*Bull. zool. Surv. India, 1 (3) : 211-220, 1978

# REVISION OF THE GENUS *SPONDYLUS* LINNAEUS (PELECYPODA : MOLLUSCA) FROM CRETACEOUS BEDS OF TRICHINOPOLY (S. INDIA) WITH NOTES ON RELATED SPECIES

K. V. LAKSHMINARAYANA AND C. S. ROY

*Zoological Survey of India, Calcutta*

ABSTRACT

This paper deals with the revision of the species of the genus *Spondylus* from Cretaceous beds of Trichinopoly, which includes a new subspecies. *S. subsquamosus* Forbes was given priority over *S. calcaratus* Forbes. Specimens inadvertantly placed earlier are now shifted to their proper places. Observations on related species from the adjacent countries is also appended. Keys to the subgenera and species from Cretaceous beds of Trichinopoly are provided.

## INTRODUCTION

The genus *Spondylus* Linnaeus is well represented in the Cretaceous beds of Southern India (Forbes, 1846 ; Stoliczka, 1871 ; Kossmat, 1897). The senior author, during 1970 survey of the Trichinopoly fossil bearing beds encountered some members of this genus. This material along with Stoliczka (*op. cit.*) and Kossmat (*op. cit.*) collections from Cretaceous beds of Trichinopoly available in the Geological Survey of India (here after referred to as G. S. I.) and specimens in the Indian Museum Invertebrate fossil gallery, Calcutta, were examined. This paper deals with a revision of the species involved together with notes on related species in view of the utility of the genus at times in the stratigraphic zonation as for example, *Spondylus* shales in Tibet (Hayden, 1907).

## SYSTEMATIC ACCOUNT

Subclass *PTEROIDA* Newell, 1965

Superfamily PECTINACEA Rafinsque, 1815

Family SPONDYLIDAE Gray, 1826

Genus **Spondylus** Linnaeus, 1758, *nec* *Spondylus* Thomson, 1866 *pro* *Spondylis* C. Fabricius, 1775. Type species (by subsequent designation, Schmidt, 1818 : 61) *S. gaederopus* Linnaeus.

The characters of the genus *Spondylus* were discussed by Hertlein & Cox (1969). The species are medium sized, orbicular, or oval ; gibbous ; with unequal valves ; right valve larger and more convex, pectinate, byssal notch lacking ; auriculate. Adductor impressions large, subcentral ; ligament

internal and located in a triangular pit. Teeth strong, one in the left and two in the right valves on either side of the ligament pit. Radial costae usually spinose. Ranges from Jurassic to Recent. Hertlein & Cox (1969) recognized three subgenera viz., *Spondylus s.s.*, *Corallospondylus* Monterosato, and *Eltopera* Iredale.

In the following descriptions, rib has been used for prominent stout costa, and costae or costellae for longitudinal striations in between two ribs or otherwise, basing on their width ; wings are preferred to ears.

### *Key to the subgenera*

1. Shell small, terebratuloid ; radial costellae delicately or weakly spinose . .. ..... .. .. ..... ..... *Corallospondylus* Monterosato
— Shell large, inflated .....2.

2. Shell strongly inflated ; radial sculpture spinose, or foliaceous ; right valve large, triangular : crural teeth short, heavy, smooth, or crenulated ..... ... ..... *Spondylus* L. *s.s.*

— Shell less inflated : radial sculpture weakly spinose ; cardinal area of the right valve much elongated ; crural teeth small, widely separated ..... .. ..... ..... *Eltopera* Iredale

### *Species Reported*

Five species are known from Cretaceous beds of Trichinopoly. On the basis of our examination, it is possible to group them under the following subgenera :

1. *S.* (*Spondylus*) *subsquamosus* Forbes (=*S.* (*S*) *calcaratus*). Podicherry (Forbes, 1846) *Trigonarca* beds of Pondicherry (Forbes. 1846 ; Kossmat, 1897) ; Trichinopoly (Stoliczka, 1871).

