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Genus *Worthoceras* Adkins from Cretaceous Deposits of Tiruchchirapalli District, Tamil Nadu, India

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Abstract

Paper reports the presence of the genus *Worthoceras*. Adkins from the Utatur Group, Cretaceous deposits of Tiruchchirapalli, Tamil Nadu. The genus is represented by three species, viz., *Worthoceras vermiculum*, *W. gibbosum* and *Worthoceras* sp. aff. *W. rochatianum*. History and phylogenetic position of the genus is discussed in detail. Authors, following Henderson (1973), place the *Worthoceras* species under the family Scaphitidae and consider the genus *Otoscaphites* Wright as an evolutionary form in the lineage *Eoscaphites-Scaphites*.

INTRODUCTION

During field work, in connection with the project on the revision of fauna from Cretaceous deposits of Tiruchchirapalli District, the authors collected a number of heteromorph ammonoids. This paper deals with the occurrence of genus *Worthoceras* Adkins, 1928, collected from Odiyam (11°13′ : 78°59′30″), which was so far reported only from Madagascar, France, Czechoslovakia, U.S.S.R. and U.S.A. Presence of this genus in the Utatur Group has significance (1) in understanding the evolutionary trends within the genus and (2) in establishing the phylogenetic relationship of this genus with the family Scaphitidae.

Adkins (1928) erected the new genus *Worthoceras* with *Macroscaphites platydorsus* Scott, 1924, as its type species. But he was uncertain about the systematic position of the genus. He described the generic characters as 'initial planospiral coil, followed by a straight limb, which connects by a bend to a shorter and thicker straight limb subparallel to the first but not touching it. Ribs and tubercles reduced or absent. Suture simplified with quadrate siphonal lobe prominently divided by a simple saddle. The lobules being entire, first and second saddles equal, broader than the siphonal lobe and each subsymmetrically bifid but devoid of secondary incisions. 1st and 2nd lateral lobes simple, half as wide as saddles, 3rd saddle undivided, antisiphonal lobe small, triangular, undivided' (Adkins, 1928, pp. 218-219).

Adkins established the genus to accommodate two Upper Albian species from Texas, *Worthoceras platydorsum* (Scott) and *W. worthense* (Adkins) and also referred *Scaphites vermiculus* Shumard, an early Turonian species to this new genus.

Moreman (1942) gave the systematic position of this genus as belonging to Cosmaceratidae, Subfamily Scaphitinae. He referred *Scaphites vermiculus* Shumard to *Worthoceras vermiculum* on the basis of specimens collected by Conlin with well preserved long lappets. Moreman described a new species *Worthoceras gibbosum* Moreman with more inflated whorl section, shorter shaft, which is rounded, not straight and more frilled suture than the other species. Both the species were reported from the Lower Turonian of the Eagle Ford Group of North and Central Texas (Moreman, 1942; pp. 214-215).

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Wright (1953) assigned a new systematic position to this genus. He sub-divided Scaphitidae Meek 1876, into two subfamilies as Scaphitinae and Otoscaphitinae. Otoscaphitinae Wright included *Worthoceras* Adkins and *Otoscaphites* Wright, both of which have lateral lappets, with *Worthoceras gibbosum* Moreman and *Scaphites minutus* Moreman (considered to be an *Otoscaphites* by Wright) as link. He indicated that the early member of the *Otoscaphitinae* evolved in parallel to the Scaphitinae but never developed a complex suture or ornamentation. Wright pointed out that *Macroscaphites rochatinus* d'Orbigny a Lower Turonian form reported from different parts of Western and Central Europe was clearly a *Worthoceras* and very close to *W. vermiculus* (Wright, 1953; pp. 474, 475).

Wright (1957) has adopted the same classification in the Treatise on invertebrate Paleontology, 1957. He pointed out that long straight lappets on the aperture are characteristic of the genus, which are commonly broken in the fossils (Wright 1957; p. 1231).

