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JURASSIC PELECYPODS FROM CUBA

Abstract. — The paper presents descriptions of 16 species of Jurassic pelecypods including 3 new — *Vaugonia* (*Vaugonia*) *postutahensis* sp. n., *V.* (*V.*) *cubanensis* sp. n. and *V.* (*V.*) *cayetanoensis* sp. n. — belonging to 7 families: Bakevelliidae King, Plicatulidae Watson, Gryphaeidae Vialov, Ostreidae Rafinesque, Trigoniidae Lamarck, Astartidae d'Orbigny and Corbiculidae Gray. Growth changes in shells of some species, inferred mode of life of these pelecypods are discussed.

INTRODUCTION

The present paper deals with fossil material gathered in the course of mapping in Pinar del Rio province, western Cuba, by geologists from the Institute of Geological Sciences of the Polish Academy of Sciences, Warsaw, Institute of Geology of the Warsaw University and Instituto de Geologia y Paleontologia, Academia de Ciencias de Cuba, La Habana. The hitherto existing data on Jurassic pelecypod fauna of the Pinar del Rio province in Cuba are scarce. Previous authors reported the presence of *Modiolus* sp., *Gryphaea* sp., *Catinula* sp., *Quenstedtia* sp., *Corbula* sp. and *Cuspidaria* sp. as well as *Trigonia* (*Vaugonia*) *krömmelbeini* de la Torre (Krömmelbein 1956, 1962; de la Torre 1960; Imlay *in*: Judoley and Furrazola-Bermudez 1968).

Pelecypods discussed here are derived from the Jagua Formation in Sierra de los Organos, basal parts of the Artemisa Formation in Sierra del Rosario and upper parts of the San Cayetano Formation in that region. The majority of oysters were gathered in basal parts of the Jagua Formation, i.e. the Pan de Azúcar member and recently differentiated Zacarias member (see Wierzbowski 1976: fig. 2) from the vicinities of Mogote la Mina (fig. 1). Other oysters were found in middle parts of that formation, Jagua Vieja member, and basal parts of the Artemisa Formation. Trigoniids were gathered from the San Cayetano Formation in Sierra de los Organos. The remaining marine fauna as well as brackish fauna reported from the vicinities of San Andrés are derived from the latter formation.

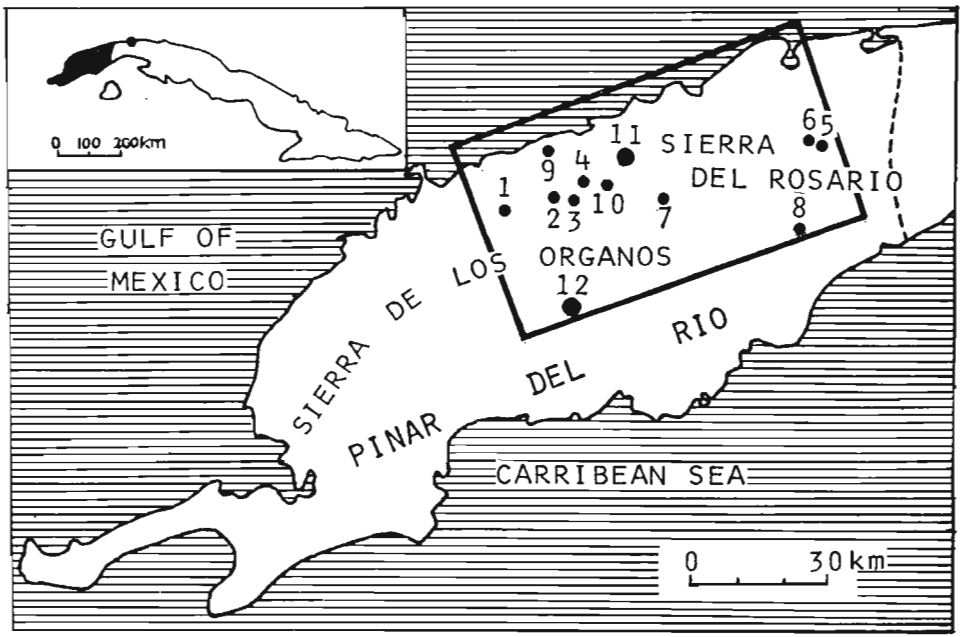

Fig. 1. Jurassic localities (*1—12*) of described fauna in Pinar del Rio province (inset shows its position in Cuba), after Wierzbowski *et al.*, 1976, modified.
1 Pan de Azúcar, *2* puerta del Ancón, *3* Zacarias mogote, *4* Mogote la Mina, *5* Altos de San Francisco, *6* Cinco Pasos village, *7* Hoyo de la Sierra, *8* Artemisa village, *9* San Cayetano, *10* Jagua Vieja, *11* La Palma village, *12* Pinar del Rio village.

The bulk of described pelecypods is derived from Oxfordian deposits with good ammonite record. The Zacarias and Jagua Vieja members presumably correspond to the *Gregoryceras transversarium* Zone and possibly lower part of the *Perisphinctes bifurcatus* Zone in the Submediterranean zonal scheme. The lowermost part of the Artemisa Formation may correspond to a part of the *Perisphinctes bifurcatus* Zone or *Epipeltoceras bimammatum* Zone. The deposits of the Francisco Formation from Sierra del Rosario appear similar to ammonite-bearing deposits of the Jagua Formation and, therefore, may also be assigned to the *Gregoryceras transversarium* Zone. Detailed analyses of stratigraphic position of these deposits were presented by Wierzbowski (1976), Myczyński (1976) and Kutek *et al.* (1976).

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The systematics of pelecypods was accepted after Cox *et al.* 1969. The material studied is housed in the Paleontological Museum of the Institute de Geologia y Paleontologia, Academiai de Ciencias de Cuba, La Habana (abbreviated as JPC).

MATERIAL

Jurassic pelecypod fauna from Pinar del Rio province in Cuba is highly differentiated taxonomically. It comprises representatives of three subclasses, Pteriomorphia Beurlen, 1944, Palaeoheterodonta Newall, 1965, and Heterodonta Neumayr, 1884, fairly distant from one another in the accepted systematic subdivision. The subclass Pteriomorphia is represented by the largest number of species (7). Marine fauna predominates in the material and brackish fauna is represented only by individuals belonging to the family Corbiculidae Gray. Oysters and corbiculids occur in masses, whereas the remaining pelecypod taxa are represented by not numerous, or sometimes single specimens (e.g. *Gervillaria*).

Cuban pelecypods described here are usually badly preserved. The assemblages of oyster and corbiculid pelecypods comprise representatives of all the growth stages. Representatives of juvenile growth stages are usually best preserved. Prodissoconch is, as a rule, preserved on oyster valves; details of internal morphology such as hinge and adductor and Quenstedt muscle scars are better preserved on juvenile valves than on adult or senile specimens (pl. 7:1—3, 5). In oyster cocquinas forming intercalations in lower parts of the Zacarias member of the Jagua Formation were found: *Liostrea sandalina* (Goldfuss), *Exogyra fourtaui* Stefanini, *Ostrea broughtoni* Imlay and *Plicatula* cf. *weymouthiana* Damon; in corbiculid cocquinas of the San Cayetano Formation: *Eocallista* (*Hemicorbicula*) *parva* (Sowerby), *Eocallista* (H.) *veneriformis* (Loriol), *Eocallista* (H.) *cuneovata* (Cragin) and *Eocallista* (*H.*) *intermedia* (Loriol). The remaining oysters, i.e. *Gryphaea mexicana* Felix and *Liostrea mairei* (Loriol) were found in a single species accumulations in the cocquinas of the Pan de Azúcar and Jagua Vieja members of the Jagua Formation and in basal parts of the Artemisa Formation, respectively. Representatives of the family Trigoniidae Lamarck were also found in small clusters. Three new trigoniid species, *Vaugonia* (*V.*) *postutahensis* sp. n., *Vaugonia* (*V.*) *cubanensis* sp. n. and *V.* (*V.*) *cayetanoensis* sp. n., were found in rocks of the San Cayetano Formation in Sierra de los Organos. They are hard to be extracted from the rock.

The remaining pelecypod taxa are represented by not numerous individuals. *Gervillaria* sp. of the family Bakevellidae was identified on the basis of valve outline, characteristic outline of the ear and ornamentation. This species was found together with *Neocrassina* (*N.*) *ovata* (Smith) and *Neocrassina* (*Coelastarte*) *cotteausia* (d'Orbigny) of the family

Astartidae in upper parts of San Cayetano Formation at El Abra, the town south of Sierra Ancón. Better preserved representatives of the latter species display well-preserved valve ornamentation and colored bands; the bands are visible in ordinary light but usually they can be discerned under ultraviolet light (Nuttall, N70 in: Treatise on Invertebrate Paleontology, 1969; here pl. 11:1a, 5b). Such preservation of valves of the *Neocrassina* is rather unusual with fossil forms. Arcuate course of colored bands is also typical of ther representatives of the order Veneroida Adams and Adams, 1856 (Nuttall 1969: *l.c.*).

