

## NEW PELOMEDUSID TURTLE (PLEURODIRA: CHELONIA) REMAINS FROM LAMETA FORMATION (MAASTRICHTIAN) AT DONGARGAON, CENTRAL INDIA, AND A REVIEW OF PELOMEDUSIDS FROM INDIA

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### ABSTRACT

The side-necked turtles belonging to the family Pelomedusidae do not find a place among the extant fauna of India. Their fossil record in India is also extremely scanty. New skeletal material, including carapace-plastron and bones of girdles and limbs, are described from the Upper Cretaceous of Central India. The fossils are assigned to *Shweboemys pisdurensis* n. comb. Other species of *Shweboemys* and their distribution is discussed.

### INTRODUCTION

The earliest collections of turtle remains from Central India were made by Lydekker (1890) from Pisdura (spelt as Phisdura) who described the chelonian plastron as "*Hydraspis leithii*". In an earlier publication Carter (1852) had described a turtle skull as *Hydraspis leithii* from the Inter-trappeans of Bombay, and Lydekker believed that his material belonged to the same taxon. Williams (1953) erected *Carteremys* to accommodate original material of Carter and, by implication, also Lydekker's material as well. He concluded that *H. leithii* was pelomedusid rather than a chelid turtle. Wood (1970) reviewed the pelomedusid turtles of Asia and considered the relationships of *Carteremys* within the family Pelomedusidae as uncertain due to lack of reliable information on the holotype. Jain (1977) described an uncrushed skull from Pisdura, assigning it to *Carteremys pisdurensis*, and suggested that "*Carteremys* can be regarded as closest to *Shweboemys*" (p. 363). In the communication it was mentioned that considerable collection of post-cranial skeletal elements were in hand but not described due their fragmentary nature. During the interval (1977-86) concerted efforts to collect new material have resulted in a sizable collection which includes carapace, plastron and other elements of the girdles and limbs. The collection have been made mainly from Dongargaon, a locality about 16 Km south-east of Pisdura (Fig. 1). The systematic description of this new collection forms the main basis of the present work. The fauna and age of the ossiferous horizons at Pisdura and Dongargaon have been discussed in a number of recent publications (Robinson, 1970; Berman and Jain, 1982; Jain and Sahni, 1983 and Jain and Sahni, 1985). Both Pisdura and Dongargaon localities have been considered Santonian to Maastrichtian in age; Pisdura having part freshwater and part estuarine to marine environment and Dongargaon indicating a continental facies.

Infra-Traps and Inter-Trappean vertebrates from Peninsular India occur in several pockets in Central India and have been given geological ages ranging from Late Cretaceous to Paleocene, depending upon an aspect being considered (Sahni *et al*, 1982; Sahni, 1984). The vertebrate assemblages include dasyatids, *Rhinoptera*, myliobatids, pycnodonts, *Lepisosteus*, tetraodonts, osteoglossids, *Enchodus*, pelobatid and other frogs, lizards, snakes, crocodiles, pelomedusid turtles, carnosaurian and titanosaurid dinosaurs, eggs and egg-shell of sauropod dinosaurs and mammals (Sahni, 1984). This suggests a mixed environment containing marine, estuarine and terrestrial fauna.

The pelomedusid turtles have only five surviving genera, all freshwater, representing some 24 species (Pritchard and Trebbau, 1984). They form an important reptile fauna of equatorial regions of Southern hemisphere: Sub-Saharan Africa, South America and Seychelles. No pelomedusid turtle survives in India today. The fossil record of the pelomedusids, however, is extensive with representatives in North and South America, Europe, Africa and Asia. It includes the largest turtle that ever lived—*Stupendemys geographicus* from the Late Tertiary of Venezuela. The environment of fossil pelomedusids ranges from marine, freshwater to terrestrial habitats.

The pleurodire turtles are currently recognized into two families: the Pelomedusidae and Chelidae. Members of both the families have the capability of withdrawing the head by sideways bending of the neck. This attribute has earned these reptiles the title of 'side-necked turtles'. The cervical vertebrae of these turtles are highly specialized for retraction of the neck in a lateral plane. Our understanding of these turtles, in recent years, has been largely due to the comprehensive works of Mlynarski (1974), Gaffney (1975) and Pritchard and Trebbau

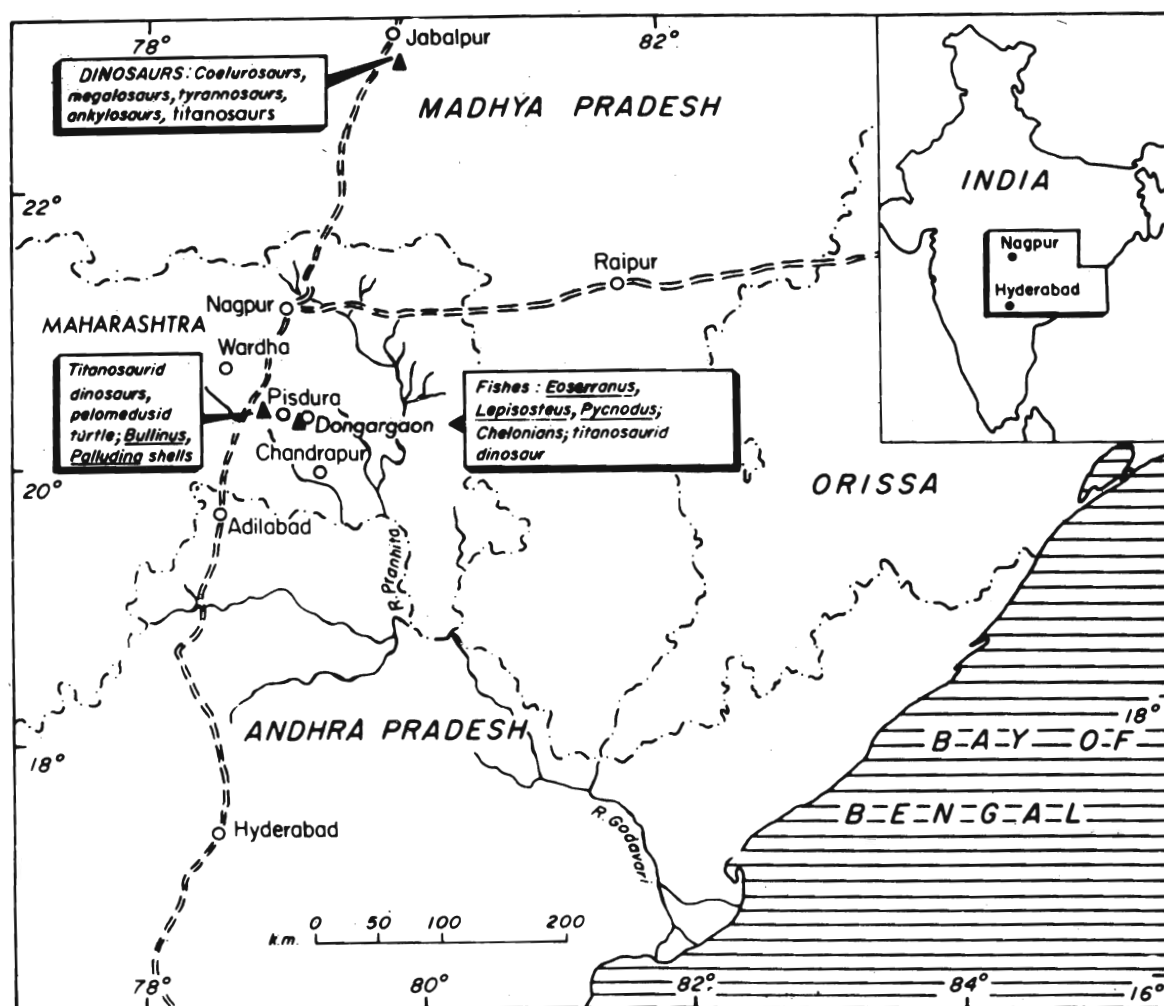


Fig. 1. Locality map showing fossiliferous sites at Pisidura and Dongargaon, Maharashtra State, India; Inset-map of India (from Berman and Jain, 1982).

