XVI. THE INDIAN MUD-TURTLES (TRIONYCHIDAE).

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(Plates V—VI.)

The main object of the present paper is to supplement Mr. G. A. Boulenger's admirable account of the Indian Chelonia published in the volume on Reptilia and Batrachia in the "Fauna of British India." It is now twelve years since this volume appeared and although additions to our knowledge of the Trionychidae since that date have not been very numerous or important so far as India is concerned, the fact that its author had not access to the bulk of the large collection accumulated in the Indian Museum by the late Dr. J. Anderson and his contemporaries and successors rendered certain omissions unavoidable.

I have been able, moreover, to institute special inquiries into the distribution of certain species and races and have received assistance in so doing from several naturalists in different parts of India, especially from Dr. J. R. Henderson, Superintendent of the Madras Museum, and from my colleague Mr. B. L. Chaudhuri, who has supplied me with valuable information.

One species and two subspecies not recognized by Mr. Boulenger in the "Fauna" are here described. The species belongs to the genus *Trionyx* and is interesting because it represents this genus in a geographical area in which information about its distribution was peculiarly scanty.

This *Trionyx* was described, it must be confessed inadequately, by Dr. Anderson, who named it *T. nigricans*. It inhabits a tract of country intermediate between the Brahmaputra river-system and the Arrakan streams in which a Burmo-Malay species of the genus first makes its appearance. I have found it necessary, moreover, to recognize the races of *Emyda* that occur in Chota Nagpur and Orissa on the one hand and in Ceylon on the other as distinct subspecies. The name *intermedia* is here proposed for the former race, while Gray's "*ceylonensis*" is available for the latter.

List of the Indian Trionychidae.

1. Dogania subplana (Geoffr.). Mergui, Malay Peninsula, Sumatra, Sinkep I., Java, Borneo, and the Philippines.

2.	Trionyx gangeticus, Cuvier.	The river-systems of the Indus, the Ganges and the Mahanaddi.
3.	,, leithii, Gray. ..	The rivers of western, central, and northern India.
4.	,, hurum, Gray. ..	The lower reaches of the Ganges; the Brahmaputra as far east as its entry on the plains.
5.	,, nigricans, Anderson.	Chittagong.
6.	,, formosus, Gray. ..	The Irrawaddi, the Sittang and the Salween.
7.	,, phayrei, Theobald.	Arrakan, Pegu, Tenasserim, the Malay Peninsula, Sumatra, Java, and Borneo.
8.	,, cartilagineus (Boddaert).	Pegu, Tenasserim, Siam, Cambodia, the Malay Peninsula, Sumatra, Borneo and Java.
9.	Pelochelys cantoris (Gray).	The lower Ganges system, Burma, the Malay Peninsula, Annam, S. China, Borneo, Sumatra, the Philippines and New Guinea.
10.	Chitra indica (Gray). ..	The Ganges and Irrawaddi system, as far as the base of the Himalayas in the former.
11.	Emyda granosa (Schoepff).	The valleys of the Indus and the Ganges; the Arrakan Coast.
11*a*.	,, ,, intermedia, nov.	Chota Nagpur; the Central Provinces: Orissa and the north-east of the Madras Presidency.
11*b*.	,, ,, vittata, Peters.	The greater part of the Bombay Presidency (including Cutch); the whole of the Madras Presidency except the north-eastern part; Travancore.
11*c*.	,, ,, ceylonensis, Gray.	Plains of Ceylon.
11*d*.	,, ,, scutata, Peters.	The valleys of the Irrawaddi and the Salween.

From the above list it will be seen that the Trionychids of the Indian Empire fall naturally into three groups, if considered from a geographical point of view:—(1) those of the Indo-Gangetic and Brahmaputra river-systems; (2) those of the valleys of the rivers of Peninsular India, and (3) those of Burma.

The exact limits of these areas are, however, not strictly observed, for while the typical form of *Emyda granosa*, a characteristic Indo-Gangetic race, ranges in a south-easterly direction as far as the Arrakan Coast, the common Indo-Gangetic *Trionyx* (*T. gangeticus*) is apparently not only replaced in Arrakan by

T. phayrei but also separated from that species in Chittagong by *T. nigricans*, in many respects an intermediate form. Very little information is as yet available about the exact distribution of the South Indian species of *Trionyx*, but we now know that an Indo-Gangetic species (*T. gangeticus*) occurs in the Mahanaddi.

Both the southern race of *Emyda granosa* (subsp. *vittata*) and the northern or typical form have been found to be different from that which occurs in the Central Provinces and Chota Nagpur and inhabits even the valleys of rivers such as the Kasai and the Barakar which actually reach the sea through the Hughli estuary, south of the Hughli itself.

The Burmese forms are either endemic or found also in the Malay Peninsula, except the monotypic genus *Chitra* which has only been found in the Ganges and the Irrawaddi. *Trionyx formosus* is only known from the Irrawaddi, the Salween and the Sittang; *Emyda granosa scutata* only from the valleys of the two former rivers, while *Dogania subplana* and *Trionyx cartilagineus* are typical Malayan forms. *T. phayrei*, on the other hand, in all probability originated in the hills of Arrakan and has made its way southwards into the Malay Peninsula and certain islands of the Malay Archipelago and eastwards into Indo-China.

Only one of the Indian Trionychids has a really wide geographical range in both the Malayan and Indian sub-regions, namely *Pelochelys cantoris*. This appears to be a somewhat scarce species wherever it occurs, although it has been found both in the lower reaches of the Ganges and in New Guinea, as well as in many intermediate localities.

In preparing these notes I have not thought it necessary to give detailed reference to all the works that have appeared before or since the publication of Mr. Boulenger's volume in the "Fauna." To do so in respect to previous works is needless except in a few instances, whereas a full bibliography of recent references can be extracted from Dr. E. Siebenrock's "Synopsis der rezenten Schildkröten" (Zool. Jahrbucher, Jena, 1909). I have referred to this most useful work throughout simply by the author's name with the page number added.

Genus DOGANIA, Gray (1844).

Siebenrock, p. 605.

This genus, which is not recognized by Mr. Boulenger (at any rate in the "Fauna") as distinct from *Trionyx*, has the whole series of costal plates separated by neurals, instead of having the last pair of costals in contact in the middle line. The plastron [1] is also less fully ossified than in *Trionyx* in a restricted sense, and the branchial skeleton differs in that the basihyoid bones are in close contact in the middle line.

Only one species, which is widely distributed in Malaysia and occurs in the coastal districts of Burma, is known to exist.

1 Siebenrock, S. B. K. Akad. Wiss. Wien, CXI. pp. 817—8, fig. 2, 1902.

1. Dogania subplana (Geoffr.).

Boulenger, Fauna, p. 9.

Distribution.—Arrakan, Tenasserim, Mergui Archipelago, the Malay Peninsula, Sumatra, Java, Borneo, and the Philippines.

Specimens:—

Burma.

11589 (spirit): juv. .. Tibu, King I., Mergui Archipelago .. *Dr J. Anderson.*
13468-9 (stuffed): juv. ,, ,, ,, ,,
661 (spirit): juv. .. "Sinkep I., off E. Coast of Sumatra" .. *J. Wood-Mason.*

The two specimens in spirit are very young; their coloration has been obscured by fading but six rather small ocelli can still be distinguished on the disk, while the head and neck bear traces of longitudinal markings. The stuffed specimens from Mergui are probably half-grown, the disk measuring about 23·6 cm. in length. These and the young individual in spirit from the same district are referred to by Dr. Anderson in his "Fauna of the Mergui" (Jour. Linn. Soc. Zool., xxl, p. 342).

Mr. H. C. Robinson informs me that this is a purely estuarine and marine species.

Genus TRIONYX. Geoffr. (1809).

Boulenger, Fauna, p. 10 (*partim*): Siebenrock, p. 595.

This genus, which is by far the largest in the family and occurs in the warmer parts of all the continents except Europe, is well represented in the Indian fauna, to which at least eight species can be assigned.

The species are difficult to recognize, unless cranial and skeletal characters are considered as well as coloration. The lower jaw in particular affords diagnostic features of great importance in most species.

The branchial skeleton of this genus is less fully ossified and less complex than in some genera of the family. I have been able to find specific differences in it in some species. The basal part consists in the adult of three pairs of bones, a pair of basihyals in front, followed by two pairs of basibranchials. The basihyals are widely separated by a cartilaginous plate in which small irregular ossifications sometimes occur; their external margins are somewhat protuberant anteriorly but do not form regular horns. The basibranchials are in close contact in the middle line; the large cornua are articulated to prominent condyles situated on their external margins. The hypobranchials are well developed. They are articulated to the posterior border of the posterior basibranchials. The ceratobranchials and pterygobranchials are sometimes represented by cartilage, sometimes ossified.

An examination of the fine collection accumulated in this museum by the late Dr. John Anderson renders it necessary to reinstate one species (*T. nigricans*) inadequately described by him and since ignored by most writers on the Chelonia. All the recognized Indian and Burmese species are represented in the Indian Museum, but *T. leithii* and *T. cartilagineus* only by young specimens. We possess the types of the following described species :—

T. buchanani, Theobald. (= *T. hurum*, Gray). No. 1090 (skeleton). Proc. As. Soc. Bengal, 1874, p. 78.

T. nigricans, Anderson. Nos. 1898 and 735 (skeletons). Ann. Mag. Nat. Hist., (4) XVI, 284 (1875).

Mr. Boulenger suggests in his "Catalogue of the Chelonians, etc. in the British Museum" (p. 243) that at least some species of *Trionyx* are dimorphic, the two phases differing in the form and structure of the jaw and their characteristic features being produced, in the case of the individual, by the method of obtaining food adopted at an early age.