GENERAL PART

REMARKS ON LITHOLOGY AND ECOLOGY

In Sierra de los Organos oyster cocquinas mainly occur in the Pan de Azúcar (see Pszczółkowski *et al.* 1975) and Zacarias members. The former member comprises massive, hard shelly and bioclastic limestones locally intercalated by either micritic limestones or cherts, and the latter — clay shales (Wierzbowski 1976: 141, fig. 2, sections 8—9). Oysters are especially numerous in basal part of that member, forming several thin cocquina layers in the Mogote la Mina area. Oyster cocquinas are also known from the San Cayetano Formation (Haczewski 1976: 340, fig. 8). They indicate the conditions of shallow littoral sea or proximity of shores.

The remaining oyster fauna forms a-single-species accumulations and is here limited to the representatives of the genera *Liostrea* and *Gryphaea* (*L. mairei* and *G. mexicana*, respectively). The former as a rule occurs together with ammonites. That species was recorded in carbonate nodules known as "quesos" in the middle of the Jagua Formation, in the Jagua Vieja member from the locality Hoyo de la Sierra in Sierra de los Organos. The nodules are common in that member and also contain other invertebrates, mainly ammonites, and well-preserved remains of fishes and reptilians. The Jagua Vieja member comprises alternating bitumen and marly limestones, marls and marly shales. *Liostrea mairei* also occurs in lowermost parts of the Artemisa Formation in Sierra del Rosario which are represented by micritic limestones intercalated by clay shales (Kutek *et al.* 1976). *Gryphaea mexicana* occurs in thick cocquinas of the Pan de Azúcar member of the Jagua Formation in Sierra Ancón.

Intercalations and layers of corbiculid cocquinas were found in the San Cayetano Formation south of San Andrés in Sierra de los Organos. This formation comprises sandstones intercalated by shales and, sometimes, limestones. The deposists yield plant debris and numerous pieces

of wood. They could have originated in various sedimentary environments including the alluvial, deltaic and shallow marine ones (Haczewski 1976).

Pelecypods of the genera *Gervillaria* and *Neocrassina* were found in upper part of the San Cayetano Formation at El Abra south of Sierra Ancón (G. Haczewski, oral inf.). Trigoniids were found in sandstones and siltstones of the San Cayetano Formation in various places in Sierra de los Organos. The species of *Vaugonia* (*Vaugonia*) described here as new were also found in upper parts of that Formation in the vicinities of El Abra (G. Haczewski, oral inf.).

The above review of deposits yielding the studied pelecypod fauna indicates a marked differentiation in environments and, therefore, mode of life of the pelecypods. Oysters attached to the substratum by left valve belong to the group of epifaunal suspension feeders (Wright 1973). The representatives of the genus *Gervillaria* are assigned to the same group. They lived close to the sea floor, being attached with byssus to either a hard substratum or plants. Similarly as oysters, they required a steady supply of organic suspension, i.e. the environment of well-aerated and turbulent water. Their mass occurrence and the presence of shells of all the growth stages indicate that the environmental conditions were favourable for these organisms.

The mode of life of trigoniids and neocrasines was different from that of the above mentioned pelecypods as they were burrowing to a shallow depth in sandy-silty sea floor. This mode of life is suggested by their thick-walled shells, the lack of elongate siphonal lobes and the valves not opened at the anterior or posterior but rather closely adjoining one another along with whole periphery. Organisms of that type represent the infaunal nonsiphonate suspension feeders.

A detailed analysis of share of representatives of particular families in the ammonite spectra from different formations of the Jurassic of Pinar del Rio province made it possible to trace bathymetric differentation in this Oxfordian basin (Wierzbowski 1976). The depth of that basin was of the order of some dozen to 100 m in the case of lower and middle parts of the Jagua Formation (Zacarias and Jagua Vieja members), and markedly smaller, of the order of a few to about a dozen meters, in the case of the Pan de Azúcar member. The pelecypods recorded in deposits of that basin rather preferred its shallower parts, sandy-silty-calcareous bottom and moderately strong bottom currents.

GEOGRAPHIC AND STRATIGRAPHIC DISTRIBUTION OF DESCRIBED SPECIES
(Table 1)

Some pelecypod species described from the Pinar del Rio province in Cuba are characterized by wide geographic and stratigraphic ranges. This is especially the case of cosmopolitan oyster *Liostrea sandalina*, known

from the Bajocian to Oxfordian of Europe, Caucasus, Crimea, Balkan Mts, Iran as well as southern Israel and Morocco. The remaining species are characterized by markedly smaller geographic distribution. *Exogyra fourtaui* is known from the Callovian to Kimmeridgian of the African--Indian region. *Liostrea mairei* also occurs in the Callovian and Oxfordian of both North Africa and the Oxfordian of Switzerland. *Gryphaea mexicana* is known from the Oxfordian of Mexico and the Kimmerdgian of

Table 1

Species	Cuba	Mexico	Western Europe				N. Africa	USA	India
			England	France	GFR	Switz.			
	JO	O T	O K PB	O "PB"	O	O	C O	K	O K
Gervillaria sp.	+	– –	– – –	– –	–	–	– –	–	– –
Plicatula cf. *weynouthiana* Damon	+	– –	– – –	– –	–	–	– –	–	– –
Gryphea mexicana Felix	+	+ –	– – –	– –	–	–	– –	+	– –
Liostrea sandalina (Goldfuss)	+	+ –	+ + –	+ –	+	+	+ +	+	+ +
Liostrea mairei (Loriol)	+	– –	– – –	– –	–	+	+ +	–	– –
Exogyra fourtaui Stefanini	+	– –	– – –	– –	–	–	+ +	–	+ +
Ostrea broughtoni Imlay	+	– –	– – –	– –	–	–	– –	+	– –
Vaugonia (*V.*) *postutahensis* sp. n.	+	– –	– – –	– –	–	–	– –	–	– –
Vaugonia (*V.*) *cubanensis* sp. n.	+	– –	– – –	– –	–	–	– –	–	– –
Vaugonia (*V.*) *cayetanoensis* sp. n.	+	– –	– – –	– –	–	–	– –	–	– –
Neocrassina (*N.*) *ovata* (Smith)	+	– –	+ + –	+ –	+	–	– –	–	– –
Neocrassina (*C.*) *cotteausia* (Loriol)	+	– –	+ + –	+ –	–	–	– –	–	– –
Eocallista (*H.*) *parva* (Sowerby)	+	– –	– – +	– –	–	–	– –	–	– –
Eocallista (*H.*) *veneriformis* (Loriol)	+	– –	– – –	– +	–	–	– –	–	– –
Eocallista (*H.*) *intermedia* (Loriol)	+	– –	– – +	– +	–	–	– –	–	– –
Eocallista (*H.*) *cuneovata* (Cragin)	+	– +	– – –	– –	–	–	– –	–	– –

C — Callovian, O — Oxfordian, K — Kimmeridgian, JO — Jurassic and Oxfordian, T-Tithonian, PB — Purbeckian, „PB" — „Purbeckian of Jura Mts".

southern USA where it is accompanied by *Ostrea broughtoni. Plicatula weymouthiana* known from the Oxfordian of southern England and the species of *Neocrassina* known from the Oxfordian and Kimmedrigian of that area were also recorded in the Oxfordian of southern France and Federal Republic of Germany.

The representatives of the genus *Eocallista*, typical of the brackish environment, are known from the Purbeckian of southern England, "Purbeckian" of the Jura Mts and Lower Tithonian of Mexico.

Trigoniid fauna from Cuba appears somewhat similar to that from the southern USA and Argentina as well as that of the southern Asia.

SYSTEMATIC PART

Suborder **Pteriina** Newell, 1965
Superfamily **Pteriacea** Gray, 1847
Family **Bakevelliidae** King, 1850
Genus *Gervillaria* Cox, 1954
Gervillaria sp.
(pl. 9:5—6)

Material. — Mould of left valve with damaged anterior and posterior parts, JPC No I/43.

Description. — Valve moderately large. Posterior lobe about 23 mm long, set at the angle of about 35° to the valve. Umbo prosogyral, slightly protruding. Valve S-shaped in outline, with convexity increasing from about 7 mm near the umbo to 15 mm close to the venter. Ornamentation consisting of growth lines and irregular striae; the striae running along the anterior margin are roughly parallel to it, more widely spaced and wider distributed than those running along the posterior margin. The latter enter the surface of lobe with a strong twist (pl. 9:5). The lobe is ornamented with growth lines and striae which end at the right angle at the hinge margin. Along with growth the angle becomes more and more acute and the lines and striae — more and more arcuate. In postero-ventral region growth lamellae are visible in central part of the valve and on the lobe.

Remarks. — The Cuban specimen resembles the representatives of the Lower Cretaceous species *Gervillia alaeformis* (Sowerby) (Weaver 1931:201, pl. 15:61—63) from Argentina in valve outline and convexity as well as umbo shifted towards the anterior. It differs from the latter in lack of radial striae marked on the valve and the mode of ornamentation of lobe as arcuate growth lines and striae are limited to the umbonal part in the specimen from Argentina. The difference in course of growth lines increases along with time and they end at the hinge margin at, or almost at, the right angle in the latter.

The Cuban specimen also resembles *Gervillela orientalis* (Douville) from the Bajocian of Tanganyika (Cox 1965:43, pl. 4:7—8) in valve curvature and size of posterior lobe, differing primarily in lower, less protruding and directed backwards umbo.

It follows from the data presented by Cox (1969) that shells in the genus *Gervillaria* Cox exceed 140 mm in height. The genus is known from the Jurassic and Cretaceous of Europe and Lower Cretaceous of England.

Occurrence. — Western Cuba: Middle Oxfordian (sierra de los Organos, San Cayetano Formation at El Abra).