(1984), among others. In addition, descriptive accounts of Venezuelan and Burmese forms have been given by Swinton (1928, 1938), North American genus *Bothremys* by Gaffney and Zangerl (1968), another North American form *Taphrosphys sulcatus* by Gaffney (1975 a), South American forms by Wood and Gamero (1971), Puerto Rican form by Wood (1972), Cretaceous pleurodire *Podocnemis* from Israel (Hass 1978, '78 a) Nigerian forms by Brion (1980), a review of African pelomedusids by Wood (1983), review of Asian pelomedusids by Wood (1970) and a description of an Indian pelomedusid by Jain (1977), among others.

*Shweboemys pisdurensis* Swinton, 1939 (Jain, 1977) n. comb.

Synonym: *Carteremys pisdurensis* Jain, 1977.

**Holotype:** Nearly complete skull, appx. 39 × 30 mm from Pisidura (District Chandrapur, Maharashtra, India); Palaeontological Collections, Indian Statistical Institute, Calcutta-700 035, Registration No. R 200.

**Diagnosis (amended):** Small to medium sized turtles; skull with extensive emargination of skull roof from behind, well developed crest contributed by parietal and occipital, lacking nasals, frontals in contact with orbits, inter-orbital width less than the diameter of orbits, orbits oval and face laterally, long contact between pterygoids in midline, outer border of palatines not parallel to midline axis but diverging from it at an angle of approximately 30 degrees, laterally projecting prominent ectopterygoid process, enlarged carotid canal, basisphenoid with long anterior process over the pterygoids; carapace with large nuchal, hexagonal neutrals, first neural elon-

SYSTEMATIC PALAEOLOGY

- Class Reptilia
- Subclass Anapsida
- Order Chelonia
- Family Pelomedusidae
- Genus *Shweboemys* SWINTON, 1939

gated, first costal enlarged, large vertebrals and pleurals, cervical absent; plastron flat, anterior lobe short and semi-circular, posterior lobe narrow and long, mesoplastra well developed, large inter-gular, gulars and humerals do not meet in the mid-line; ischium and pubis scar marks present on xiphiplastra.

**Distribution:** Upper Cretaceous (Maastrichtian) of Central India, fossiliferous localities at Pisdura and Dongargaon in Chandrapur District, Maharashtra, India.

**Referred material:** The following new fossil material has been used in the present study; all specimens (except R 194) have been collected from a site near village Dongargaon (Fig. 1) and have been deposited in the Palaeontological Collections of the Indian Statistical Institute (I.S.I.), Calcutta.

- R. 185 Associated carapace-plastron, posterior part missing, well-marked mesoplastra, neural elements 1-5, 170 × 125 mm (Plate I); occurs in limestone concretion.
- R. 186 Associated carapace-plastron, anterior portion only (partly missing), well-marked nuchal and 1-3 neurals, 1-4 costals, plastrals, including mesoplastra, 225 × 190 mm (Plate II—2 & 3); occurs in limestone concretion.
- R 187 Plastron preserved from anterior to posterior region, incomplete in mesoplatral region, mid-line suture and pelvic scars on xiphisternum preserved, 250 × 140 mm (Plate III, 1 and 2); occurs in green sandstones just below limestone concretions.
- R 188 Right side femur, proximal part, trochanter and part of shaft preserved, estimated length 55 mm (Plate II—1 & 4); recovered from green sandstones.
- R 189 Left coracoid, distal extremity damaged, estimated length 55 mm (Plate III—5 & 6); recovered from green sandstones.
- R 190 Left scapula, dorsal and ventral blades partly preserved, including glenoid, estimated length of dorsal blade 50 mm (Plate III—3 & 4); from green sandstones.
- R 191 Left scapula, dorsal and ventral blades partly preserved, estimated length of dorsal blade 50 mm (Plate III—7 & 8); from green sandstones.
- R 192 Right side humerus with associated (but disarticulated) scapula and coracoid, also ulna, humerus 50 mm (Fig. 4); embedded in limestone concretion.
- R 193 Right ilium blade, incomplete proximally, 85 × 50 mm (Plate II—5); isolated fragment.
- R 194 Vertebra, carapacial region, detached, 48 × 27 mm (Plate 1—3); isolated fragment from Pisdura.

#### DESCRIPTION

**Carapace:** There are numerous specimens exhibiting part of the carapace from Red Clays at Pisdura as well as isolated fragments embedded in concretions at Dongargaon. These are not being considered because they do not give evidence of total carapacial features. Among the better preserved specimens are R 185 and 186. In both cases, the carapace and plastron are preserved together,

both are slightly crushed and in both the posterior region is missing in R 186. Both specimens occur in limestone concretion. The specimens indicate a turtle of moderate proportions having carapace 180-225 × 200-250 mm (estimated) in overall dimensions, slightly oval in shape. A fairly large nuchal is present. It is diamond-shaped. A series of five neurals can be discerned in R 185 and only three in R 186 (Plates I—1 and II—3). In all there were probably six neurals; no information is available on the pygeal region. First neural is extremely elongated, having approximate proportions of 1:3 in both specimens. Neurals 2 to 4 are elongated-hexagonal in shape in R. 185. The fifth neural is incomplete but appears to have the same proportions as neural 4. Restoration of nuchal and neurals in Fig. 2 is based on R 185 and 186. Costals 1 to 5 of both right and left side are seen in R 185 and 1 to 4 of left side in R 186. The first costals are the largest. The posterior edge of the first costal medially touches the angles of neural 2. The remaining costals are of nearly equal depth. All the costals exhibit slight curvature. No information is available on the region posterior to the fifth costal. Seven large marginals of the left side can be discerned in R 186 articulating with nuchals and costals. These have been restored in Fig. 2. The marking of vertebrals on the carapace can be discerned in R 186. The first vertebral passes posteriorly

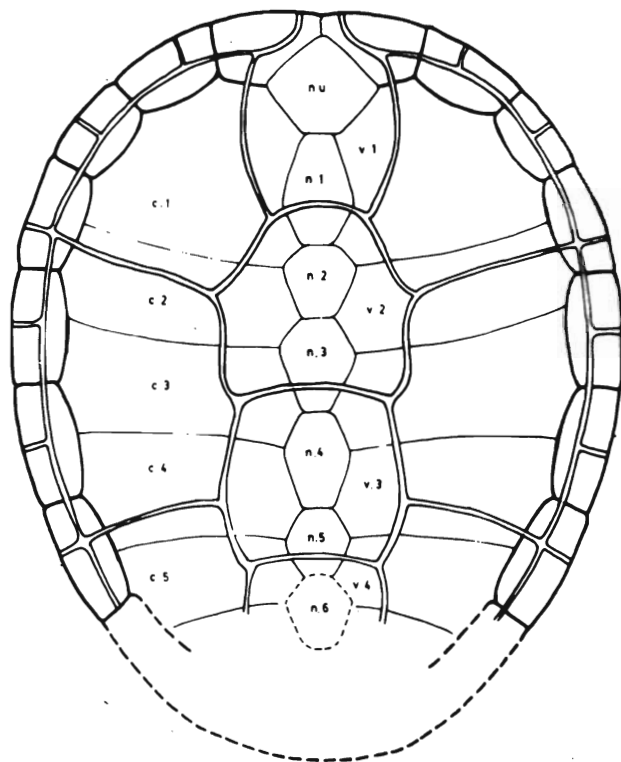


Fig. 2. *Shweboemys pisdurensis*, carapace restoration based on ISI R 185 and R 186; c. 1 to c. 5—costals 1 to 5, n. 1 to n. 6—neurals 1 to 6, nu.—nuchal and v. 1 to v. 4—vertebrals 1 to 4.

