JURASSIC PTEROSAUR FROM INDIA

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Introduction: No definite pterosaurs are known from India. There is, however, a doubtful fragment reported by Dubey and Narain (1946) from the Inter-trappean beds (Lower Cretaceous) of Kotah, Rajasthan and another by Rao and Shah (1963) from Lower Jurassic Kota formation. The former has not been assigned to any genus but the latter has been assigned to *Rhamphorhynchus*. Neither of the material has been noticed by Kuhn (1967) in a review of the class Pterosauria. However, Colbert (1969) while describing a pterosaur from Cuba has commented on the doubtful identification of material of Rao and Shah. Excellent material of pterosaur has been

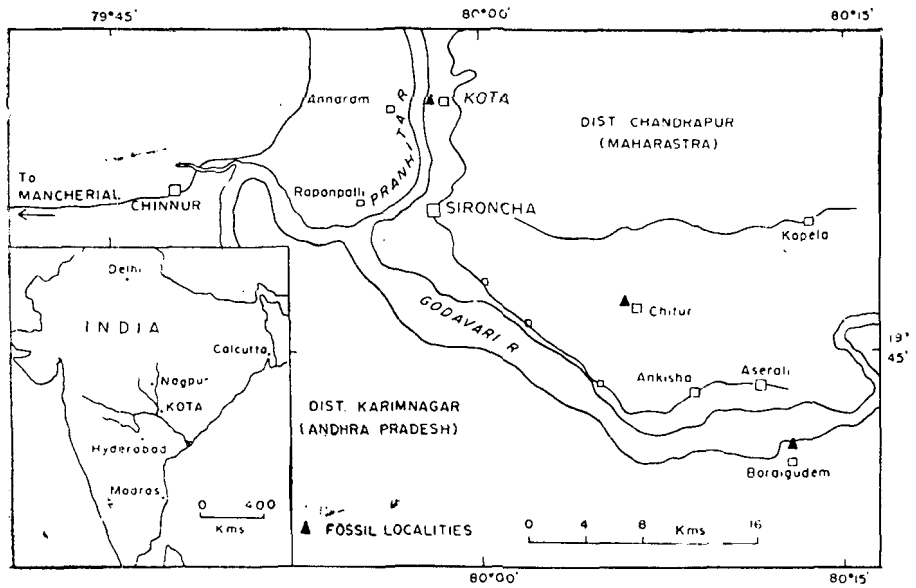

Figure 1. Map showing fossil pterosaur localities (▲) in India.
Inset: outline map of India showing river Godavari and its tributaries.

recently obtained from the Lower Cretaceous of Sinkiang, China and described by Young (1964). There has been a report of the discovery of *Rhamphorhynchus* in Soviet Asia (Anonymus, 1966). Thus it seems that pterosaurs enjoyed a wide distribution in Asia, in addition to their known distribution in Europe, East Africa and fragmentary remains from North and South America and Cuba.

The author came across the material which is described here during the course of investigation on the fossil vertebrates from the Kota formation (Lower Jurassic) in the Pranhita-Godavari valley (Fig. 1) as a part of the programme of integrated geological research. The Kota formation is a member of the Upper Gondwanas, occurring exclusively in the Pranhita-Godavari valley. The formation has been known to have yeilded a variety of fish, crocodile scutes, dinosaurs, estherians (Robinson, 1970) but it is mainly on the basis of fossil fishes that the evidence of its probable Liassic age lies.

Figure 2. A. *Campylognathoides indicus*, holotype (I.S.I. R. 48), exhibiting anterior part of skull and upper jaw with 3 teeth. From limestone ledge near Kota, Kota Formation.

B. *Campylognathoides indicus*, holotype (I.S.I. R. 48), a portion highly magnified to show the premaxillary teeth t_1, t_2, t_3).

C. *Campylognathoides indicus* (I.S.I. R. 49), fragment displaying dissociated post-cranial bones. From limestone ledge near Boraigudem, Kota Formation.

Material: The fossil material has been collected from known localities in the Kota formation as isolated fragments of finely laminated limestone (Fig. 2). Very little preparation work was necessary as the bone surface had been cleared by natural agencies. The material has been deposited in the Palaeontological collections of the Indian Statistical Institute, Calcutta.