2. *S.* (*S.*) *lamellosus* Kossmat. *Trigonarca* beds of Pondicherry (Kossmat, 1897).

3. *S.* (*Corallospondylus*) *arrialoorensis* Stoliczka. Ariyalur (Stoliczka, 1871 ; *Trigonarca* beds of Pondicherry (Kossmat, 1897).

4. *S* (*Eltopera*) *sulcatellus* Stoliczka. Ariyalur (Stoliczka, 1871).

5. *S.* (*E.*) *subcostulats* Stoliczka. Utatur (Stoliczka, 1871).

The new subspecies described here under, viz., *kallarensis* belongs to *S.* (*S.*) *lamellosus* Kossmat.

### *Remarks on the Species*

1. **Spondylus (Spondylus) subsquamosus** Forbes, 1846

(pl. II, fig. 1 A-C.)

*Spondylus* (*Spondylus*) *subsquamosus* Forbes, 1846. *Trans. geol. Soc. Lond.*, (2) 7 : 154, pl. xviii, fig. 1.

*S. calcaratus* Forbes 1846. *Trans. geol. Soc. Lond.*, (2) 7 : 155, pl. xviii, fig. 2

*S. calcaratus* Forbes : Stoliczka, 1871. *Palaeont. indica*, (6) 3 : 448, pl. 33, figs. 10. (*partim*).

*S. calcaratus* Forbes : Kossmat, 1897. *Rec. geol. Surv. India*, 30 (2) : 6, 10.

*? S. calcaratus* Forbes : Bion, 1926. *Rec. geol. Surv. India*, 56 (3) : 268.

Stoliczka (1871) stated that he agrees with d'Orbigny, in concluding that *S. subsquamosus* Forbes and *S. calcaratus* Forbes are conspecific. Strangely, however, he used the name *S. calcaratus* (Forbes, 1846, p. 155, pl. 18 fig. 2 in preference to *S. subsquamosus* (Forbes, 1846, p. 154, pl. 18 fig. 1) which is untenable under the *Rules of Priority*. Therefore, we restore *S. subsquamosus* Forbes as the name of the species.

Stoliczka collections in G. S. I. include four specimens labelled as *S. calcaratus* Forbes, bearing the Type Nos. 1335 (pl. 33 fig. 6), 1336 (pl. 33 figs. 7, 7a), 1338 (pl. 33 figs. 9, 9a), and 1339 (pl. 33 fig. 10). Of these, only Type No. 1339 (pl. 33 fig. 10) belongs to *S. calcaratus* Forbes *sensu* Stoliczka (1871) and the other specimens bearing Type Nos. 1335, 1336, 1339, belong to *S. sulcatellus* Stoliczka (Stoliczka, 1871 : 448, pl. 34, fig. 1 Therefore, we included *S. calcaratus* Forbes *sensu* Stoliczka (*partim*) and referrable to his specimen with Type No. 1339, pl. 33 fig. 10 only in the species under discussion,

Forbes (1846) described and figured excellently the species. The Z. S. I. has several examples, some of which are nearly complete and others are broken. Wings are however present in G. S. I. specimen. Shape of the valves suborbicular with radiating longitudinal ribs alternating with finer striations or costae numbering from 2-5. Transverse striations are present, but indistinct towards the umbonal region. The characteristic feature of the species lies in the presence of scaly tubercles placed at irregular intervals, which at times fuse when they are crowded ; the tubercles are confined to the longitudinal ribs, but often overlap the striae also.