over the first neural at about 2/3rd length; the second across the third neural and the third across the fifth neural. The pleural 1 to 3 can be discerned, each passing over costals 1, 2 and 4, respectively, before joining with the peripherals. The marginals and peripherals alternate on the margins of the carapace (Fig. 2). The carapace is markedly larger in proportions to the plastron. The individual bones of the carapace vary in thickness 3-5 mm in both specimens.

**Plastron:** There are three specimens in the collection which give reliable information on plastron: R 185, R 186, both in association with carapace and R 187 as an isolated plastron. R 185 and R 186 represent plastron which is incomplete posteriorly; the last part of hypoplastra and whole of xiphiplastra is missing. These specimens are in blocks, hence the visceral aspect of the plastron cannot be examined. R 187 has been prepared from both ventral and visceral aspects; the plastron is preserved upto xiphiplastra of which the extreme tip is missing. This specimen is deficient in the region of mesoplastra. The plastron is rather flat, having an anterior lobe short and semicircular and the posterior lobe narrow and long. The estimated overall dimensions of plastron are 250 × 200 mm, including marginals. The plastron is suturally divided mid-way by hyo—and hypoplastra which on either side meet mesoplastra (Plate I—2; Plate II—2 and Fig. 3). Each mesoplastra is somewhat D-shaped, with rounded side mesially and straight suture towards the marginals. The cervical shield is absent. The epi—and entoplastra are seen best in R 187. The entoplastra are diamond-shaped and the epiplastra collar-shaped. The hyoplastra are the largest of the plastral bones and laterally, form bridges with the marginals to buttress with the carapace. The hyoplastra also develop fontanelles laterally for the forelimbs. Similarly, the hypoplastra form the posterior bridge with the marginals to buttress with the carapace and fontanelles for the hind-limbs. The xiphiplastra are preserved only in R 187 and a restoration is attempted in Fig. 3. On the visceral side of the xiphiplastra characteristic scar marks for the articulation of ischium and pubis are seen (Fig. 4). Nine marginals on either side can be discerned. The arrangement of ventral shields is best seen in R 187 and partly in R 185 and 186 (Fig. 3 and 4A). There is a large, median intergular, small gulars and large humerals. The gulars and humerals do not meet in the mid-line; the posterior end of intergular lies somewhere at two-third length of entoplastra. The configuration of these anterior shields is being documented for the first time in the genus *Shweboemys* since this region is not preserved in other species. This arrangement is somewhat similar to the arrangement in the allied genus *Stereogenys*. The pectorals are extensive, abdominals less so and femorals and anals follow the general pelomedusid pattern (Fig. 3). The marginals

alternate with the peripherals in arrangement on the margins of plastron.

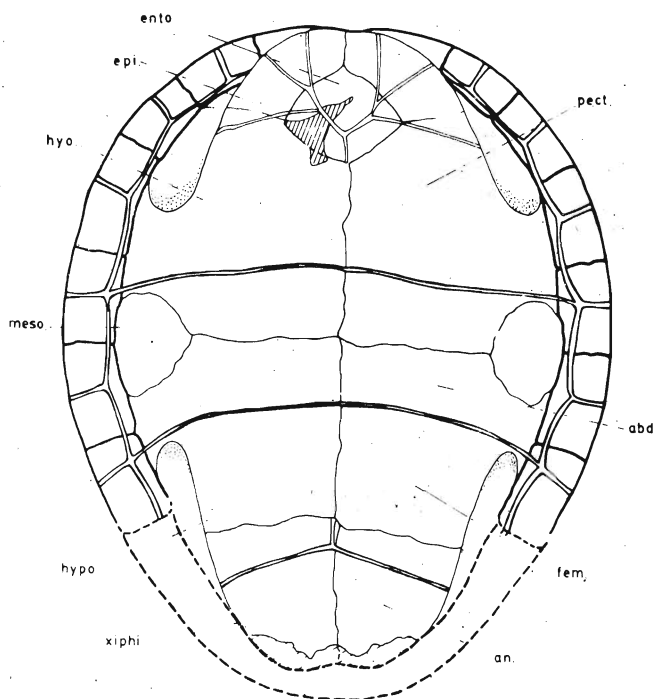


Fig. 3. *Shweboemys pisdurensis*, plastron restoration based on ISI R 185, R 186 and R 187; abd.—abdominal, an.—anal, ento.—entoplastra, hyo.—hyoplastra, hypo.—hypoplastra, meso.—mesoplastra, xiphi.—xiphiplastra.

**Other skeletal elements:** Information about the axial and appendicular skeleton of *S. pisdurensis* is scrappy as there is little associated material. The fossils occur either in limestone concretions as isolated blocks or *in situ* in green sandstones. Pectoral girdle is represented in R 189, R 190 and R 191. The girdle is tri-radiate, with a long blade-like coracoid and scapula having a long dorsal blade and a short ventral blade. Left coracoid (R 189, Plate III—3 & 4) has a narrow proximal end, developed into a glenoid cavity and a distal end which is flat and blade-like. The extremity of distal end is missing, R 190 and R 191 represent left side scapulae, the former better preserved than the latter (Plate III—3, 4, 7 & 8). The dorsal process of the scapula is approximately 50 mm long and the ventral about less than half of it, as estimated. The coracoid is also estimated to be about 50 mm long. Associated but disarticulated pectoral girdle has been prepared from a limestone concretion (R 192) and is illustrated in Fig. 5. The coracoid (55 mm) and scapula with both dorsal (45 mm) and ventral processes (incomplete), bear the structural resemblance to the same elements as in R 190 and R 192. In addition, this block also has nearly complete humerus, 50 mm, with well-marked head and delto-pectoral crest and slightly

recurved shaft. The ulna is partly covered by scapula; its proximal end is, however, close to the distal end of humerus. The olecranon process is poorly developed; estimated length of ulna is 40 mm.