So far as the Gangetic species are concerned I have been unable to obtain any evidence that this is so. Two distinct species, the skulls of which are different at all ages, occur together, namely *T. gangeticus* and *T. hurum*. The former has a blunt, the latter a sharp snout; and the youngest skulls can be distinguished with ease by the length of the symphysis of the lower jaw. I have examined many hundreds of living individuals, as well as a large series of skulls, and have never come across a specimen that was in any way intermediate between the two species in structure; while only one specimen of *T. hurum* (No. 16627) had some resemblance to *T. gangeticus* in colour, or rather differed so widely in this respect from normal individuals of its own species that its superficial appearance was reminiscent of *T. gangeticus*, although it lacked the characteristic head-markings of that species.

A not uncommon abnormality in the Indian species is an upward curvature of the vertebral column that results in the carapace, instead of being flat, assuming a conical form and actually in some instances being deeper than it is broad. The presence of a deep groove on the middle line of the carapace is another common abnormality.

The nature of the food of the members of the genus is apparently a disputed point. So far as my own observations go, they are practically omnivorous, at any rate when living in a semi-domesticated state. In the Malay Peninsula certain individuals (probably of *T. cartilagineus*) haunt rivers in the vicinity of villages and act as scavengers. The specimens of *T. formosus* that are kept in the Arrakan Pagoda at Mandalay feed readily on curry and rice and those of (?) *T. hurum* that live in somewhat similar conditions in a tank attached to one of the temples at

Puri in Orissa, eat sweetmeats made of parched rice and palm-sugar. In such conditions they grow very tame and come to feed when called. Those at Puri are popularly believed to be the descendants of a man named Gopal who offended Juggernaut; they are summoned by the priests by this name, to which they answer sometimes—but by no means always—by appearing on the surface and swimming towards the edge of the tank.

The distribution of the Indian species of *Trionyx* is a matter of considerable interest but one in need of further elucidation, especially in respect to the species that occupy the rivers of western and southern India. There can be no doubt that one species (*T. gangeticus*) occurs both in the Indus and the Ganges, but whether this is the only form that will be found in the former river we do not know. Whether *T. leithii* is to be found in all the rivers of western, central and northern India we do not know. What species occur, if any do occur, in the rivers that water the southern and south-western parts of the Madras Presidency, and whether any species occur in Ceylon are questions that I have been unable to solve.

In the Gangetic delta, and I believe in the other parts of India, *Trionyx* is regarded as an important article of diet. Very large numbers are caught, chiefly in the Khulna district, for the Calcutta market and are sent to town by train. They are captured in nets in autumn, when the rivers begin to sink, and are stored in the vicinity of Calcutta in small ponds, their fore and hind feet being sewed together and a hole, to which a string is attached, bored in the cartilaginous part of the disk. In this condition they live for many months. The only species I have actually seen treated in this way are *T. hurum* and *T. gangeticus*, but I understand *Chitra indica* is dealt with in a similar manner.

Key to the Indian species of Trionyx.

1. Two neural plates between the first pair of costals.
   (A) A strong longitudinal ridge on the mandibular symphysis; coloration of adult very dark..... *T. nigricans.*
   (B) The longitudinal ridge on the mandibular symphysis feebly developed or absent.
      a. Mandibular symphysis produced in front, its length being much greater than that of the orbit; at least four large and conspicuous ocelli as well as a dark reticulation on the disk of the young, that of the adult dark..... ....*T. hurum.*
      a[1]. Mandibular symphysis not much longer than the orbit.
         a. Disk pale, with radiating dark lines but no ocelli in the young; inner margin of mandible ridged..... *T. gangeticus.*

a'. Disk of young with four ocelli; inner margin of mandible without a ridge.....*T. leithii.*

11. A single neural plate between the first pair of costals; a strong longitudinal ridge on the mandibular symphysis.

A. Epiplastra widely separated immediately in front of the entoplastra.....*T. formosus.*

B. Epiplastra in contact in front of the entoplastra.

a. Plastral callosities feebly developed, finely sculptured.....*T. phayrei.*

a[1]. Plastral callosities well developed, deeply sculptured.....*T. cartilagineus.*

The above key is based on the one given by Mr. Boulenger on pp. 10 and 11 of his volume in the "Fauna," but has been modified to include the species omitted by him.

A table of measurements of the skulls of this genus and of *Dogania* preserved in the Indian Museum is given at the end of this paper.

2. **Trionyx gangeticus**, Cuvier (pl. v, figs. 1, 1a, 2).

Boulenger, Fauna, p. 12: Siebenrock, p. 596.

DISTRIBUTION.—The Indus, the Ganges, the Mahanaddi and their tributaries; probably also the Brahmaputra system. Mr. Boulenger is wrong in suggesting that this species does not occur in the Indus, for specimens from Karachi are identical, at any rate so far as head-markings and skull-characters are concerned, with those from Lower Bengal. The species, although not so abundant in the Calcutta market as *T. hurum*, is sold for food in considerable numbers, being brought from different places in the Gangetic delta, especially from Khulna.

SPECIMENS:—

BENGAL.

1805 (no skull)	Calcutta.	*Purchased.*
1808 ,,	,,	,,
1806 (skl.)	,,	
1080-3 : 1089 (skulls)	,,	,,
78-9 (skull)	,,	,,
3870 (skulls)	,,	,,
1720-2 (stuffed)	,,	,,
1724 ,,	,,	,,
1716 ,,	,,	,,
1893 (carapace & skull)	,,	*Dr. J. Anderson.*
1895 (skl.)	,,	,,
1052-3 (skulls)	Ganges.	,,
1054 ,,	,,	?
288 (spirit)	Hughli.	?
879 (32 b. A. S. B.)	Calcutta.	*E. Blyth, Esq.*
881 (32 d. A. S. B.): juv.	,,	,,

881 (32 d. A. S. B.): juv.	Calcutta.	*E. Blyth, Esq.*
882 (32 e. A. S. B.) ,,	,,	,,
883 (32 f. A. S. B.) ,,	,,	,,
884 (32 g. A. S. B.) ,,	,,	,,
1084-6 (skulls)	,,	,,
16750-1 (skl.)	Probably from Khulna Dist.	*Dr. N. Annandale & B. L. Chaudhuri, Esq.*

United Provinces.

1810 (carapace): juv.	Allahabad.	*E. Atkinson, Esq.*
1729 (stuffed)	,,	*J. Cockburn, Esq.*
468 (spirit)	,,	,,
285 (,,)	,,	,,
286 (head in spirit)	,,	,,
756 (skull)	,,	,,
1732 (stuffed)	Agra ?	*Dr. Stoliczka.*
1727 ,,	Agra.	,,
1728 ,,	,,	*Riddell Museum, Agra.*

Sind.

1835-6 (skulls)	R. Indus, Karachi.	*Karachi Museum.*
3869, 3871-2 (heads in spirit)	,,	,,

Very old individuals lose the characteristic markings to a greater or less extent, sometimes becoming of an almost uniform pale olive-green all over the dorsal surface of the head and body. The ventral surface is never dark. The iris varies in colour from emerald-green to golden yellow.

The bony carapace of the largest specimen I have seen measures 48·5 cm. in length by 53·4 cm. in breadth. So far as I am aware, there are always two neural plates between the first pair of costals. The presence or absence of a callosity on the entoplastron is not correlated, either in this species or in *T. nigricans*, with age or sex. In some small individuals it is present, while in other much larger and evidently older ones no trace of it can be found. The median projection of the hyoplastra,[1] except in very young individuals, is double and comparatively short and stout, disappearing altogether in very large specimens, in which the two hyoplastra are in contact or almost in contact in the middle line for the greater part of their length. The sculpture on the sternal callosities is very deep and strong. The skull becomes much broader and blunter with age. The hypobranchials (fig. 1) are long and comparatively slender. In old individuals they are followed at the distal end by four or five short flattened oval bones, but in the young these are represented by cartilage.

[1] Cf. Siebenrock, S. B. K. Akad., Wiss. Wien, CXI, p. 280, fig. 3.

3. Trionyx leithii, Gray.

T. leithii, Gray, P. Z. S. 1873, p. 49, fig. 3. *T. gangeticus*, *id.*, *ibid.*, pl. viii.

Boulenger, Fauna, p. 12. Siebenrock, p. 597.

