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fuss, 1834–1840; Lamarck, 1819; Stokes and Stifel, 1964). Only Stokes and Stifel (1964) have reported color patterns in the genus from North America.

Pigments in shells are thought to be waste products of metabolism secreted in the shell as a means of disposal (Nuttal, 1969). While the pattern might be for protection in some forms, it may have no function in many bivalves which are infaunal (Nuttal, 1969) or, in the case of gryphaeiform shells, lived with the left valve in or against the substrate (Stokes and Stifel, 1969).

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FIRST RECORD OF BATHONIAN *BULLATIMORPHITES* (JURASSIC, AMMONITINA) FROM KACHCHH, INDIA

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ONLY TWO specimens of the family Tulitidae Buckman were previously reported from Kachchh (also Cutch, Kutch, Katch, or Kachh) in the state of Gujarat, i.e., "Stephanoceras bullatum (d'Orbigny)" of Waagen (1875) from the lower Callovian Golden Oolite of Kheera. Parona and Bonarelli (1897) named Waagen's illustrated specimen "Sphaeroceras" cosmopolitum, which Spath (1924) later designated as the type species of Kheraiceras Spath. The only other tulitid known from the Indian subcontinent is the single Bullatimorphites (Kheraiceras) cf. bullatus from the Polyphemus Limestone of Baluchistan, Pakistan, described by Noetling (1896, Pl. 6, fig. 2, 2a).

Recently, Kanjilal (1978) described "*Kheraiceras probullatum*" from Habo Hill, Kachchh, which the authors consider to be a junior synonym of *Macrocephalites chariensis* (Waagen). The specimen described here, collected by D.K.P. in the Bathonian of Pachham "Island" (also Pachham or Pachcham Hill) (Figure 1), is therefore only the second record and third specimen of *Bullatimorphites* from Kachchh, and the first from the Bathonian.

STRATIGRAPHY AND AGE

The specimen of *Bullatimorphites* n. sp. A described here came from a 1.5 m thick bed, the Shell Limestone Member, Patcham Formation of Pachham "Island." It was associated with *Clydoniceras triangulare* Pandey and Agrawal and *Paracenoceras kumagunense* (Waagen). The bed is overlain by a 6.5 m thick interval yielding *Clydoniceras pachchhamense* Pandey and Agrawal, Micromphalites (Clydomphalites) cf. clydocomphalus Arkell, and Procerites (Gracilisphinctes) sp., according to Pandey et al. (1984) and Pandey and Agrawal (1984). Whereas Clydoniceras ranges from the Middle to Upper Bathonian in Europe, Micromphalites (Clydomphalites) has been dated in Arabia as Middle Bathonian (Arkell, 1952a; Arkell et al., 1957) or Lower Bathonian (Enay and Mangold, 1984). In Madagascar, Micromphalites occurs in the highest Middle Bathonian (probably coeval to the Cadomites bremeri Zone of western Tethys), as well as in the Upper Bathonian where it is an index of the Micromphalites hourcqui Zone (Collignon, 1964). Procerites ranges no higher than basal Upper Bathonian. Hence, Middle Bathonian (to ?basal Upper Bathonian) is indicated for the lower horizon with Bullatimorphites.

SYSTEMATIC PALEONTOLOGY

Suborder Ammonitina Hyatt, 1889 Superfamily Perisphinctaceae Steinmann, 1890 Family Tulitidae Buckman, 1921 Genus Bullatimorphites Buckman, 1921

Type species. -B. bullatimorphus Buckman, 1921 (=Ammo-nites bullatus Lycett, 1863, non d'Orbigny, 1846), by original designation.

Remarks. – Two dimorphic subgenera are distinguished, Bullatimorphites s.s. and Kheraiceras. Bullatimorphites s.s. (microconch Sphaeroptychius Lissajous, 1923) ranges from the middle



FIGURE 1-Simplified geological map of Kachchh, with the "Jura domes/ islands" stippled.

Zigzag (Standard) Zone, Lower Bathonian, to the Middle Retrocostatum and Orbis (Aspidoides) Zones in the lower Upper Bathonian; B. (*Kheraiceras*) (microconch Bomburites Arkell, 1952, including Treptoceras Enay, 1959) ranges from the lower Retrocostatum Zone to the Athleta Zone in the Upper Callovian (Callomon in Donovan et al., 1981; Westermann and Callomon, 1988). *Bullatimorphites* s.s. is moderately involute, with subcircular to rather depressed septate whorls and a gradually uncoiling to moderately elliptical adult body chamber; *B. (Kheraiceras*) has highly involute and depressed septate whorls and a hook-shaped, heteromorphic body chamber which partially occludes the umbilicus.

Subgenus KHERAICERAS Spath, 1924

Type species.—*Sphaeroceras cosmopolitum* Parona and Bonarelli, 1897, by original designation.