*Material Examined* : One example, Andoor ; Ariyalur group (sp. No. L 57 in the box No. L 5/58 in show case No. 79 of the Invertebrate fossil gallery, Indian Museum, Calcutta, labelled as *S. calcaratus* Forbes ; (G. S. I. Type No. 1339), Serdamungalam, Trichinopoly Group, labelled as *S. calcaratus* Forbes, pl. 33 fig. (10), Coll. *F. Stoliczka* colls. ; 9 examples (Z. S. I. Regd. Nos. IVP 42-50), Kallar River beds, 1.5 km S. E. of Kallankuruchi village, *c* 5 km E. of Ariyalur (Ariyalur Stage), 17. i. 1970, coll. *K. V. Lakshminarayana.*

| | | *Measurements* (cm) *Height* | *Length* | |
|---|---|---|---|---|
| G.S.I. Type No, 1339 | | 7.7 | 7.6 | |
| Z.S.I. IVP | 42 | 10,2 | 8.3 | (Incomplete) |
| | 43 | Incomplete specimen | | |
| | 44 | 7.2 | 7 2 | |
| | 45 | 10.4 | 10.2 | (Incomplete specimen) |
| | 46 | 8.5 | 6.3 | -do- |
| | 47 | 6.7 | 6.8 | (Incomplete specimen) |
| | 48 | Incomplete specimen | | |
| | 49 | -do- | | |
| | 50 | -do- | | |

*Remarks* : We preferred to treat this species as *S.* (*S.*) *subsquamosus* Forbes for the reasons already cited. The material referred to by Forbes (1846), Kossmat (1897), and Bion (1925) are not however, available in the G. S. I. collections. Forbes (1846) reported it from Pondicherry and Kossmat (1897) also recorded it from the *Trigonarca* beds of Pondicherry Cretaceous which corresponds to the Lower Ariyalur stage in the Trichinopoly Cretaceous. Bion (1925) doubtfully identified his specimens from the Upper Cretaceous beds of Afghanistan *i. e.* K. 11314, end of gorge of the Karnard River, left bank, just above Andao (lat. 35° 20′ ; long. 67° 53′) (H. H. H.), and H. 42/556, south-eastern slope of Koh-i-ab-i-shora, South of Shadian, near Balkh, Afghanistan. Stoliczka (1871) though reported four specimens labelled as *S. calcaratus*, (G. S. I. Type Nos. 1335-1339) only 1339 in fact, pertains to this species. Our material collected from Kallar River beds near Kallankuruchi village, definitely belongs to the Ariyalur stage, and it is interesting to note that Kossmat (1897) also reported it from *Trigonarca* beds equivalent to Lower Ariyalur Stage in Pondicherry. Since Stoliczka (1871) reported it from Trichinopoly Stage, it can be safely inferred hat the species extends probably from the uppermost beds of Trichinopoly Stage and extends into Ariyalur Stage both in Tamil Nadu and Pondicherry.

**2. Spondylus (Spondylus) lamellosus Kossmat,** 1897

Apart from Kossmat (1897), no one else have so far reported this species either from Pondicherry or elsewhere and Z. S. I. collections include this species, which we consider to be a subspecies of *S.* (*S.*) *lamellosus* Kossmat.

**2. (a) Spondylus (Spondylus lamellosus** Kossmat, *sens. str.* 1897. *Rec. geol. Surv. India*, 30 (2) : 94, (also 61, 106) pl. IX, fig. 10 a. b.

