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Inoceramids and buchiids in the Tithonian deposits of western Cuba: a possible faunistic link with South-Eastern Pacific²

(Figs 1–4)

Abstract. Occurrence of the “Boreal type” bivalves: inoceramids (represented by the genera: *Inoceramus* Parkinson, 1819; *Retroceramus* Koshelkina, 1963 and *Anopaea* Eichwald, 1861) and buchiids (*Buchia* Rouillier, 1845) in the Tithonian sections of the Sierra de los Organos and Sierra del Rosario belts, western Cuba, is described. *Anopaea* and other “Boreal” bivalves probably migrated to the Cuban Jurassic basin over the South American shelf and probably through Southern Mexico. Their occurrence might reflect cooler temperature in the proto-Caribbean basin caused by oceanic currents and/or upwelling, rather than tectonic transport from Southern Boreal province.

Key words: Western Cuba, Tithonian biopaleogeography, inoceramids, buchiids, ammonites.

INTRODUCTION

The problem of existence of a cool (antiboreal) zone in the southern hemisphere during the Jurassic period, corresponding to the southern Pacific Subrealm (*sensu* Westermann, 1984), was frequently discussed in geological literature (Hallam, 1971, 1975, 1981, 1983; Parrish & Ziegler, 1980; Parrish, 1992). According to Stevens (1980, 1994), the Jurassic period in the southern hemisphere was characterized by wet and warm climate. The Jurassic glacial sediments are not known from the antiboreal zone (see Stevens, 1980; Parrish & Ziegler, 1980; Parrish, 1992; Ricciardi *et al.*, 1992; Bradshaw & Challinor, 1992; Enay & Cariou, 1997). Ice-rafted pebbles, an evidence for cold climate, appear for the first time in Lower Cretaceous deposits of South Australia and New Zealand (see Stevens, 1994). This climate change is related to continental dispersal (Stevens, 1971, 1980, 1989, 1994). The

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presence of inoceramids and buchiids are considered to be characteristic for Boreal Realm of the northern hemisphere (Zakharov, 1981). However, the climatic change alone does not adequately explain their presence in the Upper Jurassic and Lower Cretaceous deposits of Antarctica and southern part of South America (see Crame, 1982; Parrish, 1992).

The opening of the Gulf of Mexico in the Middle-Late Jurassic and formation of a proto-Caribbean basin, occurred due to the separation of North and South America. Hypothetical reconstruction of the Late Jurassic proto-Caribbean basin, was given by Pindell (1985) and Ross & Scotese (1988).

The present paper gives a systematic revision and palaeontological description of the inoceramids and buchiids collected from Tithonian deposits of the Guaniguanico terrane in western Cuba. A discussion on their significance for the paleogeography of the Caribbean region is also given. Occurrence of inoceramids and buchiids in Jurassic deposits is usually interpreted as an indicator of low temperature (boreal) conditions. Nevertheless, occurrence of Jurassic deposits of western Cuba inside the San Pedro del Gallo terrane (Mexico), and their later tectonic transport from higher Northern palaeolatitudes southwards, as proposed by Pessagno *et al.* (1998), is difficult to accept. According to Coleman *et al.* (1995), and the present author, cooler temperature in the Tithonian proto-Caribbean basin might be caused by oceanic currents and/or upwelling.

"BOREAL TYPE" BIVALVES AND CO-OCCURRING TITHONIAN AMMONITES IN THE GUANIGUANICO TERRANE

Sierra de los Organos belt

"Boreal" bivalves were found in the Jurassic deposits of the Sierra de los Organos and the Sierra del Rosario belts (Guaniguanico terrane – Fig. 1), western Cuba (Houša, 1974; Myczyński, 1989, 1994b). According to Judoley and Furrázola-Bermúdez (1968, p. 1), one specimen of *Inoceramus* sp. was found in the San Cayetano Formation (Lower Jurassic?–Middle Oxfordian).

In the Sierra de los Organos belt, inoceramids similar to *Anopaea stoliczkai* (Holdhaus, 1913) are common in Tithonian dark limestones assigned to the El Americano Member (Guasasa Formation). This species was described for the first time from the Tithonian (?Lower Tithonian) deposits of the Himalaya by Holdhaus (1913). Crame (1981) described *Anopaea stoliczkai* (Holdhaus, 1913) from Tithonian of Antarctica. This species was also found in the Upper Tithonian strata of the Sula Islands (Indonesia) and New Zealand (see Crame, 1981).

In the Sierra del Infierno section (Fig. 1: 1), the inoceramids occur in the upper part of the Lower Tithonian limestones. The species *Inoceramus* ex. gr. *curacoensis* Weaver was found in the El Americano Member of the Guasasa Formation in the Hacienda El Americano section (Figs 1: 2; 2) exposed along the La Palma - San Andrés highway (see Judoley & Furrázola-Bermúdez, 1968). The species *Inoceramus curacoensis* Weaver was also described from the Lower Tithonian of the Neuquén province in Argentina (see Weaver, 1931), where the genus also *Buchia* was found