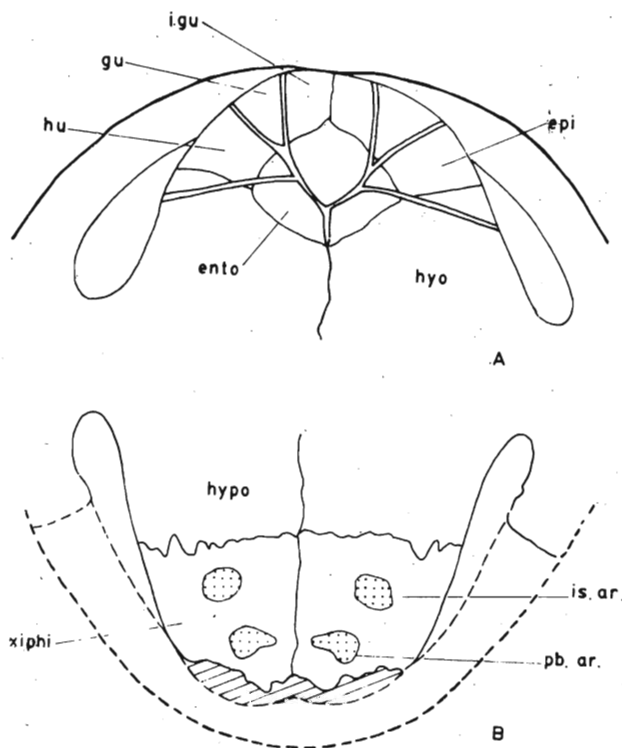


Fig. 4. *Shweboemys pisdurensis*, A, anterior part of plastron, ventral view; B, posterior part of plastron, visceral view; ento.-entoplastra, epi.-epiplastra, gu.-gular, hu.-humeral, hypo.-hypo-plastra, hypo.-hy.-poplastra, i.gu.-intergular, is.ar. ischium articulation scar, pb.ar.-pubis articulation scar, xiphi. xiphoplastra.

One isolated femur is available in the collections as R 183. It is fairly complete in the region of the head, third trochanter and about three-fourth of the shaft. The distal part of the shaft and condyles are missing (Plate II—1 & 4). Estimated to be about 55 mm when complete, the femur has an extremely robust, rounded head, directed at a slight angle to the shaft. The third trochanter is present close to the head and the shaft has a pronounced twist. Among the isolated elements, a nearly complete bone, (except for the tip of the proximal end) is probably an ilium (Plate II—5). It has a broad blade almost half as much as the length and has a general resemblance to turtle ilium. It measures 40 × 25 mm.

No definite elements of the vertebral column are present in the collections. However, there is an isolated fragment which has the shape of an arrow-head, with smooth rounded angles posteriorly, a sharp ridge running medially and a pointed end anteriorly (Plate I—3). It has a fine groove running along the flat surface, being on the

reverse side of the surface having a ridge (not seen in Plate). It is being considered a probable vertebra of the carapacial region. It measures 45 × 24 mm. The photograph in Plate I, 3 shows the ventral aspect of the vertebra.

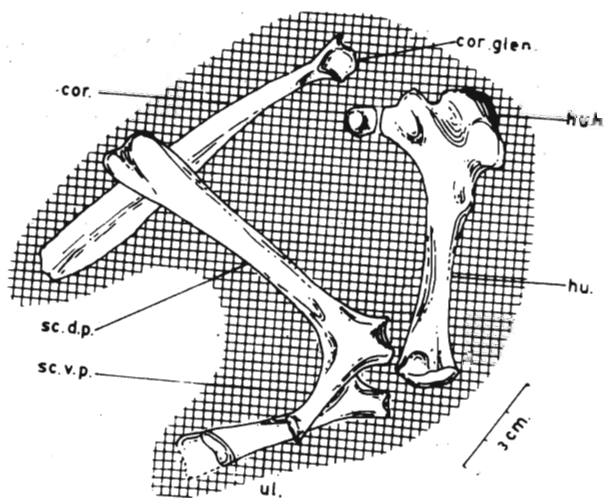


Fig. 5. *Shweboemys pisdurensis*, sketch of ISI R 192 showing part of fore-limb and pectoral girdle; cor.-coracoid, cor.gl.-glenoid cavity of coracoid, hu.-humerus, hu.h.-head of humerus, sc.d.p.-dorsal process of scapula, sc.v.p.-ventral process of scapula, ul.-ulna.

#### DISCUSSION

The fossil pelomedusid turtles of Asia have had a chequered history which is not very different from their records elsewhere, especially in South America (Wood, 1970; Pritchard and Trebbau, 1984). The turtles present difficulties of taxonomic assessment due to the fact that rarely skull and shell material (including appendicular skeleton) is found together. Evaluation based on certain parts of the skeleton has often required revision when such elements as are diagnostic have been found. The description of some material (and illustration) during 19th and early part of the 20th century have been rather sketchy and superficial leading to questionable assessments later. Lastly, the vagaries of time and intervention of two World Wars have displaced or permanently lost some valuable fossils.

Prior to the discussion on the turtle described here a review of the pelomedusids from the Indian subcontinent would be useful. The earliest remains of a turtle to be identified as a pelomedusid were from Nila in the Salt Range of West Pakistan (then in India) by Lydekker (1887) as *Podocnemis indica*. The material consists of a fairly complete carapace and some plastral fragments. Recently Wood (1970) has evaluated this turtle, including the possible age of the deposits as Palaeocene rather than Eocene. Wood has commented that (1) there is no

evidence whether or not pelvis was fused to the shell, (2) presence or absence of mesoplastra is unknown and (3) the scute pattern of the anterior plastral lobe is not preserved. As these features are crucial to the taxonomic determination, "*P*" *Indica* cannot be considered a pelomedusid or a member of the genus *Podocnemis*, with certainty. Wood (1970:3) has, however, drawn attention to the fact that the shape of the carapace, number and arrangement of neurals and lack of cervical in "*P*" *indica* show some resemblance to the shell of *Shweboemys* from Egypt. It can, therefore, be considered a probable pelomedusid turtle but not a member of the genus *Podocnemis*. The uncertainty about generic identification will continue until more satisfactory material is collected and described. In any case a century has already elapsed since the discovery of the first specimen without any new report.

A second turtle was described by Carter (1852) as *Hydraspis leithii*, as a chelid chelonian, from the Inter-Trappean beds near Bombay, associated with the remains of frogs (*Indobatrachus pusillus*). The age of Bombay Inter-Trappeans has been debated by several workers (Wadia, 1953; Krishnan, 1960; Pascoe, 1964 and Robinson, 1970). These are regarded as of Eocene age; Robinson (1970; 245) considered them as having been laid down in freshwater and Pascoe (1964: 1386) favours shallow, marshy environment. After a century of Carter's original description, Williams (1953) re-evaluated the material and description and eventually concluded that "*Hydraspis*" *leithii* was not a chelid but represented a new pelomedusid taxon which he named as *Carteremys*. Carter's material consisted of two complete carapaces, 18-20 cms in length, which have now been lost (Williams, 1953: 2). Sukheswala (1947, abstract report only) reported the find of a new shell material; this is on display at the Indian Museum, Calcutta. Two other specimens (later found by Sukheswala) have been recorded in the general report of the Geological Survey of India for 1948 (West, 1950). No description or illustration of these specimens has ever been published. Williams (1953: p. 6 & Pl. 3) provided a restoration of skull and shell based on Carter's figures and material subsequently found. He considered a combination of several characters to conclude that Carter's turtle was not a chelid: (1) the absence of cervical scute, (2) the relative proportions of the first and second vertebrals, (3) remarkably large inter-gulars (4) lack of a parieto-squamosal arch and (5) presence of jugal-quadratojugal bar. The presence of mesoplastra, an important pelomedusid feature, has been questionable: Williams (1953: 4) inferring that small, laterally placed mesoplastra may have been present; Wood (1970: 4), on the other hand, holding the view that there is no conclusive evidence bearing on this point. Further, none of the specimens subsequently col-

lected from Carter's locality are sufficiently complete to demonstrate the presence or absence of these structures (Williams, 1953: 6). My own examination of the plastron from Carter's locality, on display at the Indian Museum, Calcutta, did not reveal presence of mesoplastra in the specimen. In conclusion, it may be stated that *Carteremys* continues to be an ill-defined genus due to poor preservation of fossil material.