TABLE I

**OTHER KNOWN SPECIES FROM INDIA**

( All measurements are given in

| *Name of the species* | *Epoch/Locality* | *Source of information* |
|---|---|---|
| 1 | 2 | 3 |
| 1. *S. santoniensis* D'Orb. | U. Cretaceous ; Baluchistan (Pakistan). | Noetling, 1897. |
| 2. *Spondylus* sp. | —do— | —do – |
| 3. ? *S. calcaratus* Forbes | Cretaceous ; Afghanistan | Bion, 1925 |
| 4. *S. rouaulti* d'Archiac & Haime | —do— | —do— |
| 5. *S. subserratus* Douv. | —do— | —do— |
| 6. *S roxanae* Vredenburg in Cossmann & Pissarro | Palaeocene ; Upper Ranikot, Sind (Pakistan) | Vredenburg in Cossmann & Pissarro, 1927. |
| 7. *S. alexandrae* V. in C. & P. | —do— | —do— |
| 8. *S. rouaulti* d'Archiac & Haime | Palaeocene-Eocene. Palaeocene ; Upper Ranikot, Sind (Pakistan) Eocene ; | d'Archiac & Haime, 1854 |
| | 4.8 km above Dzong Tibet. | Douville, 1916 |
| | Palaeocene ; Upper Ranikot ; (Sind, Pakistan) ; Eocene ; Laki beds of Salt Range (Pakistan) & Laki beds ? of Tibet. | Cox, 1931. |
| | Lower Miocene ; Kathiawar. | Pascoe, 1963 |
| 9. *S. perhorridus* Oppenheim | Eocene ; Kohat Shales (Basal Kirthar) of Kohat, N. W. F. P (Pakistan) | Cox, 1931. |
| 10. *S. geniculatus* d' Archiac & Haime | Eocene ; Sind (Pakistan) | d'Archiac & Haime, 1854 |
| 11. *S. radula* Lamarck | Eocene ; Laki limestone of Kohat, N. W. F. P. (Pakistan) ; Lower Kirthar of Baluchistan (Bugti Hills). | ——— |
| | (Pakistan). Hisai Jebel, Bahra'n Is., Persian Gulf. | Cox, 1936 |

AND ADJACENT COUNTRIES

cm Height × Length)

| *Type/Regd. No.* | *Remarks* |
|---|---|
| 4 | 5 |
| G. S. I. No. 3019 ( 12.4×10.0 ) | |
| G. S. I. No. 3021 (4.0×3.8) | Does not appear as *Spondylus*. |
| —— | Specimens not available. |
| —— | —do— |
| —— | —do— |
| G. S. I. No. 10983 ( 5.2×4.0 ) | Finer striae and prominent ribs present. Appears similar to *S. subcostulatus* Stol, but the long axis is more and tubercles prominent. |
| G. S. I. No. 10982 ( 2.6×2.7) G. S. I. No. 10984 3.0—3.6×3.2—3.9 | Though this specimen is labelled as *S. alexana drae*, it is identical with *S. roxanae*. Cox (1931) however, considers these two species conspecific with *S. rouaulti*. |
| —— | Specimens not available. |
| G. S. I. No. 12800 ( =k9/495 ) ( 4.8×4.6 ) ; G. S. I. No. 12801 ( 4.7×4.5) | Prominent ribs with costae in between. Intercostal furrows equal to costae, which are also tuberculated. Transverse striations are also more. 12801 incomplete. Exact specific diagnosis not possible. |
| —— | Specimens not available. |
| —— | Specimens not available. |
| —— | Specimens not available. Strongly tuberculated with prominent ribs in Cox's figures. |
| —— | Specimens not available. |
| —— | Specimens not available. From the figures it appears closer to *S. sulcatellus* Stol., but well tuberculated. |
| G. S. I. No. 17361 (=k9/763 ) ( 1.5×1.5 ) | Cox (1936) figured this specimen (pl. 3 fig. 10). Very small. Impression only. Tubercules and wings not clear. Costae very fine. |

TABLE 1 (Contd.)

( All measurements are given in

| | | | |
|---|---|---|---|
| 12. | *S. crassicosta* Lamarck | Eocene ; Close to Latidun, w. of Bandar Abbas, (Persia) | Cox, 1936 |
| 13. | *Spondylus* sp. | Eocene : Musefeni Pass, e. of Kasedan, Baluchistan, (Pakistan) | ——— |
| 14. | *Spondylus* sp. | Bet. Muniari Fort & Karry Kachh, Nummulitic beds. | ——— |
| 15. | *S. tallavignesi* d'Archiac & Haime | Miocene ; Sind (Pakistan) | d'Archiac & Haime, 1854. |
| 16. | *Spondylus* sp. | Miocene ; Burma, in zone of *Aricia humerosa*, Thayetmyo. | Noetling, 1897 |
| 17. | *Spondylus* sp. off. *entiacus*. | Miocene ; Fars Series, Kharak Is., Persian Gulf. | ——— |
| 18. | *Spondylus* sp. | Miocene ; Gaj Stage, Nearing the Gorge Panigumbrok, Sind, (Pakistan) | ——— |
| 19. | *Spondylus* sp. | Miocene, Gaj Stage, Bet. Pindara & Virpur, W. Kathiawar. | ——— |

(Pl. II, fig. D)

Although, Kossmat (1897) considers this species a very common one in the Ariyalur stage of Pondicherry (*Trigonarca* beds), yet his collections include a single specimen which is available in G. S. I. collections. The species is similar to the above, but with concentric lamellae instead of scaly tubercles at irregular distances from one another which are very characteristic.