Wiedmann (1965) regarded *Otoscaphites* as closely related to the lineage *Eoscaphites-Scaphites* and not related to *Worthoceras,* which he put under Ptychoceratinae. He defined *Worthoceras* as being evolute spire, generally lacking ornament and a simple suture with a trifid lateral lobe and a narrow undivided umbilical lobe. He regarded *Worthoceras* as a phylogenetic end form which is showing, slow evolutionary trend, with no essential features in common with true Scaphitids. And so according to Wiedmann, subfamily Otoscaphitinae should be abandoned (Wiedmann, 1965; pp. 439-443).

Clark (1965) followed Wright's classification. He reported four species from Texas Cretaceous, i.e. *Worthoceras platydorsum* (Scott), *W. worthense* (Adkins), *W. vermiculum* (Shumard) and *W. gibbosum* Moreman. He observed more or less complete sequence of *Worthoceras* species confirming Wright's ideas that this genus and it's species constitute evolutionary series and the various species are not occasional aberrant offshoots of the Scaphitinae as suggested by Spath (Clark, 1965; pp. 40-63).

Kennedy described *Worthoceras* sp. from Cenomanian of Southern England referring the genus to Ptychoceratidae following Wiedmann's classification (Kennedy 1971; pp. 5, 6).

Cobban and Scott, while describing the ammonite fauna near Pueblo, Colorado have followed Wiedmann's classification. They reported two species as *Worthoceras gibbosum* Moreman and *W. vermiculum* (Shumard) from Cenomanian beds (Cobban and Scott, 1972; pp. 43, 44).

Henderson (1973) pointed out that *Worthoceras* is closely related to other members of the family Scaphitidae as far as coiling, ornamentation and early stages in ontogenic sutural development are concerned. After studying New Zealand species he came to the conclusion that the genus is highly variable and far from a phylogenetic end stock. Similarly, according to him, Wright's Otoscaphitinae lineage in which *Worthoceras* was thought to have evolved into *Otoscaphites* is difficult to evaluate. Thus, he found that a close phylogenetic relationship between *Worthoceras* and *Otoscaphites* can neither be adequately proved nor completely dismissed and thought not to use sub-family Otoscaphitinae till more evidences are available. He reported three new species, viz., *Worthoceras parvum* Henderson, *W. costatum* Henderson and *W. johnstoni* Henderson from Albian of New Zealand (Henderson 1973; pp. 89-91, 96-99).

Wright remarks that the genus *Worthoceras* has closer affinities with Scaphitidae rather than Ptychoceratidae as described by Wiedmann (1965). However, the comments that were stated to follow in his later paper (Wright 1979 ; pp. 294-297), have not appeared in print so far (personal communication, Wright).

Marcinowski (1980) reported three species from Middle Cenomanian of Mongyshlak (U.S.S.R.) as *Worthceras rochatianum* (d'Orbigny), *W. vermiculum* (Schumard), and *Worthoceras* sp. He followed Wiedmann's classification (Marcinowski 1980, pp. 247-250).

Thus, there are two schools of thought regarding the systematic position of genus *Worthoceras*. Wright (1953) on the one hand, putting it under subfamily Otoscaphitinae of Scaphitidae and Wiedmann assigning it to family Ptychoceratidae on the other. The authors prefer the following systematic position :

Phylum : MOLLUSCA
Class : CEPHALOPODA
Order : AMMONOIDEA
Family : SCAPHITIDAE Meek, 1876
Genus : *Worthoceras* Adkins, 1928

Definition: 'Initial planospiral, evolute coil, followed by straight or slightly curved, long or short shaft, with recurving hook. Dorsal impression may or may not be present. Ornamentation of weak ribs or smooth. Suture lytoceratid, symmetrical or asymmetrical with bifid or trifid lateral lobe'.

Type species: *Macroscaphites platydorsus* (Scott).

Age: Albian – Turonian.

Remarks: As mentioned earlier, there are two schools of thought so far as systematic position of *Worthoceras* is concerned. On one hand, we have Wright (1953, pp. 474, 475) who on the basis of presence of lappets, evolute early coil with a variable shaft, recurving hook and suture with either symmetrical or asymmetrical lobes considered it necessary to assign these forms to a separate sub-family Otoscaphitinae, probably derived from *Eoscaphites*.