Superfamily **Pectinacea** Rafinesque, 1815
Family **Plicatulidae** Watson, 1930
Genus *Plicatula* Lamarck, 1801
Plicatula cf. *weymouthiana* Damon, 1860
(pl. 8:7—13)

Material. — Numerous strongly damaged, brittle and silicified shells and valves, JPC No. I/92—101.

Description. — Specimens small, with height almost equal the length which is about 6—8 mm. Right valve more convex than the left, sometimes knee-like bent with attachment surface more or less large. Ornamentation consisting of concentric, folded lamellae and spines, often radially arranged. Narrower lamellae occur together with short and sharp-pointed, radially arranged spines. These spines usually closely adjoin valve surface (pl. 8:10, 13). Wider lamellae are accompanied by wider and longer spines usually rising above valve surface. Spines of that type are formed as extensions of folds of lamellae. The longest of them are up to 1.5 mm long (pl. 8:11—12). Spiny ornamentation predominates on right valves and the lamellar — on the left. Inner surface displays complete mantle line passing very close to valve margins (pl. 8:10*b*). Teeth and triangular resilifer occurring between them are preserved in umbonal part of right valve (pl. 8:9).

Remarks. — The Cuban specimens are most similar to *Plicatula weymouthiana* Damon from the Middle Oxfordian of England (Arkell 1930:90, pl. 6:5—9), and especially to both left and right valves of the holotype (*op. cit.*, pl. 6:6, 6*a*). The surface of the former is covered with both lamellae and spines arranged in the same way as on Cuban specimens. In both cases it is possible to note the co-occurrence of wider spines and wider lamellae on some valves and narrower lamellae and sharp-pointed spines on the others. Cuban specimens are dwarfish in comparison with the English, which are 26—41 mm high, 30—45 mm long and with spines up to 5 mm long. Cuban specimens differ from the English also in spacing of rows of spines; the spiny rows (ribs) are equally wide as intervals between them in Cuban specimens and wider, up to 4 times in English ones. According to Arkell (op. cit.) the species is characterized by very high individual variability in outline and ornamentation of valves. The available Cuban specimens are, however, insufficiently preserved for assigning them to this species without reservation.

Occurrence. — Western Cuba: Middle Oxfordian (Sierra de los Organos, Jagua Formation, Zacarias member, Mogote la Mina).

Suborder **Ostreina** Férussac, 1822
Superfamily **Ostreacea** Rafinesque, 1815
Family **Gryphaeidae** Vyalov, 1936
Subfamily **Gryphaeinae** Vyalov, 1936
Genus *Gryphaea* Lamarck, 1801
Gryphaea mexicana Felix, 1891
(pl. 9:2—4)

1891. *Gryphaea mexicana* Felix: 178, pl. 27:30, 30a, 31.
1965. *Gryphaea mexicana* Felix; Alencaster de Cserna and Buitron, 21, pl. 5:8, 10—11.

Material. — One left and one right relatively complete and several more fragmentary valves, JPC No. I/40—42.

Remarks. — Cuban specimens fully match the diagnosis and correspond to spe-

cimens assigned to *Gryphaea mexicana* Felix by Felix (1891) and Alencaster de Cserna and Buitron (1965). The height and length of incomplete left valve from Cuba, equal about 19.5 mm and 16 mm, respectively, which fall within the limits of variability of left valves from Mexico: height — from 10 to 41 mm, and length — 7.8 to 33 mm (Alencaster de Cserna and Buitron 1965). The Cuban specimen is similar to the Mexican ones in ovate-triangular outline, umbo directed backwards and sinusoidal growth lines and striae forming posterior depression (pl. 9:2). Left valves sometimes display radial striae which were not found on Cuban specimen. Right valves are usually geniculated in the mid-height and ornamented with concentric growth lines and folds. The folds are nonuniformly convex and thickened close to ventral margin (pl. 9:3). Right valve umbo is rounded. Total length of right valves equals 9 and 11 mm. The holotype is very small (10 mm), narrow, high, with strongly incurved umbo and deeper posterior depression (Felix 1891: pl. 27:30, 30*a*). The features, however, fall within the limits of individual variability.

Occurrence. — Western Cuba: Middle Oxfordian (Jagua Formation, Pan de Azúcar member, Siera Ancón). Mexico: Astartian (Cerro de Titania, Flaxiaco, Oaxac), Oxfordian (Cerro Chimeco, Arroyo Agua Escondida).

Genus *Liostrea* Douvillé, 1940

Liostrea sandalina (Goldfuss, 1834)

(pl. 7:1—9)

1965. *Catinula sandalina* (Goldfuss); Freneix: 37, pl. 4:8—14.
1967. *Liostrea sandalina* (Goldfuss); Mongin: 50, pl. 2:14—15.

Material. — Numerous more or less damaged specimens, mainly isolated valves. Specimens representing juvenile or early growth stages are relatively well-preserved. Material brittle, silicified. JPC No. I/44—64.

Remarks. — Cuban specimens are exceptionally small. The measured specimens (20) attain 7—8 mm in height and 10—12 mm in length on the average whilst the representatives of that species from the Jurassic of western Europe attain up to 25 mm in height and 35 mm in length (Mongin: 1967, 50). The Cuban valves representing juvenile growth stages are rounded in outline, equilateral and uniformly convex in umbonal part. Prodisoconchs are preserved on all the valves, being separated from the rest of shell by a marked furrow (pl. 7:2*a*, 3, 6*a*) and relatively large, 0.5 mm in diameter. Valves of mature individuals are usually more unequilateral, variable in outline and the length-to-height ratio, whilst features typical of that species such as bent aside valve margins, tripartite hinge, ornamentation consisting of concentric lamellae and growth lines are well displayed by Cuban specimens (pl. 7:7, 8). Some right valves display Quenstedt muscle scar (pl. 7:1*a*, 5*a*). Valves of *L. sandalina* do not show radial ornamentation so allocation of that species in the genus *Catinula* (Freneix 1965: 37) seems invalid.

Occurrence. — Western Cuba: Middle Oxfordian (Sierra de los Organos, Jagua Formation, Zacarias member, Mogote la Mina). Cosmopolitan species: Bajocian — Oxfordian.

Liostrea mairei (Loriol, 1904)

(pl. 10:1—2)

1904. *Ostrea Mairei*, de Loriol: 247, pl. 26:6—9.
1965. *Liostrea mairei* (Loriol); Freneix: 36, pl. 4:5.

Material. — Fragments of valves or their imprints often preserved on ammonite shells; two specimens better preserved; JPC No. I/65—66.

Remarks. — Cuban specimens correspond to those studied by the authors listed in the synonymy. One of Cuban specimens figured here (pl. 10:2) displays numerous thin radial striae which are diagnostic of that species according to Loriol (1904). Another Cuban specimen fully corresponds to that from Tunisia (Freneix 1965: pl. 4:5) as it is convex, ovate in outline and ornamented with nonuniformly thickened concentric striae (pl. 10:1). The species is characterized by very high variability in outline of valves which are usually attached to substratum with its whole surface or with anterior part only. The valves are often attached to ammonite shells (Loriol, *l.c.*).

Dimensions of Cuban specimens as e.g. height approaching 30 mm, fall within the limits of variability of that species as outlined in papers cited above.

Occurrence. — Western Cuba: Middle Oxfordian (Sierra de los Organos, Jagua Formation, Jagua Vieja member, Hoyo de la Sierra locality and Sierra del Rosario, Artemisa and Francisco Formation). Tunisia, Sahara: Callovian-Oxfordian. Switzerland: Middle and Upper Oxfordian.

Subfamily **Exogyrinae** Vyalov, 1936
Genus *Exogyra* Say, 1820
Exogyra fourtaui Stefanini, 1925
(pl. 8:1—6)

1935. *Exogyra Fourtaui* Stefanini; Cox: 13, pl. 2:5.
1968. *Exogyra fourtaui* Stefanini; Ficcarelli: 35, pl. 2:5—9.
1971. *Exogyra fourtaui* Stefanini; Jordan: 152, pl. 20:6—7.

Material. — About 10 specimens including some relatively well-preserved specimens. Brittle, silicified material. JPC No. I/67—76.

Remarks. — Cuban specimens display the features of the species described in papers listen in the synonymy, differing but in smaller dimensions. The Cuban specimens attain about 7—8 mm in height and length whilst the specimens from Ethiopia and India are usually three times larger (Jordan 1971; Ficcarelli 1968). Umbonal spire of the Cuban specimens approaches 180°. Prodisoconch, usually present, is relatively large, 0.5 to 0.75 mm in diameter (pl. 8:1*a*, 2*b*). These features of the species were hitherto not considered.

Occurrence. — Western Cuba: Middle Oxfordian (Sierra de los Organos, Jagua Formation, Zacarias member, Mogote la Mina; Sierra del Rosario, lowermost part of Artemisa Formation). Africa: Callovian-Oxfordian. India. Oxfordian-Kimmeridgian.

Family **Ostreidae** Rafinesque, 1815
Subfamily **Ostreinae** Rafinesque, 1815
Genus *Ostrea* Linné, 1758
Ostrea broughtoni Imlay, 1945
(pl. 7:10—17)

1945. *Ostrea* (*Catinula*) *broughtoni* Imlay: 262, pl. 39:12—13.

Material. — About 15 well preserved specimens and numerous fragments mainly representing left valves; brittle, silicified material; JPC No. I/77—91.