*Material examined* : One example (G. S. I. Type No. 6553), Saidarampet, 0.4 km. west of Rautankupam ; two examples ; Andoor, Ariyalur group. (Sp. No. L5 / 58 in show case No. 79 of the Invertebrate fossil gallery, Indian museum, Calcutta) labelled as *S. calcaratus* Forbes.

*Measurements* (cm)

| | *Height* | *Length* | |
|---|---|---|---|
| G.S.I. Type No 6553 | 6.9—7.8 | 7.4—8.7 | (Both valves) |

*Remarks ;* This species comes no doubt very close to *S. subsquamosus* Forbes, but can easily be distinguished by the concentric irregular lamellae radiating across instead of scaly tubercles. Two examples in show case No. 79, Sp. No. L5 / 58 in the Invertebrate fossil gallery, Indian Museum, Calcutta and labelled as *S. calcaratus*, belongs to this species. Also an example in vertical show case No. 33. sp. No. 1816, in the Invertebrate fossil gallery, Indian Museum, Calcutta, from the Tertiary deposits of Beanuis, Dep. del. oise and labelled as *lamellosus* does not belong to this species.

cm Height × Length )

| | |
|---|---|
| G. S. I. No 17398 ( 5.9× 5.5 ) G. S. I. No. 17399 ( =k21/219 ) ( 8.2× 8.9 ) G. S. I. No. 17400 ( 8.7× — ). | Ribs and tubercles prominent. Intercostal furrows equal or subequal to costae. |
| Sp. No. K10/450 in show case No. 93 of the Invertebrate fossil gallery, Indian Museum. | Approaches near *S. arrialoorensis* Stol. |
| Sp. No. C. 050 E. in show case No. 93 of the Invertebrate fossil gallery, Indian Museum. | Not possible to determine its status. |
| ——— | Specimens not available. |
| ——— | Specimens not available. |
| Sp. No. C. 362/1 in Show case No. 93 in the Invertebrate fossil gallery, Indian Museum. | Approaches near *S. lamellosus* Kossmat. |
| Sp. No. 280/406 in Show case No. 98 in the Invertebrate fossil gallery, Indian Museum. | Appears near *S. subsquamosus* Forbes. |
| Sp. No. H1/24 in show case No. 99 in the Invertebrate fossil gallery, Indian Museum. | Not possible to determine. |

**2. (b) Spondylus (Spondylus) lamellosus kallarensis subsp. nov.**

(pl. II fig. E)

The material referred to under this subspecies was collected along with several examples of *S. subsquamosus.* Although, in general facies, tt agrees with *S.* (*S.*) *lamellosus sens. str.*, this subspecies can be easily distinguished from *S. lamellosus* Kossmat, by the lamellae not placed at irregular distances but are continuous from end to end, and the prominent radiating ribs are absent and the costal striations are continuous. Therefore, we are inclined to place this under a separate subspecies.

*Material examined* : One example (Z. S. I. Reg. No. IVP. 51) from Kallar River beds, 1.5 km S.E. of Kallankuruchi Village, *c* 5 km E. of Ariyalur (Ariyalur Stage), 17. i. 1970, coll. *K. V. Lakshminarayana.*

*Measurements* (cm)

| | *Height* | *Length* |
|---|---|---|
| Z.S.I. Reg. No. IVP 51 | 8.3 | 7.1 (incomplete) |

*Remarks* : The specimen although incomplete, shows the diagnostic characters very well. The species *sens. str.*, was hitherto, known only in the *Trigonarca* beds (Lower Ariyalur Stage) of Pondicherry, and therefore, the present records of the subspecies from Ariyalur Stage of Trichinopoly Cretaceous is interesting. It confirms Kossmat's view that *Trigonarca* beds belong to Ariyalur Stage only

**3. Spondylus (Corallospondylus) arrialoorensis** Stoliczka, 1871.

(Pl. II, fig. F)

*S. arrialoorensis* Stoliczka, 1871. *Palaeont. Indica*, (6) 3 : 447, pl. XXXIII fig. 5.