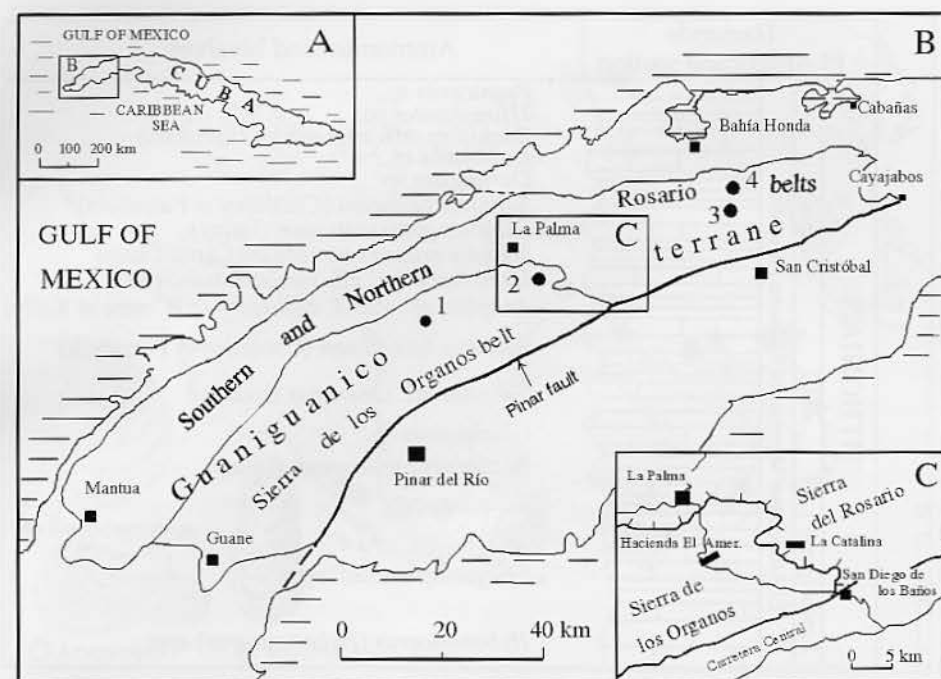


Fig. 1. A. Location of the investigated area in Cuba; B. Simplified map of the Pinar del Río Province; C. Location of the La Catalina and Hacienda El Americano sections and boundary between Sierra de los Organos and Sierra del Rosario belts. 1 – Sierra del Infierno section; 2 – Hacienda El Americano section; 3 – Loma Redonda section; 4 – La Piedra de Genaro section

(Fig. 3). Most probably, it is a younger synonymy of *Anopaea stoliczkai* (Holdhaus, 1913), a species described in detail by Crame (1981, p. 212, pl. 1a-f).

In the Hacienda El Americano section (Fig. 2), *Inoceramus* ex. gr. *curacoensis* Weaver was found together with the ammonite species *Salinites gallardoi* (Chudoley et Furrázola-Bermúdez, 1968) = *Haploceras gallardoi* of Judoley and Furrázola-Bermúdez (1968, pl. IV, figs 1, 3). Cantú Chapa (1976) attributed the Cuban ammonite genera *Hildoglochiceras* and *Haploceras* to the genus *Salinites*. The species *Salinites gallardoi* (Chudoley et Furrázola-Bermúdez) is characteristic for the uppermost Tithonian limestones in the Hacienda El Americano section (Fig. 3; see also Myczyński, 1989). In this section, the *Anopaea* bivalves appear in strata slightly older than those containing *S. gallardoi*. A small specimen of *Anopaea* sp., with weakly marked concentric growth lines, was found together with "*Virgatosphinctes*" *pinarensis* Chudoley et Furrázola-Bermúdez, 1968, and *Aulacosphinctoides* sp., which point to a Lower Tithonian age of these beds. Three other specimens of *Anopaea* have been found in younger beds which yielded *Salinites* sp. aff. *ilmenense* Imlay, 1939, corresponding to a lower part of Upper Tithonian. One of these bivalves has been classified as *Anopaea* sp. cf. *Anopaea stoliczkai* (Holdhaus), two others – as *Anopaea* sp. Two more specimens (see Fig. 4: 1, 2), determined as *Anopaea* sp. aff. *Anopaea callistoensis* Crame et Kelly, 1995 (see Crame