A third occurrence of a turtle was reported by Lydekker (1890) from so-called Inter-Trappean beds of Lameta as "*Hydraspis*" *leithii* (Syn: *Carteremys leithii* Williams, 1953). The material consisting of plastral fragments was obtained from Pisdura (spelt as Phisdura), near Nagpur. The specimen is now untraceable in the Geological Survey of India, Calcutta, and in all probability has been lost (Jain, 1977: 363-364). Wood (1970: 5) considered this material as "differing from *Carteremys* in size and in gular and inter-gular proportions; this specimen may well represent an unknown taxon, but too little is known of it to permit useful discussion." A pelomedusid turtle skull (*Carteremys pisdurensis*) has been reported from the Red Clays at Pisdura (Jain, 1977). The Red Clays at Pisdura have also yielded titanosaurs (*Titanosaurus blanfordi* Lyd., *Antarctosaurus* sp.), along with the turtle, and a Santonian-Maastrichtian age has been suggested for these beds. Overlying the Red Clays at Pisdura there is a band of white quartzitic sandstones which has yielded a fauna consisting of tetraodont, batoid, rays and teleost fishes, frogs, snakes and crocodiles (Jain and Sahni, 1983) and sauropod dinosaur egg shells (Jain and Sahni, 1985). An interesting feature of the Pisdura biota is the admixture of both marine and non-marine elements; in general a Maastrichtian age is suggested but some faunal elements are common with well dated Nagpur inter-trappeans suggesting a range in time upto Palaeocene.

*Shweboemys pisdurensis* (Syn: *Carteremys pisdurensis*) described in the present communication has been obtained from a site near Dongargaon, a locality about 16 km south-east of Pisdura (Fig. 1). Among other vertebrate fossils known from this locality are one teleostae (*Eoserranus hislopi*) and two ganoids (*Lepisosteus indicus* and *Pycnodus lametae* Woodward, 1908). In addition, Berman and Jain (1982) have recorded the braincase of a small sauropod dinosaur from Dongargaon and mentioned the collection of numerous testudinid carapace-plastra, along with dinosaur bones, as surface finds, from the green clays and limestone concretions. They have indicated a Santonian to Maastrichtian age, probably indicating a continental facies. It may be mentioned that in Dongargaon locality fossils mainly occur in two beds: (a) limestone concretions of assorted sizes overlying green clays and sandstones; Woodward's fish specimens and those subsequently collected by the

author, including turtle carapace-plastron have been found in this bed, and (b) the green clays and sandstones, underlying the limestone concretions, have yielded *in situ* material of dinosaur braincase, vertebrae, etc., as well as turtle shell and bones.

*Shweboemys* was erected by Swinton (1939) for *S. pilgrimi*; the type (Geological Survey of India, Calcutta, Regr. No. 17255) is a partial skull from Pliocene or Pleistocene of Burma. An additional specimen, slightly more complete skull, from Irrawaddy beds, Shwebo District, Burma (same locality as that of type) has been described by Wood (1970) from the collections of the British Museum (Natural History), London (BMNH R 8432). Wood has also provided excellent photographs (all views) of the type as well as hypodigm and has diagnosed *Shweboemys* and *S. pilgrimi* clearly. In addition, Wood has also erected *S. gaffneyi* for partial skull from the Early Miocene, Bugti Hills, Baluchistan (Pakistan) and has indicated the availability of new material of *S. antiqua* (Syn: *Podocnemis antiqua* Andrews, 1903) from Late Eocene, El Fayum Depression, Egypt. The genus *Shweboemys* now represents four species: *S. pilgrimi* (type) from Pliocene or Pleistocene of Burma, *S. pisdurensis* from Maastrichtian of Central India, *S. gaffneyi* from Early Miocene of Pakistan and *S. antiqua* from Late Eocene of Egypt (Fig. 6). A comparison of the size of the skull of four species reveals an interesting range: *S. pisdurensis*—4.5 cm (est.), *S. antiqua*—6.6 cm (est.), *S. gaffneyi*—1.5 cm (est.) and *S. pilgrimi*—12.5 cm (est.). Comparison of carapace-plastron may have been interesting but except for *S. pisdurensis*, the information is not available on all species.

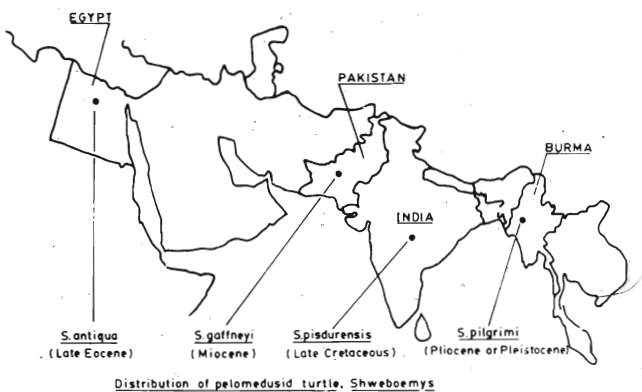


Fig. 6. Distribution of the pelomedusid turtle *Shweboemys* species.

Wood (1970) has already made comparisons of certain features of the skull of *S. pilgrimi* and *S. gaffneyi* and to a limited extent of *S. antiqua*. It may be useful to extend the comparisons to include *S. pisdurensis*. In addition to being a small skull, *S. pisdurensis* is distinctive from all other species due to a combination of characters. In the

following summary a list of important diagnostic features of all the four species is given:—

- S. pilgrimi*— interorbital width slightly greater than the diameter of orbits; orbits circular, directed forward; medial borders of palatine flanges nearly parallel to each other; little or no contact between pterygoids at midline; basisphenoid not provided with long anterior process; skull length 12.5 cm (Fig. 7B).
- S. gaffneyi*— interorbital width less than the diameter of orbits; orbits round rather than oval; medial borders of palatine flanges curving away from midline; broad contact between pterygoids in the midline; basisphenoid without long anterior process; forehead groove between orbits absent; skull length 10.5 cm (Fig. 7C).
- S. antiqua*— orbits oval and face laterally; forehead groove between orbits present; no contact between pterygoids in midline; skull length 6.6 cm. (Pending publication of details of new material from Egypt, the above information has been excerpted from Wood, 1970).
- S. pisdurensis* interorbital width less than the diameter of orbits (much less than in *S. gaffneyi*); orbits oval and face laterally; medial borders of palatine flanges curving away from midline; extensive contact between pterygoids in midline; basisphenoid with a long anterior process over pterygoid; skull length 4.5 cm (Fig. 7A).

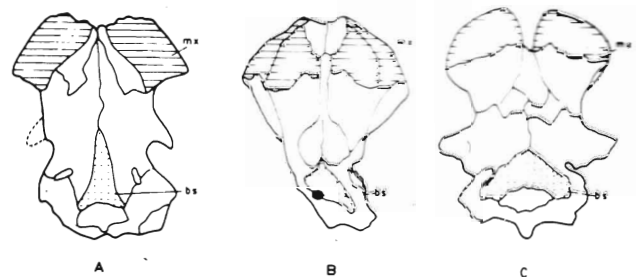


Fig. 7. A comparison of three species of *Shweboemys*, palatal view of skull in outline; A, *S. pisdurensis* from Central India (after Jain, 1977), B, *S. pilgrimi* from Burma (after Wood, 1970) and C, *S. gaffneyi* from Pakistan (after Wood, 1970); bs. basisphenoid, mx. maxilla.

