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Oxfordian ammonites of the Pinar del Rio province (western Cuba); their revision and stratigraphical significance

ABSTRACT: The revision of classical ammonite fauna of the Cuban Oxfordian, from the Jagua Vieja Member of the Jagua Fm. of the Sierra de los Organos, and from the Francisco Fm. of the Sierra del Rosario shows that these ammonites belong to the following genera and subgenera: *Vinalesphinctes* Spath (*Vinalesphinctes, Subvinalesphinctes* subgen. n., *Roigites* subgen. n.), *Perisphinctes* Waagen (*Cubasphinctes* Chudoley & Furrazola, *Antilloceras* subgen. n.), *Discosphinctes* Dacqué, *Euaspidoceras* Spath, *Ochetoceras* Haug, *Cubaochetoceras* Arkell and *Glochiceras* Hyatt (*Glochiceras*). This assemblage is of Middle Oxfordian age, Gregoryceras transversarium and possibly early Perisphinctes bifurcatus age. It became the basis for the time-correlation between the Oxfordian sections of the Sierra de los Organos and the Sierra del Rosario. The Zacarías Member, a new lithostratigraphic unit, is distinguished within the Jagua Fm., and it is regarded as a facies equivalent of the Azúcar (= Pan) Member. The Oxfordian ammonite fauna from Cuba is close to the other faunas of the Americas (except the Boreal regions). The paleobiogeographic position of all these faunas within the Tethyan realm is subsequently discussed.

INTRODUCTION

The classical areas of occurrence of Jurassic deposits in Cuba include the mountain ranges of the Sierra de los Organos and the Sierra del Rosario in Pinar del Río province (Text-fig. 1). A rich and excellently preserved Oxfordian ammonite fauna, highly important for the stratigraphy of that stage in the Americas, is known for a long time from the former mountain range. However, previous studies did not solve all the systematic and stratigraphic problems and some of statements require a thorough

revision. Moreover, the field studies connected with mapping of Pinar del Río province, and carried out by the Institute of Geological Sciences of the Polish Academy of Sciences and the Instituto de Geología y Pa-

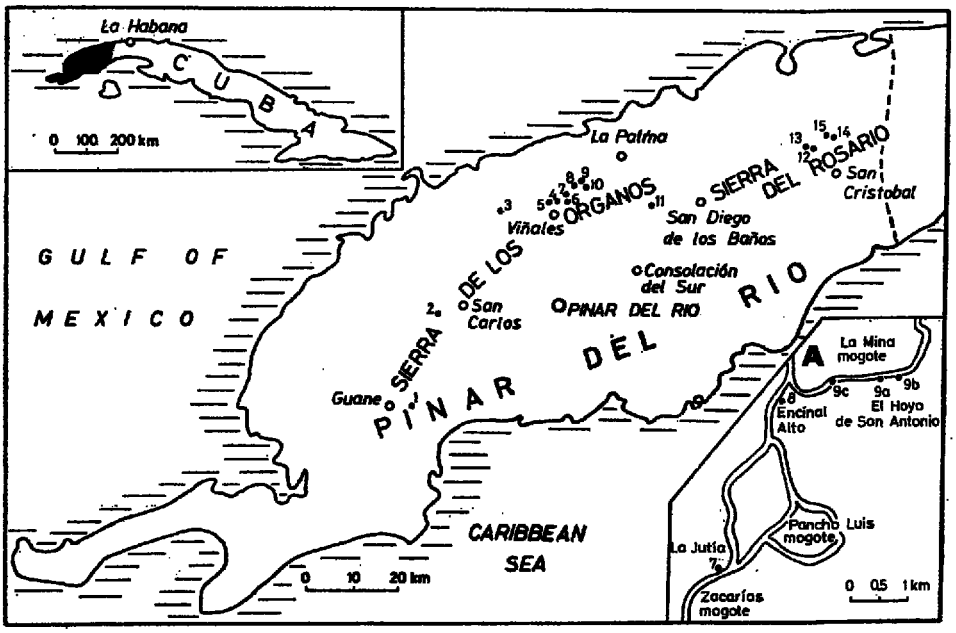

Fig. 1. Investigated faunistic localities (1—15) in the Pinar del Río province (inset shows its position in Cuba)

Sierra de los Organos: *1* Sierra de Guane, *2* El Junco village (San Carlos Valley), *3* Pan de Azúcar mogote, *4* Laguna de Piedra, *5* Puerta del Ancón, *6* Zacarías mogote, *7* La Jutia village, *8* Encinal Alto village, *9* La Mina mogote, *10* El Hoyo de San Antonio, *11* El Hoyo de la Sierra Sierra del Rosario: *12* Altos de San Francisco, *13* Cinco Pesos village, *14* Brujito village, *15* Loma Calabrote

1*A*. Location of the stratotype and reference sections for the Zacarías Member (*cf.* Text-fig. 2):

7 stratotype section of the upper boundary, *8* stratotype section of the lower boundary, *9a—c* reference sections of the lower boundary

leontología, Academia de Ciencias de Cuba supplied some new data on the ammonite fauna and stratigraphy of the Oxfordian of that region. The most important results of the studies include: the finding of Oxfordian ammonite fauna in the Sierra del Rosario, which appeared to be very close to that previously known from the Sierra de los Organos, and finding of a younger Oxfordian ammonite assemblage in the two mountain ranges. The latter ammonite fauna is the subject of separate papers (Myczyński 1976; Kutek, Pszczółkowski & Wierzbowski 1976).

The present paper consists of two parts. The first part gives the outline of the stratigraphy of Oxfordian strata from Pinar del Río province, based on the results of the new studies; here the results of field studies carried out by the present author at the turn of 1971 and 1972 and in 1973 are also given. The second part presents the results of

paleontological revision of older Oxfordian ammonite assemblage. The study covered a newly gathered fossil material as well as available specimens from older collections.

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LITHOSTRATIGRAPHY AND FOSSILS

Preliminary remarks

The succession of Jurassic strata from the Sierra de los Organos and the Sierra del Rosario, has been for a long time the subject of controversial interpretations, mostly because of the alpinotype tectonic of these mountain ranges. The interpretations which at present are of historical importance (*cf.* Imlay 1952, Arkell 1956, Bermúdez 1963, Khudoley & Meyerhoff 1971) are omitted here. The more recent papers (Hatten 1957, 1967; Herrera 1961) gave valid reconstruction of the general succession of lithostratigraphic units, whereas the results of subsequent works (Pszczółkowski 1971; Pszczółkowski & al. 1975; Pszczółkowski *in:* Kutek & al. 1976) modified or supplemented that picture

The present paper primarily deals with the lithostratigraphic units bearing fossils of Oxfordian age, as well as some units without adequate fossil record but supposedly belonging at least partly to the Oxfordian. The lithostratigraphic scheme adopted here is practically the same as recently used in explanations to the geological map of Pinar del Río province (*cf.* Pszczółkowski & al. 1975). The time-correlation between the Oxfordian sections from the Sierra de los Organos and the Sierra del Rosario (*cf.* Table 1) is discussed later.

Table 1

Correlation of the Oxfordian strata from the Sierra de los Organos and the Sierra del Rosario

Sierra de los Organos		Sierra del Rosario
formations	members and other units	formations
Guasasa (lowermost part)	San Vicente ("Viñales Limestones") lowermost part	Artemisa (lowermost part)
	breccias	
Jagua	Pimienta Jagua Vieja Azúcar = Pan / Zacarías	Francisco
San Cayetano (uppermost part)		San Cayetano (uppermost part)

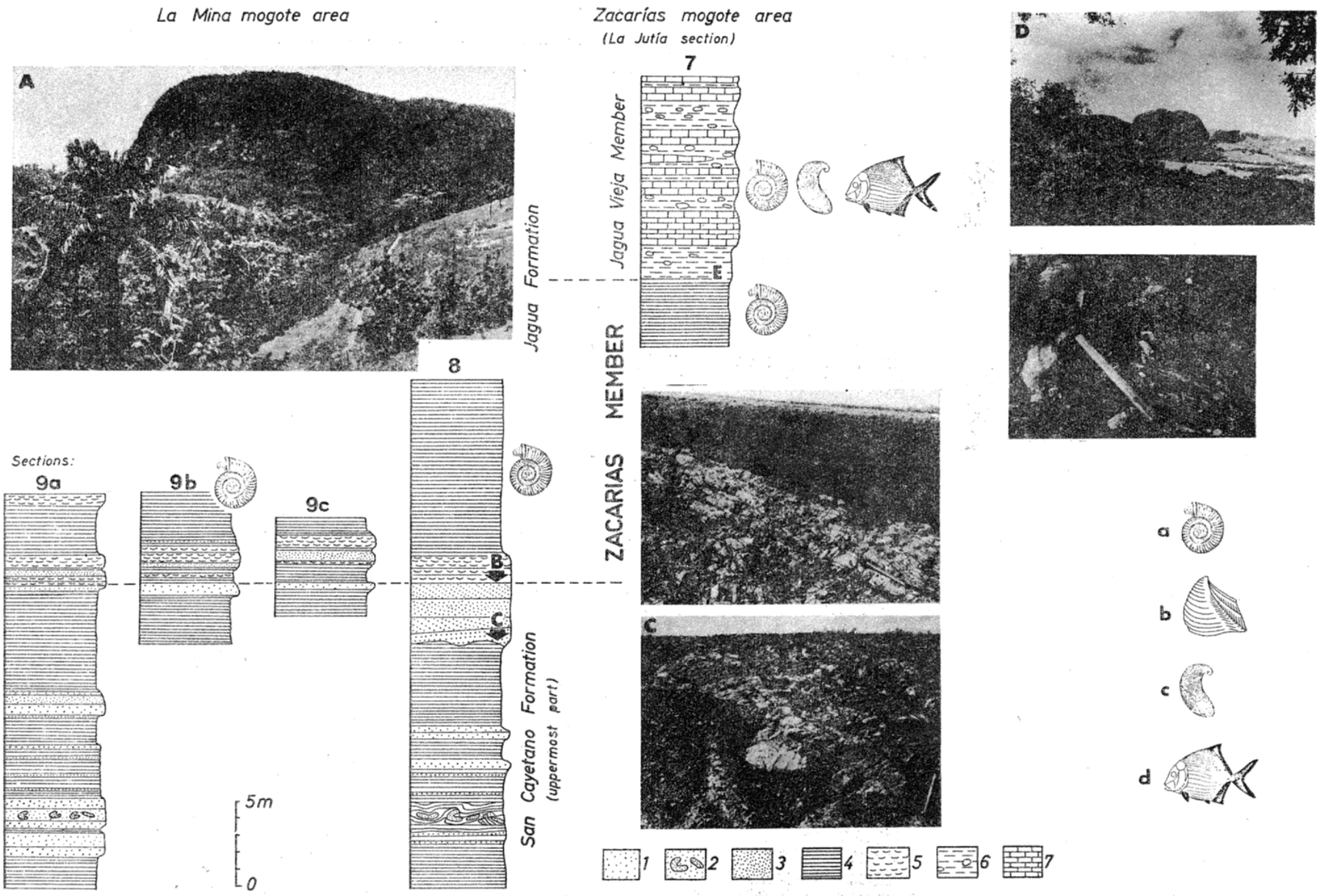
SAN CAYETANO FORMATION

The oldest formation developed in both the Sierra de los Organos and the Sierra del Rosario (Table 1) is the San Cayetano Formation (de Golyer 1918). It comprises primarily sandstones, siltstones and shales with subordinate conglomerate, lumachelle and limestone intercalations. The thickness of the formation cannot be precisely estimated because of extensive tectonic deformations; the rough estimates vary from hardly probable value of about 10 000 m (Palmer 1945) to 2000—5000 m (Furrazola-Bermúdez & al. 1964; Judoley & Furrazola-Bermúdez 1968, 1971; Khudoley & Meyerhoff 1971). The sedimentary features include cross-bedding, graded bedding, sole marks (hieroglyphs), slump structures and scour-and-fill structures; some of them are pictured on the profiles (*cf.* Text-fig. 2) illustrating the uppermost part of the formation.

The detailed analysis of sedimentary features (Haczewski 1976) indicates that depositional environments of the San Cayetano Formation range from coastal alluvial plain (and deltaic) in the Sierra de los Organos to deeper water environment with flysch deposits in the Sierra del Rosario (*cf.* also Meyerhoff & Hatten 1974).

The fossils include locally highly abundant plant remains (e.g. *Phlebopteris cubensis* Vachrameev), pelecypods, and few ammonites. The pelecypods recorded are: *Trigonia (Vaugonia) krommelbeini* Torre, *Corbula* sp., ?*Quenstedtia* sp., ?*Modiolus* sp. and others (Krömmelbein 1956; Torre A. 1960; Imlay *in*: Judoley & Furrazola-Bermúdez 1968, pp. 21—22). The distribution of pelecypod-bearing layers in the San Cayetano Fm. remains generally unclear, however, such layers are present in the uppermost part of the formation in some areas of the Sierra de los Organos (Text-fig. 2). The only ammonites recently found in the upper-

Fig. 2. Position of the Zacarias Member (lower part of Jagua Fm.) in the Jurassic sequence of the Sierra de los Organos (*cf.* Text-fig. 1A)



A landscape of La Mina mogote; *B* contact between sandstones of the San Cayetano Fm. and oyster lumachelles of the Zacarias Member; *C* erosional contact between shales and sandstones of the San Cayetano Fm.; *D* landscape of the Zacarias mogote; *E* marly shales with ammonite-bearing calcareous concretions (*"quesos"*) of the lowermost part of the Jagua Vieja Member

Lithology: *1* sandstones, *2* sandstone layers disturbed by slumping, *3* siltstones, *4* shales, *5* oyster lumachelles, *6* marly shales and marls with fossiliferous calcareous concretions (*"quesos"*) *7* marly limestones and limestones

Organic components: *a* — ammonites, *b* — pelecypods (except oysters, mostly *Trigonia*), *c* — oysters, *d* — fishes

Table 2

Ammonites of the older Oxfordian assemblage determined by the author from various localities of the Jagua Fm. and the Francisco Fm.

AMMONITES	Jagua Formation							Francisco Formation	
	Zacarías Member	Jagua Vieja Member							
		lowermost p.	middle part	probably middle part			uppermost part		upper part
	Zacarías & La Mina sogotes	La Jutía	La Jutía	El Hoyo de San Antonio	El Hoyo de la Sierra	Sierra de Guana	El Junco, San Carlos Valley	Altos de San Francisco	Loma Calabrote	Brujito
Vinalesphinctes (Vinalesphinctes) roigi Spath		+		+			+		+	
Vinalesphinctes (Vinalesphinctes) imlayi (S.R.)						+	+		+	
Vinalesphinctes (Vinalesphinctes) sagrai Ch. & F.					+				+	
Vinalesphinctes (Vinalesphinctes) niger Spath							+			
Vinalesphinctes (Vinalesphinctes) subroigi Ch. & F.							+			
Vinalesphinctes (Vinalesphinctes) cf. parvicostatus Ch. & F.										+
Vinalesphinctes (Vinalesphinctes) sp. n.							+			
Vinalesphinctes (Vinalesphinctes) spp.		+	+							+
Vinalesphinctes (Subvinalesphinctes) corrali (Ch. & F.)		+								
Vinalesphinctes (Roigites) subconsociatus (Spath)					+		+			
Vinalesphinctes (Roigites) aff. subconsociatus (Spath)						+				
Vinalesphinctes (Roigites) catalinensis (S.R.)					+					
Vinalesphinctes (Roigites) aff. catalinensis (S.R.)			+				+			+
Vinalesphinctes (Roigites) rosariensis sp. n.							+			+
Vinalesphinctes (Roigites) simplicior sp. n.							+			+
Vinalesphinctes (Roigites) spp.			+		+	+	+			+
Vinalesphinctes spp.	+	+	+	+	+	+	+		+	+
Perisphinctes (Cubasphinctes) jaworskii Ch. & F.		+		+	+					
Perisphinctes (Cubasphinctes) cf. poeyi Ch. & F.					+					
Perisphinctes (Cubasphinctes) cubanensis O'Con.				+	+	+				
Perisphinctes (Cubasphinctes) aff. cubanensis O'Con.		+								
Perisphinctes (Cubasphinctes) intermedius Ch. & F.				+						
Perisphinctes (Cubasphinctes) rutteni Jaw.					+					
Perisphinctes (Cubasphinctes) cf. rutteni Jaw.			+	+						
Perisphinctes (Cubasphinctes) gusiki sp. n.			+		+					
Perisphinctes (Cubasphinctes) albeari albeari Ch. & F.						+				
Perisphinctes (Cubasphinctes) guanensis S.R.		+								
Perisphinctes (Cubasphinctes) aff. guanensis S.R.			+							
Perisphinctes (Cubasphinctes) planatus S.R.				+	+	+				
Perisphinctes (Cubasphinctes) aff. planatus S.R.				+						
Perisphinctes (Cubasphinctes) spp.	+	+	+	+	+	+	+			
Perisphinctes (Antilloceras) antillarum Jaw.			+		+	+		+		
Perisphinctes (Antilloceras) spathi S.R.						+	+			
Perisphinctes (Antilloceras) plicatiloides O'Con.		+		+	+					
Perisphinctes (Antilloceras) aff. plicatiloides O'Con.							+			
Perisphinctes (Antilloceras) spp.	+	+	+	+	+	+	+			
Discosphinctes carribeanus (Jaw.)					+					
Discosphinctes aguayoi (S.R.)					+					
Discosphinctes aff. aguayoi (S.R.)					+					
Discosphinctes furrazolai sp. n.					+					
Discosphinctes acandai (Ch. & F.)					+					
Discosphinctes spp.	+		+	+	+	+	+			
Euaspidoceras oconnellae (S.R.)			+							
Euaspidoceras sp. (?E. vignalense Spath)							+			
Euaspidoceras spp.			+			+	+			
Ochetoceras vignalense S.R.		+					+			
Ochetoceras sp.					+					
Cubaochetoceras imlayi (S.R.)		+	+		+					
Cubaochetoceras brevicostatum Ch. & F.							+			
Cubaochetoceras pinarense Ch. & F.						+				
Cubaochetoceras submexicanum (Ch. & F.)				+						
Cubaochetoceras burckhardti (O'Con.)					+	+				
Cubaochetoceras cf. ohudoleyi nom. n.					+					
Cubaochetoceras cf. mexicanum (Burck.) = C. pedroanum (Burck)										+
Cubaochetoceras spp.	+				+	+	+			
Glochiceras (Glochiceras) amplicanaliculatum sp. n.			+		+	+				
Glochiceras (Glochiceras) aff. amplicanaliculatum sp. n.										+
Glochiceras sp. n.			+							
Glochiceras spp.	+	+	+	+	+	+	+			+

most part of the formation in the Sierra del Rosario (Myczyński & Pszczółkowski 1976) are poorly preserved perisphinctids.

The transition from the San Cayetano Fm. to younger strata is more or less gradual, without any angular or erosional disconformity. This was evidenced in the case of the Sierra de los Organos already by Hatten (1957, 1967) and Herrera (1961; *cf.* also Text-fig. 2 here), and it has been recently confirmed in the Sierra del Rosario (Pszczółkowski 1971; Pszczółkowski *in*: Kutek & al. 1976); thus, the postulated major unconformity between the San Cayetano Fm. and younger strata, related to Nevadan orogeny (Furrazola-Bermúdez & al. 1964; Khudoley 1967; Khudoley *in*: Khudoley & Meyerhoff 1971, Fig. 16), in fact does not exist.

Jagua Formation and Francisco Formation

These formations represent to some degree comparable lithostratigraphic units from the Sierra de los Organos and the Sierra del Rosario (*cf.* Table 1), everywhere having transitional character between terrigenic deposits of the San Cayetano Fm. and younger, carbonate rocks; however, the limestones predominate also in the upper part of the Jagua Fm.

JAGUA FORMATION

The Jagua Formation (Palmer 1945) occurs in the Sierra de los Organos. Two members laterally passing in one another may be distinguished in its lower part (Table 1). One of them was originally interpreted as a separate formation (*Azúcar Fm.* of Hatten, 1957; *Pan Fm.* of Herrera, 1961) [1]. It is represented by a compact, hard limestones usually rich in oysters, and sometimes with micritic limestone or flint intercalations. The algal crusts on the pelecypod shells, and onkolites are common (Piotrowski, *pers. inf.*). The thickness varies from 48 m in the type section (Pan de Azúcar mogote) up to 78 m elsewhere (Piotrowski, *pers. inf.*).

In central part of the Sierra de los Organos, in the vicinity of La Mina and Zacarías mogotes, the San Cayetano Fm. is directly overlied by argillaceous shales with ammonites (Text-figs 1—2) containing a few lumachelle layers (with *Exogyra, Ostrea, Liostrea* and *Plicatula* — Pugaczewska, *pers. inf.*) at the base. These deposits have been found in the course of the mapping works (*cf.* Pszczółkowski 1970) but their setting in the profile initially became the subject of controversy. Nuez (1972, 1974) interpreted this shaly sequence as the uppermost part of the San Cayetano Fm. whereas subsequent field studies have shown that it overlies the typical San Cayetano deposits (represented by alternating shales, siltstones and sandstones) and it is overlied by typically developed deposits of the

[1] Recently (*cf.* Pszczółkowski & al. 1975) it is proposed a new term, Pan de Azúcar Member (Hatten & Herrera).

Jagua Vieja Member, Jagua Fm. (Text-figs 2—3). It therefore appears that this rock unit occupied similar position in the profiles as the Azúcar Member (= Pan Member) and may be treated as facies equivalent of the latter (*cf.* Wierzbowski 1975). This unit is here distinguished as the Zacarías Member (after the Zacarías mogote) and assigned to the Jagua Fm.; its thickness may be estimated as about 30—40 meters. The ammonite fauna derived from that member is listed in Table 2.

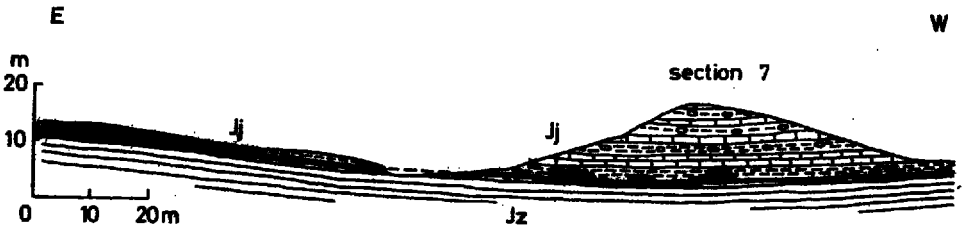


Fig. 3. Geological section at La Jutia village, near Zacarias mogote (*cf.* Text-figs 1*A* and 2), Sierra de los Organos, Jagua Fm.: J_z — Zacarías Member, J_j — Jagua Vieja Member. Lithology the same as in Text-fig. 2

Good sections of the basal part of the Zacarías Member are exposed in the area of La Mina mogote (Text-figs 1—2, localities and corresponding sections No. *8*, *9a-c*), Consolación del Norte quadrangle in the scale 1 : 50 000. The section No. *8* treated as the lower boundary-stratotype section is situated at Encinal Alto village near crossing of the road from La Palma to Viñales and the road to Jagua Vieja (coordinates 224900 and 320200); the reference sections are exposed in the roadcut from the crossing along the road to Jagua Vieja (section No. *9c* — 700 m, section No. *9a* — 1500 m, and section No. *9b* — 1900 m from the crossing, respectively). The upper boundary-stratotype section of the Zacarías Member is exposed in the area of Zacarías mogote (Text-figs 1; 2, section No. 7, corresponding to the western part of the cross-section from Text-fig. 3), Consolación del Sur quadrangle in the scale 1 : 50 000. This section is situated in a small hill near La Jutía village (coordinates 224 100 and 317 400). Other fragmentary sections of the Zacarías Member are exposed in roadcuts of a new road from La Palma to Viñales, between Encinal Alto and La Jutía villages. The latter sections display highly tectonically disturbed shales of that member and the contact with younger or older strata is obscure.

The middle part of the Jagua Formation, named the Jagua Vieja Member (Herrera 1961), is represented by alternating bituminous marly limestones, limestones, marls and marly shales (Text-figs 2—3). Early diagenetic calcareous concretions ("*quesos*" — Spanish for cheese loafs) are fairly numerous in the marls and marly shales. The concretions attain up to 100 cm in diameter and they yield excellently preserved ammonites (*cf.* Table 2), nautiloids, pelecypods (primarily oysters of the genus *Liostrea*), fishes and reptiles. Similar, but much worse preserved organic remains are also found in marls. This is the widely known, classical

fauna of the Oxfordian of Cuba, monographed by O'Connell (1920), Sánchez-Roig (1920, 1951), Jaworski (1940) and Judoley & Furrazola-Bermúdez (1968).

The strata here assigned to the Jagua Vieja Member were previously divided into two members (Herrera 1961): lower, Caiguanabo, and upper, Jagua Vieja. The former was proposed for the strata composed of thin-bedded limestones with calcareous concretions but they are practically unrecognizable from the deposits of the Jagua Vieja Member. Moreover, the same strata are sometimes developed as marls or marly shales with calcareous concretions and the limestone sequences repeatedly occur in the sections (Text-figs 2–3); detailed reconstruction of the succession is often impossible because of the tectonic disturbances.

The tectonic disturbances preclude an accurate correlation of the strata of the Jagua Vieja Member from different localities (Text-fig. 1). Undoubtful lowermost and middle parts of that member are represented in La Jutía section (Text-figs 2–3). The uppermost part of the member may be distinguished on the basis of faunal criteria — the predominance of ammonites of the genus *Vinalesphinctes* (cf. Table 2 and Text-fig. 4). The Jagua Vieja Member is supposedly 50–60 m thick.

The upper part of the Jagua Formation is represented by thin-bedded micritic limestones of the Pimienta Member (Herrera 1961). In these limestones were found recently ammonites (Myczyński 1976) representing the genera *Euaspidoceras* (only in lower part of the member), *Mirosphinctes* and *Cubaspidoceras* Myczyński, 1976, as well as hardly identifiable oppeliids. This member is about 40–60 meters thick (Pszczółkowski & al. 1975).

The total thickness of the Jagua Formation may be estimated at 150–200 m (*cf.* also Hatten 1957, 1967).

FRANCISCO FORMATION

The Francisco Formation (Pszczółkowski 1976) occurs in the Sierra del Rosario; it is represented by marly limestones, marls, shales, sandstones and siltstones; sometimes with calcareous concretions of the "queso" type. The concretions yield remains of ammonites, pelecypods (mainly oysters) and fishes. The thickness of the Francisco Fm. is estimated up to 25 m (Pszczółkowski *in:* Kutek & al. 1976). The ammonite fauna which has been collected (except the uppermost part of the formation) is very similar to that known from the Zacarías Member and the Jagua Vieja Member of the Jagua Fm. (Table 2, Text-fig. 4). The uppermost strata of the Francisco Fm. are characterized by another assemblage of ammonites belonging to the genera *Mirosphinctes, Euaspidoceras, Cubaspidoceras, Glochiceras* as well as poorly preserved Ochetoceratinae (cf. Myczyński 1976).

The Francisco Formation consists of incompetent rocks which are overlain by more competent rocks of the Artemisa Fm. Thus the former are often strongly tectonized and it is not possible to reconstruct a continuous sequence of the deposits on the basis of a single section. The deposits of that formation were described for the first time from Cinco Pesos village as "variegated shales" (*cf.* Pszczółkowski 1971); however, that section was incomplete. Subsequent studies (Pszczółkowski *in*: Kutek & al. 1976) have revealed deposits of a similar type with intercalations of limestones, siltstones and sandstones as well as with calcareous ammonite-bearing concretions, at Cinco Pesos, Altos de San Francisco, Brujito, Loma Calabrote and other localities.

GUASASA FORMATION

The Guasasa Formation (Herrera 1961) occurs in the Sierra de los Organos and it is developed as a thick sequence of carbonate rocks overlaying the Jagua Formation. At the boundary of these formations there often occur the breccias composed of limestone clasts. The breccias have been sometimes interpreted as indicative of Jurassic tectonic movements (Judoley & Furrazola-Bermúdez 1968; Khudoley *in*: Khudoley & Meyerhoff 1971, Fig. 16); but even in such a case it were only a "mild epeirogenic disturbances" (Hatten 1967), as they did not produce any angular unconformity (Hatten 1957, 1967; Meyerhoff *in*: Khudoley & Meyerhoff 1971, Fig. 16).

The lower part of the Guasasa Fm consists of thick-bedded to massive limestones and partly also dolomites. The limestones are micritic or pelletel; sometimes intraclasts occur. In places the cherts are common. These limestones have been sometimes named the Viñales Limestones[2] (*e.g.* Hatten 1967, Khudoley & Meyerhoff 1971, Meyerhoff & Hatten 1974) and they belong to the San Vicente Member of Herrera (1961). Fauna is practically unknown.

The upper part of the Guasasa Fm. is developed as well-bedded limestones. The oldest ammonite fauna known from these strata is of Tithonian age (Imlay 1942, Judoley & Furrazola-Bermúdez 1968, Houša & Nuez 1972, Houša 1974).