DISTRIBUTION.—The limits of distribution of this form are very imperfectly known. It was described from Poona in the Western Ghats and was taken by the late Colonel Beddome in the Nelambar River, which is also in the Malabar zone. Mr. Boulen-

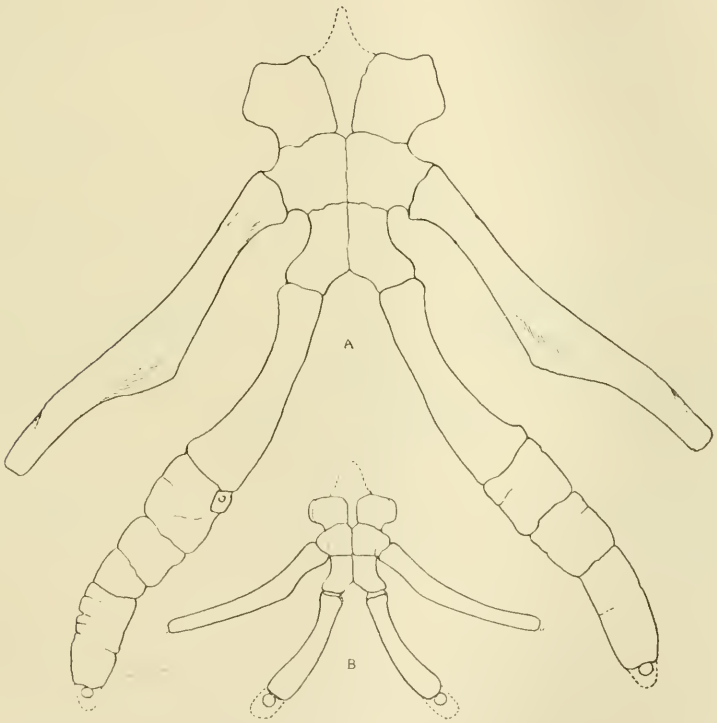

FIG. 1.—Branchial Skeleton of *Trionyx gangeticus*, × ⅔.
A, of adult; B, of young.

ger states that the species occurs in the Kistna River and that the figure of it reproduced by Gray in 1873 as representing *T. gangeticus* was a copy of a drawing of specimens from Fatteghar.[1] The late Dr. W. T. Blanford obtained specimens in the Upper Mahanaddi system and in the lower reaches of the Godavari.

SPECIMENS:—

16503 (spirit): juv. ? ?

[1] There are two places of this name in N.-W. India, one on the R. Ganges, the other in Patiala State and within the limits of the Indus system.

1731 (stuffed: skull separate): juv.	Hasdo R. (tributary of the Mahanaddi), Bilaspur district, Central Provinces.	..	*Dr. W. T. Blanford.*
522 (spirit: skull separate): juv.	Godavari valley.		,,

The only specimens in our collection that can be assigned to this species are young individuals. A figure of the plastron of the largest is reproduced below (fig. 2).

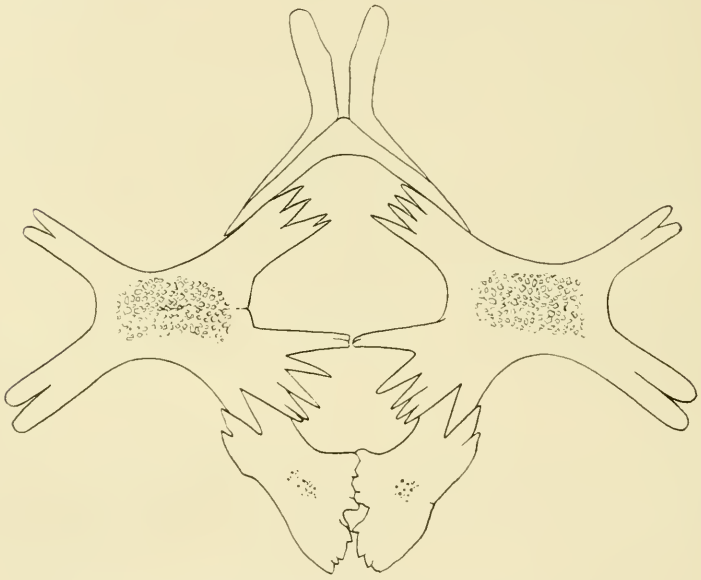

FIG. 2.—Plastron of *Trionyx leithii* (young), × ⅔.

4. **Trionyx hurum**, Gray (pl. v, fig. 3).

Boulenger, Fauna, p. 13, fig. 5 (young): Siebenrock, p. 597.

DISTRIBUTION.—The lower reaches of the Ganges; the Brahmaputra as far north and east at the point at which it debouches on the plains. The species is said to occur also in Indo-China,[1] and in the Malay Peninsula,[2] but the latter locality rests on insufficient evidence. Although *T. gangeticus* makes its way as far north as the base of the Nepal foot-hills and as far west as Karachi, I have been unable to obtain any evidence that *T. hurum* is found much above Rajmahal. Moreover the only specimen (No. 10627) I have seen that was actually taken in Bengal outside

[1] Mocquard, "Les Reptiles de l'Indo-China" (*La Revue coloniale*, 1907, p. 13).

[2] See Flower, P. Z. S. 1896, p. 861, and 1899, p. 620.

the Gangetic delta was so peculiar in coloration that it may well represent a distinct local race. Specimens from Assam are perfectly typical in coloration. I have seen a consignment of over 500 individuals from Khulna being unloaded at the railway station. The "fishery" takes place mainly in October.

SPECIMENS:—

BENGAL.

1050 (skull)	Calcutta.	*Dr. J. Anderson.*
1920 (skl.)	,,	,,
1797 (skl. deformed)	,,	,,
1049 (skl.)	Ganges.	,,
1047 (skull)	Calcutta.	*Purchased.*
270 (skl.): juv.	,,	,,
1796 (skl.)	,,	,,
1784 (stuffed)	,,	,,
6846 (spirit): juv.	,,	,,
271-2 ,,	,,	,,
1090 (Skl.) Type of *T. buchanani*, Theob.	,,	,,
16752 (skl.)	Gangetic delta.	*Dr. N. Annandale.*
292 (spirit): juv.	R. Hughli.	*Purchased.*
287; 289-91 (spirit): juv.	,,	?
273-4; 276 (spirit): juv.	Calcutta.	*Dr. W. Theobald.*
16627 (Skl.)	Oodhua *nallah*, R. Ganges, near Rajmahal.	*B.L. Chaudhuri, Esq.*
283; 660 (spirit)	Kaligunge.	*W. Dodgson, Esq.*
16505 (head in spirit)	Dacca, E. Bengal.	*H.E. Stapleton, Esq.*
5578 (spirit)	Nattore, Rajshahi Dist., E. Bengal.	*T. R. Doucett, Esq.*

ASSAM.

659 ,,	Nazir, N. of the Naga Hills, E. Assam.	*J. M. Foster. Esq.*
303 ,,	,,	,,
402-4 ,,	Sibsagar.	*S. E. Peal, Esq.*
11373 ,,	Dilcoosh, N. E. Assam.	*J. Ingles, Esq.*

In this species the coloration of the dorsal surface normally grows darker and more obscure with age, although the ventral surface is dark in the young and only assumes its uniform pale colour in half-grown individuals. Buchanan (Hamilton) in his collection of drawings now preserved in the Asiatic Society of Bengal's library figured three stages as distinct species. The first of these drawings (No. 52) is labelled *Testudo ocellata* and represents the young in which four large ocelli and a bold reticulation of black lines are conspicuous on the dorsal surface of the

disk. The second (No. 54), which is labelled *Testudo hurum*, represents an older individual in which the ocelli have become obsolescent, the ring of bright reddish yellow which surrounds the central dark spot having faded and the spot itself having increased greatly in size, while the reticulate lines have multiplied and become more vermicular in character. The third drawing (No 53) evidently represents a much larger specimen; it is labelled *Testudo chhim*. The whole of the dorsal surface of the disk has darkened and only small and somewhat obscure yellowish spots represent the pale ground-colour of the juvenile disk. The ventral surface is represented as dark olive faintly speckled with a pale shade in the first figure and uniformly pale in the others. The coloration of the head varies somewhat in the adult as regards the relative proportions of the yellow and the dark green areas. The former colour usually predominates on the snout and on the sides of the head behind the mouth and the latter on the post- and inter-orbital regions, forming a more or less close and dense reticulation. In the young the two colours are more definitely separated. In old individuals traces of dark radiating lines can sometimes be detected on the edge of the disk, while that of the young is usually spotted minutely with yellow. The iris is greyish.

The specimen from near Rajmahal to which allusion has already been made was altogether abnormal in coloration. It was a half-grown individual with a disk measuring 27·6 cm. in length. The whole of the dorsal surface was of an almost uniform pale olive, green on the head and neck and greyer on the limbs than on the disk, which showed no trace of ocelli—markings of which traces can usually be detected in even larger individuals. The disk, however, had an obscure mid-dorsal stripe crossed by five cross-bars, all of a slightly darker shade than the ground-colour. The posterior part of the upper surface and sides of the head was obscurely clouded with dark olive. The whole of the ventral surface was pale and the iris was pinkish white. Fortunately a record of the colours of this specimen, which is preserved as a skeleton, was kept in the form of rough water-colour sketches and a cast of the fresh specimen was made and painted accordingly.

The snout does not become much blunter or the head broader with age in this species. In some very old individuals, however, the nasal aperture is, on the skull, considerably broader than the inter-orbital space, but this appears to be due, judging from the rugosity of the bones, either to senility or to disease. The hypobranchials (fig. 3) are comparatively short and broad; even in aged individuals they bear at the distal end only a cartilaginous plate containing a small ossicle.

The size reached by this species is not so great as that commonly attained by *T. gangeticus*. The largest individual I have seen was a male recently purchased in Calcutta and said to have come from Khulna. Its dorsal disk measured 60 × 40·9 cm. and its bony carapace 41·6 × 40·9 cm., the disk being rather narrower than usual.