However, Wiedmann (1965, pp. 439–443) on the basis of trifid lobe, straight long shaft and dorsal impression considered these forms to be more closely related to Ptychoceratidae, whereas according to him *Eoscaphites – Scaphites – Otoscaphites* lineage is entirely a different lineage and not related to *Worthoceras*.

Henderson (1973) giving due weightage to his species *Worthoceras parvum* Henderson, *W. costatum* Henderson and *W. johnstoni* Henderson from Albian of New Zealand and comparing these with species described by earlier workers concluded that Weidmann's contention regarding *Otoscaphites* not related to *Worthoceras* but belonging to *Eoscaphites – Scaphites* lineage is more appropriate. However, he could not agree with Wiedmann so far as relationship between Ptychoceratidae and *Worthoceras* was concerned, as according to him, *Worthoceras* was related to scaphitid stock on the basis of involution and ornamentation. He preferred to consider *Worthoceras* as an independent stock derived from an early scaphitid stock through neoteny.

Adding further to Henderson's observations whereby he has noted only coiling pattern, it must be mentioned that Ptychoceratidae is essentially made up of representatives with two or three parallel shafts and at no stage either recurving into a

PLATE 1

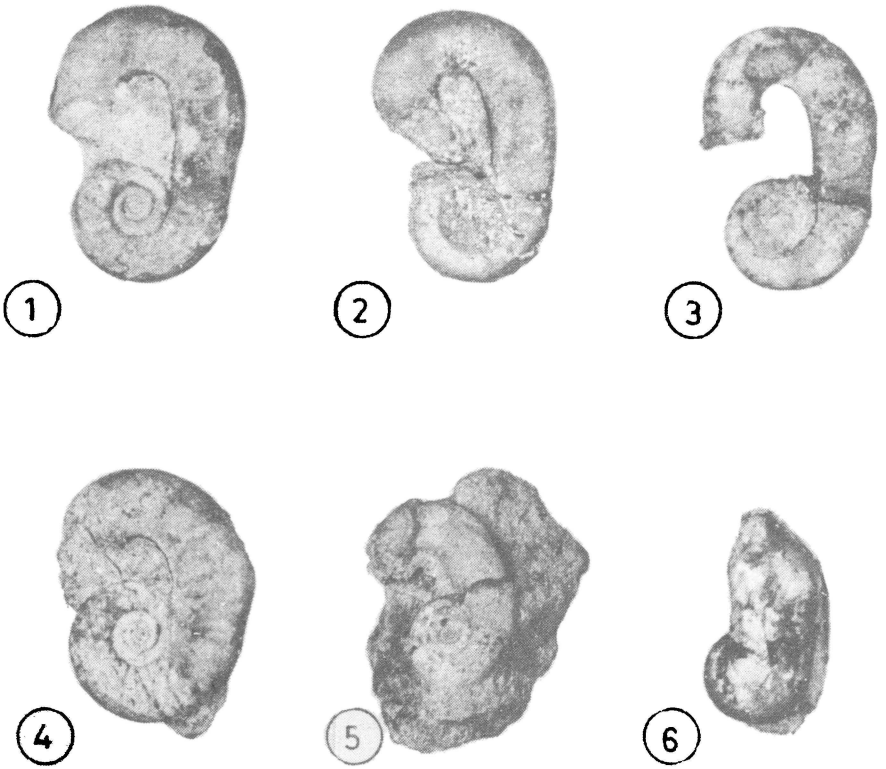


Fig. 1. *W. vermiculum* (Shumard); *Plesiotype* No. MACS G 2334, ×2

Fig. 2. *W. vermiculum* (Shumard); *Paratype* No. MACS G 2335, ×2

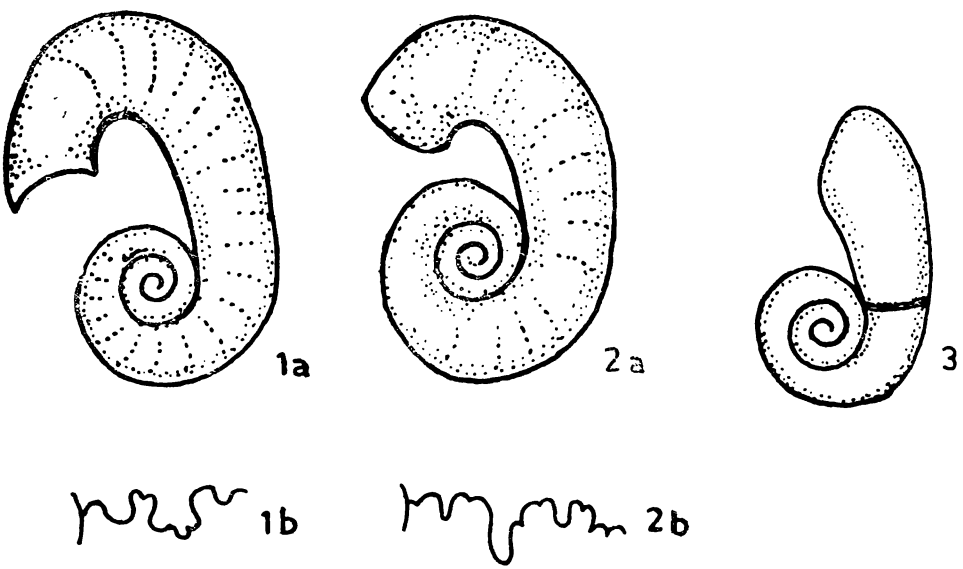
Fig. 3. *W. vermiculum* (Shumard); *Paratype* No. MACS G 2336, ×2

Fig. 4. *W. gibbosum* Moreman; *Plesiotype* No. MACS G 2337, ×2

Fig. 5. *W. gibbosum* Moreman; *Paratype* No. MACS G 2338, ×2

Fig. 6. *Worthoceras* sp. aff. *W. rochatianum* (d'Orb), Specimen No. MACS G 2339, ×2