Remarks. — Length and height of Cuban specimens are roughly equal: 8—9 mm. The specimens from the USA are markedly larger than the Cuban, being 37 mm

high and 27 mm long (Imlay 1945), but there are several features in common which prove that they are conspecific: spirally coiled umbo ornamented with radial striae, lamellar concentric ornamentation of extra-umbonal part of valve, markedly convex left valves, etc. Cuban specimens are characterized by very high individual variability which primarily concerns their height and the form of umbo left valves. They may be considered as the ecomorphs corresponding in their highly conical umbo and wide and high ligament area (pl. 7:11—12) to the recent rudist--like growth forms of *Saccostrea cucullata* (Born 1778). Similarly developed shells are found in Indo-Pacific tropical zone (Stenzel 1971: figs N104—N106). Umbonal cavities shallower than those of *S. cucullata* are known in the representatives of the genus *Crassostrea* Sacco, 1897, whilst the cavities are very shallow or lacking in the representatives of the subfamilies Gryphaeinae and Exogyrinae Vyalov, 1936 (Stenzel 1971). The cavities are sometimes very deep in the Cuban representatives of that species khich, among others, gives support to the allocation of that species to the genus *Ostrea* Linné by Imlay (pl. 7:11, 16*a*, *b*, 17).

Occurrence. — Western Cuba: Middle Oxfordian (Sierra de los Organos, Jagua Formation, Zacarias member, Mogote la Mina; Sierra del Rosario, lowermost part of Artemisa Formation). Southern USA: Kimmeridgian (Louisiana, Cotton Valley Formation).

Subclass **Palaeoheterodonta** Newell, 1965
Order **Trigonioida** Dall, 1889
Superfamily **Trigoniacea** Lamarck, 1819
Family **Trigoniidae** Lamarck, 1819
Subfamily **Vaugoniinae** Kobayashi, 1954
Genus *Vaugonia* Crickmay, 1930
Vaugonia (*Vaugonia*) *postutahensis* sp. n.

(pl. 10:4*a*-*d*)

Holotype: Left valve, JPC No. I/2; pl. 10:4*a*-*d*.

Type horizon: Middle Oxfordian, upper San Cayetano Formation.

Type locality: El Abra, San Cayetano, Sierra de los Organos, Pinar del Rio province, Cuba.

Derivation of the name: After most similar *Vaugonia utahensis* Imlay, from which it is stratigraphically younger.

Diagnosis. — Valve medium in size; umbo moderately prominent, submedial; the mode of ornamentation changing in various parts of the valve throughout the ontogeny.

Material. — Only the holotype with somewhat damaged anterior and ventral parts.

Description. — Valve wide triangular, almost equally high as long (c. 32 mm); the maximum convexity marked in upper part of the valve, about 1/3 of valve length from umbo. Anterior and posterior valve margins obliquely sloping from the umbo, forming with it almost right angle. Area is narrow, divided into two halves by a medial furrow (pl. 10:4c) and ornamented with growth lines and striae. Its width equals about one fifth of width of valve flank. Marginal carina narrow and low close to umbo, becoming wider and progressively higher along with shell growth. Its upper surface is cut by nonuniformly depressed growth lines (pl. 10:4*a*). Ornamentation of valve flanks changing from one growth stage to another. Early growth stage, with concentric ornamentation consisting of uniformly thickened ribs, ends at the fifth rib. The successive, mature stage, is characterized by tripartity

of ornamentation and it is possible to differentiate anterior, central and posterior fields. The anterior field still displays concentric ribs but they are strongly thickened and with uneven, knobby surface (pl. 10:4*d*). Central field is smooth except for concentric growth lines and striae; striae occur in groups, sometimes situated at the extension of ribs of the anterior field (pl. 10:4*c-d*).

Posterior field occupies a well-separated ante-marginal belt (pl. 10:4*a*, *c*) ornamented with convergent, broadly convex ribs equally wide as inter-rib spaces; the ribs are strongly thickened and widened distally, with uneven top surface. First ribs from the posterior field are almost parallel to marginal carina whereas the last ones are parallel to concentric striae from the central valve field. It should be noted that these ribs originate from posterior branch of subumbonal concentric ribs close to the end of juvenile growth stage (pl. 10:4*a*, *c*, *d*). The concentric rib 4th or 5th bends initially sinusoidally in its posterior parts becoming broken thereafter. Subsequently, a wide flat tubercle originates usually on the 6th concentric rib at the boundary of the central and posterior fields. This moment may be interpreted as the end of the early growth stage and the beginning of the mature stage (pl. 10:4*c-d*).

In the gerontic growth stage, concentric ribs from the anterior valve field bend sinusoidally. Subsequent ribs are oblique to them and tubercles from their surface are progressively more uneven and randomly distributed on anterior sections of the ribs (pl. 10:4*d*). Elements appearing for the first time in the central field are the finely tuberculated striae spreading in the fan-like way. Some striae are situated at the extension of radial ribs from the posterior field (pl. 10:4*a-c*) whereas others are set oblique to the former, representing some kind of continuation of central field ornamentation (pl. 10:4*a*). The crossing of these two patterns gives rise to tubercles becoming progressively more rounded and denser spaced along with shell growth (pl. 10:4*b-c*). In the posterior field the radial ornamentation is well-developed up to the peri-ventral valve belt whereas its whole posterior and central part is covered with uneven tubercles and swellings more elongate and randomly arranged (pl. 10:4*b*).

Remarks. — The species differs from all the species hitherto described primarily in ornamentation. In its wide posterior vertical ribs it is most similar to *Vaugonia utahensis* Imlay (Imlay 1964*a*: 31, pl. 3:23—25) from the Callovian of Utah. The latter differs from *V.* (*V.*) *postutahensis* sp. n. in concentric ornamentation throughout the development (somewhat obliterated in central flank field only), the lack of distinct tuberculation of ribs from the anterior field, low and obtuse marginal carina, arcuate anterior valve margin, and V-shaped posterior ribs.

Occurrence: As for the holotype.

Vaugonia (*Vaugonia*) *cubanensis* sp. n.

(pl. 10:3*a-b*)

Holotype: Right valve, No. KMJ I/1; pl. 10:3*a-b*.

Type horizon: Middle Oxfordian, Upper San Cayetano Formation.

Type locality: El Abra, San Cayetano, Sierra de los Organos, Pinar del Rio province, Cuba.

Derivation of the name: found in Cuba.

Diagnosis. — Right valve trigonally-ovate in shape, irregularly tuberculated in its middle part and with weak, longitudinal striae on flanks. Umbo trigonal, opisthogyrate, submedial, not incurved.

Material. — Only the holotype with anterior and ventral parts somewhat damaged.

Description. — Valve almost equally high as long (about 20 mm); the maximum convexity, about 12 mm, marked in antero-medial part of the valve. Area narrow, with transverse diameter equal about a quarter of transverse valve diameter, divided by medial carina with uneven top surface into larger anterior and smaller posterior parts. A narrow furrow continues along posterior side of the carina. Marginal and internal carinae relatively narrow and low (pl. 10:3*b*). Tripartity of area is accentuated by mutually step-like arrangement of both its parts. Areal surface is covered with thin growth lines and fine radial striae preserved in subumbonal part of the specimen (pl. 10:3*b*). Area and lateral surface of valve form obtuse angle somewhat more than 90° in subumbonal part and equal about 170° in ventral part of the valve.

Ornamentation of valve flank changes from concentric ribbing in the early growth stage to tuberculation at the end of growth. First ribs, 5 in number, mark the early growth stage. They are U-shaped, with posterior sinus beginning at the third rib, high and wide, thicker in distal part. The mature stage may be marked by V-shaped ribs with posterior branch more oblique to marginal carina than the anterior. The ribs are broken in the central part which results in origin of fine tubercles becoming more numerous as the shell grows. Anterior part of concentric rib is fine, with uneven surface, the posterior — strongly thickened, with smooth surface (pl. 10:3*b*). Central part of the valve is ornamented with numerous tubercles arranged in the form of triangle with apex directed upwards (pl. 10:3*a*). Mature ornamentation of the valve is clearly tripartite. The gerontic stage is characterized by appearance of progressively larger tubercles which may cover lateral valve surface at the ventral margin (pl. 10:3a). The whole valve surface is ornamented with very thin growth striae what causes the knobby appearance of top surface of ribs and striated appearance of the lateral surface (pl. 10:3*b*).

Remarks. — The early growth stages of this species resemble somewhat those of *Vaugonia krömmelbeini* de la Torre, 1960, from the Oxfordian of Cuba. Concentric ribs are U-shaped in both species but their posterior parts are tuberculate in the latter species. The differences are much larger at later growth stages. Valves of *V. krömmelbeini* are high, with sharp-pointed umbo, smooth posterior field and spiny-tuberculate ornamentation of V-shaped ribs (Krömmelbein 1956: pl. 1:1—4).

Valves of the new species are also similar to those of *Trigonia V-costata* Lycett, 1874 (Lycett 1874: pl. 15) from the Interior Colite of south-eastern England in arrangement of ribs at early growth stage. Other features and especially marked tuberculate flank ornamentation, area bipartite and with fields depressed in the step-like way, and smooth, thickened posterior branching of ribs and fine and unevenly tuberculated anterior branchings are highly specific and well define the new Cuban species.

Occurrence. — As for the holotype.