ARTEMISA FORMATION

The Artemisa Formation (Lewis 1932) has been distinguished, according to original definition in the Sierra del Rosario. In its lower part

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[2] The term Viñales Limestones was not originally precisely defined by de Golyer (1918) and subsequently it has been used for different rock units. Hence, this name should be abandoned in favour of the name Guasasa Fm., as it has been postulated recently (Pszczółkowski & al. 1975).

it is represented by thin-bedded limestones which overlay the Francisco Formation with sedimentary continuity (Pszczółkowski 1971, and *in*: Kutek & al. 1976). The basal strata of the Artemisa Fm. have yielded some ammonites (Kutek & al. 1976) of the genera *Mirosphinctes* and *Cubaspidoceras*. In the lower part of the Artemisa Fm., about 50—120 m above its base (*cf.* Pszczółkowski *in*: Kutek & al. 1976), the ammonites and aptychi of Tithonian age have been collected (Imlay 1942, Judoley & Furrazola-Bermúdez 1968).

THE FAUNAL ELEMENTS AND THEIR BEARING ON THE ENVIRONMENTAL ANALYSIS

The remarks given below concern these lithostratigraphic units which have a good faunal record, i.e. the Jagua Fm. from the Sierra de los Organos, as well as the Francisco Fm. and basal part of the Artemisa Fm. from the Sierra del Rosario.

The contribution of ammonites in faunal spectra is usually high, except for the Pan = Azúcar Member of the Jagua Fm.; however, some ammonites have been also found there (*cf.* Hatten 1957, Hatten & Meyerhoff 1974). The occurrence of ammonites indicates normal salinity of the marine environment.

In the Oxfordian sequence of the Sierra de los Organos and the Sierra del Rosario there are found distinct changes in ammonite spectra (Text-fig. 4). The changes concern contribution or disappearance of particular groups (families, subfamilies or genera) and, on much smaller scale, appearance of new genera.

The Perisphinctidae markedly predominate (97.2%), and Oppeliidea [3] are relatively scarce (2.8%) in the lower part of the Jagua Fm. (Zacarías Member). The contribution of Oppeliidae increases in the middle part of the formation (Jagua Vieja Member). There are some differences in ammonite spectra established for particular localities (*cf.* Text-fig. 4*A*), which may result from too small number of ammonites available. The average values for several localities are as follows: Perisphinctidae — 81.7%, Oppeliidae — 16.5%, and Aspidoceratidae — 1.8%. In the upper part of the Jagua Fm. (Pimienta Member), the Oppeliidae are of the same frequency, but the Perisphinctidae completely disappear, except for the

[3] Including the genus *Glochiceras*.

genus *Mirosphinctes*[4] appearing here for the first time, and the Aspidoceratidae become abundant (Myczyński 1976).

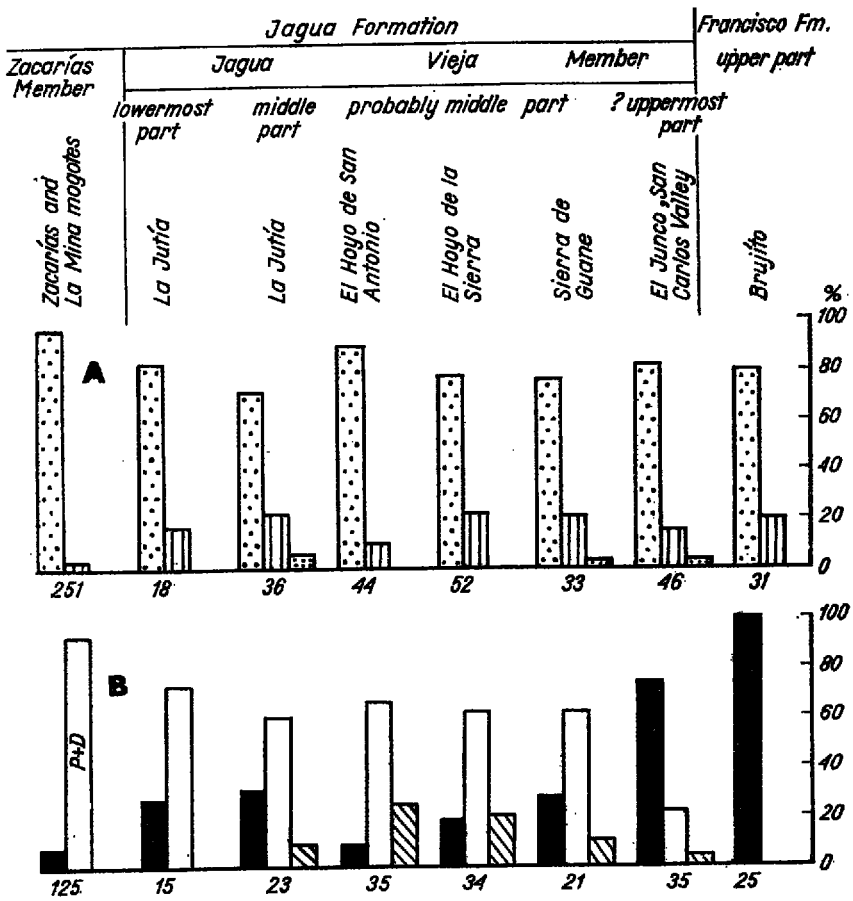

Fig. 4. Ammonite spectra for different localities of the Jagua Fm. and Francisco Fm.
A — total fauna: heavily dotted — Perisphinctidae, vertically lined — Oppeliidae including *Glochiceras*, finely dotted — Aspidoceratidae
B — Perisphinctidae determined to the generic rank: white — *Perisphinctes*, black — *Vinalesphinctes*, obliquely lined — *Discosphinctes*, P + D — *Perisphinctes* and *Discosphinctes* not separated
Number of specimens for each diagram is indicated

Similar phenomena were observed in the Sierra del Rosario where Perisphinctidae initially predominate and Oppeliidae occur in rather subordinate amounts in the Francisco Fm. (*cf.* Text-fig. 4*A*). The numerical data obtained for Brujito and Loma Calabrote localities indicate 85.3% contribution of Perisphinctidae and 14.7% contribution of Oppeli-

[4] However, this genus seems closer to *Epipeltoceras* or *Sutneria* than to the typical Perisphinctidae (*cf.* Enay 1966, Geyer 1969).

idae. In the uppermost part of the Francisco Fm., the Oppeliidae are of the same frequency, but the Perisphinctidae disappear (with the exception of *Mirosphinctes*) and the Aspidoceratidae increase in importance (Myczyński 1976).

The above mentioned sharp faunistic boundary defined by the rapid increase in number of Aspidoceratidae and the appearance of the genus *Mirosphinctes,* found in both the Sierra de los Organos and the Sierra del Rosario, is preceded by some important changes in the frequency of particular genera of Perisphinctidae (*cf.* Text-fig. 4*B*). The Perisphinctidae found in Brujíto and Loma Calabrote localities, upper part of the Francisco Fm., Sierra del Rosario, represent the genus *Vinalesphinctes* only. In the uppermost part of the Jagua Vieja Member of the Jagua Fm. in the Sierra de los Organos the present author found a marked concentration of ammonites of the genus *Vinalesphinctes* in some localities. At the locality El Junco from San Carlos Valley the contribution of *Vinalesphinctes* equals 74.3% of perisphinctid spectrum (*cf.* Text-fig. 4*B*) which makes it possible to assume that the uppermost part of the Jagua Vieja Member is also represented here. It should be added that the contribution of *Vinalesphinctes* to the perisphinctid spectrum is markedly lower, 20% at the average, in other localities representing presumably somewhat older parts of the Jagua Vieja Member and its lowermost part (*cf.* Text-figs 2—4). In the Zacarías Member this genus represents only 7.2% of the Perisphinctidae (*cf.* Text-fig. 4*B*). In those older strata there is a distinct predominance of the subgenera *Cubasphinctes* and *Antillo-ceras* of the genus *Perisphinctes.*

The changes in composition of ammonite fauna, displayed by the sections of the Sierra de los Organos and the Sierra del Rosario, are well comparable with one another and they presumably took place in the same or roughly the same time (Table 1, Text-fig. 4). Distinct changes in the ammonite fauna were also found in the Oxfordian strata (La Gloria Fm.) of the northern Mexico (San Pedro del Gallo area). Burckhardt (1912, 1930) has recognized there two ammonite faunas: older from "Perisphinctes Beds", characterized by the marked predominance of Perisphinctidae and with scarce Oppeliidae, and younger from "Ochetoceras Beds", in which Perisphinctidae are accompanied by fairly numerous Oppeliidae as well as Aspidoceratidae. The changes seem to be somewhat similar to those found in the western Cuba but it should be noted that they are most probably diachronous.

The above presented data suggest that the changes in ammonite fauna in the Oxfordian sections of western Cuba are partly determined by environmental and/or ecological factors. One of the factors determining distribution of ammonite faunas is the depth of the sea (*e.g.* Ziegler 1963, 1967, 1971a, b; Zeiss 1968). A marked predominance of Perisphinctidae found in the lower and middle parts of the Jagua Fm. (Za-

carías Member and Jagua Vieja Member) and the Francisco Fm. (except for its uppermost part) seems to indicate sedimentation at shallow depths, from some tens up to a hundred meters. The deposits of the Zacarías Member, characterized by very low contribution of Oppeliidae, originated presumably in a shallower environment than the deposits of the Jagua Vieja Member, which are characterized by higher contribution of Oppeliidae. It should be noted that the former laterally pass into the deposits of the Azúcar=Pan Member (Table 1) yielding few ammonites and primarily developed as an autochthonous oyster lumachelles with onkolites, and algal crusts. Such deposits could originate at the depths from a few to about a dozen meters.

The lack of any changes in occurrence of Oppeliidae in upper part of the Jagua Fm. and the uppermost part of the Francisco Fm. comparing with the older strata may indicate similar depth conditions; the depth was not too great, surely less than 150—200 m, which is indicated by a marked contribution of Aspidoceratidae and the complete lack of Phylloceratidae and Lytoceratidae. In that situation the complete disappearance of older Perisphinctidae (the genera *Vinalesphinctes*, *Perisphinctes* and *Discosphinctes*) is intriguing. However, the distribution of the ammonite fauna was also controlled by other factors, and some of them were more significant than the depth conditions (Hallam 1969). The disappearance of Perisphinctidae is preceded by a distinct quantitative impoverishment of some elements of that group. This may be explained by a definite progressive changes of the environment or an evolutionary crisis of the whole group. The very sharp boundary defined by disappearance of Perisphinctidae may be also interpreted as a net result of overlapping effects of evolutionary crisis and some environmental or ecological factors.

Some important conclusions concerning the conditions prevailing in the basin and especially in its bottom zone has been drawn from the analysis of the whole faunal assemblages.

In the lower part of the Jagua Formation, in the Azúcar=Pan Member there is a marked predominance of benthic fauna. There is a mass occurrence of oysters, accompanied by brachiopods as well as foraminifers of the genus *Conicospirillina* (cf. Hatten 1957). The oysters are also present in the lowermost part of the Zacarías Member (cf. Text-fig. 2) but burrows are fairly numerous throughout the member. This indicates full oxidation conditions of the bottom zone.

Somewhat different faunal assemblage is found in the middle part of the Jagua Fm. (Jagua Vieja Member). Free-swimming fauna is very abundant and highly diversified here, being represented by ammonites, nautiloids (Sánchez Roig 1951, Judoley & Furrazola-Bermúdez 1968), sepioids (Schevill 1950), fishes (Gregory 1923) and ichthyosaurs (R. Torre & Cuervo 1939, fide A. Torre 1949). Ammonite and nautiloid shells are not crushed and sometimes imprints of soft parts are found (C. Torre

1953) and skeletons of fishes and reptiles are often highly complete. Sometimes both sides of ammonite shells are overgrown by pelecypods of the genus *Liostrea*, which settled either on the floating shells or on the alive ammonites (*cf.* Seilacher 1960, Heptonstall 1970). The early growth stages of the ammonites (sometimes representing only the first whorl up to the nepionic constriction) are very numerous, similarly as the early growth stages of pelecypods presumably representing mainly planktonic forms. There are also found pieces of driftwood bored by pelecypods.

In turn, benthic fauna is rather monotonous and impoverished, being represented mainly by pelecypods (primarily oysters) usually overgrowing shells (mostly the umbilicus) of dead ammonites or, sometimes, present in the deposits. They are sometimes accompanied by small-sized gastropods (Sánchez Roig 1920, Brown & O'Connell 1922). Attention should be paid to the complete lack of any other benthic organisms, especially of foraminifers and burrowers. This characteristics indicates that the sediments of the Jagua Vieja Member were deposited under reductive conditions. The conditions resulted from weak water circulation and decay of organic matter (and possibly mostly of the remains of terrestrial flora). The exchange of sub-bottom waters only periodically and in a limited area made it possible development of some benthic groups.

Similar conditions could prevail in the time of deposition of the upper part of the Jagua Fm. (Pimienta Member). These deposits are also characterized by impoverished benthic fauna and the nectos represented by ammonites, fish and planktonic foraminifers of the genus *Globigerina* (*cf.* Pszczółkowski & al. 1975).

Presumably similar conditions also prevailed in the Sierra del Rosario in the time of deposition of some deposits of Francisco Fm. The fauna present here (*cf.* Kutek & al. 1976) comprises some free-swimmers (ammonites, fishes) as well as numerous planktonic elements (early ontogenic stages of ammonites and pelecypods) and few benthic elements (oysters), similarly as that of the Jagua Vieja Member.

A majority of deposits of the Jagua Formation and the Francisco Formation originated in the proximity of the shore, as evidenced by local accumulations of terrestrial flora, and by bones of terrestrial dinosaurs (Torre A. 1949).

THE BOUNDARIES AND SUBDIVISION OF THE OXFORDIAN

The lower boundary of that stage is defined by the base of the Quenstedtoceras mariae Zone, and the upper — by the base of the Pictonia baylei Zone, the lowermost zone of the Kimmeridgian (Table 3). These boundaries were based on the English fauna and sections including the Yorkshire section selected as the lectostratotype of the Oxfordian (Arkell

Table 3

Subdivision of the Oxfordian stage in England (*cf.* Wright 1973) and Submediterranean Europe (*cf.* Mouterde, Enay & al. 1971); subzones of the Cardioceras cordatum Zone and Quenstedtoceras mariae Zone are omitted

Stage	Substage	England		Submediterranean Europe	
		zones	subzones	zones	subzones
KIMMERIDGIAN		Pictonia baylei		Sutneria platynota	
OXFORDIAN	UPPER	Ringsteadia pseudocordata		Idoceras planula Epipeltoceras bimammatum	 T. hauffianum E. bimammatum E. hypselum
	MIDDLE	Perisphinctes cautisnigrae Gregoryceras transversarium Perisphinctes plicatilis	A. nunnigtonense P. parandieri P. antecedens C. vertebrale	Perisphinctes bifurcatus Gregoryceras transversarium Perisphinctes plicatilis	L. sohilli P. parandieri P. antecedens C. tenuicostatum or C. vertebrale
	LOWER	Cardioceras cordatum Quenstedtoceras mariae		Cardioceras cordatum Quenstedtoceras mariae	

1946). Thus, both the lower and upper boundaries of the Oxfordian stage were originally defined by the Boreal fauna and the precise recognition of these boundaries in the areas inhabited by Tethyan faunas appears difficult sometimes.

The lower boundary of the Oxfordian may be accurately traced throughout vast areas of Europe and North America thanks to a large-scale spread of Boreal faunas towards the south (Boreal Spread of Arkell, 1956), accompanied by extensive northward migration of Tethyan elements into the areas of the Boreal province (Callomon *in:* Hallam 1971, p. 134; Imlay 1971). Overlapping of the Tethyan and Boreal faunas enables more of less accurate recognition of the lower boundary of the Oxfordian also outside the areas of strong Boreal influences.

Recognition of the upper boundary of the Oxfordian outside the Boreal areas represents a more difficult problem. In the Submediterranean Europe stretching from Portugal and Spain through southern France and Germany to Poland and Rumania, the Upper Oxfordian and Lower Kimmeridgian are divided into ammonite zones different from those distinguished in England (*cf.* Table 3). The correlation of these Submediterranean zones with the corresponding zones of England is very difficult because of the differences in the ammonite faunas. For fixing of the upper boundary of the Oxfordian in the Submediterranean zonal scheme it is

important that the ammonites *Amoeboceras (Amoebites)*, typical of the Lower Kimmeridgian of England and other Boreal regions (Mesezhnikov & Romm 1973) have been reported from the Sutneria platynota Zone of southern Germany (Wegele 1929, Zeiss 1966), but never from the Idoceras planula Zone. However, the records of the ammonites of the genus *Amoeboceras* from that latter zone are generally few. In the lower part of the Idoceras planula Zone of Central Poland the present author have found a numerous ammonites of the genus *Amoeboceras* but no one of them belongs to the subgenus *Amoebites*. They have been accompanied by the ammonites of the genus *Ringsteadia*, some of which are close to the species known from the uppermost Oxfordian, Ringsteadia pseudocordata Zone of England (Wierzbowski 1970). This indicates that the lower part of the Idoceras planula Zone still belongs to the Oxfordian. Thus the upper boundary of the Oxfordian in the Submediterranean zonal scheme passes either at the base of the Sutneria platynota Zone or in the upper part of the Idoceras planula Zone. The range of the correlation error is not very wide here; thus, because of the practical reasons it is usually assumed [5] that this boundary passes at the base of the Sutneria platynota Zone (Table 3).

In some other areas inhabited by Tethyan faunas the upper boundary of the Oxfordian may be roughly recognized by the first appearance of the ammonites of the genus *Aspidoceras*. The first representatives of this genus, characterized by two rows of tubercles on inner part of whorls, *A. binodum* (Opp.), presumably appear in the upper part of the Idoceras planula Zone in Europe [6] (*cf.* Dieterich 1940, Schmidt-Kaler 1962, Schuler 1965) and they do not become abundant before the Sutneria platynota Zone.

At present, the Oxfordian stage is as a rule divided into three substages: Lower, Middle and Upper. The substages are distinguished in both English and Submediterranean zonal schemes (*cf.* Table 3). The Lower Oxfordian usually comprises the Quenstedtoceras mariae Zone and Cardioceras cordatum Zone and the lower boundary of the Middle Oxfordian is fixed at the base of the Cardioceras vertebrale Subzone of the Perisphinctes plicatilis Zone.

The Middle/Upper Oxfordian boundary is still the subject of diverse interpretations. In England it is being placed at the base of the Perisphinctes cautisnigrae Zone (*cf.* Callomon 1964, Wright 1973) or at the

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[5] International Geological Congress, Colloquium on the Jurassic, Luxembourg 1962. Recommendations. — C. R. Mem., pp. 84—86, Luxembourg.

[6] The information on the occurrence of *Aspidoceras binodum* (Opp.) in the Epipeltoceras bimammatum Zone of the Subbetic Zone of Spain (Geyer *in:* Barthel & al. 1966; Sequeiros 1974) should be treated with caution as these ammonites are reported from condensed sequences in which the fauna is often of the mixed type. Sometimes (*cf.* Sequeiros 1974) from the same bed there are reported forms characterized by wider stratigraphic range (including *Idoceras*), known also from the Idoceras planula Zone.

base of the Perisphinctes parandieri Subzone of the Gregoryceras transversarium Zone (*cf.* Wright 1972). In the Submediterranean areas it was drawn at the base of the Idoceras planula Zone (*cf.* Zeiss 1966), the base of Perisphinctes parandieri Subzone of the Gregoryceras transversarium Zone (*cf.* Enay 1966; Enay, Tintant & Cariou 1971), the base of Perisphinctes bifurcatus Zone (*cf.* Mouterde, Enay & al. 1971) or the base of Epipeltoceras bimammatum Zone (*cf.* Kutek, Matyja & Wierzbowski 1973). It should be added that some of these propositions cannot be consequently applied in both the zonal schemes because of differences in ammonite faunas. For example, the lower boundary of the English Perisphinctes cautisnigrae Zone cannot be accurately traced in the Submediterranean zonal scheme (Brochwicz-Lewiński 1974), similarly as the lower boundary of the Submediterranean Idoceras planula Zone in the English zonal scheme. The most distinct faunistic boundary of those proposed for the Submediterranean zonal scheme, is that from the base of the Epipeltoceras bimammatum Zone. It is characterized by the first appearance of several new ammonite genera and subgenera: *Epipeltoceras, Microbiplices, Ringsteadia,* and probably also *Orthosphinctes, Progeronia,* as well as by the extinction of *Perisphinctes* (subgenera *Perisphinctes, Ampthillia, Dichotomoceras*). Close to that boundary there are also marked some changes in Aspidoceratidae: the genus *Clambites* appears below that boundary and *Physodoceras* — somewhat above it. Thus the boundary corresponds to changes concerning various group of ammonites and it presumably may be also traced in other, extra-Submediterranean Tethyan regions. This boundary may be also traced in the English zonal scheme as the base of the Submediterranean Epipeltoceras bimammatum Zone presumably coincides with the base of the English Ringsteadia pseudocordata Zone (*cf.* Wierzbowski 1970; Kutek, Matyja & Wierzbowski 1973; Wright 1973). Therefore it is accepted here as the Middle/Upper Oxfordian boundary (Table 3).

CHRONOSTRATIGRAPHY OF THE OXFORDIAN OF WESTERN CUBA

The older ammonite assemblage (Table 2) was found in the Zacarías Member and the Jagua Vieja Member, Jagua Fm. in the Sierra de los Organos, and in the Francisco Fm. (except for uppermost part) in the Sierra del Rosario [7]. The faunal list from the Sierra de los Organos comprises representatives of the genera *Vinalesphinctes* (subgenera *Vinalesphinctes, Subvinalesphinctes* subgen. n., and *Roigites* subgen. n.), *Perisphinctes* (subgenera *Cubasphinctes* and *Antilloceras* subgen. n.), *Discos-*

[7] Also poorly preserved ammonites recently found in the uppermost part of the San Cayetano Fm. in the Sierra del Rosario (Myczyński & Pszczółkowski 1976) appear to be close to some species of *Perisphinctes* from that faunal assemblage.

sphinctes, Euaspidoceras, Ochetoceras, Cubaochetoceras and *Glochiceras* (subgenus *Glochiceras*). The ammonite fauna from the Sierra del Rosario is less known; there were found: *Vinalesphinctes (Vinalesphinctes* and *Roigites), Perisphinctes (Antilloceras), Cubaochetoceras* and *Glochiceras (Glochiceras).* The ammonite faunas are similar, indicating that these strata of the Jagua Formation and the Francisco Formation may be contemporaneous (*cf.* Table 1).

The differentiation of ammonite fauna may be traced mainly in the strata of the Jagua Fm. on account of a more complete faunal record. The changes include the increase in number of Oppeliidae (genera *Ochetoceras* and *Cubaochetoceras*) and *Glochiceras* from the Zacarías Member to the Jagua Vieja Member as well as a marked increase in number of *Vinalesphinctes* at the expense of other Perisphinctidae in the uppermost part of the Jagua Vieja Member. The latter phenomenon was also noted in the upper, the most fossiliferous part of the Francisco Fm. (*cf.* Table 2, Text-fig. 4). The changes appear to be primarily quantitative in character as all the genera and subgenera found in the younger beds are also known from the older beds of the Jagua Fm. Eventual changes concerning the stratigraphic range of particular species cannot be unequivocally proved as the ammonites derived from the lower part of the Jagua Fm. (Zacarías Member) are insufficiently preserved for reliable specific identification; the ammonites from the lower part of the Francisco Fm. are not numerous; and some differences in the distribution of the species in particular localities may result from failure in collecting. It seems that a large number of the species may occur throughout the whole discussed interval of the Jagua Formation and the Francisco Formation (*cf.* Table 2).

The Table 2 shows the list of ammonites recorded by the present author from the discussed strata of the Jagua Fm. and the Francisco Fm. Some ammonites previously reported from the Jagua Vieja Member but not encountered in the collections studied by the present author were omitted in the list; this is the case of: *Vinalesphinctes (Vinalesphinctes) subniger* Chud. & Fur., *V. (Subvinalesphinctes) bermudezi* (Chud. & Fur.), *V. (Subvinalesphinctes) grossicostatus* (S. R.), *Perisphinctes (Cubasphinctes) vignalensis* S. R., *P. (Cubasphinctes) albeari ampliumbilicatus* Chud. & Fur., *P. (?Cubasphinctes) "vignalensis subquadratus"* Chud. & Fur., *P. anconensis* S. R., *Discosphinctes subguanensis* (Ark.), *D. pichardoi* (Chud. & Fur.), *Ochetoceras subvignalense* (Chud. & Fur.), *Cubaochetoceras diversicostatum* Chud. & Fur.

It follows that the ammonite assemblage known from the Zacarías Member and the Jagua Vieja Member, Jagua Fm., and from the Francisco Fm. (except for its uppermost part) is fairly uniform. The lower boundary of that assemblage is defined by the appearance of the ammonite fauna in the profile and it is without any wider chronostratigraphic importance.

The upper boundary is at the same time the lower boundary of the successive ammonite assemblage (*cf.* Myczyński 1976, Kutek & al. 1976); it passes at the base of upper part of the Jagua Fm. (Pimienta Member) in the Sierra de los Organos and within the upper part of the Francisco Fm. in the Sierra del Rosario. This boundary may be partly determined by ecological factors, but the extinction of all the Perisphinctidae occurring below may result from an evolutionary crisis in that group. The appearance of a new genus *Cubaspidoceras* Myczyński, 1976, at that boundary is undoubtedly of a wide chronostratigraphic importance as that genus seems to be a derivative of some earlier *Euaspidoceras*.

The ammonite assemblage discussed here represents the classical, previously the only assemblage of Oxfordian ammonites known from Cuba. The ammonites were previously known only from calcareous concretions ("*quesos*") from the Jagua Fm. (Jagua Vieja Member as interpreted here) of the Sierra de los Organos, but recently similar ammonites were found in the lower part of the Jagua Fm. (Zacarías Member) as well as the Francisco Fm. from the Sierra del Rosario (*cf.* Pszczółkowski 1970; Nuez 1972, 1974; Myczyński & Pszczółkowski 1975; Wierzbowski 1975); however, up to the present the latter ammonites were not studied in detail [8]. It should be mentioned that this is the oldest ammonite assemblage known from Cuba. Information about the occurrence of an older, Bajocian-Callovian fauna (*cf.* O'Connell & Brown 1922) was given without any evidence and it was presumably based on invalid paleontological identifications (Arkell 1956).

The studies on ammonites of the Jagua Fm. excellently preserved in the calcareous concretions, have a long tradition. The fauna in question was studied for the first time by C. de la Torre (1910), who erroneously compared it with Kimmeridgian fauna of Mexico (*cf.* O'Connell 1920). Sánchez Roig (1920) believed that ammonite fauna from the same beds of the Viñales area was of Upper Oxfordian, Kimmeridgian and Upper Portlandian age; however, the latter two stages were identified on the basis of erroneous determinations given in that paper: *Ataxioceras, Nebrodites, Idoceras, Simbirskites, Kossmatia, Berriasella*. O'Connell (1920) noted that a large amount of ammonites considered by Sánchez Roig (1920) as Kimmeridgian actually were of Late Oxfordian age. However, subsequently she also indicated the presence of the Lower Kimmeridgian (O'Connell 1922) or even the Portlandian (O'Connell & Brown 1922). The Kimmeridgian was to be evidenced by the ammonites of the genus *Ataxioceras* and some *Ochetoceras*, and the Portlandian — by the genera *Simbirskites* and *Kossmatia* (as reported by Sánchez Roig, 1920). Burckhardt (1930, pp. 61—62) questioned several previous identifications and especially such generic identifications as *Idoceras, Nebrodites, Simbirskites, Kossmatia* and *Berriasella;* and he interpreted the ammonites from the Viñales area as indicative of the Upper Oxfordian (Epipeltoceras bimammatum Zone) and Lower Kimmeridgian (A. poly-

[8] The recent paper of Nuez (1974) gives illustrations and descriptions of over 20 ammonites from the Zacarías Member. However, the identifications appear to be debatable; *Ochetoceras* sp. (op. cit., Pl. 1, Figs 1—2) may represent *Cubaochetoceras* as its ventral side is poorly preserved; *Perisphinctes* sp. (op. cit., Pl. 1, Figs 3—4) seems to bear a lappet and may belong to *Antilloceras* subgen. n.; *P. (?Arisphinctes)* spp. (op. cit., Pl. 2, Figs 1—4; Pl. 3, Figs 1—4), *P. (?Dichotomosphinctes)* spp. (op. cit., Pl. 3, Figs 5—6; Pl. 4, Figs 1—3, 5) and *P. (?Discosphinctes)* spp. (op. cit., Pl. 4, Figs 4, 6) represent a hardly identifiable fragments of Perisphinctidae; *P. (?Dichotomosphinctes)* sp. (op. cit., Pl. 5, Fig. 3) and *P. (Discosphinctes)* cf. *antillarum* (op. cit., Pl. 5, Fig. 2) presumably belong to the genus *Perisphinctes* but their subgeneric affinity is difficult to be established unequivocally.

plocum Zone). Spath (1931, pp. 400, 424, 449, 592) distinguished a new genus *Vinalesphinctes* and assigned some Cuban ammonites to the genera *Prososphinctes*, *?Biplices* (= *Orthosphinctes*), *Ataxioceras* and *Euaspidoceras*. Important new stratigraphic data were supplied by the studies carried out on the ammonite fauna of Cuba by Jaworski (1940). He assigned the ammonites to the following genera and subgenera: *Oppelia, Glochiceras, Ochetoceras, Neoprionoceras, Planites* (i.e., *Orthosphinctes*), *Discosphinctes, Dichotomosphinctes, Vinalesphinctes* and *Peltoceras*, and assumed Middle and Upper Oxfordian age (G. transversarium and E. bimammatum age) of the assemblage. This point of view was also held by Imlay (1942, 1952) who, however, did not exclude the possibility of the occurrence of the Lower Kimmeridgian. Sánchez Roig (1951) described a large assemblage of ammonites derived from calcareous concretions of the Jagua Fm., assuming that it comprises Oxfordian and Kimmeridgian (*Ataxioceras* and *Virgatosphinctes*) elements. According to Arkell (1956) the latter forms were misidentified and they actually represent the subgenera *Perisphinctes* and *Arisphinctes* of the genus *Perisphinctes* and the whole assemblage is typical of the Epipeltoceras bimammatum Zone of the Upper Oxfordian. This point of view was accepted by Judoley & Furrazola-Bermúdez (1968), the authors of a large monograph, who assigned all the available ammonites from the Jagua Fm. (Jagua Vieja Member) to the following genera and subgenera: *Ochetoceras, Cubaochetoceras, Orthosphinctes, Arisphinctes, Cubasphinctes, Dichotomosphinctes, ?Ampthillia, Discosphinctes, Decipia, Vinalesphinctes* and *Euaspidoceras*. Similar opinion concerning the age of these strata was also expressed by the present author in a preliminary report (Wierzbowski 1975); however, the presence of *Decipia, Arisphinctes* and *Ampthillia* in the Jagua Fm. was questioned there. The studies recently carried out have shown that a large part of the previous identifications should be revised. In relation to the last paleontological study (*cf.* Judoley & Furrazola-Bermúdez 1968) the essential changes at the genus-group are as follows:

The subgenus *Cubasphinctes* Chud. & Fur., of the genus *Perisphinctes* comprises the type species as well as the ammonites previously misidentified as *Arisphinctes* and *Orthosphinctes*. The subgenus *Antilloceras* subgen. n. of the same genus comprises a large part of Cuban *"Dichotomosphinctes"* as well as some *"Discosphinctes"*. The representatives of the subgenera *Arisphinctes, Dichotomosphinctes* and *Orthosphinctes* are not known from Cuba.