hook at the aperture or a coil in initial stages is present. Considering the suture it can be seen that the early forms like *W. worthense* and *W. rochaiianum* (text Fig. 4I and H) show presence of trifid lobe, whereas *W. vermiculum* and *W. gibbosum* (text Fig. 4A-D) have distinctly bifid lobes. Of these *W. worthense* is Albian form, whereas the remaining three are Cenomanian – Turonian in age. Now this bifidity and trifidity of lobes, maintaining primitive Lytoceratid nature is common amongst Ptychoceratids. Whereas lytoceratid suture with variations is noticed amongst Scaphitidae, it is in genus *Scaphites*, that suture ceases to be regularly lytoceratid and it is at *Clioscaphites* stage that the first lateral lobe becomes trifid or more asymmetrically bifid. Thus purely on considerations of minor differences of sutures it would be unjustifiable to assign any systematic position to Worthoceratids. This appears more so since all the Albian species from New Zealand described by Henderson (1973), have bifid first lateral lobe (Text Fig. 4E-G). This indicates that bifid and trifid nature of first lateral lobe existed throughout the history of *Worthoceras*, i.e., from Albian to Turonian. It is significant to note that Arkell *et al.* (1957, p. L98) mentioned that 'the same suture on two flanks may not be identical and (p. L111) Cretaceous heteromorphs need not be identified as phylogenic end forms on the basis of their sutural pattern '.



Figures 1-3. Line drawings of the type specimens.

1a. *Worthoceras vermiculum* (Shumard), *Plesiotype* No. MACS G 2334, ×2: 1b. Suture of the same ×8; 2a. *W. gibbosum* Moreman, *Plesiotype* No. MACS G 2337, ×2; 2b. Suture of the same ×6; 3. *Worthoceras* sp. aff. *W. rochatianum* (d'Orbigny, specimen No. MACS G 2339 ×2).