Vaugonia (*Vaugonia*) *cayetanoensis* sp. n.

(pl. 9:1*a*-*c*)

Holotype: Left valve. No. JPC I/3; pl. 9:1*a*-*c*.

Type horizon: Middle Oxfordian, Upper San Cayetano Formation.

Type locality: El Abra, San Cayetano, Sierra de los Organos, Pinar del Rio province, Cuba.

Derivation of the name: occurring in San Cayetano Formation.

Diagnosis. — Valve of medium size, umbo prominent, submedial, opisthogyrate; flank ornamented with radial, fan-shaped folds, posterior in place.

Material. — Only the holotype with damaged umbonal part, JPC No. I/3.

Description. — Valve wide, triangular, 31 mm high and about 40 mm long; the maximum convexity equal about 15 mm comprising upper-anterior part. Anterior margin broadly arcuate; antero-ventral margin lobe-like extended; protruding, ventral margin broadly arcuate, forming a small sinus in front of marginal carina; posterior margin straight, short. Siphonal margin sinusoidally bent, almost vertically sloping to ventral margin and subsequently widening into short postero-ventral lobe (pl. 9:1*b*). Area relatively narrow, equal about a third of width of flank near ventral margin and halved by radial furrow. Area and lateral valve surface are set at the right angle below the umbo and at obtuse angle about 165° close to ventral margin (pl. 9:1*b-c*). Area ornamented with growth lines and striae. Marginal carina very narrow, low, slightly protruding in the proximity of the umbo, rapidly widening and rising as the shell grows. Its subumbonal part is ornamented with widened tubercles, the rest — with nonuniformly protruding growth lines (pl. 9:1*c*).

Ornamentation of flanks changes during ontogeny from concentric ribbing at early growth stages to V-shaped and fan-shaped and limited to a narrow submarginal valve part in the final growth stage. The early growth stage is marked by 5 concentric, swollen, low ribs, equally wide as the inter-rib spaces (pl. 9:1*c*). In the mature growth stage, posterior branch of ribs becomes vertical. Arrangement of radial folds with uneven, tuberculate surface, becomes progressively more fan-like. First, 4—5 anterior folds deviate closer to the anterior valve margin, medial folds are set perpendicular to the ventral margin and the posterior, 3—4 in number, deviate towards the posterior margin. These folds are fairly short, begin at various distance from umbo and are connected by distal ends with concentric folds covering central and anterior parte of valve. The vertical and concentric folds are set at obtuse angle in umbonal part of the valve, at almost right angle in central part and at acute angle in sub-ventral part (pl. 9:1*b-c*). Concentric elements of ornamentation disappear and vertical folds follow wavy course in the gerontic stage. The whole surface of valve is covered with very fine radial microfolds more protruding at the end of growth and well visible close to the ventral valve margin (pl. 9:1*b*). Inner surface displays a fragment of hinge, i.e. large main tooth with damaged apex and lateral pits (pl. 9:1*a*).

Remarks. — The Cuban specimen somewhat resembles those from the Lower Hauterivian of Mangyshlak, assigned to *Iotrigonia jakshysaurensis* (Luppov) by Savelev (1958: pl. 31:1—2). The similarities concern: the outline of valves, course of wide concentric ribs in umbonal parts of the valves, the mode of development of posterior radial elements of ornamentation and a wide posteroventral lobe. *Trigonia heterosculpta* Stanton (Stanton 1901: pl. 4:16—18) from the Cretaceous of Patagonia resembles the Cuban specimen in valve outline and the style of ornamentation, differing in more anterior location of arcuate umbo, longer and more protruding posteroventral lobe, concentric ornamentation well-marked throughout valve surface, V-shaped arrangement of anterior and posterior ribs, the presence of V-shaped ribs in anterior part of young valve, with the apex of "V" directed towards the umbo.

The features of the Cuban specimen as, first of all, fan-shaped arrangement of posterior ribs, folded surface of the ribs, the presence of micro-wrinkles, angle of connections of concentric and radial elements of ornamentation changing during the ontogeny are highly specific and justify the erection of new species in the subgenus *Vaugonia* (*Vaugonia*).

Occurrence. — As for the holotype.

Subclass **Heterodonta** Neumayr, 1884
Order **Veneroida** Adams a. Adams, 1856
Superfamily **Crassatellacea** Férussac, 1822
Family **Astartidae** d'Orbigny, 1844
Genus *Neocrassina* Fischer, 1886
Neocrassina (*Neocrassina*) *ovata* (Smith, 1816)
(pl. 11:5—6)

1839. *Astarte crassitesta* Roemer: 39, pl. 19:18.
1874. *Astarte Michaudiana* d'Orbigny; Loriol: 95, pl. 15:8.
1874. *Astarte bruta* Contejean; Loriol: 86, pl. 15:9.
1934. *Astarte ovata* Smith; Arkell: 231, pl. 32:1—12, figs 55—56 (see synonymy).

Material. — Two valves with somewhat damaged umbonal part and the inside; left is juvenile and the right — mature; JPC No. I/34—35.

Remarks. — Both Cuban specimens correspond to those described in the papers listed in synonymy. They are somewhat longer than high, having 20 mm and 38 mm in the length, and 18 mm and 36 mm in the height, respectively. These values fall within the limits of variability given for representatives of that species; the largest specimens may be over 80 mm long and 73 mm high (Arkell 1934: 232). Left valve is rounded in outline whereas the right, representing mature growth stage, is subquadrate, which is typical of this species. In umbonal part of both specimens, concentric ribs are V-shaped, except for the earliest ribs which are U-shaped. The sinus progressively deepening is clearly marked in posterior part (pl. 11:5—6). Typical ribbing is limited to a small part of valve, stretching at about 10 mm distance from umbo, being later replaced by irregularly concentric ornamentation consisting of wrinkles and folds, between which very thin growth lines may be noted. Concentric ribs crossed by radial rows of fine tubercles are visible on umbonal part of the larger, right valve representing the mature growth stage (pl. 11:5*a*). There are also visible concentric, progressively more loosely spaced furrows which presumably separate successive phases of shell growth (pl. 11:5*a*). The number of ribs appearing in inter-furrow spaces increases from 3—4 in the middle of valve to 7—8 at its ventral margin. The surface of larger valve displays colored, dark and light bands stretching from the umbo towards ventral margin in the form of gentle arc (pl. 11:5*b*). Similar specimen was figured by Arkell (*l.c.*: pl. 32:11) who emphasized a high individual variability in that species, mainly concerning valve outline changing from oblique-ovate to triangular and subquadrate, as well as forward shift and size of umbo (Arkell *l.c.*; Loriol 1874). The representatives of this species display high hinge with structure typical of that genus (Roemer 1839; Chavan 1969: N567).

The specimen determined by Imlay (1964: C34, pl. 4:6—8) as *Astarte* (*Coelastarte*) sp. n. indet. from the Callovian (Carmel Formation) of Central and southern Utah, USA, resembles the species in question in several features including: subquadrate valve outline, course of ribs disappearing with the shell growth and fine granulation marked on early concentric ribs which is visible on the Cuban specimens. The American form would be more properly assigned to *Neocrassina* (*N.*) *ovata* and this would mean that the stratigraphic and geographic ranges of this species are wider than it was hitherto assumed and comprise Callovian of the USA.

The genus *Neocrassina* Fischer, 1886, is typical of Lower Jurassic — Upper Cretaceous deposits of Europe, Madagascar and southern Africa (Chavan *l.c.*: N567).

Occurrence. — Western Cuba: Middle Oxfordian (San Cayetano and Jagua Formations, El Abra locality in sierra de los Organos). France: Astartian (Boulonge-

-sur-Mer, Mont des Boucards). Federal Republic of Germany, Hannover area: Oxfordian. England: Lower — Upper Oxfordian and Lower Kimmeridgian. ?USA: Callovian.

Neocrassina (*Coelastrate*) *cotteausia* (d'Orbigny, 1850)
(pl. 11:1—4)

1874. *Astarte Cotteausia* d'Orb., 1850; Loriol: 100, pl. 15:42.
1936. *Astarte* (*Coelastarte*) *cotteausia* (d'Orbigny) de Loriol; Arkell: 369, pl. 51:16—17 (see synonymy).

Material. — Slightly damaged shell and 3 fragments of valves, JPC No. I/36—39.

Remarks. — Cuban specimen it most similar to those studied by the authors of papers listed in the synonymy in ovate-subquadrate outline of valves and the same course of concentric ribs. It is about 47 mm long and about 30 mm high, i.e. slightly smaller than the French (Loriol 1874: pl. 15:42) and English specimens (Arkell 1936: pl. 51:16—17). Typical concentric ribs of subumbonal area are replaced in Cuban, English and French specimens by irregular growth wrinkles at about 10 mm from the umbo (pl. 11:1*b*, 2). Ornaentation disappears first in posteroventral part of valves (pl. 11:1*b*, 4) but often may be well-developed till the end of growth (pl. 11:3). A fine granulation visible around the umbo on the Cuban specimen is known also from valves of *Neocrassina* (*N.*) *ovata* (Smith) but it was not mentioned by the authors cited in the synonymy of both species. Umbo of the Cuban specimens is strongly shifted towards the anterior end, contrary to the specimens figured in papers mentioned above, it may be more protruding and higher on valves of young individuals (pl. 11:2). One of the Cuban specimens of *N.* (*C.*) *cotteausiai* displays colored bands which are, however, shorter and more arcuate than similar bands found on the valve of *N.* (*N.*) *ovata* but the lighter-colored bands, are wider, shorter and more arcuate (pl. 11:1*a*). As it follows from the literature, shell coloring may be characteristic of different taxa (Nuttall 1969: N70-N71) and its certain types are typical of some families or genera. Colored bands similar to those displayed by Cuban specimens are known, e.g. from the genus *Tellinella* (Neogene of Borneo) or in *Macrocallista laevigata* (Lamarck) (Eocene of France), which, as *Neocrassina*, represent order Veneroidea Adams and Adams.