Specimen No. 1094, an articulated male skeleton, is the type of Theobald's pseudo-species *T. buchanani*. It presents a very large male only slightly smaller than the one to which I have just referred, the bony carapace measuring 38·4 mm. in length and being distinctly broader than long.

The structure of the carapace and sternum of *T. hurum* is closely similar to that found in *T. gangeticus* except that the two

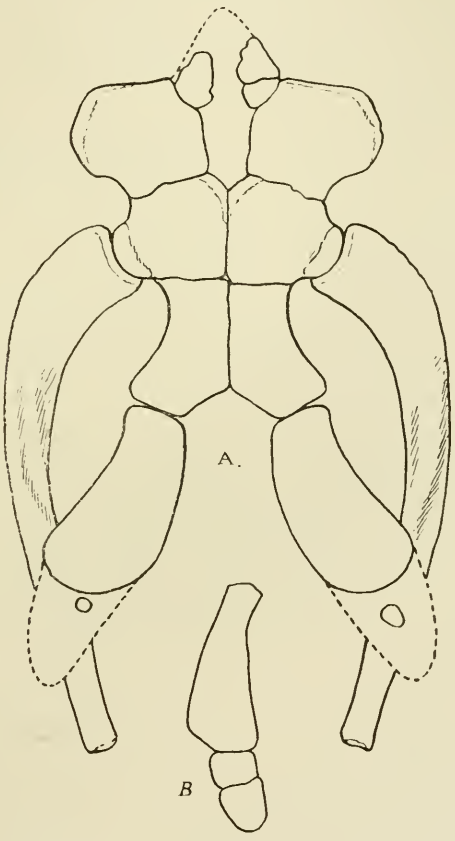

FIG. 3.—Branchial skeleton of *Trionyx hurum* and *T. formosus*.
A, complete apparatus (nat. size) of adult *T. hurum*.
B, hypobranchial, etc. of *T. formosus* (nat. size).

hyoplastra approach one another at a rather earlier stage and that their median processes are slighter and always single although distinctly bifid at the tip.

A not uncommon abnormality, noticed in both young and old individuals, is the presence of three neural plates between the first pair of costals. This is due to the separation of a small bone, sometimes quite symmetrically, from the central part of the anterior border of the first normal neural plate.

5. Trionyx nigricans, Anderson (pl. v, fig. 5).

Anderson, Ann. Mag. Nat. Hist., (4), XVI, p. 284 (1875).

The first pair of costals are separated by two neural plates. The posterior paired bones of the plastron are provided with well-developed callosities on which the sculpturing is only a little less strong than in *T. gangeticus*, and in some individuals there is also a callosity on the entoplastron. The hyoplastra do not meet in the middle line and are strongly divergent posteriorly, although they are relatively larger than in *T. phayrei*; their median process is single, short, stout and blunt, indistinctly bifid at the tip. The epiplastra are narrowerly separated or actually in contact in front of the entoplastron.

The skull is moderately broad, the snout a little longer than the diameter of the orbit; the interorbital width is greater than that of the nasal fossa and the postorbital arch is about one-third as wide as the orbit; the zygomatic arch is horizontal, less distinctly curved than in *T. phayrei*.

The alveolar surface of the upper jaw bears low median and internal longitudinal ridges. The lower jaw has a strong longitudinal ridge on the symphysis, which is a little longer than the orbit; there is no internal alveolar ridge.

Anderson describes the external characters as follows:—

"Carapace rather flattened on the back, with the vertebral groove ill-defined anteriorly, but well marked posteriorly. Nuchal swelling broader than in *T. gangeticus*, but not prominent, the carapace on either side being flattened. Alae of plastron well defined, projecting equally beyond the carapace. Nuchal flap narrow, and covered with rather large nodose folds; and the hinder portion of the cartilaginous margin of the carapace with little nodosities. The rugosities of the osseous carapace coarser than in *T. gangeticus*.

The under surface of the thighs and tail and of all the soft parts, including the head and neck, covered with little papillae. No trace of rugosities on the axygos plate of the plastron visible through the skin.

The tail in the female does not reach to the margin of the cartilaginous portion of the carapace.

Colour of the carapace dark blackish plumbeous, with a tinge of olive due to the presence of blackish spots, among which are inter-mixed many rusty brown spots, which overlie as it were the black spots. The head, neck, and upper surface of the limbs are almost black; the upper lip in its two posterior thirds is white; and there is a great white blotch over the ear.

The area between the neck and the four legs is whitish; and there are some white spots on the margin of the carapace. The head is reticulately spotted; and there is a distinct infraprae-orbital band, and a trace of another above the eyes; but the head is so black that these markings are difficult to distinguish. The under surface of the head and neck is almost black; and the

plastron is densely spotted with blackish purple, especially over the bones, and the tail is similarly marked. The claws are yellow."

DISTRIBUTION.—With one exception the specimens of this species are labelled as being from Chittagong in the extreme south-eastern corner of the old Province of Bengal. The one exception is labelled as being from Calcutta, but this locality is probably incorrect and in view of the fact that large numbers of Trionychids are imported into this city for food, carries in any case very little weight unless supported by independent evidence. It should therefore be ignored, unless it can be substantiated by the capture of specimens in the Gangetic delta, the probability being that *T. nigricans* is a species intermediate in habitat, as it is in structure, between *T. gangeticus* and *T. phayrei*.

SPECIMENS:—

BENGAL.

1918 (skl.)	..	Chittagong Tanks	..	*A. L. Clay, Esq.*
754 (skl.)	..	,, ,,	..	,,
1908 (skl.)	..	,, ,,	..	,,
1898 (skl.) }				
735 (skl. } Types.	..	,, ,,	..	,,
no skull) }				
1849 (skl.)	..	"Calcutta"	..	*Dr. J. Anderson.*

T. nigricans may be stated in general terms to resemble *T. phayrei* in the structure of its skull and mandible and *T. gangeticus* in that of its carapace and plastron. In coloration, however, it evidently differs from both and neither its skull nor its plastron agrees precisely with that of the species which they respectively recall. All the specimens appear to be adult and both sexes are, to judge from Anderson's labels, represented. The bony carapace of the largest measures 40·3 cm. in length by 46·7 cm. in breadth.

6. Trionyx phayrei, Theobald (pl. v, fig. 4).

Anderson, P.Z.S. 1871, p. 154, fig. (plastron): Boulenger, Fauna, p. 14: Flower, P.Z.S. 1899, p. 620: Siebenrock, p. 598.

DISTRIBUTION.—Arrakan, Pegu, Tenasserim, the Malay Peninsula, Sumatra, Java (*Max Weber*) and Borneo. In Arrakan this species occurs in mountain streams and Flower states that he found a specimen in a similar situation in Johore. As Mr. H. C. Robinson has pointed out to me, the locality "Penang" must be accepted with caution, for there is a Chinese temple on the island in which tortoises from many different parts of the Malay Archipelago are kept.

SPECIMENS:—

755 (skull and plastron)	..	"Penang"	.. *Dr. J. Anderson.*
1094 (stuffed: skull separate)	..	Arrakan	.. (*Purchased*).

Both these specimens present fully adult individuals and have already been referred to in published works. No. 1094 is the one mentioned by Theobald on p. 15 of his "Catalogue of Reptiles in the Museum of the Asiatic Society of Bengal" as *T. guntherii*, Gray; while the other (No. 755) is all that remains of the specimen described in detail by Anderson in 1871.

I was at first inclined to think that neither could belong to the species described by Theobald as *T. phayrei*, because of the broadness of the skulls (fig. 4) and of the fact that the callosities

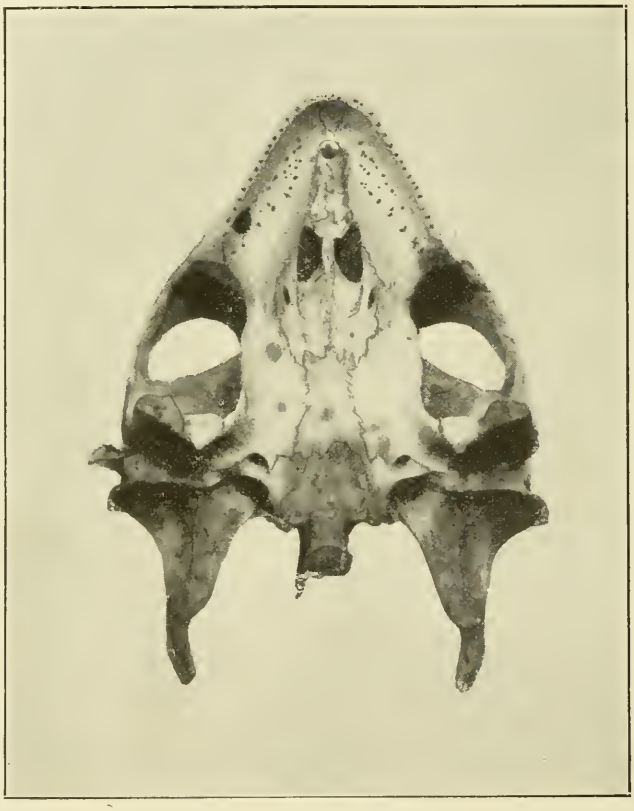

Fig. 4.—Adult skull of *Trionyx phayrei* from below (reduced).

of the plastron are distinctly though not deeply sculptured. It is, however, probable that these discrepancies are due entirely to the fact that most of the specimens hitherto examined have not been fully adult, for parallel if not quite as great differences may be noticed between the skulls of half-grown and of full-grown individuals of *T. gangeticus* as those that evidently exist between the skull figured by Gray under the name *T. jeudi* (and by Boulenger in his British Museum Catalogue (p. 252, fig. 76) under that of *T. phayrei*) and those now before me. It is evident, moreover,

that Anderson in describing and figuring the plastron of his specimen did not remove the outer integument, which still adheres to the bone, and that in consequence he believed the surface to be smoother than actually was the case. As a matter of fact it is more nearly smooth than that of any Indian species, although by no means devoid of sculpturing.