The range of the genus *Vinalesphinctes* is extended by the introduction of two new subgenera *Subvinalesphinctes* and *Roigites; Subvinalesphinctes* comprises forms described as *Decipia, ?Ampthillia, "Perisphinctes" bermudezi* Chud. & Fur. and *?Vinalesphinctes grossicostatus* (S. R.) by Judoley & Furrazola-Bermúdez (1968); *Roigites* comprises some new species as well as some Cuban *"Dichotomosphinctes"* and *"Prososphinctes" subconsociatus* Spath.

The presence of the genera *Cubaochetoceras* and *Ochetoceras* is confirmed but the boundary between the two genera is delineated in a different way.

Several data should be taken into account in defining the age of the strata yielding this ammonite assemblage:

(i) The ammonite assemblage does not comprise the representatives of *Perisphinctes (Kranaosphinctes)*. The subgenus *Kranaosphinctes* is characterized by a vast distribution in the Tethyan areas, being known from Submediterranean Europe, Madagascar (Collignon 1959), India (*e.g.* Spath 1931), Japan (e.g. Sato 1962), Philippines (*e.g.* Andal & al. 1968), Indonesia (Boehm 1907) and South America (Stipanicic 1951, 1966). In Europe, the ammonites of that subgenus are known from the early Middle Oxfordian

— the Perisphinctes plicatilis Zone, becoming very scarce in the uppermost part of this zone, i.e., in the upper part of Perisphinctes antecedens Subzone (cf. Callomon 1960, Enay 1966, Behmel 1970, Brochwicz-Lewiński 1974). In other regions the ammonites may also occur in the Lower Oxfordian as it is indicated by their occurrence with *Parawedekindia* and/or *Peltoceratoides* in Japan (*cf.* Sato 1962), Philippines (*cf.* Andal & al. 1968) and Indonesia (*cf.* Boehm 1907). The Cuban fauna does not comprise any Lower Oxfordian Peltoceratinae such as *Peltoceratoides, Parawedekindia* and *Peltomorphites* characterized by vast geographic distribution and known also from South America (Burckhardt 1903; Stipanicic 1951, 1966; Stipanicic & Rodrigo 1970). The record of *Peltoceras* (*?Peltoceratoides*) sp. indet. by Jaworski (1940, pp. 129—130) from Cuba is disputable as the specimen was never figured and was poorly preserved. It should be also mentioned that Lower Oxfordian Cardiocertinae, unknown from Cuba, are fairly numerous in North America (Alaska, Western Canada, Western Interior of the USA, Idaho) and single individuals of some species including *Quenstedtoceras mariae* were reported from South America (Klohn 1960, fide Stipanicic 1966). It would follow that the Oxfordian ammonite assemblage from Cuba is younger than the Lower Oxfordian and early Middle Oxfordian (the Perisphinctes plicatilis Zone with the possible exception of its uppermost part).

(ii) Directly above this ammonite assemblage in Cuba there appear ammonites of the genus *Mirosphinctes,* being accompanied by *Euaspidoceras* as well as *Cubaspidoceras,* the occurrence of which ammonites suggests the uppermost Middle Oxfordian, Perisphinctes bifurcatus Zone (*cf.* Myczyński 1976, Kutek & al. 1976).

(iii) The further conclusions are drawn from the analysis of the whole ammonite assemblage and from the comparisons. In the strata studied in Cuba the genus *Ochetoceras* is accompanied by numerous *Cubaochetoceras.* The latter may be compared with tricarinate European genera or subgenera: *Neoprionoceras, Canaliculites* and *Fehlmannites.* In Europe the occurrence of these ammonites and *Ochetoceras* was found in the Middle Oxfordian from the uppermost part of the Perisphinctes plicatilis Zone (upper part of P. antecedens Subzone) up to the Perisphinctes bifurcatus Zone; very few tricarinate forms accompany the genus *Ochetoceras* in the lowermost Upper Oxfordian (Enay 1962, Brochwicz-Lewiński 1974). Cuban *Discosphinctes* may be compared with European *Subdiscosphinctes* known from the P. antecedens Subzone of the P. plicatilis Zone to the P. bifurcatus Zone of the Middle Oxfordian of Europe (Brochwicz-Lewiński 1975). Cuban subgenus *Cubasphinctes* of the genus *Perisphinctes* may be compared with European *Platysphinctes.* The latter previously known from the lowermost Middle Oxfordian (Tintant 1961, Enay 1966), was subsequently recorded (Malinowska 1970) from the beds yielding the fauna of the uppermost Middle Oxfordian (Perisphinctes bi-

furcatus Zone) and/or lowermost Upper Oxfordian (lower part of the E. bimammatum Zone). To the genus *Vinalesphinctes* there may be probably assigned two South American species recently described as ?*Decipia desertorum* (Stehn) and ?*Decipia gottschei* (Stein.) by Hillebrandt (1970). These ammonites were found above *Gregoryceras* cf. *transversarium* (Quen.) and below or along with early representative of the genus *Idoceras* (cf. Hillebrandt 1970). It should be mentioned here that forms close to the genus *Idoceras* are known already from the Epipeltoceras bimammatum Zone of the Upper Oxfordian (Enay 1966, Pl. 40, Fig. 7a—c; Karvé-Corvinius 1966, Pl. 23, Fig. 2a—b) and possibly from the uppermost Middle Oxfordian (R. Enay, *pers. inf.*). Other genera known from Cuba (*Euaspidoceras* and *Glochiceras*) are characterized by wider stratigraphic range; but, nevertheless, *Euaspidoceras* is not known higher than the E. bimammatum Zone in Europe, becoming scarce above the Euaspidoceras hypselum Subzone (*cf.* Dorn 1931; Enay 1966; Enay, Tintant & Cariou 1971; Behmel 1970). The information on the occurrence of that genus in the latest Upper Oxfordian (*cf.* Schmidt-Kaler 1962, Schuler 1965) was based on erroneous interpretation of some species nowadays assigned to the genera *Paraspidoceras* or *Epaspidoceras* (cf. Zeiss 1962, Schairer 1968, Sequeiros 1974). Cuban *Glochiceras* are close to European species *G. subclausum* (Opp.) and *G. tectum* Zieg., known from the Middle and Upper Oxfordian (Ziegler 1958, 1971a).

It follows that the strata yielding this ammonite fauna, the lower and middle parts of the Jagua Fm. (Zacarías Member and Jagua Vieja Member) from the Sierra de los Organos and the Francisco Fm. (except for uppermost part) from the Sierra del Rosario, may be assigned to the Middle Oxfordian. The strata may correspond to the uppermost part of the Perisphinctes plicatilis Zone (upper part of the P. antecedens Subzone), Gregoryceras transversarium Zone and Perisphinctes bifurcatus Zone in the Submediterranean zonal scheme (*cf.* Table 3). However, it may be doubted whether the strata represent the whole chronostratigraphic interval. They may represent only a part of it, *viz.* a part of the Gregoryceras transversarium Zone, and possibly a part of the Perisphinctes bifurcatus Zone. These datings settle definitely the question of the age of the Azúcar = Pan unit. This unit is nowadays interpreted as a member of the Jagua Fm., representing a facies equivalent of the Zacarías Member (*cf.* Table 1). These two members occupy similar positions in the lithostratigraphic profile and seem to be of similar age. Thus the Azúcar = = Pan Member belongs to the Middle Oxfordian, similarly as the Zacarías Member. It should be mentioned that the former was hitherto assigned to the Callovian, taking into account the record of some foraminifer of the genus *Conicospirillina*, typical for the Callovian according to M. Furrer (*cf.* Hatten 1957, 1967; Judoley & Furrazola-Bermúdez 1968; Khudoley & Meyerhoff 1971; Meyerhoff & Hatten 1974). However, this foraminifer

represents the species *Conicospirillina basiliensis* Mohler (*cf.* Seiglie 1961), known from the Oxfordian (Mohler 1938, Groiss 1970).

The deposits of the San Cayetano Fm. occur directly beneath those of the Jagua Fm. in the Sierra de los Organos and the Francisco Fm. in the Sierra del Rosario, with a sedimentary continuity (*cf.* Table 1); hence, it could be assumed that the former partly belong to the Oxfordian and the upper boundary of the San Cayetano Fm. is roughly isochronous in both mountain ranges. In the time when this paper was being written this assumption was unexpectedly confirmed by the finding of several Oxfordian perisphinctids (including a form close to *P. plicatiloides* O'Connell) in the uppermost part of the San Cayetano Fm. in the Sierra del Rosario (Myczyński & Pszczółkowski 1976). It should be added that hitherto there were reported from the San Cayetano Fm. only some pelecypods, such as *Trigonia (Vaugonia)*, and plant remains (*Phlebopteris cubensis* Vachr.); these fossils have been considered as typical of the Middle and possibly Lower Jurassic (*e.g.* Krömmelbein 1956; A. Torre 1960; Furrazola-Bermúdez & al. 1964; Judoley & Furrazola-Bermúdez 1968, 1971; Khudoley & Meyerhoff 1971). Thus it may be assumed that the lower boundary of the Oxfordian passes through the San Cayetano Fm.

The younger ammonite assemblage was recently found (Myczyński 1976, Kutek & al. 1976) in the upper part of the Jagua Fm. (Pimienta Member) in the Sierra de los Organos and the uppermost part of the Francisco Fm. and basal strata of the Artemisa Fm. in the Sierra del Rosario (Table 1). The stratigraphic problems related to that fauna are discussed in detail in the above papers and only a brief comment is here given.

The ammonite fauna found in these strata comprises indeterminable Ochetoceratinae as well as *Glochiceras, Mirosphinctes, Cubaspidoceras* Myczyński, 1976, and *Euaspidoceras*. The latter genus was found only in the lower part of these strata (uppermost part of the Francisco Fm. and the lower part of the Pimienta Member of the Jagua Fm). The ammonites of the genus *Cubaspidoceras* are very close to some European representatives of the genus *Clambites* (as e.g. *C. schwabi* (Opp.), *cf.* Oppel 1863, Pl. 63, Fig. 4a, b) and *"Neaspidoceras" tietzei* Neum., known from the uppermost Middle Oxfordian (Perisphinctes bifurcatus Zone) and lowermost Upper Oxfordian (Kutek & al. 1976). The genus *Mirosphinctes* is known to occur in the Lower and Middle Oxfordian, up to the upper boundary of the Perisphinctes bifurcatus Zone in Europe, with debatable exception of Portugal, where is believed to be known also from somewhat younger strata (Choffat 1893, Ruget-Perrot 1961, França & al. 1964). Thus it may be suggested that the lower part of the Pimienta Member of the Jagua Fm. and the uppermost part of the Francisco Fm., characterized by the occurrence of *Cubaspidoceras, Euaspidoceras* and *Mirosphinctes* are of latest Middle Oxfordian (P. bifurcatus) age (*cf.* Myczyński 1976, Kutek & al. 1976). The

upper part of the Pimienta Member in the Sierra de los Organos and the basal strata of the Artemisa Fm. in the Sierra del Rosario characterized by occurrence of *Mirosphinctes* and *Cubaspidoceras* are of more disputable age; the lack of *Euaspidoceras* may even suggests Upper Oxfordian age of these strata. In such a case it should be assumed that *Mirosphinctes* in Cuba ranges up somewhat higher than in the majority of European profiles.

The upper boundary of the Oxfordian in Cuba cannot be precisely recognized. The Kimmeridgian fauna is still unknown. The Tithonian ammonites were found in the lower part of the Artemisa Fm. in the Sierra del Rosario (*cf.* Imlay 1942); the lowermost Tithonian is evidenced in the Sierra de los Organos by *Mazapilites* found in the Guasasa Fm., directly above massive "Viñales Limestones" of the San Vicente Member (Houša & Nuez 1972, Houša 1974). Thus the Kimmeridgian comprises a part of strata of the Artemisa Fm. and a major part of unbedded "Viñales Limestones", while the Oxfordian/Kimmeridgian boundary most probably passes through the lowermost parts of the two lithological units (Table 1).

REMARKS ON THE OXFORDIAN STRATIGRAPHY OF THE AMERICAS (EXCLUDING BOREAL REGIONS)

Outside Cuba, the Oxfordian strata with ammonite records are reported from Mexico, the United States, as well as from Chile, Argentina and Peru.

In Mexico the Oxfordian ammonite fauna is known from the La Gloria Fm. of the eastern Durango, and primarily from San Pedro del Gallo area (Burckhardt 1912, Pl. 1–7; Imlay 1939, Pl. 5, Fig. 8; Pl. 6, Fig. 1; Pl. 7, Figs 1, 7; Pl. 8, Figs 1–2; and Imlay 1945, p. 258), where Burckhardt (1912, 1930) distinguished two ammonite assemblages.

The older assemblage occurs in the "Perisphinctes Beds" and comprises mainly numerous representatives of the genus *Perisphinctes* recently assigned to its subgenus *Dichotomosphinctes* (cf. Arkell 1956; Imlay 1961, 1965); some of which may, however, represent the subgenus *Cubasphinctes* (e.g. *P. durangensis* Burck.). The form described as "*P.* cf. *rota* Sinz." by Burckhardt (1912) presumably belongs to the Cuban species *P. (Antilloceras) plicatiloides* O'Con. The majority of the perisphinctids present here differs from the Cuban species hitherto known. These strata from Mexico have also yielded some forms of *Taramelliceras, Creniceras* and presumably of the genus *Amoeboceras* (cf. Burckhardt 1930, p. 66). This Mexican assemblage was usually dated to the Middle Oxfordian (*cf.* Burckhardt 1930, Imlay 1961), and more precisely to the Gregoryceras transversarium Zone. This appears to be evidenced by the record of the genus *Amoeboceras,* never found lower than the G. transversarium Zone,

P. parandieri Subzone in Submediterranean Europe (Enay 1966; Enay, Tintant & Cariou 1971; Mouterde, Enay & al. 1971). It seems that this Mexican assemblage is just older than the older ammonite assemblage from the Oxfordian of Cuba or they slightly overlap.

The younger assemblage from "Ochetoceras Beds" comprises: *Cubaochetoceras mexicanum* (Burck.), *C. pedroanum* (Burck.), *C.* aff. *burckhardti* (O'Connell) and various *Discosphinctes* (cf. Burckhardt 1912, Pl. 1, Figs 1—17; Pl. 5, Figs 5, 8—9; Pl. 7, Figs 4—14), including some probably close to the species *D. carribeanus* (Jaw.); as well as *Taramelliceras* and *Euaspidoceras*. The majority of these ammonites are known from the older ammonite assemblage of Cuba (*cf.* Table 2). Thus it seems that these faunas from Mexico and Cuba may be contemporaneous. This indicates that "Ochetoceras Beds" of Mexico may correspond to the G. transversarium Zone and/or P. bifurcatus Zone of the Middle Oxfordian. The strata from Mexico were previously ascribed to the E. bimammatum Zone of the Upper Oxfordian (*e.g.* Burckhardt 1930, Arkell 1956, Imlay 1961) which seems to be in contradiction with the commonness of tricarinate *Cubaochetoceras*, the European equivalents of which become rare in strata younger than Middle Oxfordian.

The Oxfordian fauna comparable with the younger assemblage from Cuba is not known up to the present from Mexico. Some younger strata from the latter region yielded Lower Kimmeridgian fauna (Burckhardt 1906, 1912; Imlay 1939) comprising the representatives of *Aspidoceras, Sutneria, Idoceras, Nebrodites* and *Streblites*.

In the southern part of the United States, in Gulf Coast region, the Oxfordian ammonites were found in core material from the Smackover Formation (Imlay 1945, Pl. 41, Figs 7—14; *cf.* also Imlay 1971). The ammonites are poorly preserved and specifically unidentifiable; the generic status of some of them is also questionable. According to Imlay (1945, 1971) they belong to the genera *Ochetoceras, Euaspidoceras, Discosphinctes* and *Perisphinctes (Dichotomosphinctes),* and they appear similar to those known from the Oxfordian of Mexico and Cuba. Thus it may be assumed that they are of Middle Oxfordian age. The ammonites of possibly similar age were described as *Discosphinctes* and *Perisphinctes (Dichotomosphinctes)* from the Mariposa Formation and the Monte de Oro Formation of California, and the Galice Formation of south-western Oregon (Imlay 1961, Pl. 3, Figs 1—10; Pl. 4, Figs 2, 4, 7—8). They appear somewhat similar to some species described from the Middle Oxfordian deposits of Mexico, especially to *Perisphinctes elisabethaeformis* Burck., *P. wartaeformis* Burck., *P. durangensis* Burck., as well as to Cuban-Mexican species *Discosphinctes carribeanus* (Jaw.) (*cf.* Imlay 1961). An older ammonite fauna, of early Oxfordian age, is known from the western Idaho (Imlay 1964, Pl. 2, Figs 1—5); however, similarly as those from the Western Interior of

the United States, western Canada and Alasca, it comprises Boreal ammonites of the genus *Cardioceras*.

There is no paleontological record of the Upper Oxfordian, as interpreted here, from the southern parts of the United States. In turn, there are known several Lower Kimmeridgian ammonites from these regions. These reported from Louisiana and western Texas are very close to Lower Kimmeridgian ammonites from Mexico (*e.g.* Arkell 1956, Imlay 1971); however, from California are also known Boreal ammonites of Kimmeridgian age — *Amoeboceras (Amoebites)* (cf. Imlay 1961, Pl. 2, Figs 24–28).

Ammonites of Oxfordian age are known from Chile (especially the areas of Caracoles and Cordillera Domeyko), Argentina (Neuquén and Mendoza provinces) and southern Peru. The fauna is primarily known from the strata corresponding to the La Manga Formation in Argentina and resting below the "Main gypsum" ("Yeso principal"; Auquilco Formation from Argentina). From various sections of the Oxfordian deposits in Argentina there were reported the Lower Oxfordian ammonites (Stipanicic 1951, 1966; Stipanicic & Rodrigo 1970) such as: *Peltoceratoides, Parawedekindia, Peltomorphites, Prososphinctes*. In Chile (Klohn 1960, fide Stipanicic 1966) there was found *Quenstedtoceras* cf. *mariae* (d'Orb.), indicative of the earliest Lower Oxfordian. The Middle Oxfordian ammonite fauna is rich and highly differentiated but, unfortunately, still poorly known and shown on few photographs. From the La Manga (Mendoza, Argentina) section there were reported (Stipanicic 1951, Pl. 1; Pl. 2, Fig. 2; Pl. 3, Fig. 2) *Perisphinctes (Kranaosphinctes)* and *P. (Arisphinctes)* indicative of the early Middle Oxfordian (*P. plicatilis* Zone); and from the Caracoles area, Chile (Leanza 1947, Pl. 1, Figs 1–5) — ammonites of the genera *Ochetoceras, Euaspidoceras* and *Perisphinctes*. The perisphinctids from the latter region were assigned to the subgenus *Arisphinctes* but this assignation is disputable because of their poor preservation. This assemblage may be of Middle Oxfordian age and it is probably younger than the early Middle Oxfordian as the genus *Ochetoceras* recorded here does not appear below the upper part of the Plicatilis Zone in Europe (Brochwicz-Lewiński 1974). From Cordillera Domeyko of Chile there are known (Hillebrandt 1970) the strata of Gregoryceras transversarium Zone yielding: *Gregoryceras toucasianum* (d'Orb.), *G.* cf. *transversarium* (Qu.), *Ochetoceras, Mirosphinctes* and *Euaspidoceras*, accompanied by *Perisphinctes andius* Stein., *P. boehmi* Stein. and *P. gleimi* Stein., hitherto represented by rather incomplete material (*cf.* Steinmann 1881, Pl. 9, Figs 1, 3–5) and thus of disputable systematic position. From the same region there is known a younger faunal assemblage (Hillebrandt 1970) found somewhat below and at the base of "Main gypsum". It comprises the representatives of the genera *Ochetoceras, Cubaochetoceras* ("*Campylites*" cf. *mexicanus* Burckh.), *Euaspidoceras, Discosphinctes, Vinalesphinctes*

(*"Perisphinctes" gottschei* Stein., *cf.* Steinmann 1881, Pl. 9, Fig. 2; *"Perisphinctes" desertorum* Stehn, cf. Stehn 1923, Pl. 5, Fig. 3; *cf.* also remarks given in description of the genus *Vinalesphinctes* here); there was also recorded an early form of *Idoceras*. The species *Perisphinctes cubanensis* O'Con. was reported from northern Chile and southern Peru (Cecioni 1961, *fide* Stipanicic 1966; *cf.* also Szekely 1971) directly below "Main gypsum".

The faunal assemblage recorded at the base of the "Main gypsum" is very close to the older Oxfordian assemblage from Cuba (*cf.* Table 2). Thus it may be indicative of the late Middle Oxfordian (the Gregoryceras transversarium Zone and/or Perisphinctes bifurcatus Zone), but possibly also of the earliest Upper Oxfordian, which would be suggested by the occurrence of the genus *Idoceras*. In that situation the previous dating of all that assemblage to the Epipeltoceras bimammatum Zone of the Upper Oxfordian (Hillebrandt 1970; Cecioni 1961, *fide* Szekely 1971) appears to be unsubstantiated.

Directly above the "Main gypsum", in the Chacay Melehué and Rahuecó sections (Neuquén, Argentina) there were found: *Streblites, Nebrodites, Idoceras, Aspidoceras* and *Euaspidoceras* (Leanza 1946, 1947, fide Stipanicic 1966, 1969; Stipanicic & Rodrigo 1970). This fauna is typical for the latest Oxfordian (Idoceras planula Zone) and the earliest Kimmeridgian. However, the presence of the genus *Euaspidoceras* may indicate also early Upper Oxfordian age.

PALEOBIOGEOGRAPHIC POSITION OF THE OXFORDIAN AMMONITES FROM CUBA

The evaluation of the paleobiogeographic relationships between the ammonite faunas of Cuba and other parts of the Tethyan realm in a wider sense (Hallam 1971, Stevens 1971, Cariou 1973) appears to be difficult. The difficulties are primarily related to the insufficient knowledge of late Middle Oxfordian and Upper Oxfordian ammonite faunas from a large part of Indopacific regions. Moreover, the existing similarity of the ammonite fauna of the Cuban Oxfordian to the well-known faunas from the Mediterranean areas does not evidence the direct connections between these regions as some of these faunal elements may have much wider geographic distribution.

The previous authors often emphasized the separate position of the Cuban region, taking into account the local occurrence of some ammonites such as *Cubaochetoceras* and *Vinalesphinctes*. This was the premise for distinguishing a separate Cuban province (Cariou 1973). Sometimes these genera were treated as Pacific elements of a possibly limited distribution (Imlay 1965); which seemed to be confirmed by undoubtful affinity of the younger, early Kimmeridgian faunas of the Americas (mostly Mexico)

and other Pacific regions (Arkell 1956; Imlay 1965; Stevens 1965, 1967, 1971; Hallam 1971).

It should be stressed, however, that the ammonite faunas of Oxfordian age in Cuba do not differ distinctly from other contemporaneous faunas from the remaining parts of the Americas, with the exception of the Boreal regions. Some genera hitherto considered as Cuban endemic elements or not recorded outside Cuba are at present known also from Mexico and/or South America (genera *Cubaochetoceras* and *Vinalesphinctes*). From the late Middle Oxfordian deposits of Cuba, Mexico and South America there are recorded the same species: *Cubaochetoceras mexicanum* (Burck.), *C. pedroanum* (Burck.), *Discosphinctes carribeanus* (Jaw.), *Perisphinctes (Cubasphinctes) cubanensis* O'Con. The existing differences seem to be primarily related to the failure in collecting as all the studied ammonite collections gathered outside Cuba are relatively poor. It follows that the whole area of Central and South America should be treated as biogeographically uniform.

In evaluation of possible biogeographic connections of that area with the Indo-western-Pacific regions the following data should be taken into account:

(i) Ammonites of the genus *Mayaites* have been mentioned from the Lower and early Middle Oxfordian deposits of South America (Stipanicic 1966). The ammonites are typical of the Ethiopian province and Indo-western-Pacific regions.

(ii) There is some evidence for the occurrence of some ammonites indicative of the late Middle Oxfordian of the Americas in the Indo-western-Pacific regions. For example, the genus *Vinalesphinctes* was reported from Iraq (Sayyab 1971). Professor R. Enay kindly sent the present author the photograph of a fragmentary ammonite, somewhat similar to some representatives of the genus *Vinalesphinctes* and obtained from the strata of presumedly Perisphinctes bifurcatus age from southern Turkey. Poorly preserved, incomplete specimens possibly close to the genus *Discosphinctes* are known from the Oxfordian deposits of Indonesia (*cf.* Hummel 1923, Pl. 11, Fig. 7; Arkell 1956, p. 438) and India (Spath 1931). It should be mentioned that the genus *Discosphinctes* was proposed on the basis of the material from Ethiopian province. However, the relationship between those ammonites of debatable age with Oxfordian ammonites from other regions assigned to that genus is still unclear (*cf.* also remarks on the genus *Discosphinctes* given here). Some ammonites from Japan: *Perisphinctes kochibei* Yok. (*cf.* Yokoyama 1904, Pl. 1, Fig. 5) as well as *Ataxioceras kurisakense* Kob. & Fuk. (*cf.* Kobayashi & Fukada 1947, Pl. 11, Figs 2–3; Sato 1962, Pl. 2, Figs 9–10; Pl. 8, Figs 4–5, 8–9, 12; Text-fig. 15) appear to be similar to *Perisphinctes (Cubasphinctes)*. The former species was found in strata of disputable age; the occurrence of *Ataxioceras kurisakense* and

disputable *Euaspidoceras* (cf. Sato 1962, Pl. 10, Fig. 5) may eventually indicate the Oxfordian age of yielding them strata.

The above discussion does not solve unequivocally the question of the relationship between American and Indo-western-Pacific regions during the Oxfordian, but it seems to be in favour of that relationship. Such interpretation agrees with some ideas of Stevens (1965, 1967, 1971), according to whom the evolution of endemic Indo-Pacific elements during the late Oxfordian and early Kimmeridgian resulted from isolation of these areas from the Mediterranean Zone due to tectonic movements affecting the Balkan, Asia Minor and Middle East regions.