A few comments on the environment of pelomedusid turtles may be made. All living pelomedusids are inhabit-

ants of fresh-waters; the fossil records, however, indicate marine, freshwater and terrestrial environment. Among the various genera of pelomedusids, it may be seen that *Shweboemys* is the only turtle so far known to have established a successful, enduring lineage outside the main centres in South America and Africa. No pelomedusid is known from central or eastern Asia. The localities of Asiatic species of *Shweboemys* are widely separated geographically and no representative has been recorded from the intervening (and considerably younger) Siwalik deposits of India (Wood, 1970: 18). *S. pilgrimi* (Swinton, 1939) was probably a freshwater rather than a terrestrial turtle (Wood, 1970: 18) in view of the fact that the Irrawady beds of Shwebo District in Burma are of fluvial origin (Krishnan, 1960: 498). Some questions remain to be solved about the absence of precise stratigraphic data for Swinton's specimen but the morphologic identity of a second specimen of *S. pilgrimi* described by Wood (1970) from Irrawady beds suggests a possible horizon of the turtle specimens. *S. gaffneyi* was recovered from the area around Dera Bugti in Baluchistan (Pakistan); Pilgrim (1908: 159) has referred to the Bugti beds as "freshwater formation" and Krishnan (1960: 492) has regarded them as being fluvial. *S. pisdurensis* has been obtained from two localities: Pisdura Red clays which, in addition to turtle, have yielded titanosaurid sauropod dinosaurs and molluscs, suggest freshwater environment (Jain, 1977); Dongargaon sediments (green clays and sandstones) from which turtle and dinosaur bones have been recovered suggest continental facies (Berman and Jain, 1982). *S. antiqua* from Fayum Depression (Late Eocene of Qasr el-Sagha Formation) of Egypt also indicates a continental facies. Thus all species of *Shweboemys* occur in freshwater or continental deposits.

Testudines from Lower and Upper Siwaliks are known and have been summarized by Smith (1931). Several species of *Chelonia*, *Trionyx* and *Emys* (Pascoe, 1964) are known. In general, these turtles resemble the contemporary fauna, except being larger in size. However, Tiwari and Badam (1969) have described a part of the carapace of an Emydid chelone, *Geochelone sivalensis*, from the Upper Siwaliks and Grigorescu and Verma (1976) have reported the skull of *Geoclemys*, another emydid chelone from Upper Tatrot (Upper Pliocene) in Haryana, India. Tiwari and Badam (1969: 557-558) mention the presence of "only parts of two fairly preserved mesoplastra" in their specimen of *Geochelone sivalensis*. No illustration of this feature has been given. The authors consider it to be an Emydid turtle, though the presence of mesoplastra is an important pelomedusid feature. It will be interesting to re-examine the specimen to find whether the mesoplastra are actually present or not. Further specimens to bear this point would be also

helpful.

The species of *Shweboemys*, as stated earlier, are separated by great geographical distances and barriers. Any suggestion about their origin and dispersal can be very tenuous. As the oldest occurrence, *S. pisdurensis*, in the Upper Cretaceous beds in Central India, suggests an early confinement and later dispersal from Central India to Egyptian, African, (Sahni, 1984: 134) and Pakistan and Burmese regions (Fig. 7). Wood (1970: 18) has also suggested derivation of *S. pilgrimi* "more or less directly" from *S. gaffneyi* and that *S. gaffneyi* "directly descended from *S. antiqua*." Extension of this argument on the basis of older geological age of *S. pisdurensis* would imply that *S. antiqua* may be deemed to have descended from the former. This interpretation, apart from being simplistic, is not based on morphological evidence. In addition to the great geographical distances involved, *S. pisdurensis* is sufficiently distinctive in skull characters to visualize it being antecedent to *S. antiqua*; in any case little is known about the skull of *S. antiqua*. The skulls of *S. pilgrimi* and *S. gaffneyi* show a great deal of resemblance. This feature has been noted by Wood as well. Comparison of the features of carapace plastron would have been much useful to throw light on the above aspect but unfortunately this evidence is not available on all species.

Food habits of certain pelomedusid turtles have been commented upon by several workers, including Gaffney and Zangerl (1968), Wood (1970) and Pritchard and Trebbau (1984). Occlusal surfaces of maxillary region in the skull of several pelomedusids bear large, deep pits. It has been suggested that these may have functioned to facilitate cracking objects larger than the pits themselves, such as certain types of molluscs. Species of *Shweboemys* (*S. pilgrimi* and *S. gaffneyi*) have a broad secondary palate with a narrow median cleft; Wood (1970) has suggested that this feature could be designed for crushing mollusc shells. The Indian pelomedusid (*S. pisdurensis*) also has its maxillary surface pitted but the feature is not pronounced since it is the smallest skull. However, a diet of molluscs is suggested for this turtle as well since the horizons of *S. pisdurensis* are extremely rich in gastropod shell of all sizes (*Bullinus prinseprii* and *Palludina deccanensis*).

## CONCLUSION

The documentation and updating of pelomedusid turtles from India has been done on the basis of review of literature, examination of some existing material from earlier collections and description of new collections. The record of pelomedusid turtle from Bombay Intertrappeans requires further work as the plastron does not show diagnostic characters, though the skull is pelomedusid-like. The description of a pelomedusid turtle



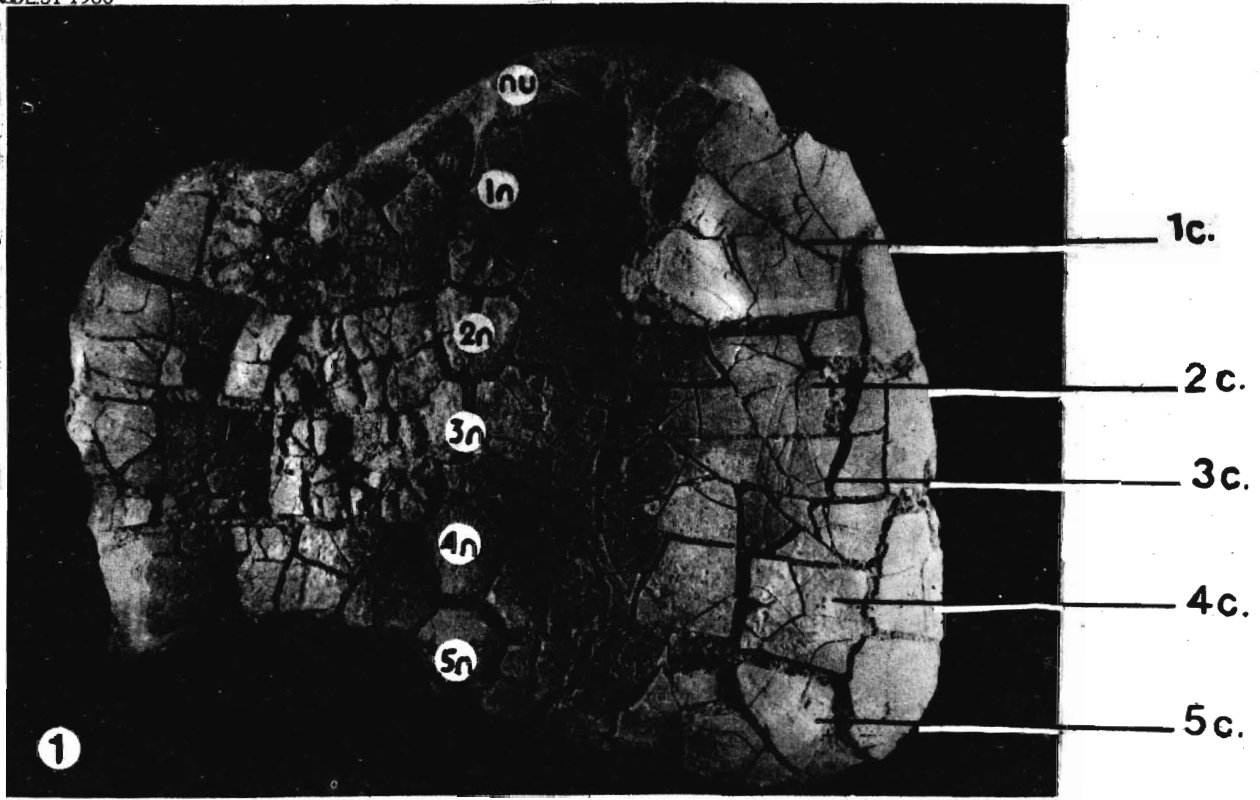
from Central India based on skull (Jain, 1977) is now supplemented with description of carapace, plastron, girdles and limb bones. *Shweboemys pisdurensis* may now be regarded as the best known pelomedusid from India as well as the better documented among all other species of *Shweboemys*. A review of all species of *Shweboemys* (*S. pisdurensis*-Upper Cretaceous, India; *S. antiqua* Late Eocene, Egypt; *S. gaffneyi*-Early Miocene, Pakistan and *S. pilgrimi*-Pliocene, Burma) has been made. The oldest occurrence of these turtles in India suggests an early confinement in the subcontinent and later dispersal to Pakistan, Egypt and other African countries on the one hand and Burma on the other; extant distribution of pelomedusids is restricted to Sub-Saharan Africa, Madagascar and South America.