The bony carapace of specimen No. 1094 measures 40·3 cm. by 50·6 cm.; that of No. 755 was, according to Anderson, slightly smaller. The median processes of the hyoplastra in this species are single, slender and pointed. They are never bifid at the tip.

T. phayrei is connected with *T. gangeticus* through *T. nigricans*, from which it differs chiefly in having only one neural plate between the first pair of costals. The skull is also broader than that of *T. nigricans*, in fully adult individuals.

7. **Trionyx formosus**, Gray (pl. v, fig. 6).

Boulenger, Fauna, p. 14: Siebenrock, p. 598.

DISTRIBUTION.—The Irrawaddi, Sittang and Salween Rivers. In the Irrawaddi this species is found near the Chinese frontier, as well as in the lower reaches. Numerous individuals, many of which are deformed, are kept in a small pond at the Arrakan Pagoda in Mandalay. I take it they belong to this species. It is very possible that statements regarding the occurrrence of *T. hurum* in the Malay Peninsula actually refer to *T. formosus*, but the latter species has not been definitely recorded from any Malay locality.

SPECIMENS:—

		BURMA.	
1786 (skl.)	..	Moulmein	.. *Maj. Sladen.*
277-8 (spirit)	..	Mandalay	.. ,,
634 (skull)	..	Bhamo	.. *Maj. Lowndes.*
1837 (skl. juv.)	..	Burma	.. *Dr. J. Anderson.*
1063 (skull)	..	,,	.. *Hon. A. Eden.*
605 (skl.)	..	,,	.. *Maj. Sladen.*
685 (skl.)	..	Irrawaddi	.. *Maj. Lowndes.*
687 (spirit)	..	,,	.. *Hon. A. Eden.*
1051 (carapace and palastron)	..	,,	.. *Dr. F. Stoliczka.*
766 (skl.)	..	Burma	.. *Hon. A. Eden.*

This appears to be a comparatively small species. The bony carapace of the largest specimen in the collection measures only 27·4 × 26·5 cm.; its skull appears to be fully adult. In this specimen there are actually two neural bones between the first pair of costals, but the suture is asymetrical and there can be no doubt that the condition is abnormal. In most cases the median process of the hyoplastra is short, single and rather stout, its

apex being bluntly pointed. In one skeleton, however, the right process is double.

The branchial skeletion (fig. 3, p. 163) resembles that of *T. hurum*, but the distal bones of the posterior process are more fully ossified, the hypobranchial being followed by two distinct bony plates of moderate size.

8. Trionyx cartilagineus (Boddaert).

Boulenger, Fauna, p. 15: Siebenrock, p. 599.

Distribution.—Pegu, Tenasserim, Siam, Cambodia, the Malay Peninsula, Sumatra, Java, Borneo. This is evidently a Malayan species which has made its way into Lower Burma. It appears to be scarce in Pegu and Tenasserim but to be the common species of the Malay Peninsula.

Specimens :—

Burma.

2632 (spirit: skull separate): juv. .. R. Irrawaddi .. *Dr. W. Theobald.*

Malay Peninsula.

13207 (spirit): juv. .. Perak .. *Dr. J. Anderson.*

Both of the above specimens are very young. Their skulls, which I have had removed, show the specific characters quite clearly.

Genus PELOCHELYS, Gray (1864).

Boulenger, Fauna, p. 15: Siebenrock, p. 606.

This genus is closely allied to *Chitra* but may be readily distinguished therefrom by the large and prominent orbits, which occupy a less anterior position on the skull. The plastron and carapace are very similar in the two genera. *Pelochelys* is another monotypic genus but has a much wider range, so far as we know, than *Chitra*.

9. Pelochelys cantorii, Gray.

Distribution.—The lower reaches of the Ganges, (?) Assam, Burma, Indo-China, Siam, the Malay Peninsula, Borneo, the Philippines and New Guinea. *P. cantorii* appears to be a scarce species in all the localities in which it is found. I have not seen a single fresh specimen, and the two old ones in our collection are probably immature.

Specimens :—

Bengal.

1781 (skl.) .. R. Hughli, Calcutta .. *Dr. J. Anderson.*
886 (33 a. A.S.B.) .. , ,, .. ?

Genus CHITRA, Gray (1844).

Boulenger, Fauna, p. 16: Siebenrock, p. 608.

This genus, of which only one species is known, is easily recognized by the elongate appearance of the skull, the eyes being situated close to the snout, and the complex form and unusually complete ossification of the branchial skeleton. The plastron [1] and carapace do not differ materially from those of *Trionyx*. The photographs reproduced on plate vi show clearly the general structure and proportions of the branchial skeleton, although its position relative to the skull is perhaps a little distorted. The basal part consists of four pairs of bones either sutured in the middle line or narrowly separated. Those of the most anterior pair (fig. 2, 1) are in close contact with one another for the greater part of their length as well as being firmly sutured to the next pair. They are roughly triangular in shape and probably represent the basihyal element, although they are not produced into horns at the sides. Behind them follow three other pairs of bones which may be taken to be the basibranchial; those of the first pair are smaller than those of the two posterior pairs and remain separated in the middle line even in old individuals. Those of the next pair are transverse in shape and form a median suture; they support the greater cornua, which are articulated to their sides. These bones are comparatively stout and long and are not expanded dorso-ventrally; they bear very large and well-developed muscular impressions near the proximal end of their external margin. The posterior processes are of great size and considerably expanded in the lateral plane, their ossification being unusually complete. Each consists of three broad bones fitted together by serrated sutures. The first of these is much the longest of the three and probably represents the hypobranchial and ceratobranchial fused together. In this case the second bone would be the epibranchial and the third the pterygobranchial. The former is a short plate of bone, the latter, although no broader at its outer margin, is bluntly produced towards the ventral margin in such a way that it is more than twice as broad within as it is without. The whole process curves inwards and upwards towards its fellow. In the large specimen mentioned below the length of the bony hyoid apparatus is nearly as great as the skull; the basal part measures 9 cm., each horn 11 cm., and each posterior process 13 cm. in length.

10. Chitra indica (Gray) (pl. vi, figs. 1, 2).

DISTRIBUTION.—The Ganges and Irrawaddi river-systems, as far as the base of the Himalayas in the former. The species is not uncommon in the Gangetic delta and large individuals can often be bought in the Calcutta market, in which, however, they are less abundant than *T. hurum* and *T. gangeticus*.

[1] Siebenrock, S.B.K. Akad. Wiss. Wien, CXI (1), p. 833, fig. 12, 1902.

Specimens:—

Bengal.

1776; 1113 (skl.) ..	Calcutta. ..	*Purchased (Dr. J. Anderson.)*
3543 ,, ..	Zoological Gardens, Calcutta.	*Peer Bux.*
1046 (skull) ..	R. Hughli, Calcutta	?
1055 ,, ..	Dacca, E. Bengal ..	*Dr. Wise.*
16753 (skl.) ..	Probably from Khulna	*B. L. Chaudhuri, Esq.*

United Provinces.

483 (spirit): juv...	Allahabad ..	*J. Cockburn, Esq.*

Chitra indica is apparently the largest of the Indian Trionychids. The bony carapace of the largest specimen examined measures 52·3 cm. × 59·7 cm. The length of its skull (pl. vi, figs 1, 2) measured from the tip of the snout to that of the articular condyle is 17·8 cm., and the greatest breadth 10 cm. The carapace may be distinguished from any purely Indian species of *Trionyx* by possessing only one neural bone between the first pair of costals. The epiplastra are more widely separated from one another than in *T. hurum* and *T. gangeticus* and the anterior part of each is shorter than in most species of *Trionyx*. There are three or four processes on the inner margin of each hyoplastron.[1]

Genus EMYDA, Gray (1831).

Boulenger, Fauna, p. 49: Siebenrock, p. 590.

A consideration of this genus, which probably occurs only in the Indian Empire and in Ceylon, raises questions of considerable taxonomic and geographical interest. As a genus it is easily distinguished from all other Trionychids of the Oriental Region by the fact that the hind limbs are protected by cartilaginous flaps or valves which can be closed over them on the ventral surface. Mr. Boulenger recognizes three species in the "Fauna," but expresses a doubt as to whether two of them are really distinct. After examining a large series of skeletons and specimens in spirit and seeing living individuals in different parts of India, I find it possible to recognize only one species with several local races or subspecies.

The branchial skeleton resembles that of *Trionyx* but differs in having the basihyals in close contact, the lateral margin of each basihyal produced into a blunt horn, the posterior margin of the posterior basibranchials deeply emarginate and the hypobranchials (with which the ceratobranchials are perhaps fused) very long and slender.