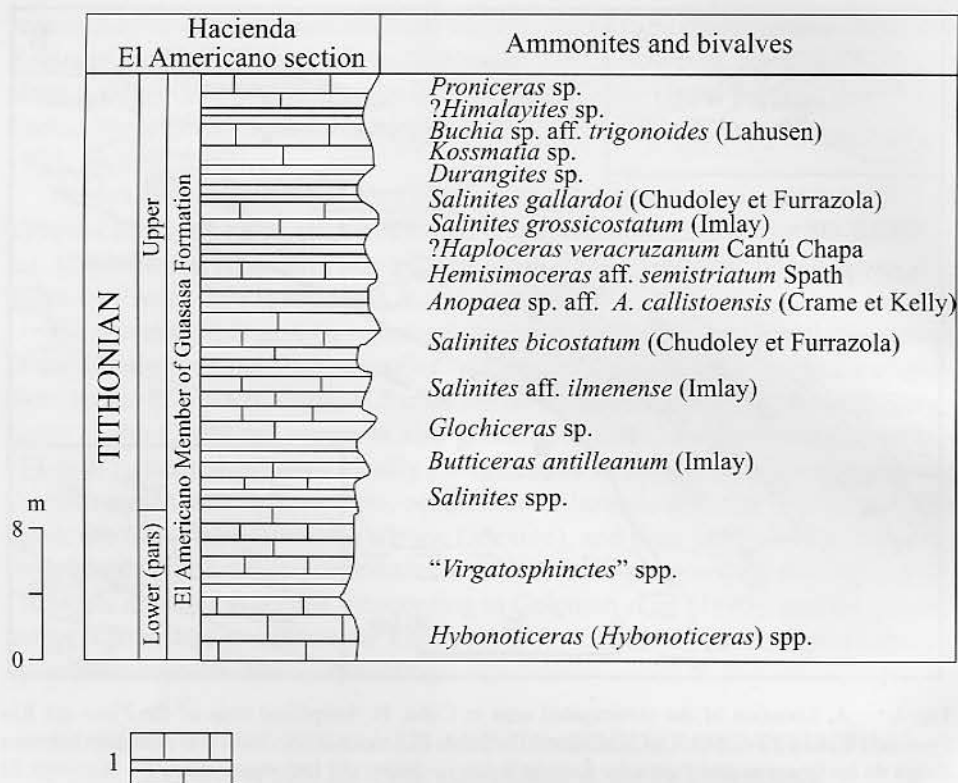


Fig. 2. Generalized lithostratigraphic column with succession of the fauna at Hacienda El Americano section, Sierra de los Organos belt, Pinar del Río province (for detailed biostratigraphical subdivision in this section see Myczyński, 1989). 1 – dark-grey to blue micritic limestone with intercalations of marly limestone and calcareous shale

& Kelly, 1995, p. 93, pl. 1, figs 1-7; text-figs 3A-B, 3 D-E, 4B), were found about 3 m higher up the section in a bed containing *Salinites bicostatum* (Chudoley et Furrázola-Bermúdez, 1968). The species *Anopaea callistoensis* Crame et Kelly, 1995, was originally described from the Tithonian of Antarctica as *Anopaea* sp. aff. *A. sp. nov.?* (Crame, 1981, p. 213, pl. 2 e-j).

In the highest part of the section discussed (close to the Tithonian–Berriasian boundary), two specimens of *Buchia* sp. aff. *B. trigonoides* (Lahusen, 1888), (Fig. 4: 3, 5) were found. An ammonite assemblage collected in this part of the section contains: *Proniceras* sp., *Kossmatia* sp., *Durangites* spp., *Salinites grossicostatum* (Imlay) and *S. gallardoi* (Chudoley et Furrázola-Bermúdez, 1968). This assemblage is of Late Tithonian age (Myczyński, 1989; Myczyński & Pszczółkowski, 1990).

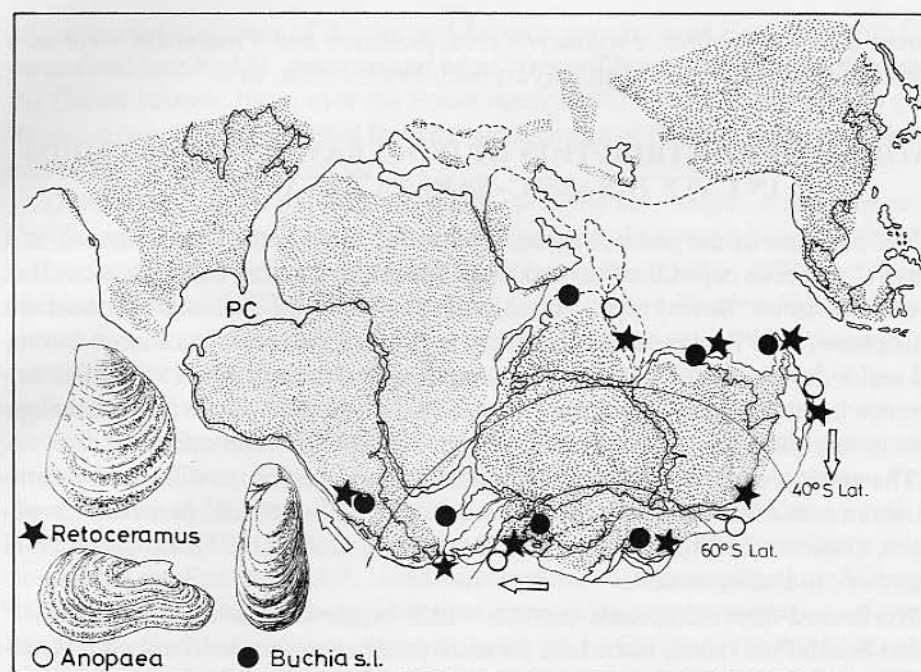


Fig. 3. Occurrence of inoceramids and buchiids in the Southern Hemisphere. Asterisks indicate the presence of the genus *Retroceramus*. Black dots denote occurrence of the genus *Buchia*, white dots denote occurrence of the genus *Anopaea* (after Crame, 1981, and Stevens, 1987). White arrows indicate probable migration routes of bivalves during the Jurassic. PC – location of the proto-Caribbean basin in Late Jurassic. The general reconstruction for Middle and Late Jurassic is based on Howarth (1981) with modification by Stevens (1990). Proto-Caribbean basin simplified reconstruction is based on Pindel (1985), and Ross and Scotese (1988)