Hence, the genus needs redefinition (*vide supra*) to include characters like straight or slightly curved, long or short shaft with bifid or trifid lateral lobe as described earlier. Such variation of suture is seen in both the families Ptychoceratidae and Scaphitidae. But, considering the other characters, authors prefer to follow Henderson (1973) in not placing this genus under a separate subfamily Otoscaphitinae.

In the following paragraphs three species of genus *Worthoceras* Adkins, namely, *W. vermiculum* (Shumard), *W. gibbosum* Moreman and *Worthoceras* sp. aff. *W. rochetianum* (d'Orb.) are described from Utatur Group where age is established as Albian—Cenomanian by several workers like Blanford (1862), Stoliczka (1873), Kossmat (1898), Sastry and Sastri (1966), Das and Chatterjee (1973), Chiplonkar and Tapaswi (1973a), Chiplonkar and Tapaswi (1973 b) and Chiplonkar and Phansalkar (1976).

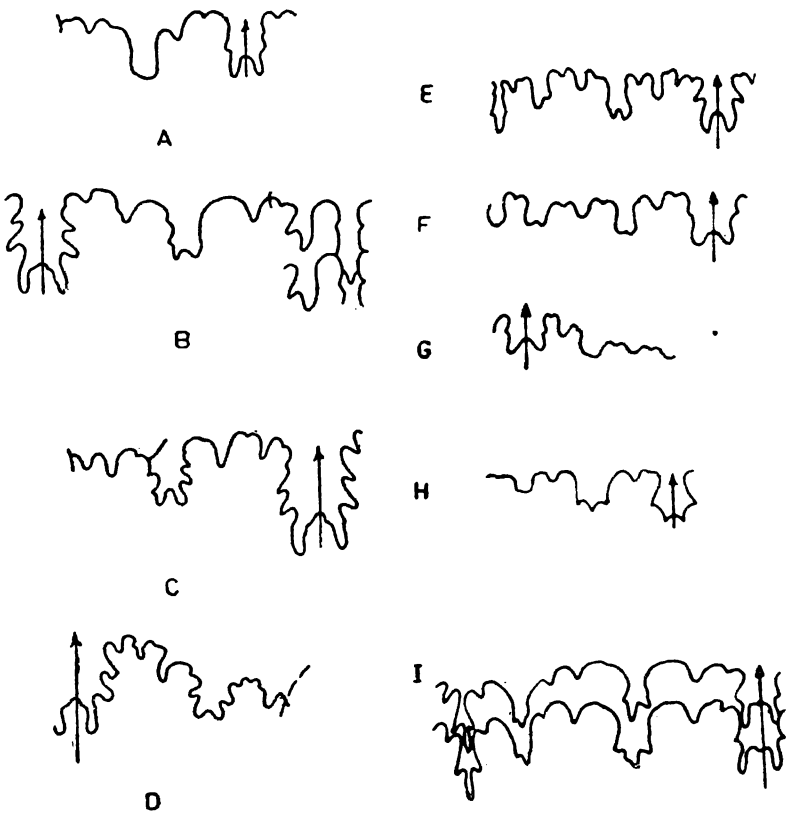


Figure 4. Sutures of different species of *Worthoceras* Adkins.

A and B – *Worthoceras vermiculum* (Shumard) (Wiedmann, 1965), C and D – *W. gibbosum* Moreman (C: Wiedmann, 1965; D: Clark, 1965), E – *W. parvum* (Henderson) (Henderson, 1973), F – *W. costatum* (Henderson) (Henderson, 1973), G – *W. johnstoni* (Henderson) (Henderson, 1973), H – *W. rochatianum* (d'Orbigny) (Wiedmann, 1965), I – *W. worthense* (Adkins) (Wiedmann, 1965).

SYSTEMATIC DESCRIPTION

Worthoceras vermiculum (Shumard)

(Plate I, figs. 1, 2 and 3. Text Fig. 1a and 1b)

1860 *Scaphites vermiculum* Shumard : Shumard, p. 594

1928 *Scaphites vermiculum* Shumard : Adkins, p. 220, 259.