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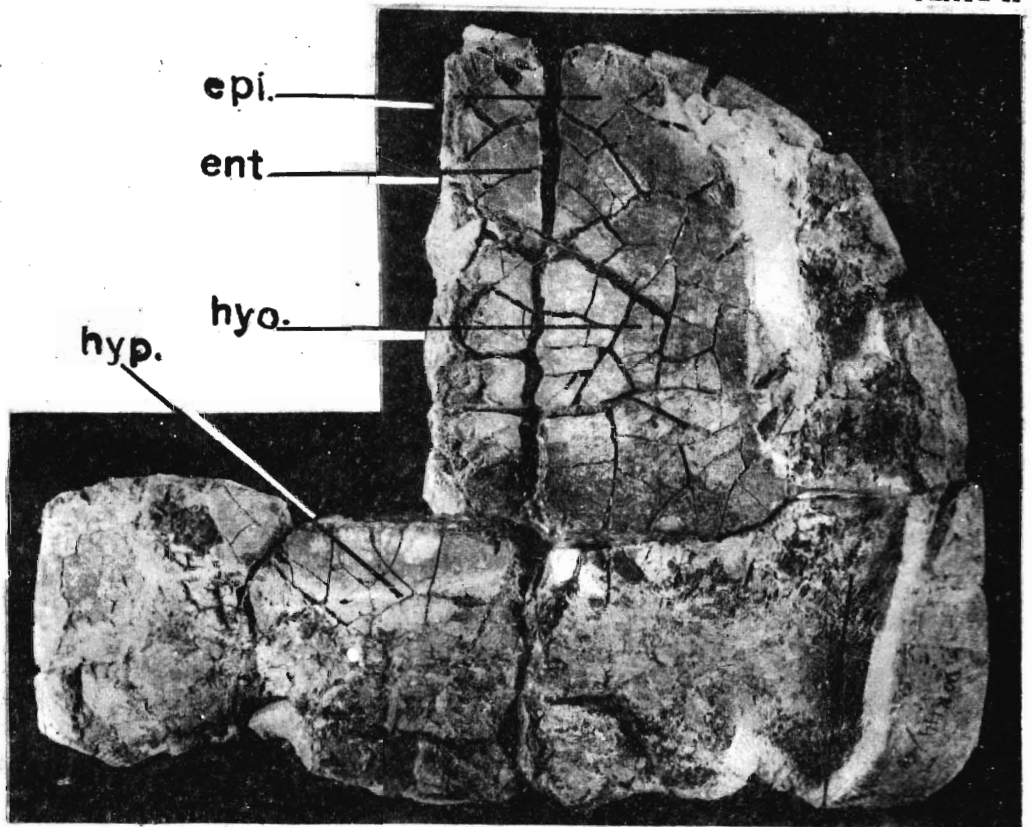
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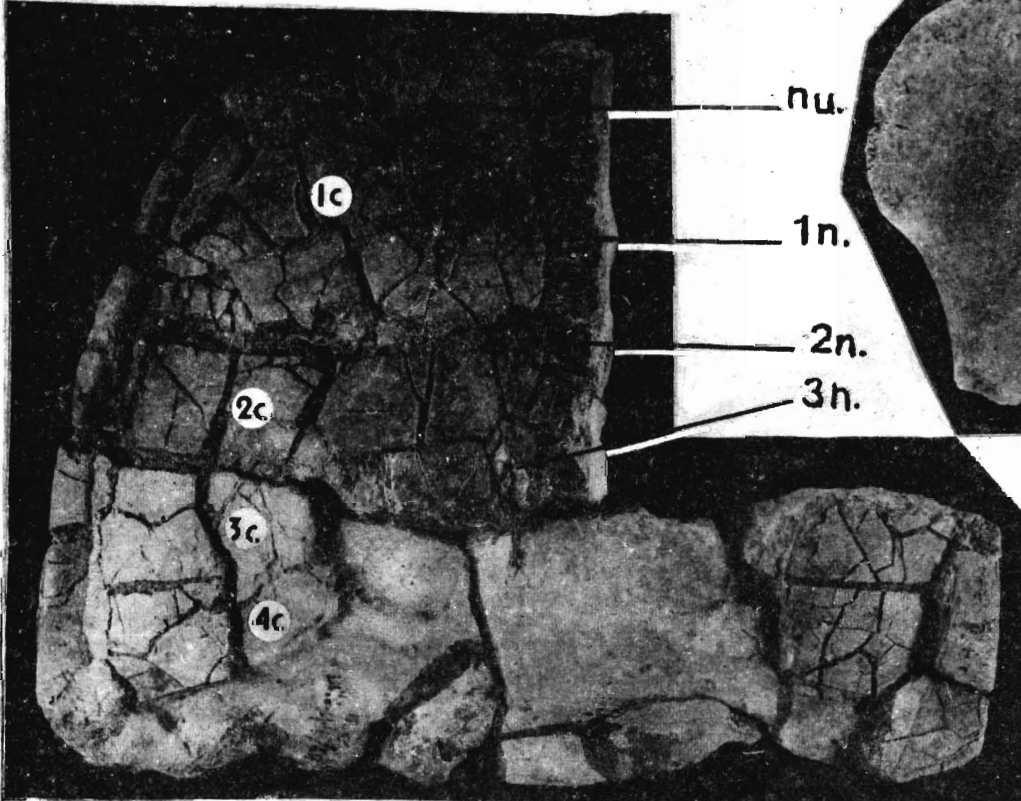
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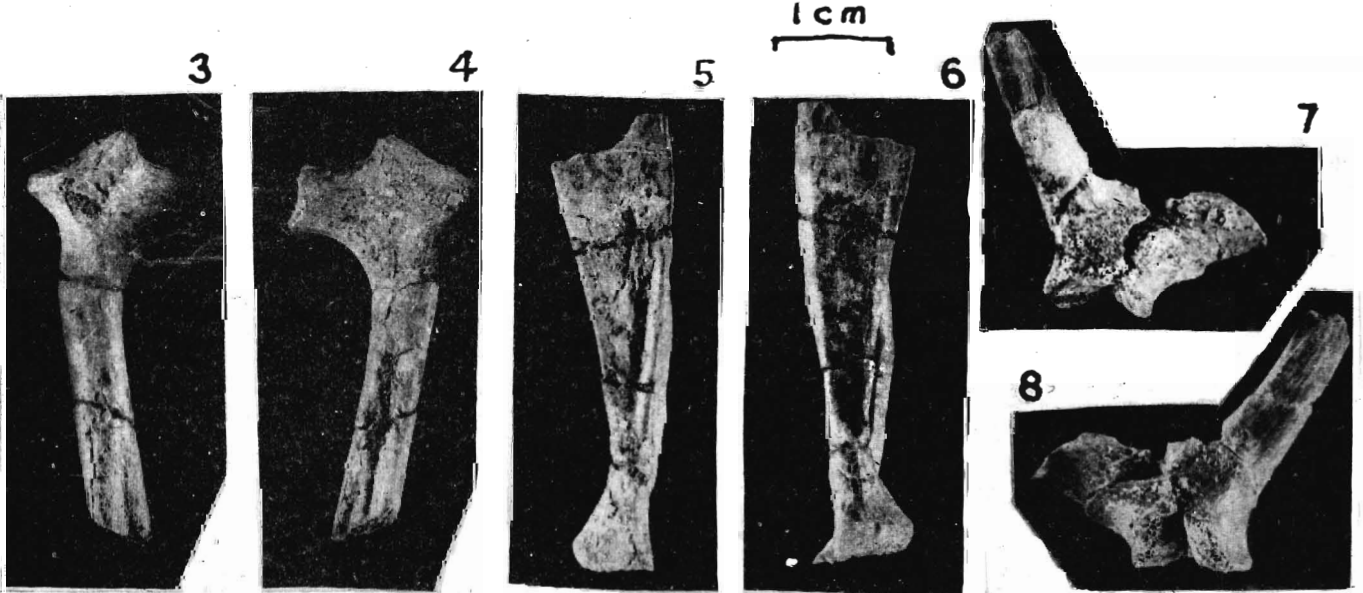
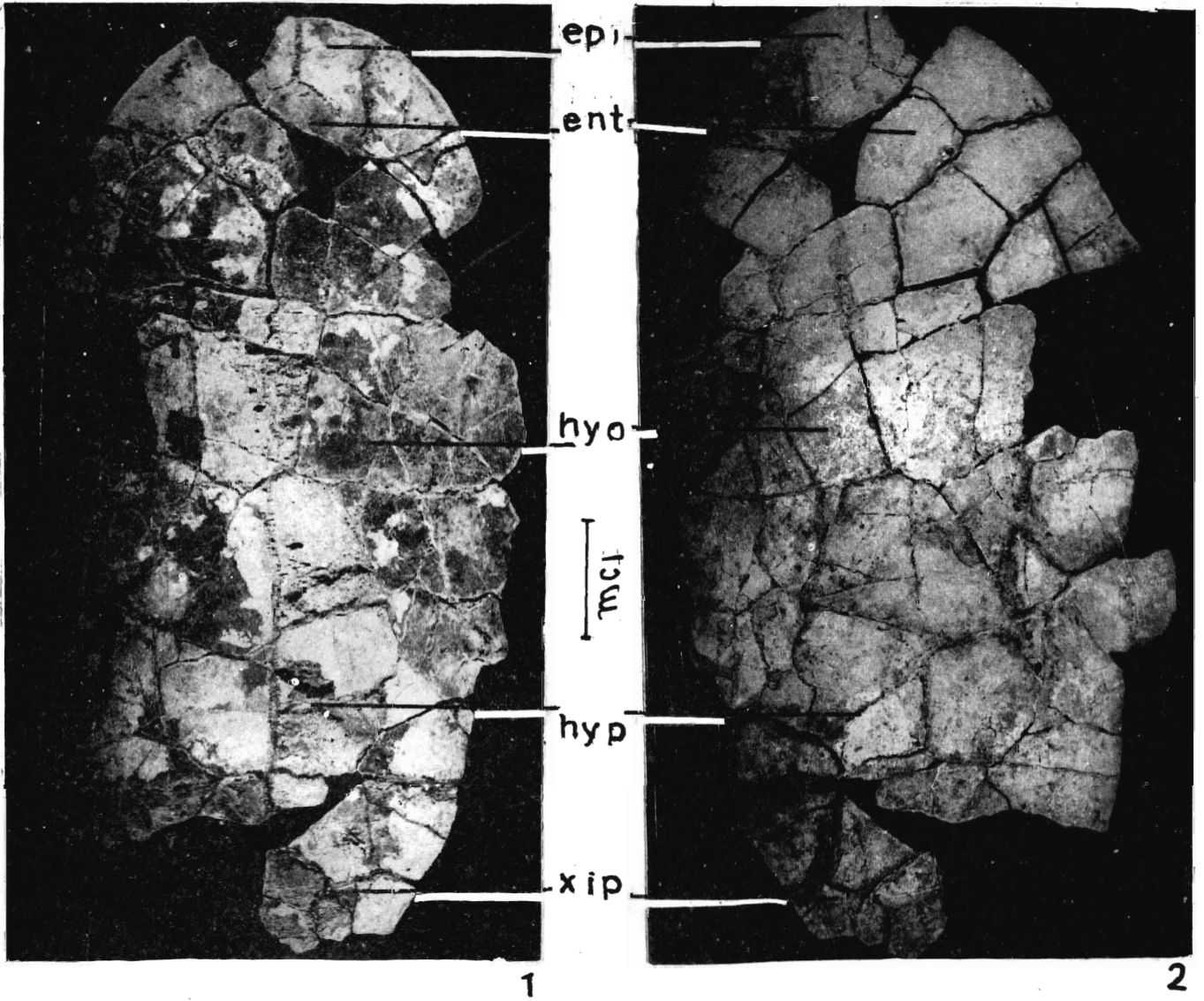
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## EXPLANATION OF PLATES

## PLATE I

*Shweboemys pisdurensis* from Lameta Formation, Central India; 1, carapace as displayed by ISI R 185; 2, plastron as displayed by ISI R 185; 3, vertebra from carapacial region; 1c to 5 c-costals 1 to 5, 1n to 5n, neurals 1 to 5, meso-, mesoplastra, nu.-nuchal.

## PLATE II

*Shweboemys pisdurensis* from Lameta Formation, Central India; 1 & 4, femur, obverse and reverse, ISI R 188; 2, plastron, ISI R 186; 3, carapace, ISI R 186 and 5, right ilium blade, ISI R 193. *Epi.*-epiplastra, *ent.*-entoplastra, *hyo.*-hyoplastra, *hypo.*-hypoplastra, *meso.*-mesoplastra, 1n to 3n.-neurals 1 to 3, nu.-nuchal.

## PLATE III

*Shweboemys pisdurensis* from Lameta Formation, Central India; 1, visceral view and 2, ventral view of plastron, ISI R 187; 3 & 4, left scapula, obverse and reverse, ISI R 190; 5 & 6, left coracoid, obverse and reverse, ISI R 189; 7 & 8, scapula, obverse and reverse, ISI R 191.