Sierra del Rosario belts

In Tithonian limestones of the Sierra del Rosario belts (Southern and Northern Rosario belts – Pszczółkowski, 1999) the “boreal”-type bivalves occur less frequently than in analogous beds in the Sierra de los Organos belt. They are represented predominantly by inoceramids of the genus *Inoceramus* (Parkinson, 1819), and *Retroceramus* Koshelkina, 1963, however buchiids are present as well (Myczyński, 1977; Myczyński & Pszczółkowski, 1994; Myczyński, 1994a, b). The specimen *Retroceramus* (*Retroceramus*) sp. cf. *R. (R.) haasti* (Hochstetter, 1863), here described and illustrated (see Fig. 4: 6), was found in the Loma Redonda section (Southern Rosario belt) (Fig. 1: 3), in a Lower Tithonian limestone of the La Zarza Member of the Artemisa Formation (lithostratigraphic units after Pszczółkowski, 1978). Other inoceramids and buchiids were found in a Lower Tithonian limestone of the La Piedra de Genaro, El Toro and La Catalina sections (see Myczyński & Pszczółkowski, 1994). Their occurrence in Upper Tithonian deposits is uncertain (beds of this age are palaeontologically poorly documented, as a rule).

Tithonian ammonite genera characteristic for the western and central Cuba: *But-*

ticerias, *Paralytrophites*, *Protancyloceras*, *Salinites* and *Vinalesites* were also found in Sierra del Rosario belt (Myczyński, 1989; 1996a, b)³.

WORLDWIDE DISTRIBUTION OF INOCERAMIDS AND BUCHIIDS IN LATE JURASSIC–EARLY CRETACEOUS

The presence of the genus *Anopaea* Eichwald, 1861, in the Upper Jurassic and Lower Cretaceous deposits of eastern England and the Russian Platform, as well as other bivalves of "Boreal type" not only in the northern, but also in the southern hemisphere (New Zealand and Antarctica) may point to the existence of an antiboreal realm during that time. However, according to Crame (1981, 1982), their occurrence in the southern hemisphere was related to specific clastic facies development in narrow tectonic basins rather than to climatic differentiation.

The genus *Anopaea* is unknown from the Tethyan realm, notwithstanding a single occurrence of this genus in rudistid-coral facies at Štramberk, Northern Carpathians, (Boehm, 1883). According to Crame and Kelly (1995), its presence at Štramberk is almost certain.

Northward-directed oceanic currents which began to circulate in "antiboreal" (paleo-South Pole) zone, since Late Jurassic could cool the western shelf of Gondwanaland (Parrish, 1992) and also Jurassic proto-Caribbean basin (Coleman *et al.*, 1995).

Rotation of the plates and upwelling zones had essential influence on marine fauna migration during Late Jurassic. According to Jansa (1998), the clockwise rotation of the North American continental plate caused a mixing of boreal and Tethyan microfauna as observed in the Tithonian–Berriasian sediments on the Grand Banks.

By the latest Jurassic, Gondwanaland had moved about 5° south, and Laurasia by about 5° north, and the upwelling zones shifted accordingly (Parrish, 1992). In their past palaeogeographic positions, the southeastern Pacific upwelling zones might occur close to the northern South America and southernmost Mexico. The southwestern South American shelf could have been cooled by an upwelling zone that was adjoining northern Chile and southern Peru (see Parrish, 1992). Palaeobiogeographic situation in the eastern part of the Pacific is difficult to reconstruct due to clustering of fossils together on allochthonous terranes (see Taylor *et al.*, 1984; Riccardi *et al.*, 1992).

According to Enay and Cariou (1997), invasion of the austral fauna from Himalaya to Patagonia took place during the Late Jurassic. This migration used the East and South Gondwanaland seaways. Those seaways were also used by buchiids and inoceramids (*Anopaea*, *Inoceramus* and *Retroceramus*). Also Stevens (1990, p.

³ Abundant fish remains occur in Upper Jurassic limestones of the Sierra de los Organos belt (Myczyński, 1996a). In the Hacienda El Americano section, fish remains appear in a limestone at the Lower–Upper Tithonian boundary and occur throughout the whole Late Tithonian section. According to A. L. Cione and G. Arratia (personal informations, 1997), these fish remains belong to the primitive Teleostei.

452) reported migration of *Buchia* and *Retroceramus* around East and South Gondwanaland (see Fig. 2). *Anopaea* and other "Boreal" bivalves probably migrated to the Cuban Jurassic basin over the South American shelf and Mexico⁴. The genus *Anopaea* has not been reported from the western part of Boreal Zone (northwestern part of North America) thus far.

During the Late Jurassic, marine fauna probably also migrated from the proto-Caribbean basin to Mexico and Antarctica. For example, some typically Cuban Oxfordian ammonites were reported both from Antarctica (Quilty, 1970) and Sonora, Mexico (Rangin, 1977). A characteristic Cuban genus *Vinalesphinctes* was reported from the Oxfordian of Chile (Meléndez & Myczyński, 1987). Some Mexican ammonites are present in Late Jurassic deposits of New Zealand (e. g., *Epi-cephalites marwicki*, *Subneumayria* cf. *ordonezi*, *Kossmatia pilicosta* – *op. cit.*). According to Stevens (1989), Late Jurassic Trachyostraca (strongly ornamented ammonites) of New Zealand migrated via New Caledonia, NW Australia, Papua–New Guinea and Indonesia to NW Himalaya, to West Antarctica, and South and Central America. These data may support views on possible marine fauna migration across the East and South Gondwanaland seaways during the Late Jurassic.