Any direct connections between the areas of the Americas and Mediterranean region, despite of the apparent similarity of the faunas, are more difficult to be accepted. During the Lower and early Middle Oxfordian some ammonite groups (as some Peltoceratinae, and Perisphinctinae such as *Kranaosphinctes*) were distributed throughout vast areas of the Tethyan realm. Therefore, their presence in the Americas and Mediterranean region cannot be accepted as an evidence for the direct marine ronnection between these areas. The characteristic forms of the Mediterranean late Middle Oxfordian and Upper Oxfordian, including *Perisphinctes (Dichotomoceras, Perisphinctes, Ampthillia), Orthosphinctes, Progeronia, Epipeltoceras,* are not known from Cuba. The similarity between the ammonite faunas of that age from Cuba (and other parts of the Americas) and Mediterranean regions results from the occurrence of some more or less close lineages (*cf.* remarks on the phylogeny here). However, similar development of some of these ammonite groups also in other Tethyan regions cannot be excluded. It seems that direct connection between the American and Mediterranean regions could exist during the latest Oxfordian and early Kimmeridgian as the Mexican species of *Idoceras* were recorded in Spain (Geyer *in:* Barthel & al. 1966; Behmel 1970). However, these data should be verified as the identifications were not supplemented with any evidence and some of the Mexican species reported from Spain are easy to be mixed up with European species (Ziegler 1959b).

AMMONITE FAUNA

The preservation of the studied older Oxfordian ammonite fauna from western Cuba is variable. The specimens from calcareous concretions (*"quesos"*) and limestones of the Jagua Vieja Member of the Jagua Formation and the Francisco Formation are preserved excellently. They always bear the shell and are fairly often complete, neither crushed nor flattened; the specimens tectonically deformed or with body chamber flattened are rather rare. When the shell is removed through preparation, the sutures are usually well visible.

The ammonites derived from shales and marls of the Zacarías Member and the Jagua Vieja Member are much worse preserved. They are as a rule heavily flattened, strongly deformed and preserved in the form of internal or external casts. It is very difficult to extract the specimens from rock as the material is very brittle. The preservation of the specimens is usually insufficient for specific or, sometimes, subgeneric or even generic identification. It is possible, however, to note that the fauna is generally close to that known from concretions ("*quesos*") and limestones.

The material studied comprises about 400 specimens; a half of which was derived from concretions and limestones, and the other half from shales and marls. The specimens were collected personally by the author, and by other, both Polish and Cuban geologists in various localities from the Sierra de los Organos and the Sierra del Rosario (*cf.* Text-fig. 1)[9] in the years 1970—1974. The collection of the Instituto de Geología y Paleontología, Academia de Ciencias de Cuba in Havana, represents the bulk of the material studied. Specimens from this collection are denoted with numbers: 2000—2234, 2379—2413, 2424, 2431—2501, 2504—2506, 2512—2515, 2604, 2670—2671, 2674, 2681, 2683, 2690. Additional specimens obtained in the course of preparation were designated with the number of the "parent" specimen and with a subsequent letters added. Two other small collections of a total of 20 specimens, include that given in 1970 by the Instituto de Geología to the Institute of Geological Sciences, Polish Academy of Sciences in Warsaw in 1970 (these are designated as *HSA*), and the collection of Dr. J. Piotrowski from the latter institution (these are designated as *P*).

During his stay in Cuba, the present author analysed some older collections housed at the Instituto de Geología y Paleontología, Academia de Ciencias de Cuba, in Havana. The largest collection (designated as *J-F*) and comprising specimens 1—127 (Oxfordian specimens numbered from 16—102 and 119—122), was illustrated and described recently by Judoley & Furrazola-Bermúdez (1968). This collection comprises some specimens gathered by Sánchez Roig (1920, 1951). Unfortunately, neither the original numbers nor labels of Sánchez Roig are usually preserved so only the specimens figured by him can be identified.

Judoley & Furrazola-Bermúdez (1968) identified the majority of the holotypes of Sánchez Roig's (1920, 1951) species; however, they sometimes interpreted them in the way contradictory with the Rules of the ICZN. The discrepancies are shown in the descriptions of the species given below (*cf.* also A. Torre 1973).

Spath (1931) proposed several new species on the basis of specimens from the collection of Sánchez Roig. However, the holotypes of these species were found neither by the present author nor by Judoley & Furrazola-Bermúdez. Professor J. H. Callomon kindly informed the present author that according to the British Museum (Natural History Museum), the specimens were borrowed by L. F. Spath and subsequently returned to Cuba in 1932.

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[9] Locations of faunistic localities of the Zacarías Member is given in description of that unit. The ammonites of the Jagua Vieja Member were derived from the following localities: La Jutía (quadrangle 1 : 50 000 Consolación del Sur, coordinates 224 100 and 317 400), El Hoyo de la Sierra (San Diego de los Baños quadrangle, 243 650 and 317 000, 243 200 and 317 000), El Hoyo de San Antonio (Consolación del Norte quadrangle, coordinates 227 550 and 320 650), Sierra de Guane (Guane quadrangle, 186 050 and 268 000) and El Junco, San Carlos Valley (Sumidero quadrangle, 193 200 and 290 200). The ammonites from the Francisco Formation were found at Brujito locality (San Cristobal quadrangle, 289 300 and 331 000), Loma Calabrote (San Cristobal quadrangle, 288 120 and 331 800) and Altos de San Francisco (San Cristobal quadrangle, 283 150 and 327 270).

The present author was not able to study the other collections of the Oxfordian ammonites from Cuba, housed in the United States (*e.g.* collection of B. Brown, partly elaborated by M. O'Connell, 1920, 1922) and Holland (collection of M. G. Rutten, elaborated by E. Jaworski, 1940), except for plaster casts of *Vinalesphinctes* from the latter, kindly supplied by Professor R. Enay.

The following abbreviations were used in descriptions of the species: D — diameter in mm, Wh — whorl height in D%, Ud — diameter of umbilicus in D%, Wb — whorl thickness in D%, b — whorl thickness in mm, h : b — whorl height/thickness ratio, Ud/Wh — umbilical diameter/whorl height ratio treated as whorl coiling index (coiling involute when Ud/Wh < 1; evolute Ud/Wh > 1), D_i — diameter at which there is onset of the fading of ribbing (in the case of some *Vinalesphinctes*), NiR — number of primary ribs per whorl, S/P — secondary/primary ribs ratio (calculated for 5 primary ribs). The changes in number of ribs along with shell size (rib curves) as well as the dependance of coiling (Ud/Wh index) on shell size are presented on the graphs. The phragmocone/body chamber boundary, if recognized, is arrowed in the photos.

The material was analysed taking into account the phenomenon of sexual dimorphism (*cf.* Makowski 1962; Callomon 1963, 1969). Remarks on the dimorphism in Perisphinctidae and Oppeliidae are given in the descriptions of particular genera and subgenera. As a rule, macro- and microconchs were assigned to separate subgenera of the same genus when they markedly differ in ornamentation of outer whorls. It should be added that such approach is widely accepted in the systematics of the ammonites (*cf.* Callomon 1963, 1969). In some instances, when the assignation of the groups of the corresponding micro- and macroconchs to a single genus would be connected with a far-going complications for the systematics and it would require an analysis of the faunas from other regions, the existing systematics was accepted, as in the genera *Cubaochetoceras* & *Ochetoceras* (M) and *Glochiceras* (m), in such a case the corresponding dimorphic forms were put into the same family.

Family **Perisphinctidae** Steinmann, 1890
Genus *VINALESPHINCTES* Spath, 1931
(Type species: *Vinalesphinctes roigi* Spath, 1931)

Preliminary remarks. — The genus *Vinalesphinctes* with the type species *V. roigi* Spath was established by Spath (1931) in his revision of Sánchez Roig's (1920) material from the Oxfordian of Cuba. Diagnoses of this genus were moreover given or commented by Jaworski (1940, pp. 124—125), Arkell (1957, p. L324) and Judoley & Furrazola-Bermúdez (1968, p. 102). Some remarks were also given by Arkell (1939, p. LXIV; and *in:* Jaworski 1940, pp. 124—125) and by Sánchez Roig (1951, pp. 84—86).

The range of the genus *Vinalesphinctes* as hitherto interpreted coincides only with the range of nominate subgenus presented in this paper. The two new subgenera — *Subvinalesphinctes* subgen. n. and *Roigites* subgen. n. — are proposed for the forms of hitherto uncertain status and which affinity with *Vinalesphinctes* was unclear.

Diagnosis. — Macroconchs (subgenera *Vinalesphinctes* and *Subvinalesphinctes* subgen. n.) large, with simple oblique peristome found in the case of the nominate subgenus. Microconchs (*Roigites* subgen. n.) small, having aperture with lappets. Body chamber about a whorl long or somewhat shorter. Coiling strongly evolute or evolute; whorl section usually ovate, sometimes circular, subquadrate, subrectangular or trapezoidal (Text-figs 7, 9). Inner whorls ornamented with single and bifurcate ribs, and later also with some trifurcate and intercalatory ribs. Outer whorls of macroconchs display decline of ribbing, particularly along the venter, but sometimes, also on the whorl sides (subgenus *Vinalesphinctes*). The last

whorl of microconchs displays fading of sculpture on whorl sides or not. The ammonites of this genus are characterized by crowding of ribs on inner whorls and, when the sculpture may be traced up to the end of last whorl, the ribs become approximated close to the peristome (Text-figs 5—6, 8 and 10). Constrictions fairly numerous, usually strong and delineated by prominent ribs.

Differences and affinities. — The above listed features generally markedly distinguish the representatives of the genus *Vinalesphinctes* from the remaining Perisphinctidae. The extremal group of this genus — *Subvinalesphinctes* subgen. n. — is somewhat similar to the genus *Decipia* Arkell, 1937; however, close phylogenetic relation (based on geographic and morphological relations) of the subgenera *Subvinalesphinctes* and *Vinalesphinctes* is considered here to be of primary importance for the systematics. It should be noted that there is no such relation between the subgenus *Vinalesphinctes* and typical representatives of the genus *Decipia*.

Some strongly-ribbed representatives of *Vinalesphinctes* (e.g. *Subvinalesphinctes*, or *Roigites* ex gr. *R. catalinensis*) appear similar in the trend of rib curve and, partly, in ornamentation to some Cuban representatives of the genus *Perisphinctes* (e.g. *Cubasphinctes* Chudoley & Furrazola-Bermúdez, 1968, or *Antilloceras* subgen. n.) ornamented with not numerous strong ribs (*cf.* Text-figs 8 and 12, and Text-figs 10*B* and 18—19, 21 respectively). The essential differences between these representatives of the genera *Vinalesphinctes* and *Perisphinctes* are as follows:

(i) *Vinalesphinctes* is usually characterized by smaller number of ribs per whorl and is generally more evolute;

(ii) In *Vinalesphinctes* ribs pass through the umbilical wall straight or with slight curve, whereas in the discussed *Perisphinctes* with marked twist on the umbilical wall;

(iii) *Vinalesphinctes* (*Subvinalesphinctes* subgen. n.) is characterized by decline of sculpture on the venter of outer whorls, whereas the venter of *Perisphinctes* (*Cubasphinctes*) is always ornamented.

Remarks on dimorphism. — Inner whorls of the representatives of subgenera *Vinalesphinctes*, *Roigites*, and possibly *Subvinalesphinctes* are very similar and the differences are limited to outer whorls and the type of peristome. Despite of postulated biological affinity between *Vinalesphinctes* (M) — *Roigites* (m) and possibly *Subvinalesphinctes* (M) — *Roigites* (m), the present author has decided to describe particular dimorphic forms under separate subgeneric and specific names. Such approach seems to be justified as there are marked differences in the appearance of outer whorls of macro- and microconchs as well as that some species of the genus *Vinalesphinctes* were distinguished for macroconchs with similar inner whorls and presumably comparable with a single species of microconchs.

The macroconchs of the genus *Vinalesphinctes* may be divided into three groups of species: (1) the group *Vinalesphinctes (Vinalesphinctes) roigi*, characterized by fairly rapid decline of sculpture on both the venter and sides of the outer whorls (*cf.* Pl. 1, Figs 1—6), (2) the group *Vinalesphinctes (Vinalesphinctes) niger*, characterized by gradual fading of sculpture starting from the venter and involving much later the whorl sides (*cf.* Pl. 1, Figs 8—9; Pl. 2, Fig.2), and (3) the subgenus *Subvinalesphinctes* with decline of sculpture on the venter of the outer whorls only (*cf.* Pl. 2, Fig. 3). In turn, the two groups of microconchs may be distinguished: (1) group *Vinalesphinctes (Roigites) subconsociatus*, characterized by fading of sculpture on the lateral sides of the last whorl (*cf.* Pl. 2, Figs 5—7), and (2) group *Vinalesphinctes (Roigites) catalinensis*, with sculpture persisting on the last whorl (*cf.* Pl. 3, Figs 1—8).

The ventral side of the last whorl in subgenus *Roigites* (m) is always ornamented, being smooth at similar diameter in the subgenus *Vinalesphinctes* (M) or displaying trend to fading of sculpture in the subgenus *Subvinalesphinctes* (M);

thus the simultaneous changes in ornamentation of whorl sides should be taken into account in identification of dimorphic relationship of particular groups of micro- and macroconch species. Early and almost complete decline of sculpture on whorl sides, displayed by *V. (Vinalesphinctes) roigi* group (M), indicates the group *V. (Roigites) subconsociatus* (m), characterized by fading of sculpture on whorl sides of the last whorl, as its presumable dimorphic companion. In turn, the group *V. (Vinalesphinctes) niger* (M) and possibly subgenus *Subvinalesphinctes* (M) may comprise dimorphic counterparts of microconchs of the group *V. (Roigites) catalinensis*, as they all are characterized by persisting of the sculpture on whorl sides at comparable diameters. The macroconch species *Vinalesphinctes (Vinalesphinctes) sagrai* Chud. & Fur. of the group *V. (Vinalesphinctes) roigi* seems to be an exception here, as it displays sculpture disappearing rather late on whorl sides and it may represent the dimorphic counterpart of the microconch of the group *V. (Roigites) catalinensis*.

Taking into account the whorl section and number of ribs per whorls it is sometimes possible to distinguish pairs of dimorphic species. For example, in the groups *V. (Vinalesphinctes) roigi* and *V. (Roigites) subconsociatus* such inferred pair includes *V. (Vinalesphinctes) roigi* Spath (M) and *V. (Roigites) subconsociatus* (Spath) (m). In the case of the group *V. (Vinalesphinctes) niger*, and possibly, *V. (Subvinalesphinctes)* on the one hand, and the group *V. (Roigites) catalinensis* on the other, a number of admissible combinations is so high that it is more difficult to identify the dimorphic relationship at the specific level. Possible dimorphic pair includes *V. (Vinalesphinctes) niger* Spath (M) and *V. (Roigites) catalinensis* (Sánchez Roig) (m). Moreover, it appears that *V. (Roigites) simplicior* sp. n. (m) may correspond to both *V. (Vinalesphinctes) subroigi* Chud. & Fur. (M) and *V. (V.) subniger* Chud. & Fur. (M); whereas a counterpart of *V. (Roigites) rosariensis* sp. n. (m) is still unknown.

Occurrence of the genus *Vinalesphinctes:* Oxfordian, western Cuba, northern Chile.

Subgenus *VINALESPHINCTES* Spath, 1931

Diagnosis. — Macroconchs up to about 220 mm in diameter. Peristome simple, oblique. Body chamber about a whorl long. Coiling strongly evolute; whorl section initially ovate, circular or subquadrate, later ovate often with flattened sides, circular or trapezoidal (Text-fig. 7). Inner whorls ornamented with biplicate and single ribs as well as some intercalatories progressively increasing in number; ribs sharp-crested, prorsiradiate, becoming usually rectiradiate close to the venter at the point of furcation; all ribs pass regularly through the venter of inner whorls. Number of ribs gradually decreasing along with shell size (Text-figs 5—6). Constrictions numerous, deep, delineated by strong ribs. Fading of sculpture begins at the transition from inner to outer whorls; in the first stage the venter becomes smooth; it may be accompanied by decline or weakening of ribbing on whorl sides, except for subumbilical area (the *V. roigi* group) or the primary ribs remain unaffected for some time (the *V. niger* group). The second stage is reflected by the disappearance of ribs from whorl sides, and the constrictions with ribs delineating them become the only distinct ornaments.

Occurrence. — Oxfordian, western Cuba, Sierra de los Organos (Jagua Fm.), Sierra del Rosario (Francisco Fm.).

Species assigned to the subgenus: the *V. roigi* group — *Vinalesphinctes (Vinalesphinctes) roigi* Spath, *V. (V.) imlayi* (Sánchez Roig), *V. (V.) sagrai* Chudoley & Furrazola-Bermúdez; the *V. niger* group — *V. (V.) niger* Spath, *V. (V.) subroigi* Chudoley & Furrazola-Bermúdez (? = *V. brodermanni* Sánchez Roig), *V. (V.) subniger* Chudoley & Furrazola-Bermúdez, *V. (V.) parvicostatus* Chudoley & Furrazola-Bermúdez, *Vinalesphinctes (V.)* sp. n.

THE GROUP *VINALESPHINCTES (VINALESPHINCTES) ROIGI*

Vinalesphinctes (Vinalesphinctes) roigi Spath, 1931
(Text-figs 5, 7; Pl. 1, Figs 1—3)

1920. *Aspidoceras* sp.; Sánchez Roig, pp. 30—31, Pl. 12, Fig. 2 (holotype).
1931. *Vinalesphinctes roigi* Spath; Spath, p. 400.
1940. *Vinalesphinctes roigi* Spath; Jaworski, pp. 125—126, Pl. 5, Fig. 3a—b; ? Pl. 3, Fig. 6; ?Pl. 7, Fig. 7.
1951. *Vinalesphinctes roigi* Spath; Sánchez Roig, p. 84 (partim), Pl. 15, Fig. 2 (holotype); non Pl. 15, Fig. 1.
1957. *Vinalesphinctes roigi* Spath; Arkell, p. L325, Fig. 416, 6a—b.
1968. *Vinalesphinctes roigi* Spath; Judoley & Furrazola-Bermúdez, pp. 102—103, Pl. 54, Fig. 1a—d; Pl. 61, Fig. 2a—d.

Material: — Nine specimens (No. 2026, 2481, 2483, 2494, 2496, 2497, 2683, HSA-1 and P-1).

Dimensions:

Table 4

Locality	Specimen No.	D (mm)	Ud (%)	Wh (%)	Wb (%)	b (mm)	h : b	D_1 (mm)
	holotype*	64	41	31.2				
Loma Calabrote	2683	39	42	37				43
El Hoyo de S. Antonio	HSA-1	43	40.7	33.7	32.5	14	1.03	43
S. Carlos Valley	2481	43	42	35	32.5	14	1.07	40
S. Carlos Valley	2483	45	42.2	33.3				44
La Jutía	2026	48	41.5	34	30	14.5	1.17	45
S. Carlos Valley	2496	47	44.7	32	30	14	1.07	49
El Hoyo de S. Antonio	P-1	55	42	32.7	30.9	17	1.06	46
S. Carlos Valley	2497	68	44	32	26.5	18	1.22	54
S. Carlos Valley	2494	76	44.7	32	30	22.5	1.09	61

*dimensions after Jaworski (1940).

Description. — Evolute, becoming progressively more evolute along with increasing diameter (Table 4). Whorl section initially broadly ovate to subquadrate with whorl sides flattened, becoming ovate later (Text-fig. 7).

Inner whorls ornamented with sharp-crested, biplicate and single, as well as some intercalatory ribs. The ratio of secondary/primary ribs increasing along with shell size. Ribs prorsiradiate on whorl sides, becoming rectiradiate near the ventral side; this bend of secondary ribs is especially well-displayed by the innermost whorls (Pl. 1, Fig. 1). All the ribs pass regularly through the venter. On the inner whorls the number of primary ribs gradually decreases along with increasing size (Text-fig. 5) from about 30—45 ribs per whorl at 30—40 mm diameter, to 28—40 (at the average about 35) at 40—50 mm diameter. Constrictions numerous, deep, commonly delineated by strong ribs.

Outer whorls display decline of sculpture. The process starts at 40—60 mm diameter (D_1 at Table 4); its first stage results in weakening and disappearance of ribs from the whorl surface except for the subumbilical area, whereas the second — in total disappearance of ribs except for those delineating constrictions. Finally, the constrictions and growth lines are the only elements of sculpture.

Remarks. — Such specific features as whorl section and ornamentation appear to be fairly uniform and easy to trace in all hitherto illustrated specimens. In turn, the number of primary ribs is highly variable, particularly in the case of innermost whorls, and the differences in number of ribs in particular specimens, are up to 15 per whorl. The holotype of *V. roigi* (cf. Sánchez Roig 1920, Pl. 12, Fig. 2;

refigured *in:* Sánchez Roig 1951, Pl. 15, Fig. 2) is one of less densicostate representatives of this species.

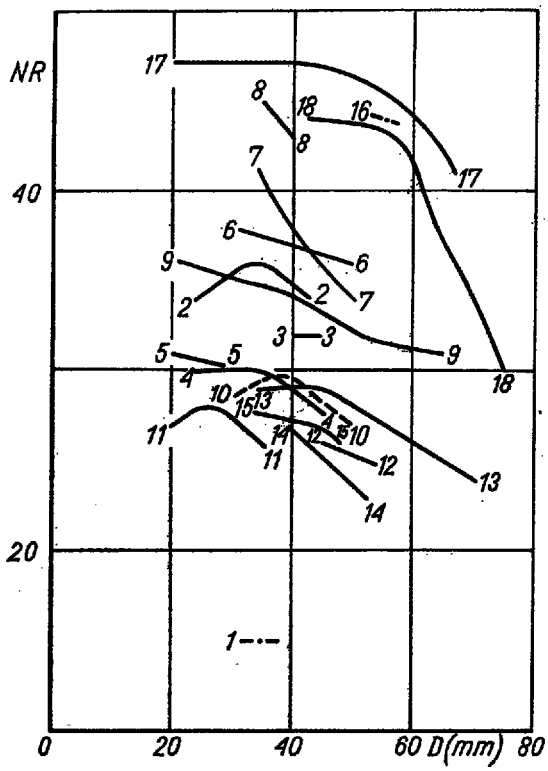

Fig. 5. Rib-curves of *V. roigi* group

Vinalesphinctes (Vinalesphinctes) roigi Spath: *1* holotype (number of ribs per half-whorl), *2* specimen No. HSA-1, *3* 2481, *4* 2483, *5* 2483, *6* 2496, *7* 2026, *8* 2494, *9* 2497;
V. (V.) imlayi (Sánchez Roig): *10* holotype (JF-97), *11* 2471, *12* 2448, *13* 2495, *14* 2462, *15* 2470;
V. (V.) sagrai Chudoley & Furrazola: *16* holotype (JF-98), *17* 2681, *18* 2683 (Rib-curves of holotypes are constructed after the illustrations presented by Sánchez Roig (1920, 1951) and Judoley & Furrazola-Bermúdez (1968)

The species *Vinalesphinctes (Vinalesphinctes) brodermanni* Sánchez Roig was interpreted as the junior synonym of *V. (V.) roigi* by Judoley & Furrazola-Bermúdez (1968). The holotype of the former (*cf.* Sánchez Roig 1951, Pl. 17, Figs 3—4) displays some weakening of ribbing at the venter, close to the end of outermost whorl preserved (at about 50 mm diameter), whereas the ribs from whorl sides remain strong. Such change of sculpture differs it from *V. roigi*, characterized by simultaneous decline of ribbing on the venter and whorl sides (except for subumbilical area). Therefore it seems that *V. brodermanni* S. R. is closer to *V. (Vinalesphinctes) subroigi* Chud. & Fur. (*cf.* description of the latter).

The species *Vinalesphinctes (V.) roigi* differs from the remaining species of the *V. roigi* group in whorl section (especially from *V. imlayi* (S. R.) and often in number of ribs (*cf.* Text-figs 5, 7). Rapid fading of primary ribs marked at the transition from inner to outer whorls differs *V. roigi* from all the species of the *V. niger* group.

Occurrence. — Sierra de los Organos, Jagua Fm. (Jagua Vieja Member) and Sierra del Rosario, Francisco Fm. In Sierra de los Organos all the specimens available were found at El Hoyo de la Sierra, El Hoyo de San Antonio, La Jutía and San Carlos Valley (near El Junco); other specimens illustrated previously from that region were derived from Puerta del Ancón and Jagua Vieja. The only specimen from Sierra del Rosario was found at Loma Calabrote.

Vinalesphinctes (Vinalesphinctes) imlayi (Sánchez Roig, 1951)
(Text-figs 5, 7; Pl. 1, Figs 4—6)

1951. *Decipia imlayi* Sánchez Roig; Sánchez Roig p. 84, Pl. 15, Figs 4—5 (holotype).
1956. *Perisphinctes (Pseudarisphinctes) imlayi* (Sánchez Roig); Arkell, p. 573.
1968. *Vinalesphinctes niger* Spath; Judoley & Furrazola-Bermúdez, pp. 104—105 (partim), Pl. 58, Fig. 2a—d (holotype).

Material. — Five specimens (No. 2446, 2470, 2471, 2492 and 2495).

Dimensions:

Table 5

Locality	Specimen No.	D (mm)	Ud (%)	Wh (%)	Wb (%)	b (mm)	h : b	D_1 (mm)
S. Carlos Valley	2482	50	42	34.8	34.8	16.5	1.0	44
S. Carlos Valley	2470	65	44.6	31.5	728	?18	?1.14	?ca 50
S. Carlos Valley	2471	46	44.6	33.7				
		62	44.3	31.5	34	21	.93	35
Sierra de Guane	2448	92	49	30	27	25	1.1	?ca 55
S. Carlos Valley	2495	101	50.5	30	26.4	27	1.11	?ca 65

Description. — Evolute, becoming progressively more evolute along with increasing size. Umbilical wall initially gently sloping, later steeper. Whorl section initially subcircular, later ovate (Text-fig. 7). The specimen No. 2470 displays some deformation of the last half of outer whorl preserved thus the value of whorl thickness may be somewhat underestimated here (Table 5).

Sculpture of inner whorls somewhat similar to that of *V. roigi*, differing in stronger and generally less numerous ribs. Number of primary ribs per whorl equals 25—30 at 30—40 mm diameter and 23—28 at 40—50 mm diameter (Text-fig. 5). Constrictions numerous, deep delineated by distinct ribs.

Weakening of sculpture takes place at the transition from inner to outer whorls; it starts at about 35 mm diameter but not later than about 65 mm diameter (D_1 at Table 5), initially involving ventral side where soon only ribs delineating constrictions remain. This is followed or accompanied by decline of ribs on whorl sides (except for subumbilical part). Subsequently the ornamentation, except for ribs delineating constrictions also disappears from the whole whorl surface. This stage starts at about 45 mm diameter but not later than 75 mm diameter. Shell is covered with growth lines.

Remarks. — The holotype of *"Decipia" imlayi* of Sánchez Roig (1951, Pl. 15, Figs 4—5) was refigured and allocated in the synonymy of *V. niger* Spath by Judoley & Furrazola-Bermúdez (1968, Pl. 58, Fig. 2a—d). This specimen undoubtedly belongs to the genus *Vinalesphinctes* but its affinity with the species *Vinalesphinctes (Vinalesphinctes) niger* is doubtful. The holotype of *"Decipia" imlayi*, a part of phragmocone about 50 mm in diameter, displays weakening of ribbing starting at about 40 mm diameter and especially effecting ventral part of whorls, whereas in *V. niger* such wekening of sculpture starts as a rule much later. One of the specimens available (Pl. 1, Fig. 4) well displays inner whorls identical with those of the holotype of *"Decipia" imlayi*. Moreover its outer whorl, lacking in the holotype, is completely smooth. Such change in ornamentation is never found in *V. niger*, in which, after the decline of sculpture on ventral side, the ribs persist on the whorl sides for a long time. Thus it may be stated that *"Decipia" imlayi* represents the separate species, *Vinalesphinctes (Vinalesphinctes) imlayi* (Sánchez Roig), somewhat similar to *V. niger* Spath but only in the case of the innermost whorls.

The species *Vinalesphinctes (V.) imlayi* belongs to the group *V. roigi*, differing from the remaining species of this group in generally smaller number of ribs per whorl and in whorl section (*cf.* Text-figs 5, 7).

Occurrence. — Sierra de los Organos, Jagua Fm. (Jagua Vieja Member). The analysed forms were found at San Carlos Valley (near El Junco) and at Sierra de Guane; the holotype was found at Laguna de Piedra.

Vinalesphinctes (Vinalesphinctes) sagrai Chudoley & Furrazola-Bermúdez, 1968 (Text-figs 5, 7; Pl. 1, Fig. 7)

1968. *Vinalesphinctes sagrai* Chudoley & Furrazola; Judoley & Furrazola-Bermúdez, pp. 107—108, Pl. 59, Fig. 1a—d (holotype).

Material. — Two specimens (No 2363 and 2681).

Dimensions:

Table 6

Locality	Specimen No.	D (mm)	Ud (%)	Wh (%)	Wb (%)	b (mm)	h : b	D_1 (mm)
	holotype (JF-98)*	100	49	28	24	24	1.17	
Loma Calabrote	2681	67	41.8	33.5	24.6	16.5	1.36	767
El Hoyo de la Sierra	2363	57	43.9	31.5	30.7	17.5	1.02	60

*dimensions after Judoley & Furrazola-Bermúdez (1968).

Description. — Evolute, becoming progressively more evolute along with increasing size (Table 6). Whorl section ovate, sometimes subrectangular; whorl sides flattened (Text-fig. 7).

