few about the central nervous system of other groups. In gastropods, the presence of neuro-

secretory cells in different ganglia was reported by Gabe (1953a, b). Lever (1957) distinguished 5 cell types in the pulmonate, *Ferrissia* sp. while Krause (1960) observed only 2 types of cells in *Helix*. Among the lamellibranchs, Gabe (1955) observed only one cell type in the cerebral and visceral ganglia of 20 species. Lubet (1955) also described one cell type in the cerebral and visceral ganglia of *Mytilus* and *Chlamys*. Both these investigators failed to notice any secretory neurons in the pedal ganglia. Later, Fahrmann (1961) in *Unio* and Nagabhushanam (1962a, b, c) in *Crassostrea*, *Spisula* and *Bankia* reported two types of neurosecretory cells present in all the ganglia.

In the present investigation, two neurosecretory cell types were found in the central nervous system of *Diplothyra smithii* and they were designated as Type I and Type II Cells. The most exact resemblance is between the cells which are here described as Type I and those designated as grana II by Fahrmann (1961) in *Unio*, the pyriform-shaped cells of *Teredo* (Gabe and Rancurel, 1958) and to the Type I Cells in *Crassostrea* and *Bankia* (Nagabhushanam, 1962a, c). Grana I described by Fahrmann (1961) in *Unio* and Cell Type II of *Crassostrea*, *Spisula* and *Bankia* (Nagabhushanam, 1962a, b, c) agree very closely with Type II Cells of *Diplothyra*.

Concerning the distribution of the neurosecretory cells, Type I cells are found in all the ganglia while Cell Type II is observed only in the cerebral and visceral ganglia. Similar observations were made by Nagabhushanam (1962a, b, c) in *Crassostrea*, *Spisula* and *Bankia*. From a study of the histological sections, various authors (Scharrer, 1965, Lever, 1957; Nagabhushanam, 1962a, b, c) concluded that the neurosecretory material is transported along the axons. The observations in *Diplothyra* support this view, the secretory material being traced along the axons.

Cytochemical observations on the Type I Cells reveal that the cytoplasm of the neurosecretory material contains a high concentration of RNA and the positive tests for PAS and lipid seem to be due to the presence of glycolipid. This is in agreement with the observations of Nagabhushanam (1962a) in *Crassostrea*. Fahrmann (1961) also obtained a strong positive test for lipids in the neurosecretory material of *Unio*.

V—SUMMARY

1. A detailed morphological description of the neurosecretory cells in the pholad, *Diplothyra smithii*, is given. The general anatomy of its central nervous system conforms to that of *Martesia striata*.

2. On the basis of size and staining properties, two types of neurosecretory cells are distinguished which are characterized as follows: *Type I*: pyriform-shaped cells, measuring 18 to 22 μ in length and 12 to 15 μ in width; the secretory material stains red with Mallory's stain and blue-black with Gomori's technique. *Type II*: oval cell, measuring 12 to 18 μ in diameter and the granules stain pinkish with Mallory's and gray with Gomori's stain; vacuoles are abundant.

3. The secretory material in both the cell types is transported through the axons.

4. The cytoplasm of the Type I neurosecretory cells contains a high concentration of RNA. A positive test for PAS and lipid seems to indicate that the secretory material probably contains glycolipid.

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