ISI R 48.– holotype; fragment exhibiting the anterior part of the skull and upper jaw with 3 teeth; from limestone ledge near village Kota, appx. 130 x 102 mm.

ISI R 49.– fragment displaying dissociated bones from post-cranial region; from limestone ledge near village Boraigudem, appx. 105 x 52 mm.

GSI 17868.– fragment displaying incomplete radius, fourth metacarpal and first phalange of the wing finger; from limestone ledge near Chitur, appx. 170 x 150 mm.

SYSTEMATIC DESCRIPTION

Order: PTEROSAURIA
Suborder: RHAMPHORHYNCHOIDEA
Family: RHAMPHORHYNCHIDAE
Genus: *Campylognathoides* (Plieninger, 1894) Strand, 1928
Campylognathoides indicus sp. nov.

Diagnosis: Probably four premaxillary teeth. Anterior three teeth alike in shape and size and have tips slightly recurved towards back. Fourth tooth probably enlarged. Anterior teeth have fine vertical ridges culminating at the tip. Nasal process of premaxilla not much enlarged.

Holotype: I.S.I. R. 48.

Locality and horizon: Limestone ridge near village Kota, appx. 10 km north of Sironcha, Kota formation (Lower Jurassic), India.

Synonyms: Rhamphorhynchus sq. indet. Rao and Shah (1963).

Description: Skull—Only the anterior part of the skull is known (Fig. 3) which is preserved partly from the lateral view and partly from the palatal view. The shape of the bone and orientation of the teeth indicates clearly that these are the premaxillae of right and left side. The premaxilla of right side is almost complete with nasal process. Only the most anterior tooth (t. 1) is in position. Second and third teeth are preserved on the matrix but the sockets are well preserved on the margins of the bone. All the three teeth are similar in shape and size. The base is rather broad and its relation to the length is appx. 1 : 1½. Each tooth has fine vertical ridges culminating at the fine which is slightly recurved backwards. It appears that in cross-section each tooth at a point near the base is lanceolate. A large socket is seen along the row of tooth and sockets on the right premaxilla at the most posterior position. The corresponding tooth is not preserved. Length of the premaxilla from anterior tip to the labial end is 47 mm and upto the preserved end of the nasal process is 68 mm. Each tooth is appx. 4 mm long and 2.7 to 2.8 mm wide at the base. The anterior part of the narial opening is seen along the low angle formed by the nasal process of premaxilla and the dentigerous labial portion. It appears that the naris must have been a narrow opening.

Post-cranial structures: Imperfect radius and ulna associated with somewhat worn fourth metacarpal (Mc4) and Probable first phalange of the wing finger are

available for study in G.S.I. 17868 (Rao and Shah, 1963, Pl. 37). Radius and ulna lie closely and show the usual pterosaur features in general, in the preserved portion. Fourth metacarpal is too poorly preserved to enable comparisons with other pterosaurs. Its condylar end is worn and the proximal end is incomplete. A clawed digit assigned by Rao and Shah is probably of the manus, being associated with other bones of the fore-limb. First phalange of the wing finger is seen as an impression which is incomplete. It is unfortunate that either the proximal or the distal end of all the elements is missing or worn. The measurements (as given by Rao and Shah) are, therefore, of the preserved portion only.

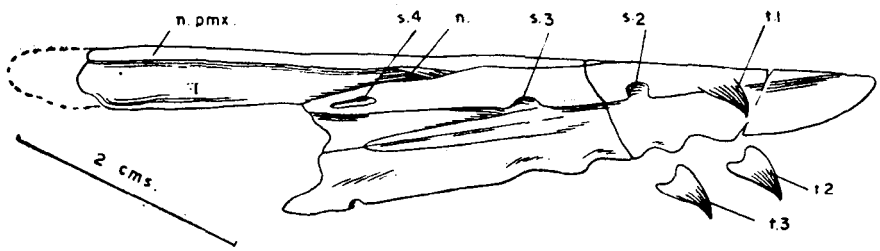

Figure 3. *Campylognathoides indicus* n. sp. holotype (I.S.I. R. 48); n. – naris, n. pax. – nasal process of premaxilla, s. 2, 3 & 4. – sockets for teeth, t. 1, 2 & 3. – teeth.