In western Cuba, the Early Tithonian ammonites suggest migration of marine fauna from the Mediterranean province to the proto-Caribbean basin (Myczyński, 1989). During the Late Tithonian this migration seems to be debatable (*op. cit.*).

PALAEOGEOGRAPHIC SIGNIFICANCE OF THE TITHONIAN BIVALVES FROM WESTERN CUBA

According to Pessagno *et al.* (1993), the occurrence of *Buchia* bivalves and radiolarians (*Parvincingula* and *Pantanellidae*), as well as some boreal ammonites in the Jurassic sequences of the San Pedro del Gallo terrane remnants in Central Mexico, suggest tectonic transport of the Mexican terranes along the Walper Megashear from Pacific to the southeast (see also Pessagno *et al.*, 1986, 1987a, b). According to Pessagno *et al.* (1993, 1998), this terrane could have been located in the Southern Boreal/Northern Tethyan zoogeographical province (about 30° N palaeolatitude). Occurrence of inoceramids and buchiids in Jurassic deposits of western Cuba might thus be interpreted in favour of an idea that Jurassic sequences of western Cuba had been tectonically transported from the Southern Boreal Province, as proposed by Pessagno *et al.* (1998).

However, other data do not confirm the above idea of Pessagno *et al.* (1998) with respect to western Cuba. So far, genus *Anopaea* was not reported from Late Jurassic deposits of San Pedro del Gallo terrane. The bivalves *Buchia rugosa* (Fischer Waldheim), *B. concentrica* (Sowerby) and *B. tenuistriata* (Lahusen), were reported from the Kimmeridgian deposits of San Pedro del Gallo by Montero *et al.* (1988).

⁴ *Inoceramus bassei* Lecolle illustrated by Cantú Chapa (1989, pl. 1, fig. 1) from the Upper Tithonian deposits of northeastern Mexico, may be interpreted as *Anopaea stoliczkai* Holdhaus, 1913.

The bivalve *Aulacomyella neogae* Burckhardt was reported from the basal part of Lower Tithonian of Poza Rica (Central Mexico) by Cantú Chapa (1971). These bivalves are unknown in western Cuba.

Furthermore, Tithonian deposits of western Cuba contain abundant remains of *Saccocoma*, *Globochaete alpina* Lombard, *Chitinoidea* and calpionellids (see Furrázola-Bermúdez, 1965; Pszczółkowski, 1978; Myczyński & Pszczółkowski, 1990, 1994). These deposits are practically devoid of corals which are known from Late Jurassic deposits of northwestern Mexico (see Beauvais, 1992). Moreover, the Tithonian ammonites of the western Cuba are similar to those of central Cuba (Im-lay, 1942; Myczyński, 1989), and from this point of view both areas must be considered together (see Pszczółkowski, 1999). Contrary to the Pessagno *et al.* (1998) idea concerning western Cuba position during Tithonian time, a unique occurrence of the genus *Anopaea* in the rudistid-coral facies of Štramberk, may also be mentioned. These data speak against the original position of Jurassic deposits of western Cuba inside the San Pedro del Gallo terrane and their later tectonic transport from higher N palaeolatitudes southwards.

Another interpretation of the occurrence of inoceramids and buchiids in western Cuba was given by Coleman *et al.* (1995) and is here adopted by the author. The suggested lower marine water temperatures in the proto-Caribbean basin, which favoured colonization of the outer shelf and/or upper continental slope by the inoceramids and buchiids, could have also been caused by cold oceanic currents and upwelling (see Parrish 1992; Coleman *et al.*, 1995). In this respect, the palaeobathymetry could also influence marine water temperatures in the proto-Caribbean basin.

According to Picard *et al.* (1998), in the Jurassic Paris-London basin existed vertical thermal variations of up to 14° C, associated with depths varying from a few meters to 170 (±30 m). This estimate was based on the difference between $\delta^{18}\text{O}$ in the Articulata brachiopod shells and fish remains (vertebrae, scales and teeth).

CONCLUSIONS

(1) The inoceramid genera (*Inoceramus* Parkinson, 1819, *Retroceramus* Koshelkina, 1963 and *Anopaea* Eichwald, 1861) and buchiids (genus *Buchia* Rouillier, 1845) are present in the Jurassic sediments of western Cuba. These bivalves probably migrated to the proto-Caribbean basin from the East and South Gondwanaland coasts, across the South American shelf and Mexico.

(2) The South-Eastern Pacific and the proto-Caribbean basin could have been affected during the Tithonian by oceanic currents and upwelling (cf. Parrish 1992; Coleman *et al.*, 1995). A possibility that the Jurassic sequences of western Cuba were tectonically transported southward from higher northern palaeolatitudes (as a part of the San Pedro del Gallo terrane – see Pessagno *et al.*, 1998) seems less probable.