Occurrence. — Western Cuba: Middle Oxfordian (San Cayetano and Jagua Formation, El Abra in Sierra de los Organos). France: Astartian (Boulogne-sur-Mer, Mont des Boucards); Rauracian: (Chatel-Censoir, Coulanges-sur-Yonne). Switzerland: Rauracian (Jura Bernois). England: Coral Rag (= Oxfordian-Virgulian) (Grimston Yorks, Upware, Cambridgeshire).

Superfamily **Corbiculacea** Grey, 1847
Family **Corbiculidae** Gray, 1847
Genus *Eocallista* Douvillé, 1921
Eocallista (*Hemicorbicula*) *parva* (Sowerby, 1936)
(pl. 12:4—7)

1955. *Eocallista* (*Hemicorbicula*) *parva* (Sowerby); Casey: 367, figs 4—5, 6*B*.

Material. — Very numerous moulds, sometimes with shell fragments, forming lumachelles; recrystallized material; JPC No. I/4—13.

Remarks. — The Cuban specimens are rounded in outline and very small. Values obtained for 10 better preserved ones are: 1.8—8.5 mm in height, 1.8—10.0 mm in length, and 0.8—3.6 mm in shell thickness. The height index, ranging from 1.0 to 0.8 tends to slope down with shell growth. Small dimensions of shells, usually below 10 mm in length, allow one to assign them to *E.* (*Hemicorbicula*) Casey. Hinge with structure typical of the genus *Eocallista* Douvillé, a characteristic mantle line truncated at the posterior muscle scar and cylindrical ligament situated at the back of umbo (pl. 12:4*a*) are consistent with the features of the type species (Casey 1955: fig. 6*B*). The Cuban representatives of this species display clearly the details of external morphology (pl. 12:4—5, 7) as well as the structure of hinge in left valve (pl. 12:6). Straight tooth 2a is connected with long, ledge-like lateral anterior tooth AII at the base. The tooth 2b is depressed at the base and the tooth 4b — along carina in posterior subumbonal part of valve.

Occurrence. — Western Cuba: Purbeckian (San Cayetano Formation, Sierra de los Organos, area south of San Andrés). England: Purbeckian (Vale of Wardour, Wiltshire).

Eocallista (*Hemicorbicula*) *veneriformis* (Loriol, 1874)

(pl. 12:1—3)

1874. *Anisocardia veneriformis* Loriol: 47, pl. 13:24.

Material. — Very numerous moulds with shell fragments, forming lumachelles; recrystallized material comprising 10 better preserved specimens; JPC No. I/14—23.

Remarks. — The Cuban specimens are trapezoidal or triangular in outline and small. Values obtained for 10 measured specimens are: 2.5—10 mm in height, 3—7.5 mm in length, and 1.5—3 mm in shell thickness. The height index equals 0.66—0.83 (0.74 on the average). The Cuban specimens are twice smaller than the French (Loriol 1874: pl. 13:24) whereas other features of the compared specimens are conformable; the height indices are also similar as that of the French specimens equals 0.73. The features such as valve outline, low and small umbo situated closer to the anterior margin and especially the hinge structure typical of the genus *Eocallista* allow to allocate "*Anisocardia veneriformis*" Loriol to *E.* (*Hemicorbicula*) Casey, 1955.

The ornamentation of the French and Cuban specimens is similar, consisting of thin concentric growth lines and wider striae bent at the angle in posterior part of valve (pl. 12:1—3).

Occurrence. — Western Cuba: Purbeckian (San Cayetano Formation, Sierra de los Organos, area south of San Adrés). France: Portlandian (Chatillon).

Eocallista (*Hemicorbicula*) *cuneovata* (Cragin, 1905)

(pl. 12:8)

1940. *Eocallista?* cf. *E. cuneovatus* (Cragin); Imlay: 409, pl. 55:2—6.

Material. — Numerous moulds with shell fragments, 5 of which are relatively well preserved. Recrystallized material; JPC No. I/24—28.

Remarks. — The Cuban specimens are small. Values obtained for 5 measured specimens are: 4.5—8.0 mm in height, 6.0—11.0 mm in length, 2.0—5.0 mm in shell thickness, and height index 0.72—0.75. The Mexican specimens are almost twice as large (Imlay 1940) whereas height index calculated from dimensions given by Imlay (op. cit.) is similar. The Cuban specimens are similar in: shell outline with

narrow anterior and wider posterior margin, small and low umbo situated in about a third of valve length from the anterior margin, posterodorsal margin long, straight and sloping towards the posterior, anterodorsal margin short, steeper than the posterodorsal and depressed beneath the umbo, and ornamentation consisting of narrow and irregularly spaced growth lines and growth furrows, the spacing of which increases along with shell growth (pl. 12:8). Individual variability concerns mainly shell outline (Imlay *op. cit.*: pl. 55:2—6).

Occurrence. — Western Cuba: Purbeckian (San Cayetano Formation, Sierra de los Organos, area south of San Andrés). Mexico: Lower Tithonian (Purbeckian) — La Casita Formation (Sierra de Parras, Coshuila).

Eocallista (*Hemicorbicula*) *intermedia* (Loriol, 1874)

(pl. 12:9—13)

1874. *Anisocardia intermedia* Loriol: 46, pl. 13:20—22.

Material. — Over a dozen moulds with shell fragments, 5 of which are relatively well-preserved; JPC No. I/29—33.

Remarks. — The Cuban specimens are small. Values obtained for 5 measured specimens are: 6—10.5 mm in height, 8.5—14.5 mm in length, 2.5—4.0 mm in shell thickness; height index equals 0.7—0.83. French specimens are somewhat smaller being 5.0—10.0 mm long whereas their height index (0.77—0.80) is very close to that of Cuban specimens (Loriol 1874). Valve hinges of juvenile and mature individuals, figured by Loriol (*op. cit.* pl. 13:20*c*, 22), display structure typical of the genus *Eocallista*. Right valve hinge of juvenile individual consists of: 2 main teeth which are oblique and protruding, triangular anterior tooth not reaching umbo, and elongate posterior tooth. The same hinge elements are displayed by juvenile right valves from Cuba (pl. 12:10). Mature individual from Cuba displays long, arcuate lateral tooth AII and rudimentary AIII (pl. 12:13).

According to the present author this species should be allocated in *E.* (*Hemicorbicula*) on account of the outline of valve, structure of hinge and small size. Similar suggestion was previously made by Casey (1955).

Occurrence. — Western Cuba: Purbeckien (San Cayetano Formation, Sierra de los Organos, area south of San Andrés). England: Middle Purbeckian. France: Portlandian (Tour Croi).

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HALINA PUGACZEWSKA

JURAJSKIĘ MAŁŻE Z KUBY

Streszczenie

W pracy opisano 16 gatunków małżów jurajskich z prowincji Pinar del Rio z zachodniej Kuby. Małże te należą do 7 rodzin: Bakevelliidae, Plicatulidae, Gryphaeidae, Ostreidae, Trigoniidae, Astartidae i Corbiculidae. Trygonie stanowią endemiczną faunę Kuby, oznaczono stąd 3 nowe gatunki: *Vaugonia* (*V.*) *postutahensis* sp. n., *Vaugonia* (*V.*) *cubanensis* sp. n. i *Vaugonia* (*V.*) *cayetanoensis* sp. n. Najliczniej reprezentowane są małże ostrygowate (5 gat.) oraz małże brakiczne (4 gat.). Obok morfologicznych badań i obserwacji nad zmianami wzrostowymi niektórych gatunków przedstawiono w pracy rozprzestrzenienie paleogeograficzne i stratygraficzne opisanej fauny, charakterystykę materiału i uwagi litologiczne.

ХАЛИНА ПУГАЧЕВСКА

ЮРСКИЕ ПЛАСТИНЧАТОЖАБЕРНЫЕ ИЗ КУБЫ

Резюме

В статье описаны 16 видов юрских двустворок из провинции Pinar del Rio западной Кубы. Двустворки относятся к 7 семействам: Bakevelliidae, Plicatulidae, Gryphaeidae, Ostreidae, Trigoniidae, Astartidae и Corbiculidae. Тригонии являются эндемичной фауной Кубы, а потому были описаны з новых вида: *Vaugonia* (*V.*) *postutahensis* sp. n., *Vaugonia* (*V.*) *cubanensis* sp. n. и *Vaugonia* (*V.*) *cayetanoensis* sp. n. Наиболее многочисленными представлены устрицоподобные (5 видов), а также соленоватоводные двустворки (4 вида). Наряду с морфологическими исследованиями и наблюдениями над изменениями роста некоторых видов, в статье представлено палеогеографическое и стратиграфическое распространение описанной фауны, а также даны характеристика материала и литологические замечания.