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1 Siebenrock, S.B.K. Akad. Wiss. Wien, CXI (1), p. 845, fig. 18, 1902.

The peculiar structure of the carapace and plastron of this genus, in which the soft parts can be more completely protected than in any other Indian genus of the family, may perhaps be correlated with a peculiarity in habits. *Trionyx* usually inhabits rivers and appears to be active at all times of the year, but *Emyda* lives in ponds and lakes and undergoes, at any rate in northern India, a considerable period of hibernation. Specimens were brought me in February at Purulia which had been dug from the mud in the basin of a dried pond, while the individuals which inhabit the Museum tank in Calcutta disappear for the whole of the cold weather. Not only can the characteristic cartilaginous flaps of the plastron close tightly over the hind limbs, but the anterior part of the carapace is flexible, owing partly to the fact that the nuchal plate is not as a rule united to the first pair of costals; it can be bent down to meet the anterior margin of the plastron in such a way that the retracted head and fore limbs are completely concealed, while the posterior part of the disk, including the marginal bones, can be bent down in a similar manner to protect the thighs and tail.

The typical form of *E. granosa*, although it rarely leaves the ponds in which it lives, is fond of sunning itself on logs or stones projecting above the surface of the water. It is extremely timid and difficult to approach. I have taken a young specimen of the South Indian form (*vittata*) at the edge of a pond among weeds.

11. Emyda granosa (Schoepff).

The distribution of this species cannot be considered apart from the question of the characters whereby its local races are separated. So far as it is possible to judge from the collection before me, three local races occur in India, one in Burma and one in Ceylon. They are:—

(1) Indian races:—*E. granosa* (typical form), subspecies *intermedia*, nov., and subspecies *vittata*, Peters.
(2) Burmese race:—Subspecies *scutata*, Peters.
(3) Ceylon race:—Subspecies *ceylonensis*, Gray.

(1) The *forma typica* is confined in India proper to the valleys of the Indus and Ganges, but it probably occurs in Assam and certainly does so on the coast of Arrakan.

The subspecies *intermedia* occurs in the valleys of the Barakar and Kasai rivers, which reach the sea, just south of the Ganges, through the Hughli estuary, and in those of the Mahanaddi and the Godavari. Politically its range extends through Chota Nagpur, the Central Provinces, Orissa and the north-eastern part of the Presidency of Madras.

The subspecies *vittata*[1] is found in the Madras Presidency, over the greater part of which it ranges, occurring on the Mysore

[1] Siebenrock (p. 591, footnote) states that the Vienna Museum possesses a specimen of this race which appears to have come from Celebes, but the evidence as regards its *provénance* is not satisfactory.

plateau at an altitude of at least 3,000 ft. and also at sea level on the coast. It also occupies the greater part of the Bombay Presidency, including Cutch.

(2) The Burmese race (*scutata*) is only known from the valleys of the Irrawaddi and the Salween.

(3) The Ceylon race (*ceylonensis*) is confined to the plains of that island.

A. *Forma typica.* The granulations on the carapace and more especially on the plastral callosities are small, even and regular and are not arranged in concentric curves. The head and the carapace, at all ages, are of a dark olivaceous shade conspicuously spotted with yellow. There are usually 14 bony marginal plates situated round the posterior part of the carapace. The entoplastral callosity is never very large and the xyphoplastral callosities are never in contact for the whole of their length, invariably diverging from one another above. The median process of the hyoplastra is long and slender.

B. *intermedia* (pl. vi, fig. 3). The granulations of the plastral callosities are coarser and more irregular, the granules being larger but not arranged definitely in concentric curves. The head of the young is very obscurely marked; the carapace is deep olive-green with obscure paler markings The head of the adult bears very conspicuous longitudinal dark lines; its carapace is dark olive-green with a darker vermicular reticulation. The entoplastral callosity is of moderate size and the two xyphoplastral callosities are never in contact for the whole of their length. The marginal and the median hyoplastral process are as in the preceding race.

C. *vittata.* The granulations of the plastral callosities are still coarser than in *intermedia* and the granules tend to be arranged in concentric curves. The head of the young bears longitudinal dark lines, but the carapace is without markings at any age. In older individuals the dark lines on the head tend to disappear, the colour being an almost uniform

dark brown. In other characters this race resembles *intermedia*.

D. *scutata*. The granulations of the plastral callosities resemble that of the *forma typica*, but the pale markings on the head and carapace are completely absent. In the young the carapace bears obscure dark spots, which tend to form a reticulation in the adult. The entoplastral callosity is very large. The marginal bones never fuse together; all are small and there are usually 18 present. The median hyoplastral process is very short and the xyphoplastral callosities are often in contact for their whole length.

E. *ceylonensis*. This race is closely allied to *vittata*, from which it is distinguished by the great relative size of the entoplastral callosity, by the facts that the xyphoplastral callosities are in contact for their whole length and that the marginal bones show a greater tendency towards fusion (only 12 being usually present), and by the extreme shortness in the adult of the median xyphoplastral process. The carapace of the young is obscurely spotted with a dark shade and there are black longitudinal lines on the head. The adult as a rule appears to be devoid of definite markings.

The only differences between these races lie in coloration, in the sculpturing of the plastral callosities, in the degree of ossification attained by the plastron, and in the number of posterior marginal bones that normally fuse together in the adult. Except coloration and plastral sculpturing none of these differences can be called constant, and even in coloration and sculpturing a certain amount of variation occurs. It may therefore be well to discuss each character separately.

To deal with coloration first: I should state that while I have seen a considerable number of living individuals of the typical form of the species and of the races *intermedia* and *vittata*, I have only been able to make a detailed examination of fresh material in the case of the two former and have not seen living individuals of either the Burmese or the Ceylon race. Specimens preserved in spirit, however, even for many years, as a rule show at least traces of the characteristic markings, except that the dorsal reticulation of the race *intermedia* disappears completely.

Moreover, Dr. J. R. Henderson has been kind enough to send me notes on the natural colours of the Madras race (*vittata*) at different stages. These notes confirm observations made on specimens preserved in spirit.

The spots on the dorsal disk of the Indo-Gangetic race are variable in size, number and arrangement but are perfectly distinct even in the largest individuals. Sometimes the larger spots have dark centres and resemble irregular ocelli. The markings on the head are much more regular. A large pale spot covers the greater part of the snout and of the interorbital region, being interrupted in the latter by a circular or nearly circular dark spot. There are two smaller pale spots beneath each eye and another above the angle of the mouth. A broad pale stripe runs obliquely backwards from below the eye towards the tympanic region and two longitudinally oval spots, sometimes united to form a V-shaped mark, form an angle above it, the anterior spot starting from the posterior upper border of the orbit. Sometimes the oblique stripe is broken up into two or more spots. There are also two or three smaller pale spots on each side of the back of the head. So far as can be judged from specimens preserved in spirit, those from Calcutta agree closely with those from Akyab on the one hand and Karachi on the other.

The pale spots on the back of the young of the race *intermedia* are very obscure and could not be recognized except in fresh specimens. The dark reticulation on the back of the adult is much more distinct but fades gradually in spirit The dark lines on the head are, however, much more persistent. They are also conspicuous on small specimens of the Ceylon race (*ceylonensis*) that have been in spirit for many years.

The races of *Emyda granosa* fall into two groups as regards the sculpturing on the plastral callosities ; in one group (consisting of the typical form, *intermedia* and *scutata*) the granules are much more regular, more uniform in size and more widely distributed on the surface of the bone than they are in the other, in which they tend to run together and to be arranged in concentric curved lines. The second group consists of *vittata* and *ceylonensis*. This difference is best observed in young individuals. The size of the entoplastral callosity is correlated to some extent with the degree of ossification attained by the other bones of the plastron. When the callosity is very large the xyphoplastra are always in close contact for the whole of their length on the inner margin. These characters, however, vary greatly in all races and it is only by examining *fully adult* individuals that satisfactory results can be obtained.

The following measurements, all of which are taken from the skeletons of adult females, show at any rate the large size of the entoplastral callosity in the adult of the Ceylon race. There is, however, considerable variation in the size of this callosity in specimens from India, although it is never nearly so large as it is in the race *ceylonensis*.

	Calcutta.	*Madras.*	*Ceylon.*
Length of carapace	22·8 cm.	22·5 cm.	24·5 cm.
Breadth ,, ...	21·0 ,,	20·4 ,,	19·0 ,,
Length of entoplastral callosity ..	2·2 ,,	2·5 ,,	5·0 ,,
Breadth ,, ,, ..	2·5 ,,	1·7 ,,	5·5 ,,
Length of xyphoplastral callosity	5·3 ,,	5·0 ,,	5·7 ,,
Breadth ,, ,, ..	3·3 ,,	3·5 ,,	3·5 ,,

In measuring the carapace the length of the marginals is omitted and the longest measurement of the callosities that can be obtained in a straight line is given.