1942 *Worthoceras vermiculum* (Shumard) : Moreman, p. 214, pl. 34, figs. 12, 13, text fig. 2p.

1965 *Worthoceras vermiculum* (Shumard) : Wiedmann, p. 440, pl. 59, fig. 8, pl. 60, figs. 1, 2 text figs. 103-109.

1965 *Worthoceras vermiculum* (Shumard) : Clark, p. 62, pl. 4, figs. 9-11.

1972 *Worthoceras vermiculum* (Shumard) : Cobban and Scott, p. 43-44.

1980 *Worthoceras vermiculum* (Shumard) : Marcinowski, pp. 248-249, pl. 2, figs. 5, 6.

1984 *Worthoceras vermiculum* (Shumard) : Cobban p. 16, pl. 2, fig 5.

Material : Three specimens. *Plesiotype* No. MACS G 2334

Remarks : By having smooth, finely, striae, evolute shell with long shaft, rounded dorsum, the species agrees well with *W. vermiculum* (Shumard) described by Marcinowski (1980) from U.S.S.R. Colorado species described by Cobban and Scott (1972) cannot be properly evaluated being poorly preserved but the Texas material described by Clark (1965) agrees well with Indian material and hence, placed under *W. vermiculum* (Shumard).

Occurrence: From Yellowish clay, of Cenomonian age, Utatur Group at Odiyam.

Distriburion: This species is reported from lowermost Turonian of the United States (Texas and Kansas), Upper Cenomanian and Middle Cenomanian of U.S.S.R. and Cenomanian of Colorado (U.S.A.)

Worthoceras gibbosum Moreman
(Plate I, figs 4 and 5. Tcxt fig. 2a and 2b.)

1942 *Worthoceras gibbosum* Moreman : Moreman, p. 215, pl. 34, figs 7, 8, text fig. 2g.

1965 *Worthoceras gibbosum* Moreman : Wiedmann, p. 441, pl. 60, figs, 3a-d, text fig. 10h.

1965 *Worthoceras gibbosum* Moreman : Clark, p. 63, fig. 22b, pl. 4, figs. 13-15.

1972 *Worthoceras gibbosum* Moreman : Cobban and Scott, p. 43

Material: Two specimens. *Plesiotype* No. MACS G 2337

Remarks: Indian material agrees well with Moreman's *W. gibbosum* (1942) in having obscure ribs, depressed whorls and body gradually increasing in width.

Wright (1953, p. 475) described *W. gibbosum* as terminal member of the *Worthoceras* group having characters intermediate between the typical *Worthoceras* and its descendant *Otoscaphites*. *Worthoceras* is having typical smooth spire with straight shaft while *W. gibbosum* is having distinct moderately ribbed spire and curved shaft.

Occurrence: From yellowish clay, of Cenomanian age, Utatur Group at Odiyam.

Distribution: This species is reported from Early Turonian of Texas, Cenomanian of Colorado (U.S.A.).

Worthoceras sp. aff. *Worthoceras rochatianum* (d'Orb.) 1847
(Plate I, fig. 6. Text fig. 3.)

Material: One specimen. *Plesiotype* No. MACS G 2339)

Description: Shell smooth, evolute spire followed by long shaft which is not straight, with flat dorsal side. The suture is not seen.

Remarks: Present material does not show clear dorsal impression as in species described by Wiedmann (1965) and Marcinowski (1980). But the coiling pattern, evoluteness and ornamentation in all three specimens being identical, the present material is considered here as *W. rochatianum*.

Occurrence: From yellowish clay, of Cenomanian age, Utatur Group at Odiyam.

'Considering the occurrence of *Worthoceras vermiculum* and *W. gibbosum* together in British Islands as well as the U.S.A., Kennedy considers these two to be a dimorphic pair rather than as two independent species' (personal communication, Kennedy).

REPOSITORY

The specimens presented in this paper are deposited in the Museum of Geology and Palaeontology, MACS Research Institute, Pune, India.

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