EXPLANATION OF THE PLATES

Plate 7

Middle Oxfordian, Sierra de los Organos, Jagua formation, Zacarias member, locality Mogota la Mina

Liostrea sandalina (Goldfuss)

1. Right valve of young specimen, JPC No. I/44: *a* internal, *b* external surface.
2. Shell of young specimen, JPC No. I/45: *a* dorsal, *b* lateral view.
3. Lateral view of shell of young specimen, JPC No. I/46.
4. Left valve of young specimen, JPC No. I/47.
5. Right valve of young specimen, JPC I/48.
6. Fragment of right valve of adult specimen, JPC No. I/49: *a* internal, *b* external surface.
7. Left valve of young specimen, JPC No. I/50.
8. Left valve of adult specimen, JPC No. I/51.
9. Left valve of adult specimen, JPC No. I/52.

Ostrea broughtoni Imlay

10. Umbonal fragment of left valve of young specimen, JPC No. I/77: external view.
11. Umbonal fragment of left valve of young specimen, JPC No. I/76: deep subumbonal cavity is visible.
12. Left valve of young specimen, JPC No. I/79: large ligament area is visible.

13. External view of left valve of young specimen, JPC No. I/80.
14. Internal surface of right valve of young specimen, JPC No. I/81.
15. External surface of right valve of young specimen, JPC No. I/82.
16. Left valve of adult specimen, JPC No. I/83: *a* internal, *b* external surface.
17. Shell of adult specimen, JPC No. I/84: external surface of umbo and right valve.

2, 3, 5, 11 × *10*
all others × 5

Plate 8

Middle Oxfordian, Sierra de los Organos, Jagua formation, Zacarias member, locality Mogote la Mina

Exogyra fourtaui Stefanini

1. Right valve of young specimen, JPC No. I/67: *a* external, *b* internal surface.
2. Shell of young specimen, JPC No. I/68: *a* left valve, *b* right valve.
3. Shell of young specimen, JPC No. I/69: *a* left valve, *b* right valve.
4. Right valve of young specimen, JPC No. I/70: internal surface.
5. Internal surface of left valve of young specimen, JPC No. I/71.
6. Left valve of young specimen, JPC No. I/72: *a* external, *b* internal surface.

Plicatula cf. *weymouthiana* Damon

7. Fragment of right valve of the specimen, JPC No. I/92: external surface.
8. Fragment of right valve of the specimen, JPC No. I/93: external surface.
9. Internal surface of right valve, JPC No. I/94: basal part of teeth are visible.
10. Right valve of specimen JPC No. I/95: *a* external, *b* internal surface.
11. Fragment of right valve of specimen JPC No. I/96: *a* external, *b* internal surface.
12. External view of right valve of specimen JPC No. I/97.
13. External view of right valve of specimen JPC No. I/98.

2—4 × 10
all others × 5

Plate 9

Vaugonia (*Vaugonia*) *cayetanoensis* sp. n.

Middle Oxfordian, San Cayetano formations, El Abra locality Sierra de los Organos, Pinar del Rio Province

1. Left valve of adult specimen JPC No. I/3: *a* hinge of the valve × 1, *b* external view of the valve, × 2, *c* external view of subumbonal part of the valve, × 2.

Gryphea mexicana Felix

Middle Oxfordian, Jagua Formation, Pan de Azucár member, Sierra Ancón.

2. Left valve of adult specimen, JPC No. I/40: lateral view, × 1.5.
3. Right valve of young specimen, JPC No. I/41: external surface, × 2.
4. Fragment of umbonal part of adult specimen, JPC No. I/42: external surface, × 1.5.

Gervillaria sp.

Middle Oxfordian, San Cayetano formation, El Abra

5. Mould of adult specimen, JPC No. I/43: external surface, × 1.5.

Plate 10

Liostrea mairei (Loriol)

Middle Oxfordian, Jagua formation, Jagua Vieja member, Hoyo de la Sierra locality, Sierra de los Organos

1. Left valve of adult specimen, JPC No. I/65: external surface, × 1.5.
2. Left valve of adult specimen, JPC No. I/66: internal surface, × 1.5.

Vaugonia cubanensis sp. n.

Middle Oxfordian, San Cayetano formation, El Abra locality Sierra de los Organos

3. Right valve of adult specimen, JPC No. I/1: *a* external surface, × 2, *b* postero--subumbonal part of the valve, × 5.

Vaugonia postutahensis sp. n.

4. Left valve of gerontic specimen, JPC No. I/2: *a* external surface, × 1.5, *b* postero--ventral part of the valve, × 3, *c* ante-carinal part of the valve, × 3 *d* middle--anterior part of the valve, × 3.

Plate 11

Middle Oxfordian, San Cayetano formation, Sierra de los Organos, El Abra locality, S from Sierra Ancón

Neocrassina (Coelastarte) cotteausia (d'Orbigny)

1. Left valve of adult specimen, JPC No. I/36: *a* traces of color ornament are visible, × 1; *b* the same specimen covered with chloride of ammonis, valve sculpture visible, × 1.
2. Umbonal part of right valve of young specimen, JPC No. I/37, × 2.
3. Postero-ventral lobe of the left valve, JPC No. I/38, × 1.5.
4. Left valve of young specimen, JPC No. I/39, × 2.

Neocrassina (*Neocrassina*) *ovata* (Smith)

5. Right valve of adult specimen, JPC No. I/34: *a* covered with chloride of ammonis, valve sculpture visible, × 1; *b* the same specimen: traces of color ornament are visible, × 1.
6. Right valve of young specimen, JPC No. I/35, × 2.

Plate 12

Oxfordian, San Cayetano formation, Sierra de los Organos, S from San Andrés

Eocallista (*Hemicorbicula*) *veneriformis* (Loriol)

1. Right valve of young specimen, JPC No. I/14, trapezoid in shape, elongated.
2. Right valve od young specimen. JPC No. I/15, trapezoid in shape, short.
3. Right valve of adult specimen, JPC No. I/16, trapezoid in shape, short.

Eocallista (*Hemicorbicula*) *parva* (Sowerby)

4. Shell of young specimen, JPC No. I/4, *a* dorsal view, *b* right valve.
5. Right valve of adult specimen, JPC No. I/5.
6. Hinge of the left valve of adult specimen, JPC No. I/6.
7. Mould or right valve of adult specimen, JPC No. I/7: mantle line slightly denticulated.

Eocallista (*Hemicorbicula*) *cuneovata* (Cragin)

8. Left valve of adult specimen, JPC No. I/24.

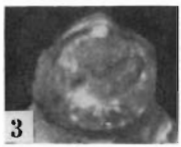
Eocallista (*Hemicorbicula*) *intermedia* (Loriol)

9. Left valve of adult specimen, JPC No. I/29.
10. Hinge of right valve of young specimen, JPC No. I/30.
11. Right valve of adult specimen, JPC No. I/31.
12. Mould of right valve of adult specimen, JPC No. I/32.
13. Hinge of right valve of adult specimen, JPC No. I/33.

figs *6*, *13* × 8
fig *10* × 10
all others × 3


1a


2a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2b


1b

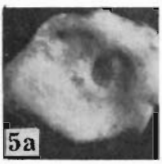

10


12


11


4a


4b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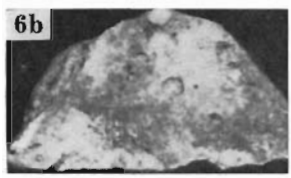
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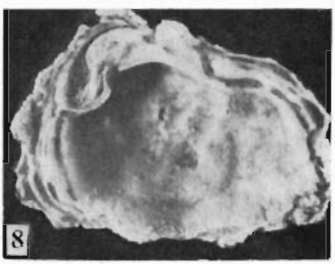
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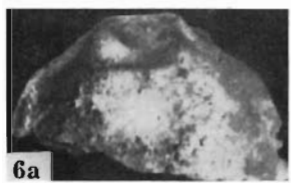
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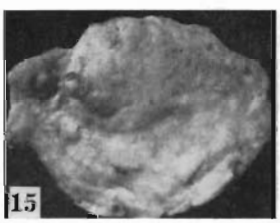
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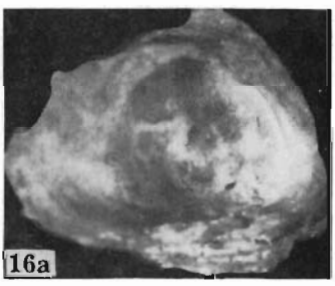
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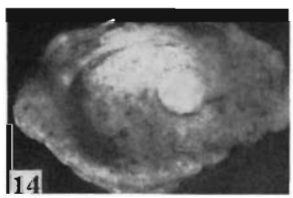
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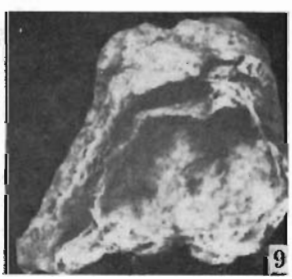
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1a