SYSTEMATIC DESCRIPTION

The inoceramids are represented by the following genera: *Inoceramus* Parkinson, 1819; *Retroceramus* Koshelkina, 1963 and *Anopaea* Eichwald, 1861. The buchiids are represented by the genera *Buchia* Rouillier, 1845 and *Malayomaorica* Krumbeck, 1923 (see Crame, 1981; Crame & Kelly, 1995).

The classification of the Jurassic bivalves proposed by Cox (1969) was adopted in this paper. The following measurements were taken: L – valve length as measured along the direction of maximum growth (in mm); W – shell width in the maximum dimension perpendicular to length (in mm); T – maximum thickness of valve (in mm); β – the beak angle.

Order **Pterioidea** Newell, 1965

Family **Inoceramidae** Giebel, 1852

Genus **Anopaea** Eichwald, 1861

Type species: *Inoceramus lobatus* Auerbach & Frears, 1861

Anopaea sp. aff. *Anopaea callistoensis* Crame & Kelly, 1995

(Fig. 4: 1, 2, 4, 7)

Material: Four internal moulds of right valve: MR 25/48; MR-25/49; MR-25/51; VA-17.

Specimen	Maximum length (L)	Maximum width (W)	Thickness (T)	Beak angle (β)	Folds per cm
MR-25/48	38	33	14	87°	5
MR-25/49	52	72	26	88°	3
MR-25/51	-	66	27	-	5
VA-17	34	34	16	85°	4

Description: Valves medium-sized, moderately inflated, pyriform shaped, wider than long, with low lobelike anterior region. Maximum degree of convexity occurring in umbonal and central regions. Umbo prominent, prosogyrous, rising slightly above hingeline. Narrow umbonal region appears to have been strongly projecting and curved gently forwards. Lunule probably deep. Posterior region high, well rounded. Anterior sulcus not prominent. Surface covered with more or less regular, band-like, loosely concentric folds. Smaller valves (especially, MR-25/48) have features very similar to characteristics of a large valve (MR-25/49), e. g. prosogyrous umbo, rounded posterior margin and similar ornamentation. Incomplete preserved specimen (MR-25/51) resembles the large valve (MR-25/49).

Remarks: Some of the specimens here described were earlier erroneously assigned to the genus *Buchia* Rouillier, 1845 (Myczyński, 1989). Based on papers by Crame (1981) and Crame & Kelly (1995), it was possible to revise these specimens as

belonging to the genus *Anopaea* Eichwald, 1861. Distinctive pyriform shape, low lobelike region (MR-25/48) and probably deep lunule, are characteristic for this genus. The ornamentation and shape of our specimens are similar to *Anopaea callistoensis* Crame et Kelly, 1995 (see Crame, 1981, p. 213, pl. 2e-j = *Anopaea* sp. nov.?; Crame & Kelly, 1995 p. 93, pl. 1, figs 1-7; text-figs 3 A-B, 3 D-E, 4B) described from Late Tithonian of Alexander Island, West Antarctica. The Cuban specimens are preserved in form of internal casts. In comparison with *Anopaea callistoensis* Crame, the specimens described in this paper have a weak, low, acute ornamentation (slightly less pronounced concentric folds and less sharp crests) and also more inflated shell. The Cuban specimens are different in shell form and ornamentation from other species of the genus *Anopaea* Eichwald, 1861. The Cuban specimens may represent a new species of this genus. However, poor preservation (only internal moulds) and small number of specimens collected preclude creation of a new species.

Occurrence: All specimens here described were found in the El Americano section in the Sierra de los Organos region, Pinar del Río province, western Cuba, in dark Upper Tithonian limestone at the top of the El Americano Member of Guasasa Formation (see Myczyński, 1989). The species *Anopaea callistoensis* Crame et Kelly, 1995, with which the Cuban specimens were compared, was described from the Late Tithonian–Early Berriasian of Alexander Island, West Antarctica.