The relative size of the anterior marginals is due in the first instance to the fusion or non-fusion of several bones. The full number of marginals appears to be eighteen, nine on either side. In all the Indian races, and also in the Ceylon race, several of the most anterior of these bones normally fuse to form a single plate, the fusion taking place at a comparatively early age. Many irregularities, however, occur and it is often the case that the number of bones which have fused on one side is not the same as that of those which have fused on the other. Moreover, the pattern of the granules on the ventral surface often shows the line in which fusion has occurred, even in old individuals. Especially in the Ceylon race, moreover, the bone fused by the fusion of the first three marginals tends to increase greatly in width as the animal grows old. In the Burmese race (*scutata*) no such fusion normally occurs, but it is noteworthy that in a half-grown individual from Akyab which exhibits all the other characters of the typical *granosa* the marginals remain separate as in *scutata*, although in a slightly larger individual from the same locality the first three bones on either side are completely fused.

Emyda granosa (Schoepff).

BENGAL.

875-7 (stuffed): 13470-1 (carapace) 1714: 1772 (skl.) 1027-32 (plastra)	Calcutta and neighbourhood.	*Purchased; Dr. J. Anderson; E. Blyth, Esq.; Medical College.*
242-3, 226-8, 239, 13380, 213-6, 218, 233-5, 237-8, 220, 4229 32, 370-1, 16501, 240-1 (spirit)	Ditto	*Purchased; Dr. J. Anderson; E. Blyth, Esq.; W. Theobald, Esq.; O. L. Fraser, Esq.; Dr. J. T. Jenkins; C. Swaries, Esq.; D. Cunningham, Esq.*
1034-42 (skulls)	Calcutta or N. W. Provinces	?
1824 (skull)	Jessore	*C. Tweedie, Esq.*
1023 (skl.)	Sunderbunds	*O. L. Fraser, Esq.*

Sind.

3878-80 (spirit)	R. Indus, Karachi	*Karachi Museum Ex.*
3377 ,,	Jempir	,, ,, ,,

Burma.

244-5 (spirit)	Akyab	*Deputy Commissioner, Akyab.*
12627-9 ,, : juv.	Jergo I., Off Arrakan Coast.	*Indian Marine Survey.*

Emyda granosa intermedia, Annandale.

Chota Nagpur and Orissa.

1663, 1665, 1669-71, 1673-5, 1677-80, 1688, 1686, 1689, 1694 (skl.)	Hazaribagh.	*Lt.-Col. Boddam.*
250 (spirit)	,,	,, ,,
1662, 1664, 1666-7, 1672, 1676, 1681-2, 1692-3 1685 (skl.)	Chota Nagpur	*Col. Dalton.*
1733-41 (plastra)	,,	,,
1024, 1683 (skl.)	Singhboom	*H. Hayes, Esq.; Lt.-Col. Boddam.*
257-61, 294 (spirit)	,,	*H. Hayes, Esq.*
246 (spirit)	Surjuga	*Dr. V. Ball.*
251-3 ,,	Ranchi	*Col. Dalton.*
16694 (skl.)	Chaibassa.	*Rev. A. Logsdail.*
405-7 (spirit)	Sambalpur.	*Dr. V. Ball.*
12568 ,,	Dharma	*C. H. Dreyer, Esq.*
16764 ,, TYPE.	Near Purulia, Manbhum Dist.	*Dr. N. Annandale*
16765 ,,	,, ,,	,, ,,

Central Provinces.

249 (spirit)	Raipur	*Dr. W. T. Blanford.*

Madras Presidency.

15990 (spirit)	Gopkuda I., Lake Chilka, Ganjam.	*Museum Collector.*
15991 (skl. & skull)	,, ,, ,,	*Dr. W. T. Blanford.*
520-1 (spirit)	Godavari River	,, ,,

Emyda granosa vitata, Peters.

Madras Presidency.

13497 (spirit)	Coconada, Coromandel Coast.	— *Mairguy, Esq.*

263-5 (spirit)	Travancore	*Prince Rama Varma.*
254-6 ,, } 1022 (skl.) }	Madras	*Madras Museum.*
16689 (spirit): juv.	Bangalore (3,000 ft.)	*Dr. N. Annandale.*

BOMBAY PRESIDENCY.

1660 (skl.): 1043 (skull)	Cutch.	*Dr. Stoliczka.*
247-8 (spirit): 566 ,,	Goa	*Purchased*; *Dr. J. Anderson.*
1774 (skull)	Sind	*Dr. W. T. Blanford.*

Emyda granosa ceylonensis, Gray.

280-2 (spirit)	Ceylon	*Dr J. Anderson.*
1025-6 (skl.)	,,	*Dr. Kelaart.*
1043 (skull)	Colombo	*Dr. J. Anderson.*

Emyda granosa scutata, Peters.

1705-7 (skl.)	Burma	*Hon. A. Eden.*
783 (skull)	,,	,, ,,
266-7, 269, 3885, (spirit): juv.	,,	*Hon. A. Eden, Maj. Sladen, Dr. W. Theobald, Dr. F. Stoliczka*
268 (spirit): juv.	Moulmein, Lower Burma.	*Dr. W. T. Theobald.*
1708 (skl.)	Bhamo, Upper Burma	*Capt. Lowndens.*
1709 ,,	Mandalay, ,, ,,	*Maj. Strover.*

Lydekker (Pal. Ind. III (ser. x), p. 197 (43), 1886) states that *Emyda vittata*, Peters, occurs as a fossil in the Siwalik deposits of the Punjab and suggests that the Indo-Gangetic form (*granosa*) had not been produced when these beds were formed.

The shell he figures as that of the former, however, resembles the race *ceylonensis* (which he did not distinguish from *vittata*) in having the xyphoplastral callosities in contact for the whole of their length, agreeing in other respects well enough with *vittata*. It is not improbable that it actually represents a form from which both of the southern races have been evolved. The other fossil remains figured by the same author appear to have belonged to forms that were both less highly specialized and considerably larger than the modern ones. They show, however, that in Post-Tertiary times two types of plastral sculpturing had already become fixed. The North Indian and Burmese races may be descended from *Emyda sivalensis* or *E. palaeindica*, and there are indications that *scutata* possibly represents the latter species. If it could be proved that the different races of the one surviving species were derived from comparatively recent fossil forms that were specifically distinct from one another, it would be permissible

to cite them as instances of convergence produced by isolation, the ancestors of different species isolated by some means from one another having, in the absence of enemies and the presence of a liberal supply of food, tended to revert in general structure to their common but long extinct ancestor, while retaining certain unimpor-

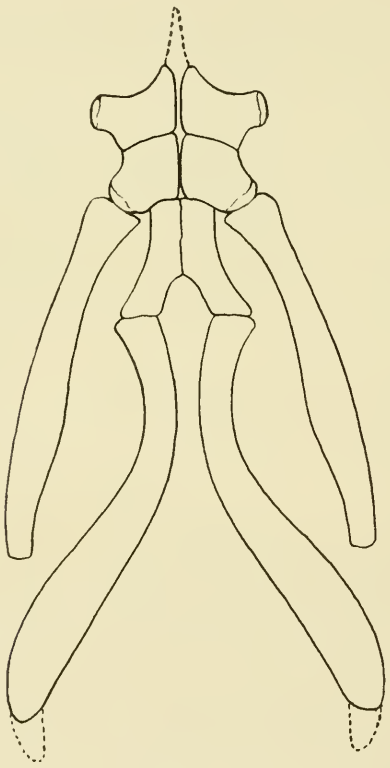


FIG. 5.—Branchial skeleton of *Emyda granosa*, × 2.

tant distinctive features. Theoretically it would be difficult in that case to regard such forms as local races of one species, but in practice this seems at present to be the only possible course to adopt, if we are to pay any attention to geographical considerations in distinguishing between subspecies and varieties. (See Annandale, Fauna Brit. Ind.—Freshwater Sponges, etc., p. 18, 1911.)

Measurements of Skulls of TRIONYX *and* DOGANIA.