Inner whorls ornamented with sharp-crested, biplicate and single ribs, as well as some intercalatories; the latter increase in number particularly at the transition from the inner to outer whorls where the ratio of secondary/primary ribs reaches its maximum value (about 3.4 at D_1 = 60—67 mm in the case of specimens studied by the present author). The number of primary ribs gradually decreases on inner whorls along with increasing size (Text-fig. 5), from about 44—47 at 20—50 mm diameter to about 40 at about 60 mm diameter, *i.e.* at the transition from the inner to outer whorls.

Outer whorls display gradual fading of sculpture. It primarily concerns secondary ribs, whereas primary ribs still continue to occur, being especially well-marked in subumbilical whorl part. The ribs become markedly more widely spaced, decreasing in number to about 30 per whorl (Text-fig. 5). Constrictions deep, wide, and delineated by distinct ribs.

The subsequent growth stage, displayed by the holotype, results in the decline of primary ribs and the ornamentation becomes limited to the constrictions and ribs delineating them.

Remarks. — The holotype of *V. (V.) sagrai*, being the largest known representative of this species, is insufficiently preserved for a detailed analysis of ornamentation of inner whorls, whereas the specimens studied by the present author (cf. Pl. 1, Fig. 7) are immature and may be compared primarily with inner whorls of the holotype. The inner whorls of the holotype and comparable whorls of the specimens studied however appear to show the same dense ribbing; moreover, fading of sculpture seems to start at similar diameter.

The species *Vinalesphinctes (V.) sagrai* is characterized by relatively rapid fading of sculpture on the outer whorls, which is typical of the *V. roigi* group. It differs however from the remaining species of this group in somewhat longer persisting of the primary ribs, which results in some similarity to *V. niger* group.

The species *Vinalesphinctes (V.) sagrai* differs from all the remaining species of this subgenus in markedly more densicostate inner whorls and a large difference in density of ribbing of the inner and early-outer whorls (*cf.* Text-fig. 5).

Occurrence. — Sierra de los Organos, Jagua Fm. (Jagua Vieja Member) and Sierra del Rosario, Francisco Fm. The holotype is derived from unknown locality in Sierra de los Organos; one of the author's specimens was found at El Hoyo de la Sierra (Sierra de los Organos) and another — at Loma Calabrote (Sierra del Rosario).

THE GROUP VINALESPHINCTES (VINALESPHINCTES) NIGER

Vinalesphinctes (Vinalesphinctes) niger Spath, 1931
(Text-figs 6, 7; Pl. 1, Fig. 8)

1920. *Perisphinctes* cf. *colubrinus* Reinecke; Sánchez Roig, pp. 19—20, Pl. 4, Fig. 1 (holotype).
1931. *Vinalesphinctes niger* Spath; Spath, p. 400.
1940. *Vinalesphinctes niger* Spath; Jaworski, pp. 127—128 (partim); non Pl. 6, Fig. 2a—d; non Pl. 7, Fig. 4a—b.
1951. *Vinalesphinctes niger* Spath; Sánchez Roig, pp. 84—85, Pl. 15, Fig. 3 (holotype); Pl. 16, Fig. 1.
1963. *Vinalesphinctes niger* Spath; Judoley & Furrazola-Bermúdez, pp. 104—105 (partim), Pl. 52, Fig. 1a—b; Pl. 53, Fig. 1a—b; Pl. 55; non Pl. 56, Fig. 2a—d.

Material. — One specimen (No. 2493).

Dimensions:

Table 7

Locality	Specimen No.	D (mm)	Ud (%)	Wh (%)	Wb (%)	b (mm)	h : b
Puerta del Ancón S. Carlos Valley	holotype*	56	ca 41.5	ca 30			
	2493	56	46.4	32	32	18	1.0
		75	52	28	29.3	22	0.95
		97	52	28			

*dimensions after Jaworski (1940).

Description. — Evolute, becoming progressively more evolute along with increasing size. Coiling of inner whorls fairly variable; Ud ranging from about 41.5% (in the case of the holotype — *cf.* Jaworski 1940, p. 127) to 46.4% at 56 mm diameter (Table 7). Whorl section initially subcircular, low-trapezoidal thereafter (Text-fig. 7). Whorl thickness initially equals whorl height, later as a rule larger. Umbilical wall moderately steep.

Inner whorls ornamented with single and biplicate as well as some intercalatory ribs; the ratio of secondary/primary ribs increasing along with shell size. Primary ribs initially sharp-crested, becoming progressively more coarse towards the outer whorls; ribs usually prorsiradiate on whorl sides, becoming somewhat rectiradiate near the ventral side and passing regularly across the venter.

Outer whorls display gradual fading of sculpture. First stage of this process involves ventral side, starting at about 60 mm diameter. Ornamentation of whorl sides continues for some time, consisting of primary ribs fairly strong and broad

close to the umbilicus and gradually fading away towards the venter. There is a distinct decrease in number of the ribs in comparison with the inner whorls (Text-fig. 6). This stage may be markedly prolonged as the ribs are still found at about

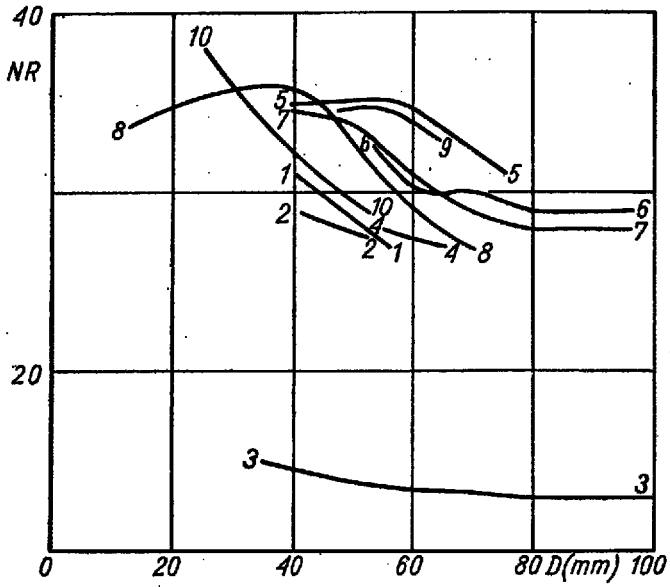

Fig. 6. Rib-curves of *V. niger* group

Vinalesphinctes (Vinalesphinctes) niger Spath: *1* holotype, *2* specimen No. JF-92 (cf. Judoley & Furrazola-Bermúdez, 1968, Pls 52—53), *3* 2493 (number of ribs per half-whorl), *4* (cf. Sánchez Roig, 1951, Pl. 16 Fig. 1);

V. (V.) subroigi Chudoley-Furrazola: *5* holotype (JF-96), *6* 2464, *7* 2492, *8* (= *V. niger* in Jaworski, 1940, Pl. 6, Fig. 2a—d);

V. (V.) brodermanni Sánchez Roig, *9* holotype;

V. (V.) cf. *parvicostatus* Chudoley & Furrazola; *10* 2504.

Rib-curves of holotypes and other specimens presented by Sánchez Roig (1920, 1951) and Judoley & Furrazola-Bermúdez (1968) are constructed after the illustrations

100 mm and 110 mm diameters in one of the specimens studied (Pl. 1, Fig. 8) and another from the collection of Judoley & Furrazola-Bermúdez (1968, Pl. 55), respectively. The second stage results in complete decline of ribs.

Constrictions, delineated by strong ribs, are found throughout the development. Two types of the constrictions may be distinguished: (1) narrow constrictions uniformly deep along the whole whorl side, (2) wider constrictions, becoming shallower towards the venter. The latter are immediately followed by distinct increase in whorl height. Both types are found in the same specimens (Pl. 1, Fig. 8; cf. also Sánchez Roig 1951, Pl. 16, Fig. 1).

Remarks. — The species *Vinalesphinctes (Vinalesphinctes) niger* markedly differs from the remaining species of this subgenus in low-trapezoidal section of outer whorls. Its inner whorls are somewhat close to those of *V. imlayi* (S. R.), but it differs from the latter in longer persisting of ribs. The specimens illustrated by Jaworski (1940, Pl. 6, Fig. 2a—d; Pl. 7, Fig. 4a—b) as *V. niger* (cf. also the synonymy in: Judoley & Furrazola-Bermúdez 1968) markedly differ from typical representatives of this species in more compressed whorls and presumably belong to *Vinalesphinctes (V.) subroigi* Chud. & Fur.

Occurrence. — Sierra de los Organos, Jagua Fm. (Jagua Vieja Member). The holotype is derived from Puerta del Ancón, and the specimen studied by the author — from San Carlos Valley, near El Junco.

Vinalesphinctes (Vinalesphinctes) subniger Chudoley & Furrazola-Bermúdez, 1968

1968. *Vinalesphinctes subniger* Chudoley & Furrazola; Judoley & Furrazola-Bermúdez, pp. 105—106, Pl. 56, Fig. 1a—b and Pl. 57, Fig. 1a—b (holotype).

Remarks. — This species is not encountered in the material studied. Its only representative, the holotype, appears close to *Vinalesphinctes niger*, differing in more densicostate inner whorls (about 37 ribs at 55 mm diameter) and high-trapezoidal whorl section. This form resembles *V. (V.) subroigi* Chud. & Fur. in density of ribbing of inner whorls, differing in somewhat earlier fading of sculpture. The latter feature makes *V. subniger* closer to the *V. roigi* group than any other species of *V. niger* group.

Occurrence. — Sierra de los Organos, Jagua Fm. (Jagua Vieja Member).

Vinalesphinctes (Vinalesphinctes) subroigi Chudoley & Furrazola-Bermúdez 1968 (Text-figs 6, 7; Pl. 1, Fig. 9)

1940. *Vinalesphinctes niger* Spath; Jaworski, pp. 127—128 (partim), Pl. 6, Fig. 2a—d; ?Pl. 7, Fig. 4a—b.
1968. *Vinalesphinctes subroigi* Chudoley & Furrazola; Judoley & Furrazola-Bermúdez, pp. 103—104; Pl. 58, Fig. 1a—b (holotype).

Material. — Two specimens (No. 2464 and 2492).

Dimensions:

Table 8

Locality	Specimen No.	D (mm)	Ud (%)	Wh (%)	Wb (%)	b (mm)	h : b
S. Carlos Valley	2492	63	47.6	30	26.2	16.5	1.12
		81	49.4	30	26	21	1.14
S. Carlos Valley	2464	72	48.6	30	25.7	18.5	1.16
		95	47.3	30.5	24.2	23	1.26
	holotype (JF-96)*	152	54	24	20	31	1.2

*dimensions after Judoley & Furrazola-Bermúdez (1968).

Description. — Evolute, becoming progressively more evolute along with increasing size. Whorl section initially low-ovate, becoming ovate later (Text-fig. 7). Whorl sides and venter flattened. Whorl thickness initially equals whorl height, becoming markedly smaller soon.

Inner whorls ornamented with biplicate, single and some intercalatory ribs. Primary ribs sharp-crested, becoming somewhat coarser towards the outer whorls; ribs prorsiradiate on whorl sides, becoming somewhat rectiradiate at the venter. All the ribs pass regularly across the venter.

Gradual fading of sculpture starts at the transition from inner to outer whorls; on the venter it starts relatively early, at 50—60 mm diameter, whereas ribbing long

persists on whorl sides. The primary ribs are here less numerous than on inner whorls as the number of ribs decreases from about 35 per whorl at 40 mm diameter, to about 27–30 per whorl at 80 mm diameter (Text-fig. 6). The specimens studied, about 100 mm in diameter, are ornamented with primary ribs to the end of their outer whorls preserved (Pl. 1, Fig. 9). In the holotype (Judoley & Furrazola-Bermúdez 1968, Pl. 58, Fig. 1a–b), being the largest representative of this species recorded so far, the primary ribs persist to 140 mm diameter. During the subsequent stage, the ribs fade away.

Constrictions numerous, delineated by ribs, deeper on inner whorls, shallower on outer whorls.

Remarks. — The species *Vinalesphinctes subroigi* is characterized by outer whorls ornamented with primary ribs for much longer time than in any other representative of the *Vinalesphinctes niger* group. This feature also differs *V. subroigi* from *V. roigi* Spath, displaying similar ornamentation of inner whorls. The species *Vinalesphinctes subroigi* differs from *V. niger* Spath in being somewhat more densicostate (*cf.* Text-fig. 6) and in whorl section; it is initially low-ovate and later ovate in the former, and almost circular and low-trapezoidal in the latter (*cf.* Text-fig. 7).

The specimens figured by Jaworski (1940, Pl. 6, Fig. 2a–d; and possibly that from Pl. 7, Fig. 4a–b), and described as *V. niger*, appear to be very close to *Vinalesphinctes subroigi*. Analysis of plaster cast of the largest of Jaworski's specimens, 70 mm in diameter, has shown that it is characterized by an ovate whorl section untypical for *V. niger* and by whorl height/thickness ratio equals 1.2 (Jaworski 1940, p. 127) i.e. nearly the same as in *V. subroigi*. Also the trend of rib curve appears closer to that of *V. subroigi* than that of *V. niger* (cf. Text-fig. 6).

A special attention should be paid to the relationship between *V. (V.) subroigi* and *V. (V.) brodermanni* S. R. An incomplete specimen, being the holotype of the latter (Sánchez Roig 1951, Pl. 17, Figs 3–4), was recently put in the synonymy of *V. roigi* by Judoley & Furrazola-Bermúdez (1968). As it was shown in the description of *V. roigi*, the holotype of *V. brodermanni* differs from *V. roigi* in weakening of sculpture limited only to the ventral side at the end of its whorls preserved. This feature indicates the affinity of *V. brodermanni* rather to the *V. niger* group, whereas the trend of rib curve and whorl section indicate its affinity to *V. subroigi*. At lack of adequate comparative material it may be only supposed that the name *V. subroigi* is the junior synonym of the name *V. brodermanni*.

Occurrence. — Sierra de los Organos, Jagua Fm. (Jagua Vieja Member). The specimens from the author's collection are derived from San Carlos Valley, near El Junco. The type locality is unknown. The specimens of Jaworski (1940) are derived from Puerta del Ancón and from the Guane area. The holotype of the species *V. brodermanni* was found at Puerta del Ancón.

Vinalesphinctes (Vinalesphinctes) parvicostatus Chudoley & Furrazola-Bermúdez, 1968 (Text-fig. 6, 7; Pl. 2, Fig. 1)

1968. *Vinalesphinctes parvicostatus* Chudoley & Furrazola; Judoley & Furrazola-Bermúdez, pp. 106–107, Pl. 60, Fig. 1a–c and Pl. 61, Fig. 1 (holotype); Pl. 62.

Material. — One specimen (No. 2504) assigned here with reservation.

Remarks. — The species *Vinalesphinctes parvicostatus* is up to the present represented by two large specimens, one of which displays peristome of the macroconch type (*cf.* Judoley & Furrazola-Bermúdez, 1968, Pl. 62). The two specimens

display development of sculpture typical of the subgenus *Vinalesphinctes*. Inner whorls, as far as visible, are covered with strong, sharp-crested ribs, some of which are surely biplicate; subsequently, the primary ribs become coarser and less numerous, decreasing in number to about 20 per whorl. Ornamentation gradually disappears on the outer whorls; in the first stage the ribs fade only at the venter, and this indicates the affinity of this species with the *V. (V.) niger* group. The later stage results in decline of ribs from whorl sides. Constrictions wide, numerous.

The specimen studied by the author (*cf.* Pl. 2, Fig. 1) is referred to as *Vinalesphinctes* cf. *parvicostatus*. It is immature, 52 mm in diameter, and represents phragmocone with a small portion of body chamber; sutures are not approximated. The specimen is evolute (Ud = 44% and Wh = 33% at D = 50 mm) and its whorl section rounded (Text-fig. 7). Innermost whorls are covered with numerous ribs; subsequent whorl displays decrease in number of primary ribs, to 30 at 50 mm diameter (Text-fig. 6); this is accompanied by an increase in number of secondary ribs and in the secondaries/primaries ratio up to 3.8. This specimen resembles closely inner whorls of *Vinalesphinctes parvicostatus* in whorl section and trend of rib curve and presumably in the ratio of secondary/primary ribs. The two representatives of the species (*cf.* Judoley & Furrazola-Bermúdez 1968) have inner whorls insufficiently preserved for determining the ratio of secondary/primary ribs but, taking into account the rapid decrease in number of the primaries with increasing diameter, it may be assumed that this ratio is rather high as in the specimen under study.

The species *Vinalesphinctes (V.) parvicostatus* differs from the remaining species of this subgenus in a small number of primary ribs on all the whorls but the innermost ones, as well as in subcircular whorl section.

Occurrence. — Sierra de los Organos, Jagua Fm. (Jagua Vieja Member). The two specimens figured by Judoley & Furrazola-Bermúdez (1968) were derived from unnamed locality. The specimen here identified as *V.* cf. *parvicostatus* was found in Francisco Fm., at Brujito, Sierra del Rosario.

Vinalesphinctes (Vinalesphinctes) sp. n.
(Pl. 2, Fig. 2)

Material. — One specimen (No. 2500) strongly deformed and with poorly preserved inner whorls.

Description. — Relatively large size (about 160 mm in diameter) and approximated sutures, indicate that the form is fully grown. Peristome not preserved. Body chamber about a whorl long.

Coiling strongly evolute. The deformation precludes any more accurate measurements but the width of umbilicus may be estimated at over 50% of diameter in the case of outer whorls. Whorl section ovate, becoming high-ovate later; whorl sides flattened. The ratio of whorl height/thickness equals about 1.4 at about 140 mm diameter.

Inner whorls, ornamented with densely spaced ribs about 50 per whorl at 60 mm diameter; point of branching high, obscured by subsequent whorl. Ventral side, observable at 70 mm diameter, displaying biplicate and intercalatory ribs; the ratio of secondary/primary ribs equalling 2.6 here. The venter becoming smooth at the transition from the inner to outer whorls, at the diameter of 75–80 mm, whereas whorl sides are ornamented with strong primary ribs, about 40 per whorl and observable up to the diameter of 150 mm. Constrictions numerous, deeply incised and delineated by strong ribs. Close to the end of outermost whorl, at 150 mm

diameter, ribbing fades away and the ornamentation comprises only the constrictions. The constrictions are followed by distinct increase in whorl height and thickness.

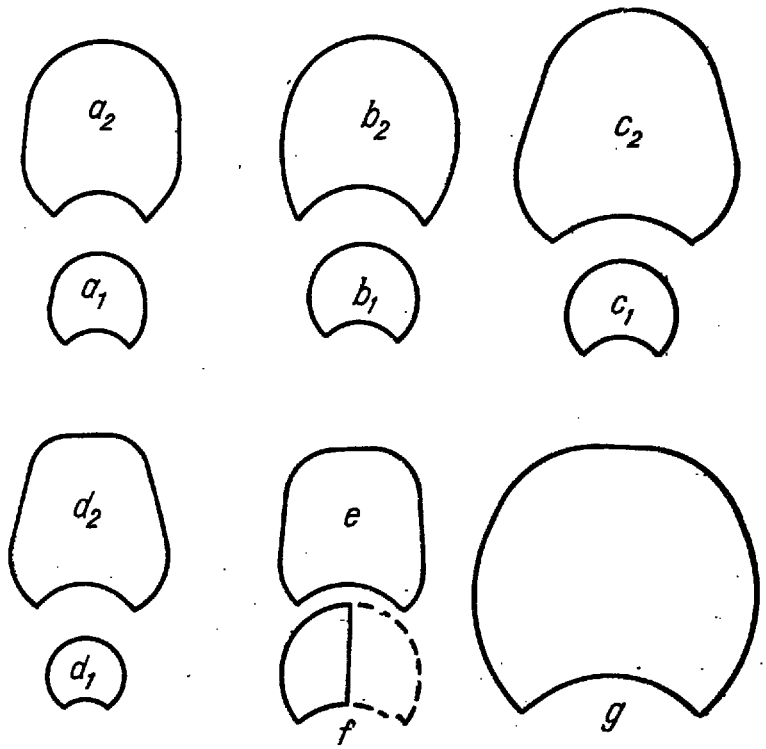

Fig. 7. Whorl sections in the subgenera *Vinalesphinctes* and *Subvinalesphinctes*
a — *Vinalesphinctes (Vinalesphinctes) roigi* Spath, a_1 specimen No. 2481 at D = 80 mm, a_2 2494 at D = 65 mm; b — *V. (V.) tmlayi* (Sánchez Roig), b_1 2471 at D = 55 mm, b_2 2498 at D = 80 mm; c — *V. (V.) niger* Spath, c_1 2493 at D = 40 mm, c_2 at D = 100 mm; d — *V. (V.) subroigi* Chudoley & Furrazola, d_1 2464 at D = 30 mm, d_2 2492 at D = 80 mm; e — *V. (V.) sagrai* Chudoley & Furrazola, 2383 at D = 65 mm; f — *V. (V.) cf. parvicostatus* Chudoley & Furrazola, 2504 at D = 50 mm; g — *V. (Subvinalesphinctes) corrali* (Chudoley & Furrazola), 2016b at D = c. 140 mm

Remarks. — This specimen displays ornamentation typical of the *V. niger* group. However, it differs from all the species of this group in higher number of primary ribs per whorl. It appears to be similarly densicostate on inner whorls as *V. sagrai* Chud. & Fur. of the *V. roigi* group, from which it differs in markedly longer persisting of sculpture.

It follows that this specimen may represent a new species of the subgenus *Vinalesphinctes*. However, its preservation is insufficient for such formal proposition.

Occurrence. — Sierra de los Organos, Jagua Fm. (Jagua Vieja Member); the specimen is derived from San Carlos Valley, near El Junco.

Vinalesphinctes (Vinalesphinctes) spp.

The material studied comprises several fragments of undoubtful representatives of the subgenus *Vinalesphinctes*, but insufficient for specific identification. Such forms were

found in several localities in Sierra de los Organos — in the material derived from the Jagua Formation (Jagua Vieja Member and its basal part, transitional to the Zacarías Member, at La Jutía), as well as in Sierra del Rosario (Francisco Fm., exposed at Brujito).

Subgenus *SUBVINALESPHINCTES* subgen. n. (Type species: *Perisphinctes corrali* Chudoley & Furrazola-Bermúdez, 1968)

Derivation of the name: from the similarity to the subgenus *Vinalesphinctes*.

Diagnosis. — Macroconchs up to 300 mm in diameter. Peristome unknown. Body chamber presumably about a whorl long. Coiling moderately evolute; whorl section trapezoidal, ovate, sometimes laterally flattened or subrectangular. Ornamentation of inner whorls still poorly known; consisting of strong, usually bi- and triplicate ribs passing across the venter; point of branching high. Outer whorls characterized by some weakening and subsequently sometimes complete decline of sculpture on the venter, whereas the ribs on their sides are strong. On the outer whorls the ribs become initially more or less distant; subsequently, close to the end of the whorls the ribs become sometimes approximated (Text-fig. 8). Constrictions fairly numerous, usually deep, delineated by strong ribs, becoming sometimes shallower and less distinct on outer whorls.

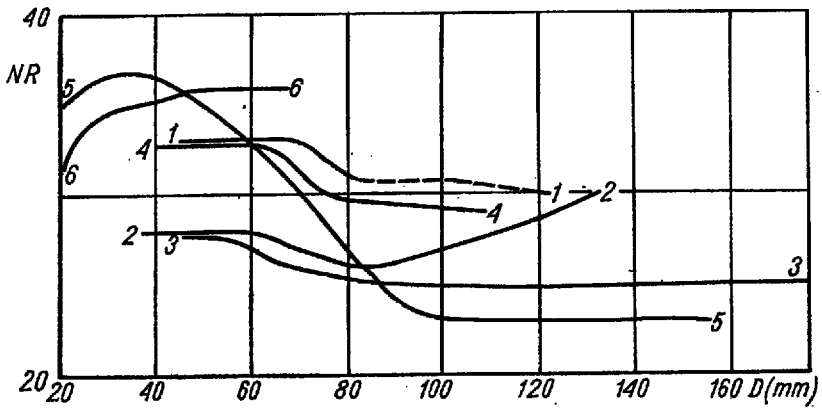

Fig. 8. Rib-curves of the subgenus *Subvinalesphinctes*

Vinalesphinctes (Subvinalesphinctes) corrali (Chudoley & Furrazola): 1 holotype (JF-80), 2 specimen No. 2016b;

V. (S.) bermudezi (Chudoley & Furrazola): 3 holotype (JF-44),

V. (S.) grossicostatus (Sánchez Roig): 4 holotype (JF-102),

V. (S.) cf. grossicostatus (Sánchez Roig): 5 JF-91 (= *Decipia* aff. *lintonensis* in Judoley & Furrazola-Bermúdez, 1968, Pls 49 and 51).

For comparison: 6 — *Vinalesphinctes* (?*Subvinalesphinctes*) *gottschei* (Stein.), holotype (= = *Perisphinctes gottschei* in Steinmann 1881, Pl. 9, Figs 2 and 2a—b), rib-curve constructed after the illustration

Remarks. — The representatives of the subgenera *Subvinalesphinctes* and *Vinalesphinctes* have several features in common: highly evolute coiling, ornamentation of inner and, in part, outer whorls (especially in the case of *Subvinalesphinctes* and the *Vinalesphinctes niger* group), similar trend of rib curve, and the character of constrictions. Both subgenera are also characterized by decline of sculpture on the venter of outer whorls; however, *Subvinalesphinctes* differs from *Vinalesphinctes* in ribs persisting on the whorl sides whereas in the latter the ribbing fades away sooner or later (in the *V. roigi* and *V. niger* groups, respectively).

Some ammonites placed in *Subvinalesphinctes* subgen. n. were previously assigned to various subgenera of *Perisphinctes* without sufficient evidence. The above characteristics gives evidence of their close affinity to the subgenus *Vinalesphinctes*, and thus to the genus *Vinalesphinctes*. Moreover, some microconchs of the subgenus

Roigites i.e. the *Vinalesphinctes (Roigites) catalinensis* group and/or some affined forms seem to be dimorphic counterparts of *Subvinalesphinctes*.

A special attention should be paid to generic and subgeneric status of two South-American (Chilean) species: *"Perisphinctes" gottschei* Stein. (*cf.* Steinmann 1881, pp. 273—274, Pl. 9, Figs 2, 2a—b) and very close to it *"Perisphinctes" desertorum* Stehn (*cf* Stehn 1923, pp. 129—131, Pl. 5, Fig. 3, Text-fig. 19). Both these species were based on single, incomplete specimens about 70 mm and 80 mm in diameter, respectively, and displaying ornamentation similar to that of inner whorls of the genus *Vinalesphinctes* (cf. also Text-fig. 8). Professor A. von Hillebrandt kindly informed the present author about the other Chilean specimen of *"Perisphinctes" gottschei*, represented in his collection. This form measuring about 200 mm in diameter represents a phragmocone with its outer whorls ornamented with strong, primary ribs. These two species were recently allocated (Hillebrandt 1970) in the genus *Decipia* with reservation. However, it seems more probable that they represent the genus *Vinalesphinctes*, possibly, subgenus *Subvinalesphinctes*.

Occurrence. — Oxfordian, western Cuba, Sierra de los Organos (Jagua Fm.), ? Sierra del Rosario (Francisco Fm.), ?northern Chile, Caracoles area and Cordillera Domeyko (uppermost La Manga Fm. and its transition to younger gypsum deposits of the Auquilco Fm. *cf.* Hillebrandt 1970; for details concerning the names of the formations *cf.* Stipanicic 1966).

Species assigned to the subgenus: *Vinalesphinctes (Subvinalesphinctes) corrali* (Chudoley & Furrazola-Bermúdez), *V. (S.) bermudezi* (Chudoley & Furrazola-Bermúdez), *V. (S.) grossicostatus* (Sánchez Roig), and possibly *V. (?Subvinalesphinctes) gottschei* (Steinmann) and *V. (?S.) desertorum* (Stehn).

Vinalesphinctes (Subvinalesphinctes) corrali (Chudoley & Furrazola-Bermúdez, 1968) (Text-figs 7, 8; Pl. 2, Fig. 3)

1968. *Perisphinctes (Ampthillia?) corrali* Chudoley & Furrazola; Judoley & Furrazola-Bermúdez, pp. 95—96, Pl. 41, Fig. 1a—b and Pl. 42, Fig. 1a—b (holotype).

Material. — One specimen (No. 2016b).

Dimensions:

Table 9

Locality	Specimen No.	D (mm)	Ud (%)	Wh (%)	Wb (%)	b (mm)	h : b
La Jutía	holotype (JF-80)*	185	59	24	24	45	1.0
		123	55.3		30	37	
	2016b	130	55.4	27	30.7	40	0.88
		104	55.3	27.4			

*dimensions partly after Judoley & Furrazola-Bermúdez (1968).

Description. — Markedly evolute (Table 9), whorl section almost low-trapezoidal with rounded umbilical wall (Text-fig. 7), thickest at one-third of whorl height. Venter wide, somewhat flattened.

Primary ribs thick, markedly elevated, almost radial or slightly prorsiradiate, dividing into 2 or 3 secondaries at the ventral side; secondary ribs strongly marked on inner whorls, become weaker and tend to fade on outer whorls. This trend is noticeable already at 70—80 mm diameter. Number of primary ribs changes insignificantly along with shell size; some maxima coincide with inner whorls and close

to the end of outer whorls (Text-fig. 8). Constrictions well-marked, fairly numerous, delineated by thick ribs passing across the venter without weakening.