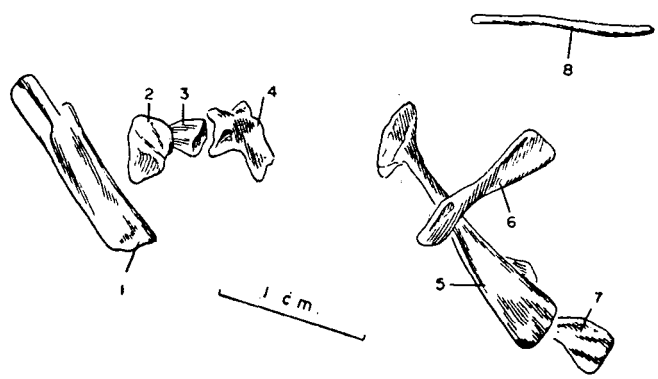

Figure 4. *Campylognathoides indicus*. Dissociated post-cranial bones. 1. ulna, 2. proximal carpal, 3. lateral carpal, 4. distal carpal, 5. ? left scapula, 6. coracoid, 7. fragment of right scapula and 8. ? second phalange of wing finger.

Three elements of the carpus are identifiable with high degree of probability in ISI R. 49. These are proximal carpal (2), lateral carpal (3) and distal carpal (4) as shown in Fig. 4. In rhamphorhynchids in general there are four elements in the carpus. It appears that one element is missing in ISI R. 49. The precise shape of these elements is more or less similar in all forms. The same block also shows ? second phalange of wing finger (8), incomplete ulna (1), ? left scapula (5) and coracodi (6). The fragment of the right scapula (7) is seen below the left scapula. Scapula (17 mm) is about $1\frac{1}{2}$ times as long as coracoid (11 mm.). The lack of common elements (except incomplete ulna) makes comparisions between GSI and ISI specimens difficult. However, evidence from preserved portion makes it clear that the GSI specimen must have been several times larger than the ISI specimen.

No material of axial skeleton, hind limbs and pelvic girdle is available for study.

Discussion: Campylognathoides indicus is known by a few fragmentary specimens (GSI 17868 & ISI 48 and 49) which have all been collected from nearby localities in the Kota formation (Fig. 1). The lack of common elements in the specimens makes comparisions difficult. The GSI specimen, in addition, does not exhibit any distinguishing character by which it could be compared with better known pterosaurs. Nevertheless, the number and shape of premaxillary teeth in ISI R. 48 are alearly suggestive of the features of the family Rhamphorhynchidae Seely 1870. It shows closest resemblance to *Campylognathoides zitteli*, which has been well illustrated by Pleininger (1894), in the number and orientation of premaxillary teeth. There are four premaxillary teeth in *C. zitteli* (excluding replacing teeth) of which the front three are almost similar in shape and size. The fourth tooth is most posterior and enlarged. ISI R. 48 has only one front tooth in position. Two more teeth, similar to the tooth in position, are preserved in the matrix. There is a large socket, situated posteriorly, in addition to the socket for the teeth on the matrix. It is, therefore, abundantly clear that ISI R. 48 had in all probability four teeth in the premaxilla, of which the posterior tooth was enlarged, similar to *C. zitteli*. However, the teeth in *C. zitteli* are nearly twice as large as in *C. indicus*, even though the labial portion of the premaxilla is approximately 25% smaller than in *C. zitelli*. Moreover the ratio between the length of the labial portion to the nasal process of premaxilla is appx. 1 : 3 in *C. zitelli*. The ratio in *C. indicus* cannot be given with precision due to imperfect end of nasal portion. The ratio of the preserved portion is appx. 1 : 1.5. The Indian rhamphorhynchid is unlikely to belong to *Rhamphorhynchus* as the teeth in *Rhamphorhynchus* are very steeply directed towards the front but in *Campylognathoides* these are either perpendicular or slightly recurved towards back (Pleininger, 1894).

Remarks on the occurrence of pterosaurs in India: The record of pterosaurs from the Indian subcontinent is still very fragmentary. In fact, in addition to the material described above, there is only a single fragment described by Dubey and Narain (1946). The fragment has probably been lost as it is neither in the collections of the Geological Survey of India nor of the Benaras Hindu University. The authors had mentioned that they expect to transmit the same to the British Museum (Natural History), London. It is doubtful if the material reached BMNH safely. However, enquiries are being made to ascertain the positon.