*S. ariyalurensis* : Kossmat, 1897. *Rec. geol. Surv. India*, **30** (2) : 60, 106, pl. X, figs. 2a, b.

This species (Stoliczka, 1871) belongs to the subgenus *Corallospondylus*, because of its small size, and the radial costellae delicately or weakly spinose. Stoliczka (*op cit.*) reported that its lower valve was attached to a fragment of *Inoceramus*. Valves are small, asymmetrical, umbonal region irregular, prominent, radially striated, with concentric rings of growth. Some of the radiating costae bear strong tubercles or spines. The wings are large.

*Material examined* : One example (G.S.I. Type No. 1334), S. W. of Mulloor, Ariyalur Stage, Coll. *F. Stoliczka.*

*Measurements* (cm)

| | *Height* | *Length* |
|---|---|---|
| G.S.I. Type No. 1334 | 2.7 | 2.6 |

*Remarks* : Only example referred to and figured by Stoliczka (1871) is available in G.S.I. collections. Material referred by Kossmat (1897) from 0.8 km W.S.W. of Tutipet from the *Trigonarca* beds (Ariyalur Stage) and numbered as G.S.I. Type No. 6559 is missing in the G.S.I. The figures however, agree with those of Stoliczka.

**4. Spondylus (Eltopera) sulcatellus** Stoliczka, 1871.

(Pl. II, figs. G-H)

*S. sulcatellus*, Stoliczka, 1871. *Palaeont. indica.* (6) **3** ; 448, pl. XXXIV fig. 1.

*S. calcaratus*, Forbes : Stoliczka, 1871.. *Palaeont. indica* (6) **3** : 448, pl. XXXIII, figs. 6, 7, 7a, 9, 9a, (*Partim*). N. Synonymy.

*S. sulcatellus* : Spengler, 1923. *Palaeont. indica*, N. S. **8** (1) : 18, pl. II, figs, 13 a, q.

Stoliczka (1871) described this species to include specimens with valves, having radiating sharp and laterally compressed ribs, with furrows equal to the thickness of the ribs. Few tubercles are present on the ribs. The valves are asymmetrical and the ribs present a rough or rugose exterior. Stoliczka (1871) described this species basing on a single example. But on examination of Stoliczka collections available in the G.S.I., we found that specimens with Type Nos. 1335, 1336, 1338, labelled as *S. calcaratus* Forbes also in fact, belong to this species, therefore, we include here partly the material of *S. calcaratus* Forbes *sensu* Stoliczka The Z.S.I. collections also include a single example of this species.

*Material examined* : One example (k1/228) N. of Poodoopolliam, Ariyalur group, Show case No. 79, Invertebrate fossil gallery, Indian Museum, Calcutta , one example (G.S.I. Type No. 1340), N. of Poodoopolliam (Pudupalayam), (Ariyalur Stage) ; three examples (G.S.I. Type Nos. 1335, 1336, 1338) from Serdamungalum (Trichinopoly Stage), Coll. *F. Stoliczka* colls. ; One example Z. S. I. Reg. No. IVP 52, Kallar River beds, 1.5 km of Kallankuruchi Village, *c* 5 km E. of Ariyalur, 17. i. 1970, Coll. *K. V. Lakshminarayana.*