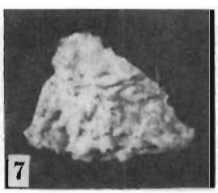

2a


4


2b


1b


3a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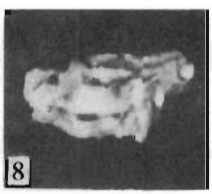
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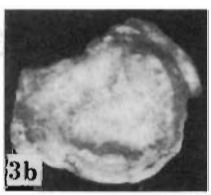
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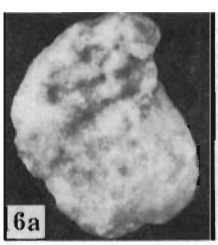
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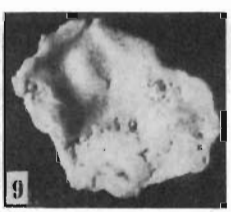
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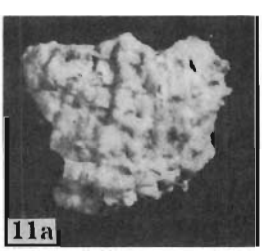
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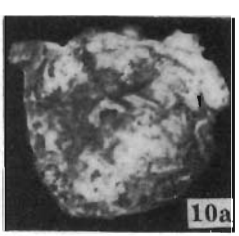
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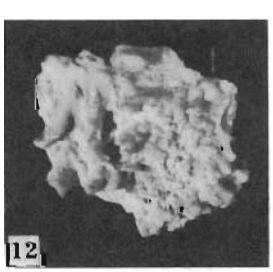
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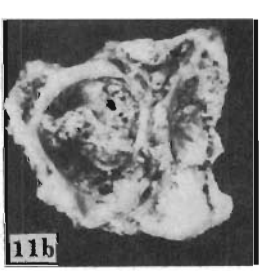
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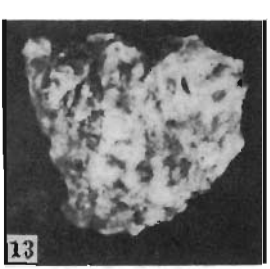
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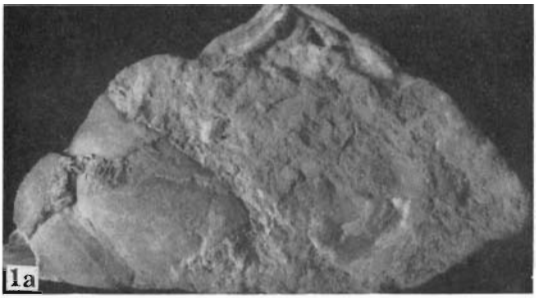
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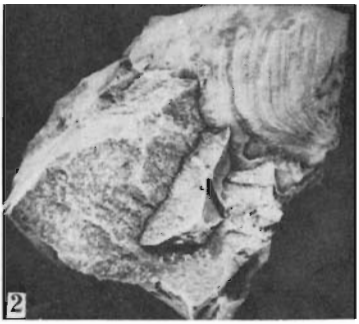
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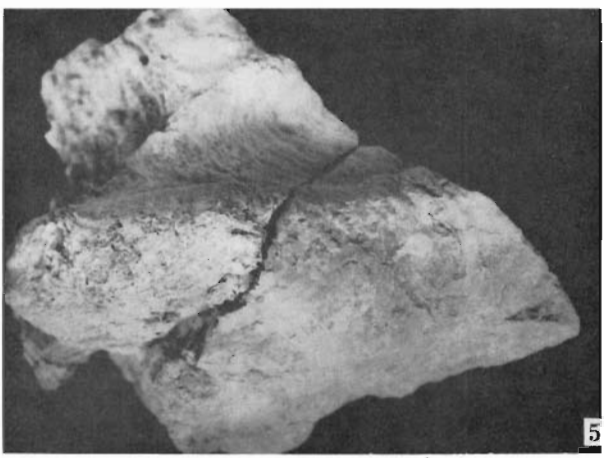
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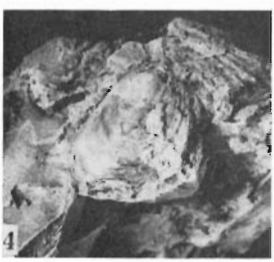
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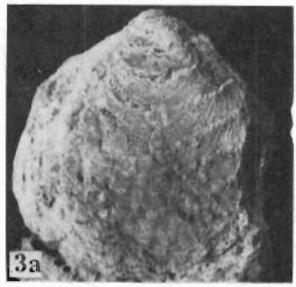
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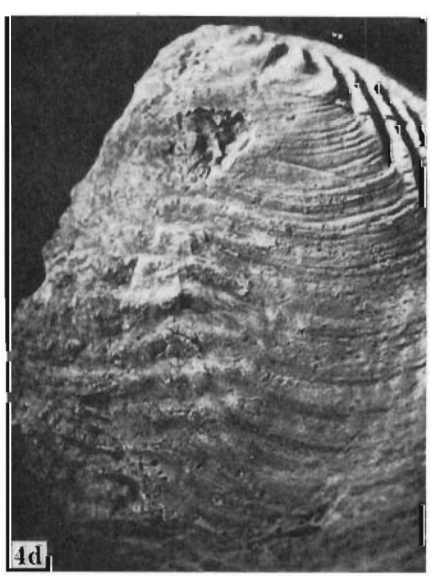
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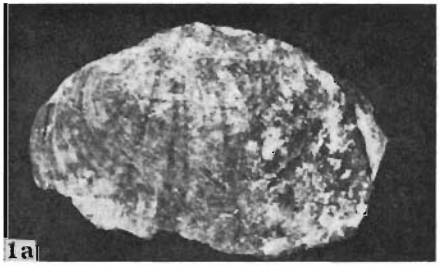
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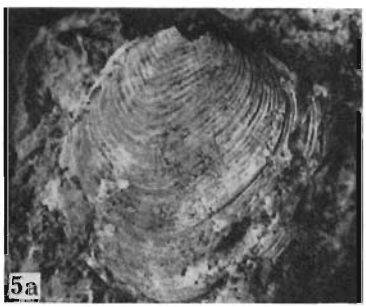
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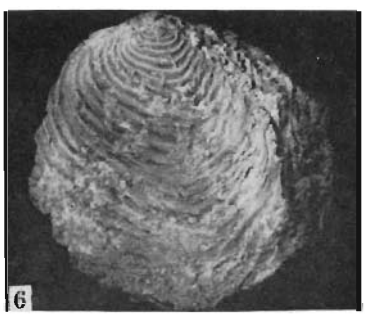
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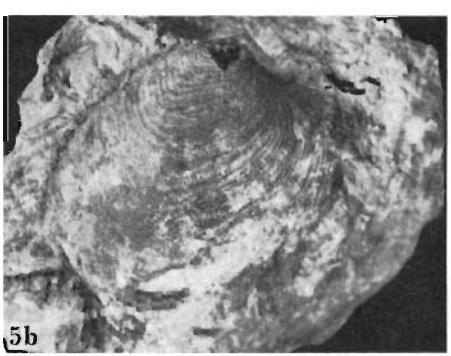
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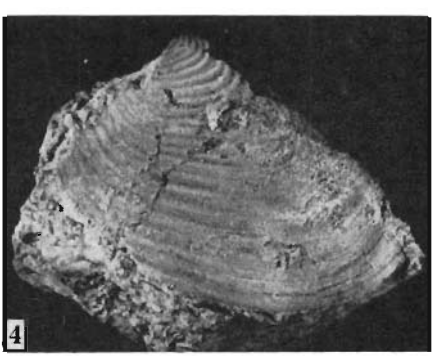
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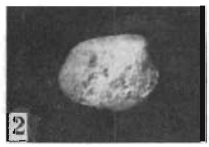
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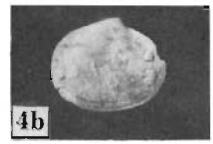
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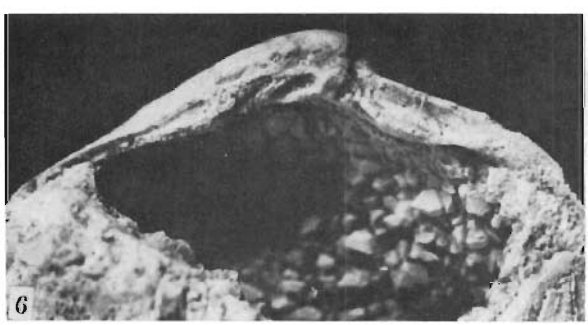
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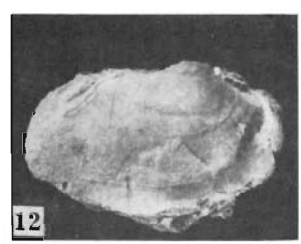
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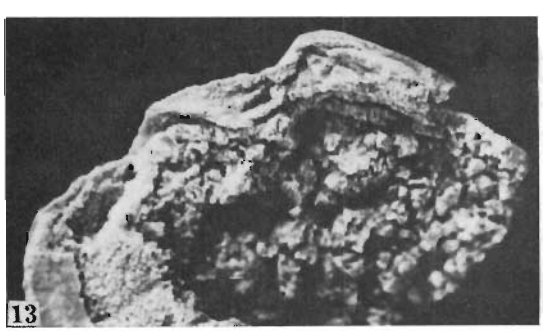
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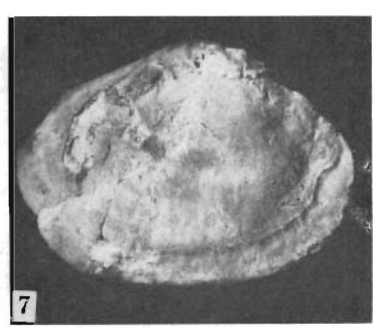
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