All the remaining material of pterosaurs from India has been obtained from two localities in the Kota formation which has been known for a number of semionotid fishes (Jain, 1973), crocodile scutes, dinosaurs (Jain, Robinson and Roy Chowdhury, 1962). In addition, estherians *(Cyzicus* and *Candona)* and undetermined blattid are also known. Robinson (1970) in a review of the Indian Gondwanas has suggested Upper Liassic age for the Kota formation. Rhamphorhynchid pterosaurs are known from Lower Lias to Upper Jurassic (Saint-Seine, 1955). *Camylognathoides* is known from the Upper Lias of Holzmaden in W. Germany and the finding of material, even fragmentary, which is assignable to this genus in the Liassic rocks in India further extends its geographical distribution. It is believed that the pterodactyles lived near the sea coast because nearly all pterosaurs have been known from marine sediments (Saint Seine, 1955). Kota sediments, however, are freshwater in origin (Robinson, 1970) and *C. indicus* probably lived around the 'margins of an expanding and very shallow lake'. The record of a definite pterosaur from India is interesting as practi-

cally nothing is known of this group of reptiles from the Gondwanas, although widely distributed in Laurasian continents.

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REFERENCES

ANONYMOUS, (1966) Palaeontological finds in Soviet Asia. *Sowjetanion heute* (Soviet Russia Today), v. 2, No. 7.

COLBERT, E. H., (1969) A Jurassic pterosaur from Cuba. *Amer. Mus. Nov.*, 2370, p. 1-26.

DUBEY, V. S. and NARAIN, K., (1946) A note on the occurrence of Pterosauria in India. *Curr. Sci.*, 15(10), pp. 287-288.

JAIN, S. L., (1973) New specimens of Lower Jurassic holostean fishes from India. *Palaeontology* 16(1): pp. 149-177.

JAIN, S. L., ROBINSON, P. L. and ROY CHOWDHURY, T., (1962) A new vertebrate fauna from the early Jurassic of the Deccan, India. *Nature, 194.* 4830, pp. 755-757.

KUHN, O., (1967) Die fossile Wirbeltierklasse Pterosauria. *Krailling (Oeben)*, 1-52, 26 Abb.

PLIENINGER, F., (1894) *Campylognathus zitelli,* einin neuer Flugsaurier aus dem oberen Lias Schwapens. *Palaeontogr*, 193-222.

RAO, C. N. and SHAH, S. C., 1963 (1967) On the occurrence of Pterosaur from the Kota-Maleri beds of Chanda district. *Rec. Geol. Surv. India*, v. 92, pp. 315-318.

ROBINSON, P. L., (1970) The Indian Gondwana formations—a review. *First Sym. Gond. Start.*, I.U.G.S., pp. 202-268.

SAINT-SEINE, P., (1955) Pterosauria in *Traité de Paléontologie.* Paris: Masson et Cie. 963-990.

YOUNG, C. C., (1964) On a new pterosaurian from Sinkiang, China. *Vert. Palasiatica*, 8(3): pp. 221-255.

ON THE OCCURRENCE OF *EOTRIGONODON* IN THE EOCENE OF RAJAHMUNDRY, ANDHRA PRADESH

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Introduction: Rajahmundry (17°0′ : 81°47′) is, perhaps, the only place in India where the monotony of the Deccan Traps is relieved by a set of marine fossiliferous strata. By virtue of their stratigraphic position, these beds are known as Inter-trappean. In a thick suit of igneous rocks, like Deccan Traps, the presence of inter-stratified fossiliferous marine strata is of considerable attraction, for they not only reveal the paleogeography and the nature of life flourishing during that period of earth's history, but contribute materially towards the much debated problem of the chronology of the Deccan Traps. It is mainly because of these considerations that the Inter-trappean beds of the Rajahmundry region have been subjected to intensive paleontological investigation.

The Inter-trappean beds of the Rajahmundry area are well-developed and show excellent exposures near Pangadi (17°1′ : 81°39′02″), about 16 km west of Rajah-