Species.	Sex.	Reg. Nos.	Length.	Breadth.	Orbit.	Snout.	Inter-orbital width.	Nasal aperture (width).	Post-orbital Arch.	Mandibular Symphysis.
T. gangeticus, Cuv.	..	1893	134 mm.	96 mm.	22 mm.	36 mm.	17 mm.	19 mm.	12 mm.	20 mm.
,, ..	..	1080	127 ,,	94 ,,	21 ,,	35 ,,	16 ,,	20 ,,	13 ,,	19 ,,
,, ..	♂	78	123 ,,	95 ,,	20 ,,	34 ,,	16 ,,	20 ,,	11 ,,	13 ,,
,, ..	..	16751	118 ,,	88 ,,	20 ,,	32 ,,	15 ,,	19 ,,	12 ,,	18 ,,
,, ..	♂	79	117 ,,	86 ,,	21 ,,	32 ,,	16 ,,	21 ,,	9 ,,	18 ,,
,, ..	♂	756	118 ,,	87 ,,	18 ,,	33 ,,	15 ,,	17 ,,	11 ,,	18 ,,
,, ..	..	1081	113 ,,	84 ,,	19 ,,	33 ,,	13 ,,	18 ,,	9 ,,	18 ,,
,, ..	..	1835	111 ,,	92 ,,	20 ,,	34 ,,	15 ,,	18 ,,	12 ,,	20 ,,
,, ..	..	1089	102 ,,	75 ,,	18 ,,	30 ,,	13 ,,	15 ,,	9 ,,	13 ,,
,, ..	..	1054	104 ,,	75 ,,	17 ,,	29 ,,	11 ,,	16 ,,	9 ,,	.. ,,
,, ..	..	1082	92 ,,	68 ,,	15 ,,	26 ,,	12 ,,	14 ,,	8 ,,	14 ,,
,, ..	♀	1083	92 ,,	63 ,,	17 ,,	25 ,,	9 ,,	14 ,,	7 ,,	12 ,,
,, ..	..	1084	89 ,,	62 ,,	16 ,,	23 ,,	9 ,,	13 ,,	6 ,,	15 ,,
,, ..	..	1052	88 ,,	62 ,,	16 ,,	23 ,,	10 ,,	15 ,,	7 ,,	15 ,,
,, ..	..	1085	74 ,,	51 ,,	14 ,,	18 ,,	7 ,,	11 ,,	5 ,,	.. ,,
,, ..	..	3870	84 ,,	58 ,,	14 ,,	22 ,,	8 ,,	12 ,,	5 ,,	.. ,,
,, ..	..	1051	88 ,,	60 ,,	16 ,,	23 ,,	10 ,,	14 ,,	6 ,,	13 ,,
,, ..	..	1086	77 ,,	52 ,,	14 ,,	19 ,,	7 ,,	11 ,,	5 ,,	11 ,,
,, ..	..	1727	68 ,,	48 ,,	14 ,,	17 ,,	7 ,,	10 ,,	3 ,,	11 ,,
,, ..	..	16750	60 ,,	41 ,,	12 ,,	15 ,,	6 ,,	9 ,,	4 ,,	10 ,,
T. hurum, Gray. ..	♂	16752	129 ,,	87 ,,	21 ,,	38 ,,	16 ,,	19 ,,	14 ,,	30 ,,
,, [1] ..	♂	1090	125 ,,	87 ,,	23 ,,	37 ,,	18 ,,	18 ,,	13 ,,	.. ,,
,, ..	♂	1050	100 ,,	62 ,,	16 ,,	29 ,,	12 ,, ?	13 ,,	7 ,,	23 ,,
,, ..	..	1920	88 ,,	58 ,,	16 ,,	28 ,,	11 ,,	11 ,,	7 ,,	22 ,,
,, ..	♀	1047	83 ,,	49 ,,	14 ,,	24 ,,	11 ,,	10 ,,	7 ,,	20 ,,
,, ..	..	1049	70 ,,	41 ,,	13 ,,	20 ,,	9 ,,	9 ,,	6 ,,	15 ,,
,, ..	..	16627	72 ,,	43 ,,	13 ,,	19 ,,	9 ,,	10 ,,	4 ,,	16 ,,
T. nigricans, Andr. ..	..	1894	126 ,,	93 ,,	21 ,,	34 ,,	20 ,,	18 ,,	10 ,,	24 ,,
,, ..	..	1898	125 ,,	90 ,,	21 ,,	32 ,,	16 ,,	17 ,,	10 ,,	22 ,,
,, ..	♀	754	105 ,,	82 ,,	19 ,,	21 ,,	13 ,,	15 ,,	8 ,,	21 ,,
,, ..	..	1908	104 ,,	74 ,,	18 ,,	28 ,,	12 ,,	15 ,,	8 ,,	19 ,,
,, ..	♀	1918	? ,,	74 ,,	18 ,,	28 ,,	15 ,,	14 ,,	9 ,,	?
,, ..	..	1731	40 ,,	26 ,,	9 ,,	9 ,,	3 ,,	5 ,,	2 ,,	6 ,,
T. formosus, Gray. ..	..	1787	88 ,,	67 ,,	17 ,,	25 ,,	13 ,,	12 ,,	9 ,,	18 ,,
,, ..	..	1786	89 ,,	60 ,,	15 ,,	25 ,,	13 ,,	11 ,,	8 ,,	21 ,,
,, ..	..	605	87 ,,	56 ,,	16 ,,	24 ,,	12 ,,	11 ,,	7 ,,	?
,, ..	♂	1063	79 ,,	54 ,,	13 ,,	20 ,,	11 ,,	10 ,,	6 ,,	17 ,,
,, ..	..	634	59 ,,	42 ,,	12 ,,	16 ,,	7 ,,	8 ,,	4 ,,	13 ,,
T. phayrei, Theob. ..	♂	755	140 ,,	114 ,,	25 ,,	39 ,,	21 ,,	16 ,,	12 ,,	27 ,,
,, ..	..	1094	? ,,	128 ? ,,	25 ,,	42 ,,	21 ,,	20 ,,	13 ,,	26 ,,
D. subplanus ..	..	661	32 ,,	22 ,,	7 ,,	8 ,,	2 ,,	4 ,,	1 ,,	5 ,,
,, ..	..	13488	70 ,,	52 ,,	7 ,,	17 ,,	5 ,,	8 ,,	1 ,,	10 ,,

[1] Type of *T. buchanani*, Theob.

ADDENDA.

The following specimens have been added to the collection or assigned to their proper position since the foregoing paper went to the press:—

Trionyx gangeticus (p. 157).

Bengal.

16791 (skl.)	..	Oodhua, near Rajmahal..	*B. L. Chaudhuri, Esq.*
16791 ,,	..	R. Mahanaddi, Sambalpur	,,
16712 ,,	..	,, Cuttack	*Mrs. L. de Monte.*

Central Provinces.

1087-8	(skulls : juv.)	Nasdo R. (tributary of the Mahanaddi), Bilaspur district.	*Dr. W.T. Blanford.*

Trionyx hurum (p. 160).

16781	(skl : skin of head in spirit).	Oodhua, near Rajmahal..	*B. L. Chaudhuri, Esq.*

This specimen agreed fairly well in coloration with the one (16627) from the same locality described on p. 162 but was rather darker.

Emyda granosa intermedia (p. 172).

Orissa.

16911 (skl.)	..	R. Mahanaddi, Cuttack..	*Mrs. L. de Monte.*
16785-6 (spirit.)	..	,, Sambalpur..	*B. L. Chaudhuri, Esq.*

Specimen No. 16785 is melanic, the whole of the dorsal surface being of an almost uniform black while the ventral surface is strongly tinged with dark pigment.

EXPLANATION OF PLATE V.

MANDIBLES OF INDIAN SPECIES OF *Trionyx*.

Figs. 1, 3, 4, 5 reduced; 1a, 2, 6 natural size.

FIG. 1, 1a, 2.—*Trionyx gangeticus*.
1, 1a. Old and young individuals from the R. Ganges;
2. Young individual from the R. Mahanaddi.

FIG. 3.—Adult of *T. hurum* from the Gangetic delta.

FIG. 4.—Adult of *T. phayrei* from Arrakan.

FIG. 5.—Adult of *T. nigricans* from Chittagong.

FIG. 6.—Half-grown individual of *T. formosus* from Burma.

[The small projections at the tip of the jaw represented in fig. 1 are artificial.]

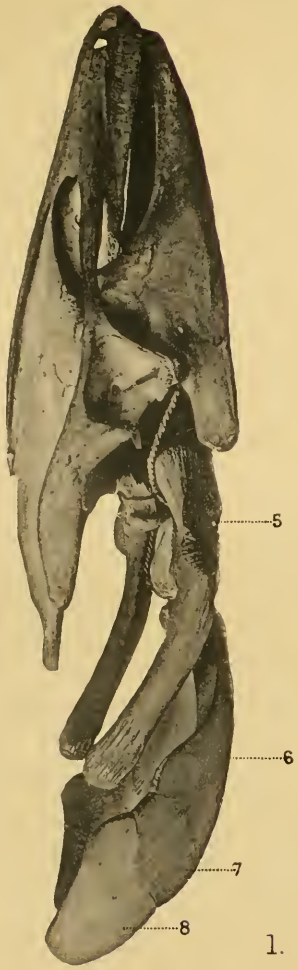
Mandibles of Indian Species of Trionyx.

EXPLANATION OF PLATE VI.

All figures reduced.

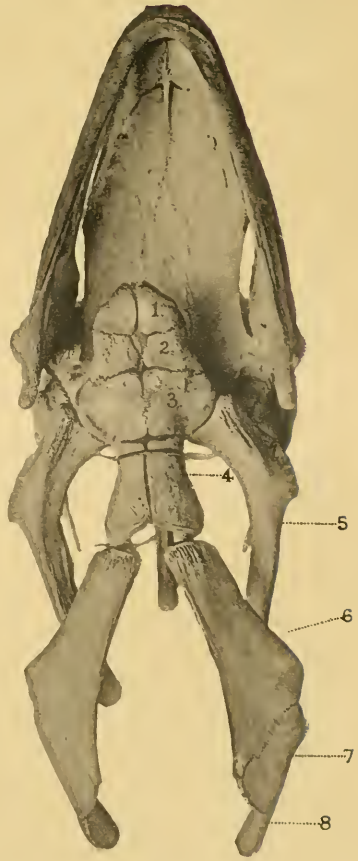
FIG. 1, 2.—Skull and branchial skeleton of *Chitra indica*.
1. basihyal; 2, 3, 4. basibranchials; 5. greater cornu; 6. hypobranchial and ceratobranchial fused; 7. epibranchial; 8. pterygobranchial.

FIG. 3.—Type specimen of *Emyda granosa* subsp. *intermedia*.



1.

3.



2.

Figs. 1, 2. Chitra indica. Fig. 3. Emyda granosa intermedia, subsp. nov.