*Measurements* (cm)

| | *Height* | *Length* |
|---|---|---|
| G. S. I. Type No, 1340 | 5.3 | 5.9 |
| ,, 1335 | 6.4 | 5.9 |
| ,, 1336 | 7.6 | 6.6 |
| ,, 1338 | 6.4 | 6.0 |
| Indian Museum No. K1/228 | 6.8 | 5.0 |
| Z. S. I. IVP 52 | 4.1 | 4.9 (incomplete) |

*Remarks* : Stoliczka (1871) collections include material from both Trichinopoly and Ariyalur Stages. The present Z.S.I., collections include one example from Ariyalur stage and therefore, we may safely conclude that the species extend from Trichinopoly to middle Ariyalur. Spengler (1923) reported this

species from Tharia ghat, Maomlah (Assam). His figures indicate that this species definitely existed in Assam region.

**5. Spondylus (Eltopera) subcostulatus** Stoliczka, 1871.

(Pl. II, fig. 1)

*S. subcostulatus* Stoliczka, 1871. *Palaeont. indica.* (6) 3 : 449. pls XXXIII fig 8 & XXXIV fig. 2,

*S. subcostulatus* Stol. : Hayden, 1913-14. *Faune Cretaciche del Caracarum spedizione Italiana de Filippi nell' Himalaia, Caracaorum E Turchestan Cinese,* (2) 6 : 124.

Stoliczka (1871) based his species on two examples. The Z.S.I. collections include one example. The valves are variable, wings when preserved are unequal. The striae or ribs are very fine, intercostal space equal to subequal to the striae. The valves tend to be very smooth, with prominent umbonal arch.

*Material examined :* One example (G. S. I. Type No. 1337), 'E. of Parally', Moraviatoor (Maruvattoor), Ootatoor Stage (Utatur Stage) ; One example (G. S. I. Type No. 1341) Locality labelled as Ootatoor group can be inferred as Odium from his description), Utatur Stage, coll. *F. Stoliczka* colls. One example (Z. S. I. Reg. No. IVP 41), Kallar River beds, 1.5 km. S. E. of Kallankuruchi village, c 5 km. E. of Ariyalur, 17. 1. 1970, coll. *K. V. Lakshminarayana.*

*Measurement* (cm)

| | *Height* | *Length* |
|---|---|---|
| G. S.. I. Type No. 1337 | 4.4 | 4.4 |
| G. S I. Type No. 1341 | 6.0 | 5.3 |
| Z. S. I. IVP 41 | 3.6 | 3.5 |

*Remarks :* Stoliczka (1871) recorded it from the Utatur Stage, and the present record from Ariyalur Stage, therefore, extends its range from Utatur to Ariyalur (Middle) and is yet to be reported from Trichinopoly Stage. Hayden (1913-14) material is not however, available for study, but the specimens from parts of Tibet are often referred to as *S. rouaulti* d' Arch.. & Haime.

*Key to the species from Cretaceous beds of Trichinopoly*

| | | |
|---|---|---|
| 1. | Tubercles scaly or lamellose ; numerous. ... ..... | 2. |
| | —Tubercles spiny ; sparse... | |
| 2. | Tubercles scaly ; stout ribs alternating with 2– 5 fine costae ... .. | *S.* (*S.*) *subsquamosus* Forbes |
| | —Tubercles lamellose..... | 3. |
| 3. | Transverse lamellose tubercles not continuous from end to end, irregularly placed ..... | *S.* (*S.*) *lamellosus lamellosus* Kossmat |
| | —Transverse lamellose tubercles continuous from end to end, regularly placed..... .. | *S.* (*S.*) *lamellosus kallarensis* n. ssp. |
| 4. | Valves large ..... | 5. |
| | —Valves small ; smooth, shining ; sulcations and ribs equal ; weakly spinose..... | *S.* (*C.*) *arrialoorensis* Stol. |
| 5. | Valves mostly asymmetrical ; ribs appear as rugose ; sulcations deep and equal to ribs ..... ..... | *S.* (*E.*) *sulcatus* Stol. |
| | —Valves regular ; ribs fine, not rugose ; intercostal spaces subequal to equal to ribs .... | *S.* (*E*) *subcostulatus* Stol. |

NOTES ON OTHER SPECIES

Other known species of India and adjacent countries along with our observations are noted in Table No. 1.