Remarks. — Judoley & Furrazola-Bermúdez (1968) assigned this species to the subgenus *Ampthillia* Arkell, 1947, of the genus *Perisphinctes* with reservation. However, it differs from the representatives of the subgenus in some features including trend of rib curve, style of ornamentation of inner whorls, numerous well-marked constrictions, etc. and it cannot be allocated in that or in any other subgenus of *Perisphinctes*. This species similarly as some others described below, displays several features in common with the representatives of the genus *Vinalesphinctes* and is allocated in *Subvinalesphinctes* subgen n.

The species *Vinalesphinctes (Subvinalesphinctes) corrali* differs from *V. (S.) bermudezi* (Chud. & Fur.) primarily in whorl section; *V. (S.) grossicostatus* (S. R.) is presumably characterized by broad ribs composed of riblet sets on the outer whorls, never found in *V. (S.) corrali*, and has somewhat different whorl section.

Occurrence. — Sierra de los Organos, Jagua Fm. (Jagua Vieja Member). The holotype is derived from unknown locality; other specimen (No. 2016b) was found at La Jutía, in the basal part of the Jagua Vieja Member, at the transition to the Zacarías Member.

Vinalesphinctes (Subvinalesphinctes) bermudezi (Chudoley & Furrazola-Bermúdez, 1968) (Text-fig. 8)

1968. *"Perisphinctes" bermudezi* Chudoley & Furrazola; Judoley & Furrazola-Bermúdez, pp. 75—76, Pl. 14 (holotype).

Description. — The only representative of this species, the holotype (No. JF--44), is about 300 mm in diameter. Coiling is markedly evolute (Ud = 55% and Wh = 24% at D = 290 mm). Inner whorls (at D = 120 mm) subrectangular in cross--section, markedly higher than wide; outer whorls ovate, with somewhat convex sides. Primary ribs thick, markedly protruding, somewhat prorsiradiate, dividing into 2 or 3 secondaries at ventral side of inner whorls; secondary ribs weaken and finally fade on the outer whorls. Number of primary ribs per whorl changes insignificantly along with shell size; certain maximum coincides with the inner whorls (Text-fig. 8). Constrictions well-marked on inner whorls.

Occurrence. — Sierra de los Organos, Jagua Fm. (Jagua Vieja Member); the holotype was derived from El Hoyo de la Sierra.

Vinalesphinctes (Subvinalesphinctes) grossicostatus (Sánchez Roig, 1951) (Text-fig. 8)

1951. *Perisphinctes (Arisphinctes) grossicostatum* Sánchez Roig; Sánchez Roig, pp. 74—75, Pl. 17, Figs 1—2 (holotype).
1956. *Vinalesphinctes grossicostatum* (Sánchez Roig); Arkell, p. 573.
1968. *Vinalesphinctes ? grossicostatum* (Sánchez Roig); Judoley & Furrazola-Bermúdez, pp. 108—109, Pl. 63, Fig. 1a—d (holotype).
?1968. *Decipia aff. lintonensis* Arkell; Judoley & Furrazola-Bermúdez, pp. 101—102, Pl. 49, Fig. 1a—b; Pl. 51, Fig. 1a—b; non Pl. 50.

Description and remarks. — The holotype (No. JF-102), 112 mm in size, represents phragmocone (93 mm in diameter) and body chamber a half of whorl long. Other representatives of the genus *Vinalesphinctes* have body chambers about a whorl long, thus it may be stated that the holotype is incomplete and that it origi-

nally measured about 140 mm in diameter. The holotype is markedly evolute (Ud = = 57.8% and Wh = 25.3% at D = 103.6 mm, according to Judoley & Furrazola-Bermúdez, 1968), with low-ovate whorl section and whorls equally high and wide, flattened on sides and broadly rounded at the venter. Primary ribs thick, strong, prorsiradiate, modified close to the end of outer whorl preserved into riblet sets. Primary ribs usually divide into 2 or 3 secondaries at ventral side; the secondary ribs are initially fairly strong and later, from a diameter of about 70 mm, gradually fade away. Number of primary ribs changes along with shell size; some crowding of ribs is found on inner whorls (Text-fig. 8). Constrictions rather deeply incised and delineated by strong ribs passing across the venter without weakening.

The species *V. (S.) grossicostatus* may also comprise a large specimen, about 180 mm in diameter, described as *Decipia* aff. *lintonensis* by Judoley & Furrazola-Bermúdez (1968). It is markedly evolute (according to these authors Ud = 55% and Wh = 26% at D = 163 mm) and resembles on its inner whorls the holotype of *V. (S.) grossicostatus* in the style of ornamentation (*cf* Text-fig. 8). Its outer whorls are ornamented with broad ribs usually composed of closely spaced or overgrown riblet sets, whereas ventral side is smooth. Ribbing of such type is comparable to that developed at the outermost preserved part of the holotype of *V. (V.) grossicostatus*.

Occurrence. — Sierra de los Organos, Jagua Fm. (Jagua Vieja Member), the holotype was derived from Jagua Vieja area.

Subgenus *ROIGITES* subgen. n.
(Type species: *Prososphinctes subconsociatus* Spath, 1931)

Derivation of the name: in honour of Dr. Mario Sánchez Roig, the student of Upper Jurassic faunas of Cuba.

Diagnosis. — Microconchs up to 75 mm in diameter; aperture with a small lappets preceded by final constriction. Body chamber 3/4 to almost a whorl long. Coiling evolute to markedly evolute; whorl section ovate (Text-fig. 9). Inner whorls ornamented with sharp-crested, biplicate and single as well as some intercalatory ribs; point of furcation high; ribs prorsiradiate on whorl sides, becoming rectiradiate at the point of furcation or somewhat above. All ribs passing across the venter without weakening. On the outermost whorl primary ribs become initially more widely spaced and intercalatories increase in number; subsequently the ribs become approximated near the peristome (Text-fig. 10*A-B*).

As the result of differences in sculpture development on the outermost whorl, two groups of species may be distinguished: the *V. (Roigites) subconsociatus* and *V. (R.) catalinensis* groups. The former is characterized by point of furcation initially shifted down to the mid-height, as well as by fading of primary ribs, especially at the point of furcation, whereas the ribbing remains unaffected at the venter; this is followed by the appearance of ribs on the whole whorl surface; these ribs are often stripe-like, composed of riblet-sets. The second group is characterized by a slight downward shift of the point of furcation (to about two-thirds of whorl height) and by persisting of sculpture. Constrictions common in both groups throughout the development, increasing in number close to the aperture where they are often accompanied by a marked increase in whorl width and height.

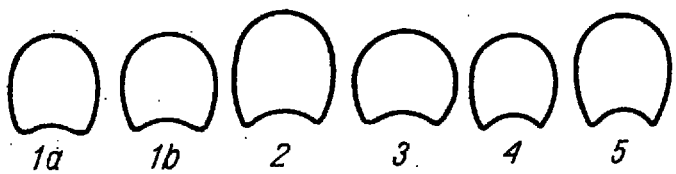

Fig. 9. Whorl sections in the subgenus *Roigites*

1 — *Vinalesphinctes (Roigites) subconsociatus* (Spath), *1a specimen* No. 2490, *1b* 2398, both sections at D = c. 40 mm; *2* — *V. (R.)* aff. *subconsociatus* (Spath), *2449*, at D = c. 50 mm; *3* — *V. (R.) catalinensis* (Sánchez Roig), 2387, at D = 45 mm; *4* — *V. (R.) rosariensis* sp. n., holotype (2671), at D = 40 mm; *5* — *V. (R.) simplicior* sp. n., holotype (2499), at D = c. 50 mm

Remarks. — The species *Vinalesphinctes (Roigites) subconsociatus* (Spath) being the type of the subgenus *Roigites* subgen n., was originally described by Spath (1931) under the generic name *Prososphinctes*. However, this author stressed its affinity with *Vinalesphinctes*. Any affinity of this form with *Prososphinctes* was questioned by Arkell (1956, p. 573), according to whom it should be placed in a new subgenus, presumably within the genus *Vinalesphinctes*. The subgenus *Roigites* proposed herein, comprises microconchs being dimorphic counterparts of the subgenus *Vinalesphinctes* and possibly *Subvinalesphinctes* subgen. n.

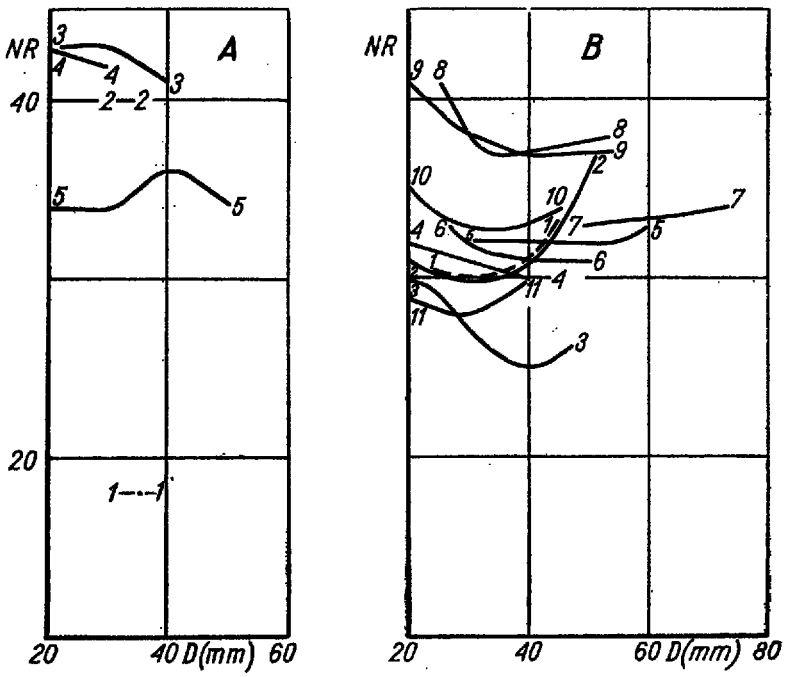

Fig. 10. Rib-curves of the subgenus *Roigites:* A — for *V. (R.) subconsociatus* group, and B — for *V. (R.) catalinensis* group

A: *Vinalesphinctes (Roigites) subconsociatus* (Spath), *1* holotype (number of ribs per half of whorl, rib-curve constructed after the original illustration), *2* specimen No. 2487 b, *3* 2398, *4* 2490; *V. (R.) aff. subconsociatus* (Spath), *5* 2449

B: *Vinalesphinctes (Roigites) catalinensis* (Sánchez Roig), *1* holotype (JF-75, rib-curve constructed after the illustration), *2* 2387; *V. (R.) rosariensis* sp. n., *3* holotype (2671), *4* paratype (2485), *5* paratype (2465a), *6* paratype (2465b), *7* paratype (2512); *V. (R.) simplicior* sp. n., *8* holotype (2499), *9* paratype (2515b), *10* paratype (2505); *V. (R.) aff. catalinensis* (Sánchez Roig), *11* 2020.

Occurrence. — Oxfordian, western Cuba, Sierra de los Organos (Jagua Fm.), Sierra del Rosario (Francisco Fm.).

Species assigned to this subgenus: the *V. (Roigites) subconsociatus* group — only *V. (R.) subconsociatus* (Spath); the *V. (R.) catalinensis* group — *V. (R.) catalinensis* (Sánchez Roig), *V. (R.) rosariensis* sp. n., *V (R.) simplicior* sp. n.

THE GROUP *VINALESPHINCTES (ROIGITES) SUBCONSOCIATUS*

Vinalesphinctes (Roigites) subconsociatus (Spath, 1931)
(Text-figs 9, 10A; Pl. 2, Figs 5—6)

1920. *Perisphinctes* sp.; Sánchez Roig, p. 23, Pl. 7, Figs 3, 3a (holotype).
1931. *Prososphinctes subconsociatus* Spath; Spath, p. 400.
?1940. ?*Vinalesphinctes* n. sp. indet; Jaworski, pp. 128—129, Pl. 7, Fig. 5a—b.
1951. *Perisphinctes (Prososphinctes) subconsociatus* Spath; Sánchez Roig, pp. 83—84, Pl. 16, Fig. 2 (holotype).
1956. ?*Vinalesphinctes* (Subgen. nov.) *subconsociatus* Spath; Arkell, p. 573.

Material. — Three specimens (No. 2398, 2487b, 2490).

Dimensions:

Table 10

Locality	Specimen No.	D (mm)	Ud (%)	Wh (%)	Wb (%)	b (mm)	h : b	D_1 (mm)
Puerta del Anoón	holotype*	57.5	40	34.8	32.2	18.5	1.08	
El Hoyo de la Sierra	2398	44	45.4	33	30.7	13.5	1.07	40
S. Carlos Valley	2487b	40	40	36.2	32.5	13	1.11	ca30
S. Carlos Valley	2490	38	43.4	34.2	31.6	12	1.08	30

*dimensions after Sánchez Roig (1951).

Description. — Form relatively small, up to about 60 mm in diameter. Aperture unknown. Body chamber about a whorl long or shorter, but not less than a half of whorl. Coiling evolute; whorl section ovate, whorl sides flattened (Text-fig. 9). Umbilical wall moderately steep.

Inner whorls ornamented with numerous, sharp-crested, biplicate and single as well as few intercalatory ribs; ribs prorsiradiate on whorl sides, becoming somewhat rectiradiate at the point of furcation. Point of furcation initially high, is lowered to about a mid-height on the outermost whorl; this is accompanied by a decrease in number of primary ribs (Text-fig. 10*A*) and increase in number of secondaries, some of which display a trend to join the former ones. The ribs fade gradually on the whorl sides and especially at the point of furcation, whereas the ribbing remains strong on the venter. Constrictions become numerous, deep and delineated with strong ribs. This change in ornamentation is observed at diameters D_1 = 30—40 mm in the specimens studied (Table 10). Close to the end of the outermost whorl the ornamentation is modified once more — there appear numerous, stripe-like ribs composed of riblet-sets, which are narrow and feeble on the whorl side, becoming markedly wider and stronger towards the venter. This is accompanied by an increase in number of constrictions and related increase in whorl height and width.

Remarks. — The fragmentary specimen described as ?*Vinalesphinctes* n. sp. indet. by Jaworski (1940, Pl. 7, Fig. 5a—b), resembles *V. (Roigites) subconsociatus* (Spath) and it presumably belongs to that species.

All the specimens of *V. (Roigites) subconsociatus* are presumably fully or almost fully grown but none of them has a peristome preserved. A closely related form, *V. (Roigites)* aff. *subconsociatus* (cf. below), is a complete microconch with lappets. Therefore it may be assumed that the representatives of the former species are also microconchs.

Occurrence. — Sierra de los Organos, Jagua Fm. (Jagua Vieja Member). The holotype, as well as Jaworski's (1940) specimen were derived from Puerta del Ancón. The specimens studied by the author were found at San Carlos Valley (near El Junco) and El Hoyo de la Sierra.

Vinalesphinctes (Roigites) aff. *subconsociatus* (Spath, 1931)
(Text-figs 9, 10A; Pl. 2, Fig. 7)

Material. — One specimen (No. 2449).

Description. — A single fully grown form, 60 mm in diameter; aperture with lappets; body chamber almost a whorl long. Coiling markedly evolute, whorl section ovate (Text-fig. 9), whorl sides flattened. Dimensions at 52 mm diameter: Ud = 49%, Wh = 30.8%, Wb = 26%, b = 13.5 mm, h : b = 1.18.

Inner whorls ornamented as in *V. (R.) subconsociatus* (cf. also Text-fig. 10*A*). The same type of ribbing is visible over a large part of the outermost whorl; however, there is reflected a trend to gradual lowering of the point of furcation. At the end of that whorl (at 52 mm diameter) fading of primary ribs may be noted, whereas strong ribbing is retained at the venter (similarly as in *V. subconsociatus*); subsequently, close to the aperture, there appear markedly prorsiradiate, biplicate and single ribs, strongly marked on the whole whorl surface.

Constrictions rather not numerous on inner whorls, increasing in number towards the end of the outermost whorl, where they are accompanied by a distinct increase in whorl height. The last constriction is followed by a small rounded lappet situated somewhat above the mid-height.

Remarks. — This specimen appears to be close to *V. (Roigites) subconsociatus*, differing in more evolute coiling and more compressed whorls. Moreover, the ornamentation of its subperistomal part consists of uniform relatively strong ribs whereas that of the latter — of stripe-like, less distinct ribs.

Occurrence. — Sierra de los Organos, Jagua Fm. (Jagua Vieja Member), the Sierra de Guane area.

THE GROUP *VINALESPHINCTES (ROIGITES) CATALINENSIS*

Vinalesphinctes (Roigites) catalinensis (Sánchez Roig, 1951)
(Text-figs 9, 10B; Pl. 3, Figs 1—2)

1951. *Berriasella catalinensis* Sánchez Roig; Sánchez Roig, p. 90, Pl. 22, Figs 3—4 (holotype).
1968. *Perisphinctes (Dichotomosphinctes) plicatiloides* O'Connell; Judoley & Furrazola-Bermúdez, pp. 92—93 (partim), Pl. 29, Fig. 3 (holotype).

Material. — One specimen representing this species (No. 2387) and another (No. 2020) identified as *V. aff. catalinensis.*

Dimensions:

Table 11

Locality	Specimen No.	D (mm)	Ud (%)	Wh (%)	Wb (%)	b (mm)	h : b
Vinalesphinctes catalinensis							
La Catalina	holotype (JF-75)*	45.3	51.2	25.8	25.4	11.5	1.01
El Hoyo de la Sierra	2387	52	50	29	29	15	1.0
		42	50	30	31	13	0.97
Vinalesphinctes aff. catalinensis							
La Jutía	2020	38	43.4	31.6	31.6	12	1.0

*dimensions after Judoley & Furrazola-Bermúdez (1968).

Description. — The holotype and the specimen under study (Pl. 3, Fig. 1) are small, about 45 mm and 53 mm in diameter and have aperture with lappets. Body chamber of the latter specimen is about 3/4 of whorl long. Coiling markedly evolute, whorl section low-ovate, whorl sides somewhat flattened (Text-fig. 9).

Inner whorls ornamented with sharp-created, strong primary ribs, prorsiradiate on whorl sides, about 30 per whorl at 20—30 mm diameter (Text-fig. 10*B*). On the outermost whorl the ribs are markedly prorsiradiate, branching at ventral side into 2 secondaries; the secondary ribs become somewhat rectiradiate at the point of furcation. There is some crowding of ribs and the point of furcation is slightly lower close to the aperture.

Constrictions relatively numerous throughout the development, well-marked, delineated by strong ribs and accompanied by a marked increase in whorl height and width at the outermost whorl. Small rounded lappets are developed in the mid--height or just above, and preceded by final constriction.

A specimen displaying highly similar ornamentation and differing from typical representatives of this species primarily in less evolute coiling (*cf.* Table 11) is here referred to as *V.* aff. *catalinensis* (Pl. 3, Fig. 2).

Remarks. — The holotype of the species was recently refigured and redescribed under the name *Perisphinctes plicatiloides* O'Connell by Judoley & Furrazola--Bermúdez (1968, Pl. 39, Fig. 3). However, this specimen markedly differs from *Perisphinctes plicatiloides* in being less densicostate on inner whorls, and in the lack of strong twist of ribs on umbilical wall, as well as a characteristic sets of two single ribs following the constrictions. On the other hand, *"Beriasella" catalinensis* and other related species described below are microconchs markedly resembling inner whorls of subgenus *Vinalesphinctes,* which justifies their allocation in the genus *Vinalesphinctes* and subgenus *Roigites.*

The species *Vinalesphinctes (Roigites) catalinensis* (Sánchez Roig) differs from *V. (R.) rosariensis* sp. n. primarily in whorl section (*cf.* Text-fig. 9), and from *V. (R.) simplicior* sp. n. in whorl section (*cf.* Text-fig. 9) and in less densicostate ribbing (*cf.* Text-fig. 10*B*), as well as in more evolute coiling (*cf.* Tables 11 and 13), provided that the form *V.* aff. *catalinensis* is not taken into account here. Moreover, it and other related species differ from the representatives of *V. (R.) subconsociatus* group in the primary ribs not fading on the outermost whorl.

Occurrence. — Sierra de los Organos, Jagua Fm. (Jagua Vieja Member), El Hoyo de la Sierra area. The holotype was found near La Catalina in Sierra del Rosario, presumably in the Francisco Formation. The specimen described as *V.* aff. *catalinensis* was found in the Jagua Formation, in the basal part of the Jagua Vieja Member at the transition to the Zacarías Member, La Jutía section, Sierra de los Organos.

Vinalesphinctes (Roigites) rosariensis sp. n.
(Text-figs 9, 10B; Pl. 3, Figs 3—5)

Holotype: specimen No. 2671; presented in Pl. 3, Fig. 3.
Type horizon: Francisco Fm. (Oxfordian).
Type locality: Brujito village in Sierra del Rosario.
Derivation of the name: from Sierra del Rosario.
Paratypes: four specimens (No. 2465a, 2465b, 2485, 2512).

Dimensions:

Table 12

Locality	Specimen No.	D (mm)	Ud (%)	Wh (%)	Wb (%)	b (mm)	h : b
Brujíto	holotype (2671)	46	49	30	27.2	12.5	1.1
S. Carlos Valley	2465a	50				13.5	1.1
S. Carlos Valley	2465b	46	51	30	25	11.5	1.2
S. Carlos Valley	2485	45				12	1.08
Brujíto	2512	62	50	28.2	24.2	15	1.16

Description. — Form relatively small, 50—75 mm in diameter when fully grown. Aperture with lappets. Body chamber 3/4 to almost a whorl long. Coiling markedly evolute, whorl section ovate, whorl sides flattened (Text-fig. 9).

Inner whorls ornamented with sharp-crested, biplicate and single ribs. Ribs markedly prorsiradiate on the whorl sides becoming rectiradiate just above the point of furcation, i.e. at ventral side; number of primary ribs ranging from about 30 to 35 per whorl at 20—25 mm diameter. On the outermost whorl the ribs become somewhat coarser and more widely spaced than on inner whorls (Text-fig. 10*B*); the ribs are biplicate; some intercalatories appear. Point of furcation, initially situated at ventral side, is lowered to about 2/3 of whorl height on the last half of the outermost whorl. The ribs become somewhat approximated near the aperture.

Constrictions relatively numerous throughout the development, well marked, delineated by strong ribs. The final constriction followed by a small, rounded lappets situated somewhat above the mid-height.

Remarks. — The species *Vinalesphinctes rosariensis* differs from *V. simplicior* sp. n. in more evolute coiling and less densicostate ribbing.

Occurrence. — Sierra de los Organos, Jagua Fm. (Jagua Vieja Member), San Carlos Valley (near El Junco); Sierra del Rosario, Francisco Fm., at Brujíto village.

Vinalesphinctes (Roigites) simplicior sp. n.
(Text-figs 9, 10B; Pl. 3, Figs 6—8)

Holotype: specimen No. 2499; presented in Pl. 3, Fig. 6.
Type horizon: Jagua Fm., Jagua Vieja Member (Oxfordian).
Type locality: San Carlos Valley nearby El Junco village, Sierra de los Organos.
Derivation of the name: on account of ornamentation more simple than in the remaining species (Lat. *simplicior* — more simple).
Paratypes: two specimens (No. 2505, 2515b).
Dimensions:

Table 13

Locality	Specimen No.	D (mm)	Ud (%)	Wh (%)	Wb (%)	b (mm)	h : b
S. Carlos Valley	holotype (2499)	48	46.8	30.2	27	13	1.12
Brujíto	2505	47	44.7	33	27.6	13	1.2
Brujíto	2515b	47	46.8	32	27.6	13	1.16

Description. — Relatively small, 50—60 mm in diameter when fully grown. Aperture with lappets. Body chamber 3/4 to almost a whorl long. Coiling evolute; whorl section ovate; whorl sides flattened (Text-fig. 9).

Inner whorls ornamented with sharp-crested, biplicate and single ribs. The ribs prorsiradiate on whorl sides, becoming somewhat rectiradiate at ventral side; number of primary ribs ranging from 35 to 40 per whorl at 20—25 mm diameter (Text-fig. 10*B*). The ribs become more widely spaced on the outermost whorl (Text-fig. 10*B*); biplicate ribs predominate here; point of furcation is lower and situated at two-thirds of whorl height; intercalatories rather few. Near the aperture the ribs become approximated; single ribs appear here.

Constrictions observable throughout the development, deeply incised and delineated by ribs; they are often followed by single rib and preceded by biplicate rib. The constrictions increase in number on the last half of the ultimate whorl, being accompanied by a more distinct increase in whorl height and width. The final constriction followed by small lappets situated somewhat above the mid-height.

Remarks. — The new species differs from the representatives of the *V. (R.) subconsociatus* group in the ribbing persisting throughout the last whorl, but it appears similar to the name-giving species of that group in coiling, whorl section and density of ribbing on inner whorls (*cf.* Text-figs 9 and 10).

Occurrence. — Sierra de los Organos, Jagua Fm. (Jagua Vieja Member), San Carlos Valley (near El Junco); Sierra del Rosario, Francisco Fm., at Brujito village.

Vinalesphinctes (Roigites) spp.
(Pl. 3, Fig. 9)

The material studied comprises several deformed or incomplete specimens with their ribs fading on sides of the last whorl, which is typical feature of the *V. (Roigites) subconsociatus* group. The specimens are characterized by whorl section and density of ribbing close to that of *V. (R.) subconsociatus* and they may belong to this species. They were found at El Hoyo de la Sierra (No. 2379a) and in San Carlos Valley, near El Junco (No. 2474a, b) in Sierra de los Organos, Jagua Fm. (Jagua Vieja Member).

According to Spath (1935, p. 490) the specimen described as *Nebrodites* aff. *agrigentinus* Favre by Sánchez Roig (1920, Pl. 14, Figs 2, 2A) was misinterpreted and it actually should be regarded as a form closely related to *Prososphinctes subconsociatus* = [*Vinalesphinctes (Roigites) subconsociatus*]. According to the present author this specimen presumably belongs to the subgenus *Roigites* and it may represent a new species of the *V. subconsociatus* group. However, any more precise evaluation of its systematic position is precluded by inadequate illustration in the paper by Sánchez Roig (1920) and the lack of comparative materials. The specimen was found at Puerta del Ancón, Jagua Fm., in Sierra de los Organos.

In the Francisco Formation exposed at Brujito in Sierra del Rosario, several damaged, somewhat incomplete and relatively small specimens were found. Approximated sutures show that the specimens are fully grown and the type of ornamentation bring them close to the subgenus *Roigites*. Single forms similarly preserved and also displaying some features of *Roigites* were found in the Jagua Formation (Jagua Vieja Member) in Sierra de los Organos.

Moreover, a few small, fully or almost fully grown specimens sometimes with lappets preserved were found in the Jagua Formation (Jagua Vieja Member) of Sierra de los Organos. Ornamentation of these forms consists of biplicate and single ribs prorsiradiate on whorl sides and becoming rectiradiate at the point of furcation, *i.e.* at the ventral side; the ribs become crowded close to the peristome. Constrictions fairly numerous, deep. Three of these specimens (No. 2004, 2424 and 2436; *cf.* Table 14 and Pl. 3, Fig. 9) except their subperistomal parts appear to be strikingly similar to the inner whorls of *V. (Roigites) subconsociatus* (Spath). It may be assumed that these specimens belong to the subgenus *Roigites* and did not reach the stage of more advanced ornamentation owing to their small ultimate sizes.

Table 14

Locality	Specimen No.	D (mm)	Ud (%)	Wh (%)	Wb (%)	h : b	NR at D = 25 mm
La Jutía	2004	28	40	32.1			40
El Hoyo de la Sierra	2424	38	43.4	34.2			42
Sierra de Guane	2438	36	39	33.3	32	1.04	44

Vinalesphinctes spp.
(Pl. 2, Fig. 4)

The inner whorls of ammonites of the subgenera *Vinalesphinctes, Roigites* and possibly *Subvinalesphinctes* are similar in ornamentation, thus the juvenile forms or inner whorls are not often determinable to the subgeneric rank. Such specimens were found in all the exposures of the Jagua Formation (Jagua Vieja Member) in Sierra de los Organos as well as in Brujito and Loma Calabrote exposures of the Francisco Formation in Sierra del Rosario. In some instances the subgeneric status of the specimens may be inferred. For example, the specimens No. 2411 from El Hoyo de la Sierra and No. 2515a from Brujito (*cf.* Pl. 2, Fig. 4), 50 mm and 65 mm in diameter respectively, display subcircular whorl section and are ornamented with loosely-spaced strong ribs; the former specimen represents phragmocone and the latter phragmocone with a part of body chamber (without crowding of sutures). These specimens appear similar to inner whorls of less densicostate representatives of subgenera *Vinalesphinctes* and *Subvinalesphinctes*. First of them appears very close to the inner whorls of *V. niger* Spath or *V. imlayi* (S. R.), whereas the second, displaying more evolute coiling than any of the species of subgenus *Vinalesphinctes* recorded so far (Ud = 55% and Wh = 26.2% at D = 61 mm), seems closer to some *Subvinalesphinctes*.