Genus *Retroceramus* Koshelkina, 1963

Type species: *Inoceramus retrorsus* Keyserling, 1848

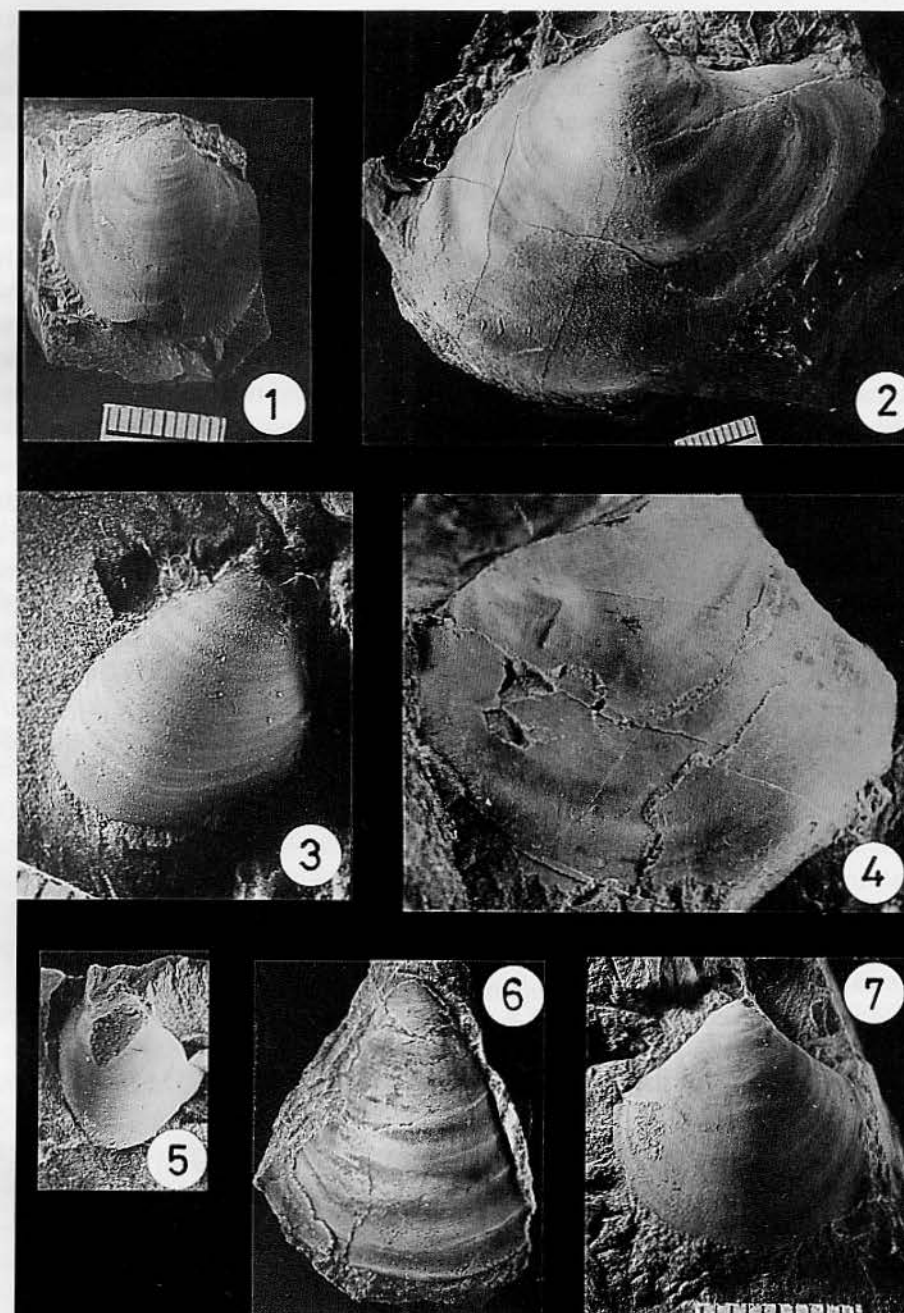
Subgenus *Retroceramus* (*Retroceramus*) Koshelkina, 1963

Retroceramus (*Retroceramus*) sp. cf. *Retroceramus* (*Retroceramus*) *haasti* (Hochstetter, 1863)

(Fig. 4: 6)

Material: Only one internal mould of incomplete left valve (LR-61): L – 41, H – 35, T – 32.

Fig. 4. “Boreal” Jurassic Bivalves of Cuba. 1 – *Anopaea* sp. aff. *Anopaea callistoensis* Crame et Kelly, 1995, Hacienda El Americano section, Pinar del Río province, Lower Tithonian, x 2; 2 – *Anopaea* sp. aff. *Anopaea callistoensis* Crame et Kelly, 1995, Hacienda El Americano section, Pinar del Río province, Upper Tithonian, x 1; 3 – *Buchia* sp. aff. *Buchia trigonoides* (Lahusen, 1888), Hacienda El Americano section, Pinar del Río province, Upper Tithonian, x 4; 4 – *Anopaea* sp. aff. *Anopaea callistoensis* Crame et Kelly, 1995, Hacienda El Americano section, Pinar del Río province, Upper Tithonian, x 1; 5 – *Buchia* sp. aff. *Buchia trigonoides* (Lahusen, 1888), Hacienda El Americano section, Pinar del Río province, Upper Tithonian, x 4; 6 – *Retroceramus* (*Retroceramus*) sp. cf. *Retroceramus* (*Retroceramus*) *haasti* (Hochstetter, 1863), Loma Redonda section, Sierra del Rosario, Pinar del Río province, La Zarza Member, Artemisa Formation, Lower Tithonian, x 2; 7 – *Anopaea* sp. aff. *Anopaea callistoensis* Crame et Kelly, 1995, Hacienda El Americano section, Pinar del Río province, Upper Tithonian, x 2



Description and remarks: Small, strongly inflated and elongated internal mould of left valve, triangular in shape. Maximum degree of inflation occurs in umbonal region and along growth axis. Posterior and ventral margins incomplete, probably rounded. Smooth inflated and narrow umbonal region. Ornament pattern of the specimen consists of single, prominent and rounded concentric ribs, with flat and wide interspaces.

Small size and poor preservation of this specimen make difficult its specific identification. The prominent, rounded concentric ribs with flat, wide interspaces permit to assign this specimen to the genus *Retroceramus* Koshelkina, 1963, the subgenus *Retroceramus* (*Retroceramus*) Koshelkina, 1963, and, particularly, to the species *Retroceramus* (*Retroceramus*) *haasti* (Hochstetter, 1863) – see Crame (1982, p. 569, pl. 57, figs 1–4). In comparison with Hochstetter's species, the Cuban specimen is small and more rounded, with longer umbonal region and low concentric ribs. It markedly differs in form and ornamentation from the other species of the subgenus *Retroceramus* (*Retroceramus*).