ACKNOWLEDGEMENTS

The authors are grateful to Drs. S Khera, the then Deputy Director-in-Charge, K. K. Tiwari, Deputy Director, S. K. Bhttacharyya Superintending Zoologist for their keen interest in this work. We are also highly indebted to the Director General, Geological Survey of India, Messrs M. V. A. Sastry, Director and Mr. N. K. Sinha, Geologist, Paleontology Dvision for placing their valuable collections at our disposal for study.

## REFERENCES


BION, H. S, 1924-25. Notes on Cretaceous Fossils from Afghanistan and Khorsan with an introduction by J. C. Brown. —*Rec. geol. Surv. India*, **56** (3) : 257-269 pls. 13-17.

COSSMANN, M. and PISSARRO, G. 1927. Introductory note on the stratigraphy of the Ranikot series.—*Palaeont. indica* N. S., **3** Mem. No. 1, 1909 : 83, 8 pls.

COX, L. R. 1931. A contribution to the Molluscan Fauna of the Laki and Basal Khirthar Groups of the Indian Eocene. —*Trans. Roy. Soc. Edin.* **57** (1), No. 2 : 25-92 pls. 1-4.

COX, L. R. 1936. Fossil Mollusca from southern Persia (Iran) & Bahrein Island. —*Palaeont. indica.* N. S. **22**, Mem. No. 2, : 1-69, pls. 1-8.

ARCHIAC, V. and HAIME, J. 1853-54. Description d'des Animaux Fossiles du Groupe Nummulitique de l'Inde precede d'un Resume Geologique et d'une Monographie des Nummulites (Paris), 4° : 373.

DOUVILIE, H. 1916. Le Cretace et l'Eocene du Tibet Central.—*Palaeont. indica* N. S., **5**, (3) : 1-52, pls. 1-16.

FORBES, E. 1845-46. Report on the Fossil Invertebrata from Southern India collected by Mr. Kaye and Mr. Cunliffe. —*Trans. geol. Soc. Lond.* (2), **7** : 154-155, 18 pls.

HAYDEN, H. H. 1907. The geology of the provinces of Tsang and U in central Tibet. *Mem. geol. Surv. India*, **36** (2) : 54, pl. II, fig. 2.

*HAYDEN, H. 1913-14. *Faune Cretaciche del Caracorum spedizione italiana Defilippinell Himalaia. Caracoram E. Turchestan Cinese* (2) **6** : 124.

HERTLEIN, L. G. and COX, L. R. 1969, "Family Spondylidae".—In R. C. Moore's *Treatise on Invertebrate Palaeontology.*—The Geol. Soc. Amer. & The univ. Kansas/Boulder, Colo, (N), **1**, Mollusca, 6 : N 378-N 380, figs. C.99, 1-3 figs.

KOSSMAT, F. 1897. The Cretaceous deposits of Pondichery.—*Rec. geol. Surv. India*, **30**, (2) : 51-111, pls. 6-10.

NOETLING, F. 1897. Fauna of the Upper Cretaceous (Maestrichtien) beds of the Mari hills.—*Palaeont. indica*, (16), **1**, (3) : 1-79. pls. 1-23.

NOETLING, F. 1907. Fauna of the Miocene beds of Burma.—*Palaeont. indica*, N. S., **1** (3) : 1-378, pls. 1-25.

PASCOE, E. H. 1950-1963. *A manual of the Geology of India & Burma.* Govt. of India/ New Delhi, **3**, 2nd. ed. : 1-2130.

SPENGLER, E. 1923. Contributions to the Palaeontology of Assam. *Palaeont. indica*, N. S. **8** (1) : 1-80, pls. 1-4.

STOLICZKA, F. 1871. The Cretaceous Fauna of Southern India. The Pelecypoda. —*Palaeont. indica*, (6), **3** : 1-537, pls. 1-50.


* Original not seen.