Some of poorly preserved specimens found in lower part of the Jagua Formation (Zacarías Member) in the area of Zacarías and La Mina mogotes, Sierra de los Organos, may be referable to the genus *Vinalesphinctes*.

The form originally described as *Kossmatia zacatecana* Burckh. by Sánchez Roig (1920, Pl. 10, Figs 1—1A) represents inner whorls of the genus *Vinalesphinctes*. Spath (1931, p. 400) supposed that it may represent a species closely affined to *Prososphinctes subconsociatus* (= *Vinalesphinctes (Roigites) subconsociatus*), but according to the present author it is too small for any reliable subgeneric or specific identification.

The specimen described as *Perisphinctes (Dichotomosphinctes) plicatiloides* O'Connell by Jaworski (1940, Pl. 4, Fig. 4), represents a fragment of whorls, 46 mm in diameter, markedly differing from the representatives of this species, but being strikingly similar to inner whorls of the genus *Vinalesphinctes* (cf. also Jaworski 1940, p. 128). It may represent inner whorls of the subgenus *Vinalesphinctes* or, when sutures are approximated, a form closely related to the *V. (Roigites) catalinensis* group.

Genus *PERISPHINCTES* Waagen, 1869
Subgenus *CUBASPHINCTES* Chudoley & Furrazola-Bermúdez, 1968
(Type species: *Perisphinctes jaworskii* Chudoley & Furrazola-Bermúdez, 1968)

Preliminary remarks. — The subgenus *Cubasphinctes* was created by Judoley & Furrazola-Bermúdez (1968) for the single species, P.*(Cubasphinctes) jaworskii* from the Oxfordian of Cuba. According to the present author several other species from the Cuban Oxfordian previously incorrectly assigned to various subgenera of *Perisphinctes* as e.g., *Arisphinctes* or *Orthosphinctes*, should be placed in that subgenus.

Diagnosis. — Macroconchs with simple peristome, up to 260 mm in diameter, but usually smaller, 100—200 mm in diameter. Body chamber 2/3 to a whorl long. Coiling of inner and middle whorls variable, involute or evolute; outer whorl always evolute. Whorl section usually ovate, initially often low-ovate, becoming high-ovate later; sometimes trapezoidal

(Text-fig. 15). Ribs marked on the whole whorl surface, appearing on umbilical wall with distinct twist, more or less prorsiradiate on whorl sides, straight, weakly concave or flexuous. Inner whorls ornamented with biplicate and single ribs as well as some intercalatory ribs; on middle whorls and initial part of the outermost whorl there appear triplicate ribs (with mono- and dischizotomous division) as well as sometimes bidichotomous ribs; intercalatories are common. The outermost whorl displays later as a rule some crowding of ribbing; biplicate, single and intercalatory ribs are predominant here. There is a marked decrease in the ratio of secondary/primary ribs on the outermost whorl in comparison with the preceding ones. Constrictions numerous throughout the development; uniform in width along the whorl side or wedge-like — widening towards the venter. They are often followed by two single ribs.

Two groups of species may be distinguished within the subgenus *Cubasphinctes:* (1) the *P. (C.) jaworskii* group, characterized by ribs densely spaced on inner whorls and more loosely spaced on middle whorls and initial part of the outermost whorl (Text-figs 11—14), and the secondaries/primaries ratio usually high, up to about 3.0—5.0; (2) the *P. (C.) albeari* group, characterized by similar number of ribs on inner and middle whorls and initial part of the outermost whorl or even some increase in number of ribs with increasing size (Text-figs 16—17); value of the secondaries/primaries ratio is often lower, up to about 2.5—3.5.

Differences and affinities. — Almost all species here allocated in the subgenus *Cubasphinctes* were previously given various subgeneric names but they were commonly referred to the genus *Perisphinctes*. The ammonites of this subgenus occupy probably somewhat peripheral position in respect to the main evolutionary steam of *Perisphinctes*, being sometimes close to *Discosphinctes* or, supposedly, even to some representatives of *Vinalesphinctes* (cf. description of the latter genus).

According to Arkell (1956), and Judoley & Furrazola-Bermúdez (1968) the large part of Cuban perisphinctids represent the subgenus *Arisphinctes* Buckman, 1924. However, the material available does not support that point of view. Judoley & Furrazola-Bermúdez (1968, p. 32, Fig. 11) noted some differences between the typical European *Arisphinctes* and Cuban forms referred to that subgenus but they did not consider them as of subgeneric character. According to the present author, the majority of Cuban "*Arisphinctes*" actually matches the diagnosis of the subgenus *Cubasphinctes*. The essential differences between the subgenera *Arisphinctes* and *Cubasphinctes* are as follows:

(i) *Arisphinctes* comprises forms very large to giants (over 900 mm in diameter), whereas *Cubasphinctes* — generally smaller, up to 260 mm in diameter;

(ii) outer whorl of *Arisphinctes* is ornamented with widely spaced, coarse primaries and its ventral side is smooth; in *Cubasphinctes* the last stage of ornamentation is marked by the appearance of numerous, fairly thin, usually biplicate and single ribs passing across the venter;

(iii) there is a distinct difference in trend of rib curves; in *Arisphinctes* the peak of rib curve coincides with middle whorls and in *Cubasphinctes* — with the end of last whorl and, sometimes, there is also other peak coinciding with inner whorls;

(iiii) inner and middle whorls of *Arisphinctes* display monoschizotomous ribbing, whereas the comparable whorls of *Cubasphinctes* — monoschizotomous as well as dischizotomous and even bidichotomous ribbing.

It should be noted that Cuban species *Perisphinctes guanensis* S. R. and *P. planatus* S. R., allocated in subgenus *Cubasphinctes* here, were considered by Arkell (1956, p. 573) as close to the subgenus *Arisphinctes*, and more precisely to the *P. (Arisphinctes) berlieri* group. The species *Perisphinctes berlieri* de Loriol is currently interpreted as belonging to *Liosphinctes* Buckman, 1925 (*cf.* Enay 1966), the subgenus partly questioned and considered as hardly separable from *Arisphinctes* by Arkell (1939, p. LIX) but at present accepted as a well-defined taxon (Callomon 1960, Enay 1966). Cuban ammonites referred to *Cubasphinctes* appear somewhat similar to *Liosphinctes*, differing from it in several features including somewhat different trend of rib curve, usually more crowded ribs on the last whorl, and in markedly more common dischizotomous and bidichotomous division of ribs in some species.

The subgenus *Cubasphinctes* appears to be the most close to *Platysphinctes* Tintant, 1961. However, the latter is based on scarce and incomplete material from

the Oxfordian of Europe and its systematic position is still debatable (*cf.* Tintant 1961; Enay 1966; Malinowska 1970; Brochwicz-Lewiński 1972, 1974). According to the present author, the relationship between *Platysphinctes* and *Liosphinctes* suggested by some authors (Enay 1966; Brochwicz-Lewiński 1972, 1974) may validate the treatment of the former as subgenus of *Perisphinctes*. However, the assumption that *Platysphinctes* represents microconch counterpart of *Liosphinctes* (cf. Enay 1966, Brochwicz-Lewiński 1972) has been never evidenced. Therefore, the problem whether *Platysphinctes* and *Cubasphinctes* represent the same subgenus, closely related subgenera or more distant forms, will not be solved untill more adequate material is available.

Other Cuban species here referred to the subgenus *Cubasphinctes*, such as *Perisphinctes cubanensis* O'Con. and *P. rutteni* Jaw., were previously assigned to the subgenus *Orthosphinctes* Schindewolf, 1925 (*cf.* e.g. Arkell 1956, Judoley & Furrazola-Bermúdez 1968). More complete material made it possible to show that these species most probably represent macroconchs and display all the features of the subgenus Cubasphinctes.

Remarks on dimorphism. — Peristomal part of undoubtful, fully grown representatives of *Cubasphinctes* is damaged (*e.g.* Judoley & Furrazola-Bermúdez 1968, Pls 15—17). Some other probably fully grown specimens such as *P. jaworskii* (No. 2399a, *cf.* Pl. 3, Fig. 11) or *P. guanensis* (No. 2029, *cf.* Pl. 6, Fig. 1) display partly preserved simple peristome. Moreover, there are some fragmentary specimens of *Cubasphinctes* with simple peristome while there is no record of lappeted representative of this subgenus. It should be also noted that representatives of *Cubasphinctes* are the only large *Perisphinctes* in the rich ammonite material of the Oxfordian of Cuba, and that these forms may represent dimorphic counterparts of the only undoubtful microconchs of the genus *Perisphinctes* — *Antilloceras* subgen. n. derived from the same Oxfordian beds. Thus, it is concluded that the all representatives of the subgenus *Cubasphinctes* should be interpreted as macroconchs.

Ammonites of the subgenera *Cubasphinctes* and *Antilloceras* are characterized by similar simple ornamentation of inner whorls, primarily consisting of biplicate and single ribs; moreover, outer whorl of the latter subgenus displays initially somewhat more complex ornamentation (triplicate ribs often with dischizotomous division, intercalatory ribs) well-matched by the ornamentation of earlier part of middle whorls of *Cubasphinctes*. Subsequently the ornamentation of these subgenera becomes different. The last stage of ornamentation in *Antilloceras* is characterized by occurrence of biplicate and single ribs, whereas in *Cubasphinctes* the ornamentation becomes increasingly complex, up to the beginning of the outermost whorl, and simplified onwards.

The analysis of the ornamentation of comparable whorls as well as other features (whorl section, dimensions) suggest dimorphic relationship between the particular species of *Cubasphinctes* and *Antilloceras*. However, a few species of *Cubasphinctes* (M) have inner whorls similar and may be paired with a single species of *Antilloceras* (m).

The species *Perisphinctes (Antilloceras) antillarum* Jaw. is a microconch characterized by flexuous ribs markedly crowded on inner whorls. Taking into account those features as well as density of ribbing and coiling of inner whorls (*cf.* Text-fig. 18) it follows that its dimorphic counterparts are presumably *P. (C.) jaworskii* Chud. & Fur. and *P. (C.) cubanensis* O'Con. of the *P. (Cubasphinctes) jaworskii* group (*cf.* Text-figs 11, 13).

Other microconch, *P. (Antilloceras) spathi* S. R. also displaying rather dense ribbing on inner whorls (*cf.* Text-fig. 19) and the straight or somewhat concave ribs, may represent dimorphic counterpart of *P. (Cubasphinctes) rutteni* Jaw. (*cf.* Text-fig. 14) of the *P. (C.) jaworskii* group.

The species *Perisphinctes (Antilloceras) plicatiloides* O'Con. is a microconch characterized by ribs not crowded on inner whorls (*cf.* Text-fig. 21) and may be paired with some species of the *P. (Cubasphinctes) albeari* group. It appears to be most similar in ornamentation of inner whorls to *P. (Cubasphinctes) albeari* Chud. & Fur. and *P. (C.) planatus* S. R., which may be treated as its dimorphic counterparts (*cf.* Text-figs 16 and 17). But it should be noted that the variety of *P. (Antilloceras) plicatiloides* characterized by less numerous ribs and more evolute coiling matches only some representatives of *P. (Cubasphinctes) albeari*, whereas other variety characterized by more numerous ribs and less evolute coiling matches both some *P. (Cubasphinctes) albeari* and *P. (C.) planatus*.

Occurrence. — Oxfordian, western Cuba, Sierra de los Organos (Jagua Fm.), presumably also Sierra del Rosario (Francisco Fm.) wherefrom the dimorphic counterpart of this subgenus, *Antilloceras* subgen. n. was recorded. The record of *Antilloceras* from northern Mexico (La Gloria Fm.) indicates that *Cubasphinctes* may be also present there. However, the paleontological material known from the northern Mexico is very poor and inadequately preserved. The only species recorded from this region, which may belong to *Cubasphinctes* is *Perisphinctes durangensis* Burck. (*cf.* Burckhardt 1912, Pl. 3, Figs 1—2). The species *P. muhlbachi* Hyatt reported from southern part of the United States (Sierra Nevada, possibly Mariposa Fm.) appears to be similar to that Mexican species (Imlay 1961, p. 24, Pl. 4, Fig. 8).

Species assigned to this subgenus: the *P. jaworskii* group — *Perisphinctes (Cubasphinctes) jaworskii* Chudoley & Furrazola-Bermúdez, *P. (C.) petrosus* (Sánchez Roig), *P. (C.) poeyi* Chudoley & Furrazola-Bermúdez, *P. (C.) vignaiensis* Sánchez Roig, *P. (C.) cubanensis* O'Connell, *P. (C.) intermedius* Chudoley & Furrazola-Bermúdez, *P. (C.) rutteni* Jaworski, *P. (C.) guziki* sp. n.; the *P. albeari* group — *P. (C.) albeari* Chudoley & Furrazola-Bermúdez, *P. (C.) guanansis* Sánchez Roig, *P. (C.) planatus* Sánchez Roig.

THE GROUP *PERISPHINCTES (CUBASPHINCTES) JAWORSKII*

Perisphinctes (Cubasphinctes) jaworskii Chudoley & Furrazola-Bermúdez, 1968

(Text-figs 11, 15; Pl. 3, Fig. 11)

1940. *Perisphinctes (Planites) cubanensis* O'Connell; Jaworski, pp. 99—104 (partim), Pl. 3, Figs 3a—b, 4; non Pl. 4, Fig. 1a—b.

1968. *Perisphinctes (Cubasphinctes) jaworskii* Chudoley & Furrazola; Judoley & Furrazola-Bermúdez, pp. 90—91, Pl. 37, Fig. 1a—d (holotype); Pl. 38, Figs 1a—d, 2—3.

Material. — Five specimens (No. 2399a, 2408, HSA-3, HSA-4, P-3 and P-4).

Dimensions:

Table 15

Locality	Specimen No.	D (mm)	Ud (%)	Wh (%)	Wb (%)	h : b	S/P at D 20–40	40–60	60–80	80–100	100–120	120–140
	holotype (JF-69)*	100	47	28	23	1.23				4.6		3.8
El Hoyo de la Sierra	2399a	113	743.5	734.5					74.0	4.2	73.2	
El Hoyo de S. Antonio	HSA-3	90	41.6	34.4					74.0	3.6		
		45	44	33.3								
El Hoyo de S. Antonio	HSA-4									4.0		
El Hoyo de S. Antonio	P-3	80	47.5	31.2								
		66	45.4	29.5	29.5	1.0		3.0	3.8	4.2		
El Hoyo de S. Antonio	P-4	81	45.7	32.1	30.2	1.06						
		62	45.1	32.3	30.5	1.05		2.8	4.4			
El Hoyo de la Sierra	2408	60				1.2			4.0	4.2		

*dimensions after Judoley & Furrazola-Bermúdez (1968).

Description. — Initially moderately evolute, increasingly evolute later (Text-fig. 11*B*). Whorl section initially low-ovate, almost so high as thick, later ovate to high-ovate. Whorl sides weakly convex (Text-fig. 15).

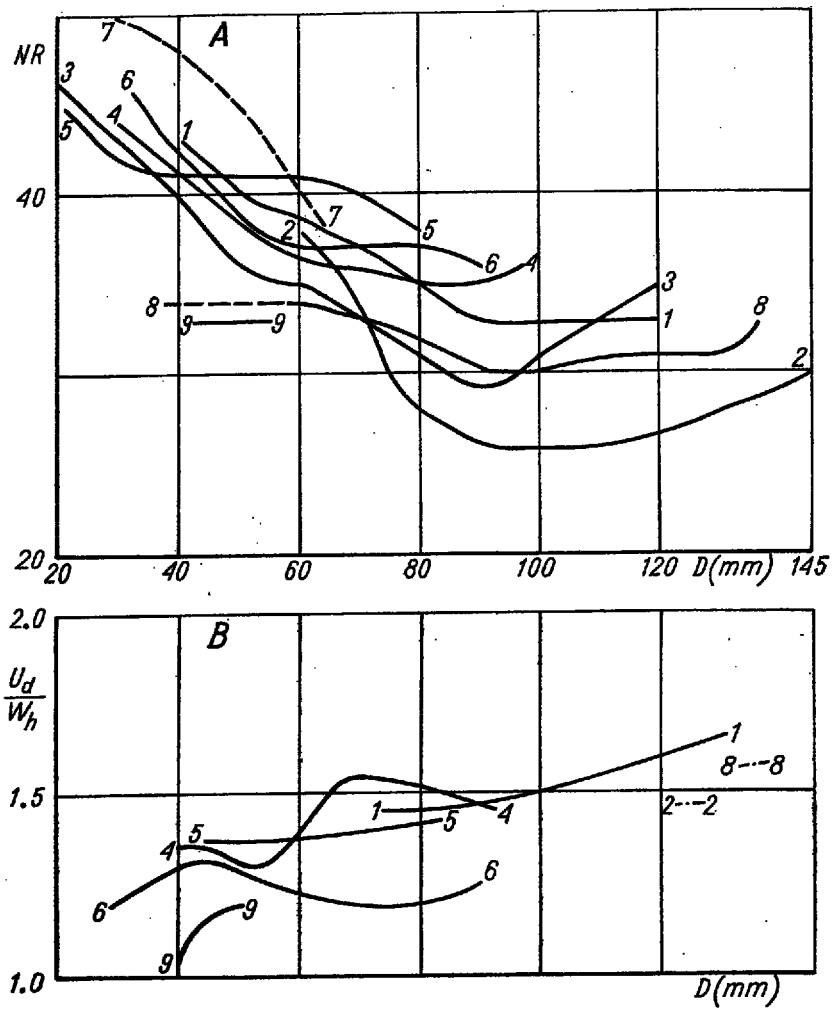

Fig. 11. Rib-curves (A) and character of coiling ,treated as the ratio of umbilical diameter/whorl height (B) for *Perisphinctes (Cubasphinctes) jaworskii* Chudoley & Furrazola and *Perisphinctes (Cubasphinctes) petrosus* (Sánchez Roig)

P. (C.) jaworskii Chud. & Fur.: *1* holotype (JF-69), *2* paratype (JF-71), *3* specimen No. 2399a, *4* P-3, *5* P-4, *6* HSA-3, *7* (= *P. cubanensis* in Jaworski 1940, Pl. 3, Fig. 3);
P. (C.) petrosus (Sánchez Roig), *8* holotype (JF-67);
P. (C.) cf. petrosus (Sánchez Roig), *9* (= *P. cubanensis* mut. *β* in O'Connell 1920, Pl. 35, Figs 1—3)
Rib-curves of specimens presented by Jaworski (1940) and O'Connell (1920) are constructed after the illustrations

Ribs strong, with a marked twist at umbilical wall, prorsiradiate on whorl sides, flexuous; the number of ribs changes along with shell size (Text-fig. 11A). Inner whorls covered with numerous, primarily biplicate ribs as well as with some intercalatories. Point of furcation situated at two-thirds of whorl height.

Middle whorls and initial part of the outermost whorl display more loosely spaced primary ribs as well as a marked increase in value of the secondaries/primaries ratio up to about 4.0—4.6 (Table 15). Division of ribs is here markedly dischizotomous or even bidichotomous, which results in variable location of the point of furcation; intercalatories are numerous. Subsequently, outer whorl displays gradual crowding of ribs and decrease in the ratio of secondary/primary ribs (Table 15, Text-fig. 11*A*, and Pl. 3, Fig. 11; *cf.* also Judoley & Furrazola-Bermúdez 1968, Pl. 38, Fig. 2). Sometimes there is a trend to weakening of ribs at the mid-height on whorl sides (*cf.* Judoley & Furrazola-Bermúdez 1968, Pl. 38, Fig. 2). One of the specimens studied (Pl. 3, Fig. 11) is fully or almost fully grown (which is proved by approximated sutures) and with a simple peristome partly preserved.

Constrictions fairly numerous, delineated by strong ribs; they are narrow and deeply incised on inner and middle whorls, becoming shallower and wider on outer whorl.

Remarks. — The allocation of some forms described by Jaworski (1940, Pl. 3, Figs 3—4) as *P. cubanensis* in the synonymy of *P. jaworskii* by Judoley & Furrazola-Bermúdez (1968) appears to be valid. These specimens display all the features typical of the latter (high evolute coiling, high secondaries/primaries ratio, common dischizotomous division of ribs), which differ them from typical representatives of *Perisphinctes (Cubasphinctes) cubanensis* O'Con.

The species *Perisphinctes (C.) rutteni* Jaw. displays equally numerous dischizotomous ribs as *P. jaworskii*, differing in more dense ribbing and straight or concave ribs as well as in less evolute coiling. In turn, *Perisphinctes (C.) petrosus* (S. R.) appears to be the closest to *P. jaworskii*, but it is relatively poorly known. The differences between the two species are discussed below.

Occurrence. — Sierra de los Organos, Jagua Fm. (Jagua Vieja Member). The type locality is unknown. The author's specimens were found at El Hoyo de la Sierra and El Hoyo de San Antonio. The specimens of Jaworski (1940), were found at Puerta del Ancón.

Perisphinctes (Cubasphinctes) petrosus (Sánchez Roig, 1951) (Text-fig. 11)

†1920. *Perisphinctes cubanensis* O'Connell mutation *β*; O'Connell, pp. 662—663, Pl. 35, Figs 1—2.
1951. *Ataxioceras petrosus* Sánchez Roig; Sánchez Roig, pp. 87—88, Pl. 24, Figs 1—2 (holotype).
1956. Subgen. nov. *petrosus* Sánchez Roig; Arkell, p. 573.
1968. *Perisphinctes (Arisphinctes) petrosus* (Sánchez Roig); Judoley & Furrazola-Bermúdez, pp. 88—89, Pl. 35, Fig. 1a—c (holotype).

Remarks. — This species was based on a single, large and well-preserved specimen, subsequently refigured by Judoley & Furrazola-Bermúdez (1968). The generic status of this form was the subject of controversies. Sánchez Roig (1951), taking into account suggestions made by Burckhardt, assigned it to *Ataxioceras*. This identification was questioned by Arkell (1956) according to whom this form represents a new peresphinctid subgenus. In turn, Judoley & Furrazola-Bermúdez (1968) assigned it to the subgenus *Arisphinctes* of the genus *Perisphinctes* with some reservation. According to the present author the holotype of this species appears markedly similar to the representatives of *P. jaworskii* Chud. & Fur., the type species of the subgenus *Cubasphinctes*. These two species are characterized by similar development of sculpture (*cf.* Text-fig. 11*A*) with initial gradual increase in value of the secondaries/primaries ratio, common occurrence of dischizotomous and bidichotomous ribs, as well as distinct crowding of ribs and related decrease in

value of the secondaries/primaries ratio at larger diameters. The latter features are displayed by the end part of outer whorl of the holotype of *P. petrosus*, where there is also distinct weakening of sculpture on whorl sides. The mode of coiling and whorl section of *P. petrosus* (cf. Text-fig. 11*B*) also appear similar to those of *P. jaworskii*. Thus, it follows that *P. petrosus* should be assigned to the subgenus *Cubasphinctes*.

The species *Perisphinctes petrosus* appears to be closer to *P. jaworskii* than any other species assigned to *Cubasphinctes*. It differs from *P. jaworskii* in less densicostate inner whorls (cf. Text-fig. 11*A*) and more common bidichotomous ribs.

The incomplete specimen, *Perisphinctes cubanensis* mutation *β* of O'Connell (1920, Pl. 35, Figs 1—2) resembles the holotype of *P. petrosus* in density (*cf.* Text-fig. 11*A*) and style of ribbing (dischizotomous and bidichotomous division of ribs) and it presumably belongs to that species.

Occurrence. — Sierra de los Organos, Jagua Fm. (Jagua Vieja Member). The holotype was found in Laguna de Piedra; the specimen of O'Connell (1920) was found in the Viñales area.

Perisphinctes (Cubasphinctes) poeyi Chudoley & Furrazola-Bermúdez, 1968
(Text-fig. 12; Pl. 3, Fig. 10)

1968. *Perisphinctes (Arisphinctes) poeyi* Chudoley & Furrazola; Judoley & Furrazola-Bermúdez, pp. 77—78, Pls 15—17 (holotype); Pl. 23, Fig. 1.

Material. — Two specimens (No. 2396 and 2403a) allocated in this species with reservation and described as *P. (C.)* cf. *poeyi*.

Remarks. — This species was originally referred to the subgenus *Arisphinctes*. The holotype (Judoley & Furrazola-Bermúdez 1968, Pls 15—17) is however fully grown, almost complete specimen about 260 mm in diameter, markedly different from representatives of this subgenus and displaying all the typical features of the subgenus *Cubasphinctes*. Crowding of ribs on inner whorls (Text-fig. 12) indicates that this species belongs to the *P. (Cubasphinctes) jaworskii* group. The species *Perisphinctes poeyi* has strong and thick primary ribs on middle whorls and its ribbing appears to be more distant than in the majority of species of *Cubasphinctes*. Other diagnostic features of this species include: low-ovate section of inner and middle whorls and ovate section of outer whorl, markedly convex whorl sides, middle whorls ornamented with bi- and triplicate ribs usually with monoschizotomous division, numerous intercalatories (the ratio of secondary/primary ribs equals about 2.6 at D = 45 mm and about 3.5 at D = 195 mm in the holotype). The ribs become more densely spaced and weaker on the last half of the outermost whorl of the holotype; and the secondaries/primaries ratio decreases there to about 2.0, similarly as in other fully grown representatives of the subgenus *Cubasphinctes*.

A poorly preserved specimen (No. 2396) presumably represents inner whorls of *P. poeyi*. It is fairly evolute (Ud = 44% and Wh = 32.7% at D = 58 mm); whorl section low-ovate with highly convex sides (Wb = 34.5%, h : b = 0.94 at D = 58 mm); ribs not numerous (Text-fig. 12), strong, bi- and triplicate, accompanied by some intercalatories (the ratio of secondary/primary ribs equals about 3.0 at D = = 50 mm).

Other specimen studied by the present author (No. 2403a; Pl. 3, Fig. 10) may also belong to this species. It is markedly evolute (Ud = 51% and Wh = 28.1% at D = 96 mm), with low-ovate whorl section and convex whorl sides (Wb = 31.2% and h : b = 0.9 at D = 96 mm) and ornamented with loosely spaced, strong bi- and

triplicate ribs as well as some intercalatories; point of furcation situated at two--thirds of whorl side; the ratio of secondary/primary ribs equals 3.0 at D = 80 mm. This specimen differs from typical representatives of *P. poeyi* in ribs not crowded

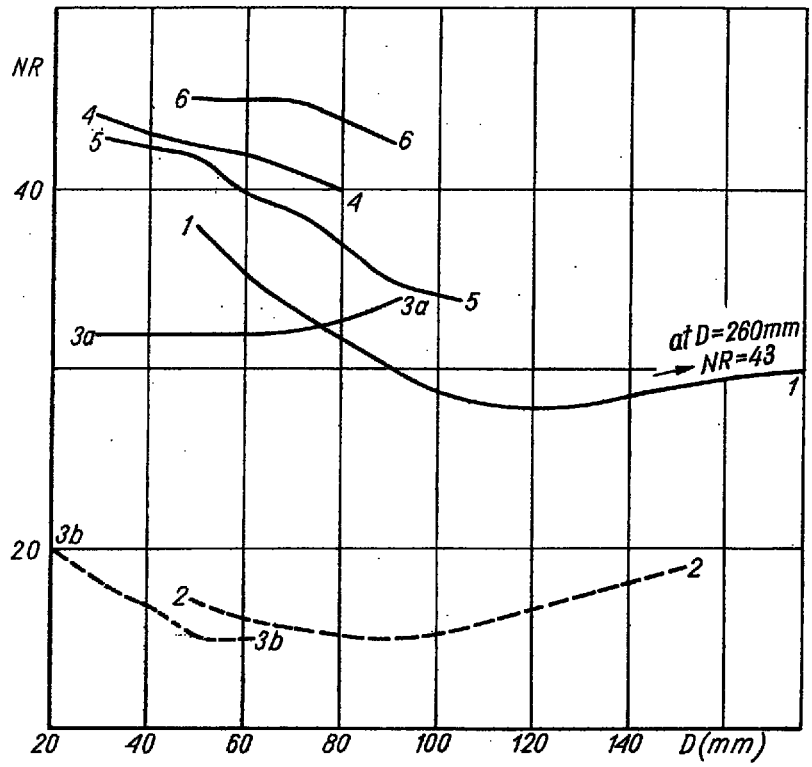

Fig. 12. Rib curves of *Perisphinctes (Cubasphinctes) poeyi* Chudoley & Furrazola and *Perisphinctes (Cubasphinctes) vignalensis* Sánchez Roig

P. (C.) poeyi Chud. & Fur.: *1* holotype (JF-45), *2* paratype (JF-50, number of ribs per half of whorl); *P. (C.) cf. poeyi* Chud. & Fur., *3a* specimen No. 2403a, *3b* 2396 (number of ribs per half-whorl); *P. (C.) vignalensis* Sánchez Roig: *4* holotype (JF-47), *5* JF-49 (cf. Judoley & Furrazola-Bermúdez 1968, Pl. 22, Fig. 2a—b), *6* JF-48 (= *P. castroi* in Sánchez Roig 1951, Pl. 18, Figs 1—2 = *P. sanchezroigi* Arkell 1956, cf. Judoley & Furrazola-Bermúdez 1968, Pl. 21, Fig. 2, Pl. 22, Fig. 1a—c)

Rib-curves of specimens JF-48, JF-49 and JF-50 are constructed after the illustrations presented by Judoley & Furrazola-Bermúdez (1968)

on inner whorls (*cf.* Text-fig. 12). Close to the end of the outermost whorl (at diameter exceeding 70 mm) the ribbing becomes more dense, presumably reflecting the beginning of the final stage of ornamentation. This stage usually begins in *P. poeyi* at larger diameters (*cf.* Judoley & Furrazola-Bermúdez 1968; also Text-fig. 12), thus it may be supposed that this specimen was much smaller when fully grown. Even if it is the case the resulting differences in size were not higher than those in other species of subgenus *Cubasphinctes* (e.g. Text-fig. 13).