Occurrence: The specimens here described were found in the Loma Redonda section in the Sierra del Rosario belt, Pinar del Río province, western Cuba, in dark Lower Tithonian limestone of the La Zarza Member of the Artemisa Formation. The species *Retroceramus* (*Retroceramus*) *haasti* (Hochstetter, 1863), with which the Cuban specimen was compared, is known from the Upper Jurassic of East Celebes, New Zealand, and Antarctic Peninsula (see Crame, 1982 p. 570). According to Crame (*op. cit.*), a Middle Kimmeridgian–Tithonian age of *Retroceramus* (*Retroceramus*) *haasti* is more probable than an Oxfordian–Kimmeridgian one.

Family **Buchiidae** Cox, 1953 (= **Aucellidae** Lahusen, 1897)

Genus **Buchia** Rouillier, 1845 (= **Aucella** Keyserling, 1846)

Type species: *Avicula mosquensis* von Buch, 1844

Buchia sp. aff. *Buchia trigonoides* (Lahusen, 1888)

(Fig. 4: 3, 5)

Material: Two internal moulds of right valve: MR 25/52; MR-25/53 (incomplete).

Specimen	Maximum length (L)	Maximum width (W)	Thickness (T)	Beak angle (β)	Folds per cm
MR-25/52	10	9	7	84°	15
MR-25/53	5	4	4	-	-

Description and remarks: These two small, triangular, inflated specimens are almost certainly juvenile shells. Maximum degree of convexity in both specimens occurs in central region. Ventral margin rounded. Umbonal region narrow, the umbo is poorly visible in specimen MR-25/52 and is broken off in specimen

MR-25/53. Ornamentation consists of finer or thicker, narrow, irregularly spaced concentric corrugations, with interspace width increasing toward ventral margin. Small size and poor preservation of the specimens preclude a closer specific identification. Their oblique (trigonoid) valves and irregularly spaced weak concentric corrugations make them very similar to *Buchia trigonoides* (Lahusen, 1888) – see Jones *et al.* (1969, p. A10, pl. 1, figs 1, 2, 4–6, 10–17, 23, 24, pl. 2, fig. 35), Sey & Kalacheva (1993, p. 59, pl. II, figs 5–8), and Sey & Polubotko (1992, pl. 127, figs 8–12). The specimens here described differ from the holotype of *Buchia trigonoides* (Lahusen, 1888) (in Zakharov, 1981 p. 104, pl. XXIII, figs 3a, b) by somewhat more irregular concentric corrugations. According to Zakharov (1981, p. 101), *Buchia trigonoides* (Lahusen, 1888) is a younger synonym of *Buchia fischeriana* (d'Orbigny, 1845), but Sey and Kalacheva (1993, p. 59) again separated both species.

The Cuban specimens also resemble *Buchia terebratuloides* (Lahusen, 1888), as figured in various papers, e. g. Jones *et al.* (1969, p. A10, pl. 2, figs 1–15), Zakharov (1981, p. 105, pl. XXII, figs 4–6; pl. XXIV, figs 1–4; pl. XXV, figs 1–10; text-fig. 24), Sey & Kalacheva (1993, p. 59, pl. II, figs 16a, b; 17–19), and Sey & Polubotko (1992, pl. 127, figs 22–26, 31), and *Buchia fischeriana* (d'Orbigny, 1845) – see Jeletzky (1965, pl. III, fig. 2A–C), Jones *et al.* (1969, p. A9, pl. 1, figs 3, 7–9), Zakharov (1981, p. 101, pl. XXI, figs 1–9; pl. XXII, figs. 1–4; pl. XXIII, figs. 1–3), Sey & Polubotko (1992, pl. 127, figs 1–7) and Sey & Kalacheva (1993, p. 59, pl. II, figs 1–4). The Cuban specimens here described differ from *Buchia terebratuloides* (Lahusen, 1888) by more oval valve and weaker concentric corrugations, and from *Buchia fischeriana* (d'Orbigny, 1845) – by weak ornamentation.

Occurrence: Both specimens were found in the El Americano section (Sierra de los Organos region, Pinar del Río province, western Cuba) in dark Upper Tithonian limestone at the top of the El Americano Member of the Guasasa Formation (Myczyński, 1989), together with a bivalve specimen described here as *Anopaea* sp. aff. *Anopaea callistoensis* Crame et Kelly, 1995.

The species *Buchia trigonoides* (Lahusen, 1888), occurs in Upper Tithonian strata of the Colyear Springs-Paskenta area, California (see Jones *et al.*, 1969) and in Upper Jurassic deposits of the Northern Far East of Russia (Sey & Kalacheva, 1993). *Buchia terebratuloides* (Lahusen, 1888) and *Buchia fischeriana* (d'Orbigny, 1845) are known from the Upper Tithonian beds of California (Jones *et al.*, 1969), Canada (Jeletzky, 1965) and the Upper Jurassic deposits of Northern Russia (Zakharov, 1981, 1987; Sey & Polubotko, 1992; Sey & Kalacheva, 1993).

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