BULLATIMORPHITES (KHERAICERAS?) n. sp. A Figure 2

Bullatimorphites bullatus (d'Orbigny). PANDEY AND AGRAWAL, 1984, p. 188.

Material. – One macroconch (Banaras Hindu University, Department of Geology, No. PG/262/2), mostly internal mold, right side eroded but otherwise complete with well-preserved inner whorls. From Shell Limestone, WNW of Sadhara, Gora Dongar, Pachham "Island," Kachchh.

Description. – Phragmocone (80 mm diameter) spheroconic, moderately involute, with depressed, ovate-subtrapezoidal whorl section. Penultimate septate whorl (43 mm diameter; Figure 2.2–2.4) strongly depressed (w/h = 1.36 to 1.44) and with steep, relatively wide umbilicus (u/d = 0.18 to 0.20). Ultimate septate whorl becoming subelliptical and much more involute (u/d \approx 0.13), with gently rounded flanks and venter. Ornamentation of penultimate septate whorl consists of moderately prominent and dense costae irregularly dividing between umbilical shoulder and mid-flank by bifurcation, rare trifurcation and fascic-



FIGURE 2-Bullatimorphites (Kheraiceras?) n. sp. A. Specimen PG/262/2, from the Shell Limestone, WNW of Sadhara, Gora Dongar, Pachham "Island" in Kachchh, Gujarat, India. 1, side view of the outer whorl, $\times 0.8$; 2-4, side, ventral, and apertural views of juvenile stage, $\times 1$.

ulation, with marked flexure; some ribs are single on one side but join a primary on the other. Toward end of phragmocone, primaries become rectiradiate, elongated, and blunt, before dying out; secondaries probably obsolescent (not exposed). Septal suture poorly preserved.

Body chamber (340° angular length) terminates at 133 mm diameter, and probably lacks only the ventral part of the peristome. Beginning of body chamber curving abruptly inward and partially occluding umbilicus, followed by rapid, "elliptical" uncoiling so that aperture barely overlaps preceding whorl (u/d = 0.30); second third of body chamber contracting markedly, followed by constant whorl width (strong negative allometry). Ornamentation consists of blunt, widely spaced undulations on venter and outer flanks, whereas inner flanks appear to be smooth.

Remarks. - The outer whorl (body chamber) closely resembles that of the latest Bathonian to earliest Callovian Bullatimorphites (Kheraiceras) bullatus (d'Orbigny) in coiling, whorl section, and ornamentation. The inner whorls are less depressed (higher) and more evolute; they thus come close to those of several middle Bathonian species, i.e., B. (Bullatimorphites) bullatimorphus Buckman, the similar (?conspecific) B. (B.) costatus Arkell, and to B. (B.) ymir (Oppel) and the similar (?conspecific) B. (B.) eszterensis (Boeckh) (for illustrations see Arkell, 1952-1954; Hahn, 1971; Sandoval, 1983; Galacz, 1980). A good match of the entire shell is B. (B.) sp. 1 of Sandoval (1983, Pl. 70, fig. 1) from the B. costatus Zone of Spain, which he considered to be intermediate between the restricted genus and B. (Kheraiceras), both stratigraphically and phylogenetically. All of these European forms differ by the more weakly modified body chamber and appear to be restricted to the upper Middle Bathonian and probably the basal Upper Bathonian of the Mediterranean Province and Indonesia, i.e., essentially the western and southern margins of the Jurassic Tethys. Bullatimorphites (Kheraiceras), on the other hand, is cosmopolitan (circum-global except Boreal).

Close comparison of the inner whorls with those of the European species, however, is limited by the poor knowledge of juvenile microconchs. The nucleus of *B. (Kheraiceras) bullatus* illustrated by Westermann (1958, Pl. 22, fig. 1a, b) is evolute (and ?constricted), but intermediate whorls become spheroconic and involute at 20–25 mm diameter (Sandoval, 1983, fig. 153).

The oldest, well-dated B. (Kheraiceras) described previously occur in horizons 12 and 13 of the Upper Bathonian Retrocostatum (Standard) Zone in Submediterranean France, coeval with the lower and middle parts of the Orbis Zone (olim Aspidoides Zone) (Mangold, 1984; Callomon, personal commun.). The faunas associated with our specimen and those superposed indicate a Middle Bathonian age. If confirmed, this would be the oldest occurrence of B. (Kheraiceras). A morphology intermediate to Bullatimorphites s.s. suggests that the new species is either near the branching point of B. (Kheraiceras) from Bullatimorphites s.s., or forms an early iterative offshoot resembling B. (Kheraiceras). Significantly, morphogenetic development is by "recapitulation," with the inner whorls resembling the ancestral stock and the outer whorl that of the derived B. (Kheraiceras).

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