The species *Perisphinctes poeyi* markedly differs from *P. jaworskii* Chud. & Fur. in less densicostate inner whorls, ribs stronger on middle whorls, very scarce dischizotomous division of ribs and presumably in lower value of the secondaries/ /primaries ratio for middle whorls. It differs from *P. petrosus* (S. R.) in ribs stronger on middle whorls, very scarce dischizotomous division of ribs and the complete lack of

bidichotomous ribs. In turn, *P. cubanensis* O'Con. is generally more densicostate; but less densely ribbed representatives of this species (*cf.* Text-fig. 13) appear to be somewhat similar to *P. poeyi*, differing in more slender whorls.

Occurrence. — Sierra de los Organos, Jagua Fm. (Jagua Vieja Member). The holotype was found at Laguna de Piedra nearby Viñales. The author's specimens were found at El Hoyo de la Sierra.

Perisphinctes (Cubasphinctes) vignalensis Sánchez Roig, 1920 (Text-fig. 12)

1920. *Perisphinctes vignalensis* Sánchez Roig; Sánchez Roig, pp. 21—22, Pl. 5, Figs 1—2 (holotype).
1951. *Perisphinctes (Dichotomosphinctes) vignalensis* Sánchez Roig; Sánchez Roig, pp. 76—77 (partim), Pl. 14, Figs 3—4 (holotype); non Pl. 14, Figs 1—2.
1951. *Perisphinctes (Dichotomosphinctes) castroi* Sánchez Roig; Sánchez Roig, pp. 80—81; Pl. 18, Figs 1—2.
1956. *Perisphinctes (Pseudarisphinctes) vignalensis* Sánchez Roig; Arkell, p. 573.
1956. *Perisphinctes (Arisphinctes) sanchezroigi* Arkell; Arkell, p. 573.
1968. *Perisphinctes (Arisphinctes) vignalensis* Sánchez Roig; Judoley & Furrazola-Bermúdez, pp. 79—80, Pl. 21, Figs 1a—d (holotype), 2; Pl. 22, Figs 1a—c, 2a—b.

Remarks. — This is one of the first species of Perisphinctidae described from the Oxfordian of Cuba. Its holotype, is represented by a not complete phragmocone, 80 mm in diameter, and a fragment of body chamber at 110 mm diameter. The specimen is evolute (Ud = 47% and Wh = 31% at D = 77 mm); whorl section initially low-ovate, ovate later (h : b = 1.14 at D = 77 mm) and with convex sides. Inner whorls ornamented with fairly numerous ribs slightly decreasing in number towards the outer whorls (Text-fig. 12). Phragmocone ornamented mostly with biplicate ribs as well as with few intercalatory ribs; bidichotomous ribs are occasionally found on the last part of phragmocone preserved. The fragment of body chamber displays three biplicate ribs and one single rib adjoining constriction.

The species *Perisphinctes vignalensis* was redescribed subsequently by Sánchez Roig (1951), who refigured the holotype and figured other specimen assigned to this species (*op. cit.*, Pl. 14, Figs 1—2). However, the latter differs from the holotype in smaller number of primary ribs on middle whorls as well as in higher value of the secondaries/primaries ratio. It presumably does not belong to *P. vignalensis* but rather to *P. jaworskii*.

Judoley & Furrazola-Bermúdez (1968) interpreted *Perisphinctes sanchezroigi* Arkell, 1956 = *Perisphinctes castroi* Sánchez Roig, 1951 as a junior synonym of *P. vignalensis*. The holotype of the former species (Sánchez Roig 1951, Pl. 18, Figs 1—2; *cf.* also Judoley & Furrazola-Bermúdez 1968, Pl. 21, Fig. 2; Pl. 22, Fig. 1a—c) appears actually similar to that of *P. vignalensis*, which seems to implicate that these specimens are conspecific.

The subgeneric status of *P. vignalensis* was the subject of controversies; this species was successively placed in the subgenera *Dichotomosphinctes* by Sánchez Roig (1951), *Pseudarisphinctes* by Arkell (1956) and *Arisphinctes* by Judoley & Furrazola-Bermúdez (1968). However, the trend of rib curve (*cf.* Text-fig. 12) appears essentially different from that of indicated subgenera and is typical of *Cubasphinctes* and especially of the *P. (Cubasphinctes) jaworskii* group. It should be also noted that differences in ornamentation of phragmocone (biplicate, occasional bidichotomous, and some intercalatory ribs, the secondaries/primaries ratio equals about 2.7 at D = 80 mm), and preserved part of body chamber (biplicate ribs) of the holotype supports the allocation of *P. vignalensis* in the subgenus *Cubasphinctes*.

Another form, *Perisphinctes vignalensis subquadratus*, has been proposed as new subspecies by Judoley & Furrazola-Bermúdez (1968, pp. 80—81, Pl. 23, Figs. 2—3) but its relation to *P. vignalensis* is not clear. The only two representatives of this subspecies, No. JF-51 (holotype), and No. JF-52, are relatively small, about 70 mm and 105 mm in diameter, respectively, and without a peristome. Primary ribs are somewhat crowded on inner whorls, becoming more widely spaced up to about 3/4 of the outer whorl, and finally, more densely spaced; this last feature may indicate that the specimens are almost fully grown. The outer whorl is ornamented with biplicate, as well as some triplicate ribs sometimes with dischizotomous division, and some intercalatories. The ratio of secondary/primary ribs initially increases at the outer whorl to 2.4—2.8 and supposedly decreases later. The form *Perisphinctes vignalensis subquadratus* differs from *P. vignalensis* in subquadrate whorl section and smaller number of primary ribs per whorl; it may represent a full new species. This form was originally assigned to *Arisphinctes* by Judoley & Furrazola-Bermúdez (1968) which is impossible to accept; the development of sculpture suggests its affinity with *Cubasphinctes*.

The species *Perisphinctes vignalensis* differs from *P. (Cubasphinctes) jaworskii* Chud. & Fur. in smaller difference in density of ribbing of inner and middle whorls (*cf.* Text-figs 11—12), lower value of the secondaries/primaries ratio, and common biplicate ribs. *P. (C.) petrosus* (S. R.) has smaller number of ribs, often displaying dischizotomous and bidichotomous division. *P. (C.) poeyi* Chud. & Fur. is characterized by less numerous (*cf.* Text-fig. 12) and stronger primary ribs and higher value of the secondaries/primaries ratio. *Perisphinctes (C.) cubanensis* O'Con. is generally characterized by higher difference in number of primary ribs on inner and middle whorls, different coiling and more slender whorls (Text-figs 13, 15 and Table 16). The remaining species of the *P. (C.) jaworskii* group differ from *P. vignalensis* in being more densicostate as well as in other features.

Occurrence. — Sierra de los Organos, Jagua Fm. (Jagua Vieja Member). The holotype was found in the Viñales area (Cuchillas de José Riviera); the remaining specimens were found in the Jagua Vieja area and at El Hoyo de la Sierra.

Perisphinctes (Cubasphinctes) cubanensis O'Connell, 1920
(Text-figs 13, 15; Pl. 4, Figs 1—6)

1920. *Perisphinctes cubanensis* O'Connell; O'Connell, pp. 648—660, Pl. 34, Figs 1—2 (holotype).
?1920. *Perisphinctes delatorii* O'Connell; O'Connell, pp. 662—670, Pl. 35, Figs 3—6.
1920. *Perisphinctes wartaeformis* Burckhardt; Sánchez Roig, pp. 18—19, Pl. 3, Figs 6, 6A; Pl. 6, Fig. 1.
1931. *Ataxioceras lictor* (Fontannes), "Cuban variety"; Spath, p. 449.
1948. *Perisphinctes (Planites) cubanensis* O'Connell; Jaworski, pp. 99—104 (partim); non Pl. 3, Figs 3—4.
1951. *Ataxioceras lictor cubanensis* Spath; Sánchez Roig, p. 87, Pl. 23.
1956. *Perisphinctes (Orthosphinctes) cubanensis* O'Connell; Arkell, p. 573.
1956. *Perisphinctes (Arisphinctes) cubanensis* Sánchez Roig; Arkell, p. 573.
1968. *Perisphinctes (Orthosphinctes) cubensis* O'Connell; Judoley & Furrazola-Bermúdez, Table (Text-fig. 10).
1968. *Perisphinctes (Arisphinctes) humboldti* Chudoley & Furrazola; Judoley & Furrazola-Bermúdez, pp. 78—79, Pls 18—20.
1968. *Perisphinctes (Arisphinctes) guanensis angustiumbilicatus* Chudoley & Furrazola; Judoley & Furrazola-Bermúdez, pp. 86—87 (partim).

Material. — Nine specimens (No. 2379, 2405, 2406, 2407, 2409a, 2450, 2457, 2460 and HSA-2).

Dimensions:

Table 16

Locality	Specimen No.	D (mm)	Ud (%)	Wh (%)	Wb (%)	h : b	S/P at D 20–40	40–60	60–80	80–100	100–120	120–140
Viñales	holotype*	55	37	38	29	1.3						
		65	38	36	28	1.3						
		86	38.5	34	24	1.35			3.2	3.0		
El Hoyo de S. Antonio	HSA-2	57	36	35	31.5	1.1	2.4	2.8				
Sierra de Guane	2460	69	38.4	37	30	1.2		2.4	3.2			
Sierra de Guane	2450	68	34.8	40.4								
		94	35	38.3				2.4	3.4	3.0		
Sierra de Guane	2457							2.8	3.2			
El Hoyo de la Sierra	2407	78	38.4	34.6								
		100	38.5	35					3.2	3.6		
El Hoyo de la Sierra	2379	96	41.6	33.2	30.2	1.12						
		112	42	32	26.7	1.2				3.6	3.8	
El Hoyo de la Sierra	2405	108	42.5	34.2	24	1.4			2.8			
El Hoyo de la Sierra	2409a	98	42	33.3						3.0		2.4
El Hoyo de la Sierra	2406	73	41.7	34.3								
		130	46	31							3.6	2.6

*dimensions after O'Connell (1920).

Description. — Coiling initially weakly evolute or close to the evolutness/involutness boundary, later increasingly involute, and finally in the case of middle and outer whorls — progressively more evolute (Table 16 and Text-fig. 13*B*). These changes may appear sooner or later in individuals but the trend is always the same. Whorl section ovate, whorl sides flattened or weakly convex (Text-fig. 15); the ratio of whorl height/thickness increasing along with shell size.

Ribs strong, with a marked twist at umbilical wall, prorsiradiate and somewhat flexuous on whorl sides, branching at about two-thirds of whorl height. Style of ribbing including the number of primary ribs per whorl changes along with shell size (Text-fig. 13*A*). Particular individuals markedly differ in number of primary ribs to about 20 per whorl at comparable diameters.

Inner whorls ornamented with numerous biplicate and some intercalatory ribs; on the middle whorls and initial part of the outer whorl the primary ribs become more distant; this is accompanied by the appearance of triplicate, mainly monoschizotomous ribs and the increase in number of intercalatories, resulting in maximum value of the secondaries/primaries ratio ranging from 3.2 to 3.8. Last part of the outer whorl displays more closely spaced primary ribs and resulting decrease in value of the secondaries/primaries ratio (Table 16). A trend to weakening of ribbing on whorl sides may be marked (Pl. 4, Fig. 6).

Constrictions fairly numerous, shallow, delineated by strong ribs. On inner whorls they are sometimes followed by two single ribs, whereas later — by one single rib and fairly often by distinctly crowded growth lines.

Remarks. — This species was assigned to the subgenus *Orthosphinctes* by Arkell (1956) and Judoley & Furrazola-Bermúdez (1968). However, it should be noted that the holotype is an immature specimen (*cf.* O'Connell 1920, p. 660) and the smooth band visible at the end of its outer whorl presumably represents a zone of crowded growth lines following the constriction. Such crowding of growth lines behind the constriction is often displayed by representatives of the subgenus *Cubasphinctes* on various growth stages. The holotype of *P. cubanensis* differs from typical representatives of *Orthosphinctes* in several features including the course of rib curve, resembling the type species of the subgenus *Cubasphinctes* — *Perisphinctes (Cubasphinctes) jaworskii* Chud. & Fur. in the general style of ribbing.

The holotype of *P. jaworskii*, similarly as the holotype of *P. cubanensis*, is not fully grown (or not complete). Further modification of sculpture proceeding in these species involves gradual increase in number of primary ribs, and decrease in value

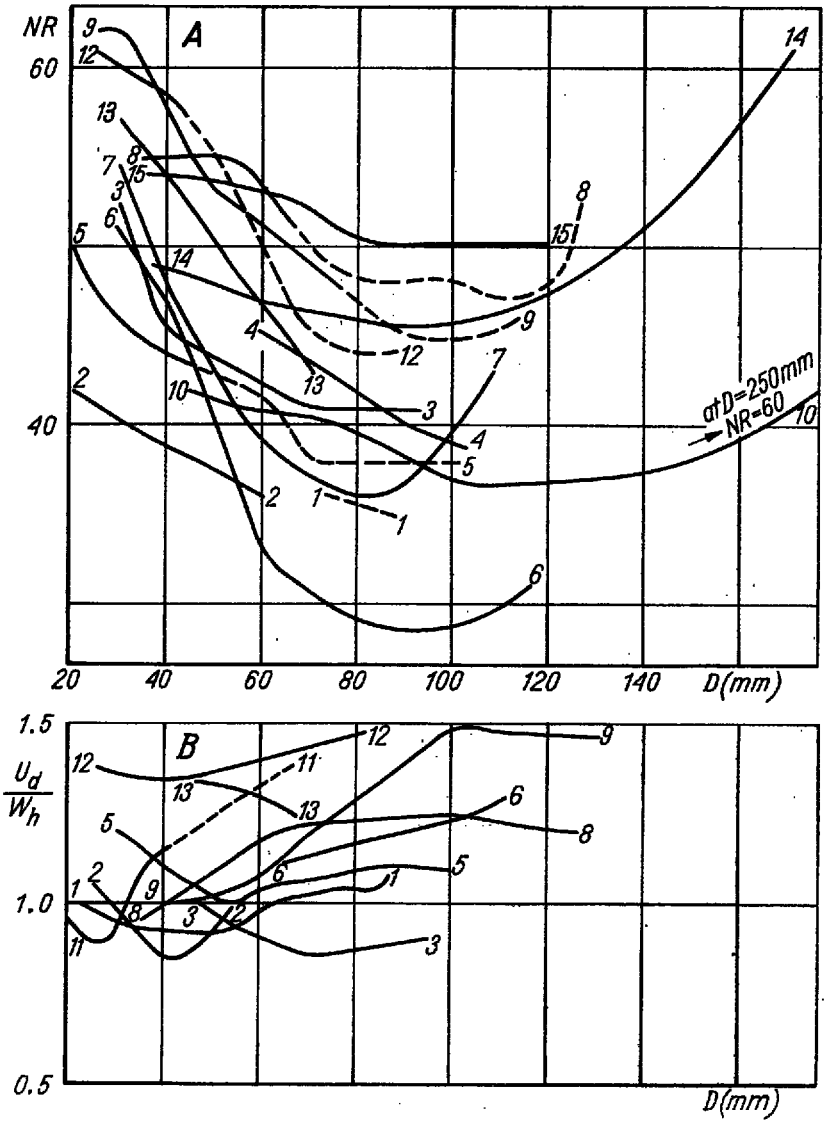

Fig. 13. Rib-curves (A) and character of coiling treated as the ratio of umbilical diameter/whorl height (B) for *Perisphinctes (Cubasphinctes) cubanensis* O'Connell and *Perisphinctes (Cubasphinctes) intermedius* Chudoley & Furrazola

P. (C.) cubanensis O'Connell: *1* holotype, *2* specimen No. HSA-2, *3* 2450, *4* 2457, *5* 2407, *6* 2378, *7* 2405, *8* 2409a, *9* 2406, *10* JF-46 (=*P. humboldti* in Judoley & Furrazola-Bermúdez 1968, Pls 18—20; *P.* cf. *cubanensis* O'Connell, *11* (= *P. delatorri* in O'Connell 1920, Pl. 35, Figs 3—6);

P. (C.) aff. cubanensis O'Connell: *12* 2014, *13* (= *P. cubanensis* in Jaworski 1940, Pl. 4, Fig. 1); *P. (C.) intermedius* Chud. & Fur.: *14* holotype (JF-57), *15* HSA-6

Rib-curves of specimens presented by O'Connell (1920) and Jaworski (1940) are constructed after the illustrations

of the secondaries/primaries ratio (*cf.* Table 16 and Text-fig. 13 with Table 15 and Text-fig. 11, as well as Pl. 4, Figs 4–6 and Pl. 6, Fig. 1). Thus it follows that the species *P. cubanensis* does not belong to the subgenus *Orthosphinctes*, but to *Cubasphinctes*.

Because of marked differences in previous identifications it appears required to discuss the systematic status of forms placed in the synonymy of *P. cubanensis*. Fragmentary preserved small specimen distinguished as *P. delatorii* by O'Connell (1920, Pl. 35, Figs 3–6) does not differ from inner whorls of *P. cubanensis* (cf. Jaworski 1940, p. 102). Relatively highly evolute coiling of the last whorl preserved of *P. delatorii* somewhat differs this specimen from the majority of *P. cubanensis*, but it may be partly explained by inaccuracy of measurement (*cf.* O'Connell 1920, Table 4).

The specimen distinguished as *Perisphinctes (Arisphinctes) humboldti* by Judoley & Furrazola-Bermúdez (1968, Pls 18–20) undoubtedly belongs to the subgenus *Cubasphinctes;* its ornamentation, dimensions and rib-curve appear similar to those of fully or almost fully grown representatives of *P. cubanensis* (cf. Text-fig 13*A* and Pl. 4, Figs 4–6). The specimen in question appears to be the largest representative of *P. cubanensis* hitherto recorded.

The systematic position of the specimen originally misinterpreted as *Perisphinctes wartaeformis* Burck, by Sánchez Roig (1920, Pl. 3, Fig. 6-6*A* and Pl. 6, Fig. 1) has been a matter of controversy. Spath (1931) considered it as representative of *Ataxioceras* and Cuban variety of *Ataxioceras lictor* (Font.); subsequently Sánchez Roig (1951) distinguished this form as the new subspecies, *A. lictor cubensis* (or *cubanensis* in his explanation to plate). In turn, according to Arkell (1956) this specimen belonged neither to the genus *Ataxioceras* nor to *Progeronia* (to which the species *Ammonites lictor* Font. is currently assigned) but to the subgenus *Arisphinctes* of the genus *Perisphinctes*. The latter point of view was subsequently accepted by Judoley and Furrazola-Bermúdez (1968). However, the affinity of this specimen with the subgenus *Arisphinctes* is also questionable. According to the present author, the specimen "*Ataxioceras lictor cubensis*" displays ornamentation (style of ribbing and trend of rib curve) typical of ammonites of the subgenus *Cubasphinctes*.

Judoley & Furrazola-Bermúdez (1968) considered "*Ataxioceras lictor cubensis*" to be very close to *Perisphinctes planatus* Sánchez Roig, 1951; at the same time in contradiction with the rules of ICZN they described these two forms under a new subspecific name *Perisphinctes guanensis angustiumbilicatus* Chud. & Fur., 1968, and designated as its holotype, the holotype of *P. planatus* S. R. (cf. also: A. Torre, 1973, p. 41). The specimen "*Ataxioceras lictor cubensis*" differs from the holotype of *P. planatus* in several features including ribs crowded on inner whorls and widely spaced later, primary ribs less numerous on middle and outer whorls and higher ratio of secondary/primary ribs. All these features clearly indicate affinity of the former with the *Perisphinctes (Cubasphinctes) jaworskii* group, and especially with *P. (Cubasphinctes) cubanensis;* "*Ataxioceras lictor cubensis*" therefore is treated here as a possible junior synonym of *P. cubanensis* O'Con. The specimen "*Ataxioceras lictor cubensis*" differs from typical representatives of the species merely in the lack of flexuous ribs at larger diameter; the difference may indicate affinity of the form in question with *P. (Cubasphinctes) intermedius* Chud. & Fur. or a very close form *P. (Cubasphinctes)* aff. *planatus* (cf. also remarks in descriptions of the species). It should be also mentioned that both *P. (C.) intermedius* and *P. (C.)* aff. *planatus* may be interpreted to some degree as forms transitional between *P. cubanensis* and *P. planatus*.

The species *Perisphinctes intermedius* Chud. & Fur. differs from *P. cubanensis* in smaller difference in density of ribbing of inner and middle whorls (*cf.*

Text-fig. 13*A*); besides, the number of ribs on middle whorls of the former species appears to be close to upper limit of variability of corresponding whorls of the latter. Moreover, *P. intermedius* differs from *P. cubanensis* in lower value of the secondaries/primaries ratio (as a rule less than 3.0) and in ribs on outer whorl markedly prorsiradiate, straight or weakly concave but not flexuous (as it is usually the case in the latter species).

The species *Perisphinctes cubanensis* differs from *P. jaworskii* Chud. & Fur. in less evolute coiling, generally denser ribbing on middle and outer whorls, lower value of the secondaries/primaries ratio, and scarcer dischizotomous ribs. *P. (C.) rutteni* Jaw. displays higher value of the secondaries/primaries ratio for inner whorls and much frequent dischizotomous ribs, as well as different course of ribs.

Occurrence. — Sierra de los Organos, Jagua Fm. (Jagua Vieja Member). The specimens under study were collected at: El Hoyo de San Antonio, El Hoyo de la Sierra and Sierra de Guane. Specimen of Sánchez Roig (1920 — *Perisphinctes wartaeformis*) was found at Puerta del Ancón and the holotype of *P. cubanensis* — in the area of Viñales (? Puerta del Ancón).

Perisphinctes (Cubasphinctes) aff. *cubanensis* O'Connell, 1920
(Text-fig. 13; Pl. 5, Fig. 1)

1940. *Perisphinctes (Planites) cubanensis* O'Connell; Jaworski, pp. 98—104 (partim), Pl. 4, Fig. 1a—b; non Pl. 5, Figs 3—4.

Material. — One specimen (No. 2014).

Remarks. — Form very close to *P. cubanensis*, differing from it in more evolute coiling (*cf.* Text-fig. 13*B*). In the case of specimen No. 2014 at 86 mm diameter, Ud = 43.5% and Wh = 30.8%, and at 67 mm diameter, Ud = 45.5% and Wh = 32%; in the case of specimen of Jaworski (1940, Pl. 4, Fig. 1), Ud = 43% and Wh = 33% at 51 mm diameter. The ratio of the secondary/primary ribs is rather low, equalling for the former about 3.2 and 3.4 at 70 mm and 80 mm diameter, respectively. The coiling of these two specimens brings them somewhat close to *P. (Cubasphinctes) jaworskii* Chud. & Fur., from which they differ in being markedly more densicostate (*cf.* Text-figs 11*A* and 13*A*), lower value of the secondaries/primaries ratio and less numerous dischizotomous ribs. They presumably represent a new subspecies of *P. cubanensis* O'Connell.

Occurrence. — Sierra de los Organos, Jagua Fm. (Jagua Vieja Member). The specimen No. 2014 was found in the basal part of the Jagua Vieja Member, at the transition to the Zacarías Member, in the La Jutía section. Jaworski's specimen was found at Puerta del Ancón.

Perisphinctes (Cubasphinctes) intermedius Chudoley & Furrazola-Bermúdez, 1968
(Text-figs 13, 15; Pl. 3, Fig. 12)

1963. *Perisphinctes (Arisphinctes) albeari intermedius* Chudoley & Furrazola; Judoley & Furrazola-Bermúdez, pp. 83—84 (partim), Pls 27—28 (holotype); non Pl. 29, Fig. 1a—d.

Material. — One specimen (No. HSA-6).

Description. — Evolute, especially on the inner and outer whorls (Ud = 50% and Wh = 28% at 169 mm diameter in the holotype, and Ud = c. 45% at 141 mm diameter in the specimen No.HSA-6); middle whorls moderately evolute (Ud = 40.8%

and Wh = 34.4% at 93 mm diameter in the case of the specimen No. HSA-6). Whorl section ovate, whorl sides flattened (Text-fig. 15).

Ribs fairly strong, with a marked twist at umbilical wall, strongly prorsiradiate on whorl sides, straight or weakly concave.

Ribbing dense; number of ribs per whorl changes along with shell size (Text-fig. 13*A*) from about 50—55 on inner whorls to about 45—50 on middle whorls. Middle whorls and initial part of outer whorl display usually biplicate ribbing with some intercalatories; the ratio of secondary/primary ribs is the highest here and it equals about 3.0. On the last part of outer whorl this ratio decreases to about 2.0, which is related to a distinct increase in number of primary ribs. Constrictions fairly numerous, shallow, delineated by strong ribs and often followed by crowded growth lines.

Remarks. — Judoley & Furrazola-Bermúdez (1968) interpreted this form as a new subspecies — *Perisphinctes albeari intermedius* Chud. & Fur. The holotype of this form differs from the representatives of the other subspecies of *P. albeari* (*P. albeari albeari* Chud. & Fur. and *P. albeari ampliumbilicatus* Chud. & Fur.) in more dense ribbing, especially on inner whorls. Other specimen assigned to *P. albeari intermedius* by Judoley & Furrazola-Bermúdez (1968, Pl. 29, Fig. 1) differs from the holotype in less densicostate inner whorls and it presumably belongs to the subspecies *P. albeari ampliumbilicatus*. In turn, the specimen here described (Pl. 3, Fig. 12) appears very close to the holotype of *P. albeari intermedius*.

Crowding of ribs on inner whorls differs *P. albeari intermedius* from both *P. albeari* and several other species treated here as the *Perisphinctes (Cubasphinctes) albeari* group. However, few specimens close to these species display some crowding of ribs on inner whorls. This is the case of the form here described as *Perisphinctes* aff. *planatus* S. R. (cf. Pl. 6, Fig. 4), also displaying number of ribs per whorl and coiling similar to those of *P. albeari intermedius*.

The overall style of costation including marked crowding of ribs on inner whorls indicates close affinity between *P. albeari intermedius* and the *Perisphinctes (Cubasphinctes) jaworskii* group — particularly the species *P. cubanensis* O'Con., but there exist some differences sufficient for separation of these forms. The differences seem to be of specific rank, hence the form *P. albeari intermedius* is here interpreted as a separate full species *P. (Cubasphinctes) intermedius* Chud. & Fur.

The species *Perisphinctes intermedius* differs from *P. (Cubasphinctes) rutteni* Jaw. in generally smaller contrast in density of ribbing of inner and middle whorls (*cf.* Text-figs 13—14), lower value of the secondaries/primaries ratio, and infrequent dischizotomous ribs.

Occurrence. — Sierra de los Organos, Jagua Fm. (Jagua Vieja Member). The holotype was found in the Jagua Vieja area, similarly as the other specimen studied by the present author (at El Hoyo de San Antonio).

Perisphinctes (Cubasphinctes) rutteni Jaworski, 1940
(Text-figs 14, 15; Pl. 5, Fig. 2)

?1920. *Perisphinctes cubanensis* O'Connell mutation *a*; O'Connell, pp. 660—662, Pl. 34, Figs 3—4.
1940. *Perisphinctes (Planites) rutteni* Jaworski; Jaworski, pp. 105—109, Pl. 7, Fig. 1a—c (holotype).
1956. *Perisphinctes (Orthosphinctes) rutteni* Jaworski; Arkell, p. 573.
1968. *Perisphinctes (Orthosphinctes) rutteni* Jaworski; Judoley & Furrazola-Bermúdez, Table (= Text-fig. 10).

Material. — One specimen (No. 2361), and two other, poorly preserved and referred to this species with reservation (No. 2012a and HSA-5).

Dimensions:

Table 17

Locality	Specimen No.	D (mm)	Ud (%)	Wh (%)	Wb (%)	h. : b	S/P at D 20–40	40–60	60–80	80–100
Perisphinctes rutteni										
Puerta del Ancón	holotype*	96	39.5	35.3		1.5				
El Hoyo de la Sierra		44	38.7	36.3		1.1		23.6	3.4	3.2
El Hoyo de la Sierra	2391	100	42	35						
		85	42	35.3		1.5			3.6	3.6
Perisphinctes cf. *rutteni*										
La Jutía	2012a	76	42.1	38.1	27.5	71.4			3.6	
El Hoyo de S. Antonio	HSA-5	50				1.27		23.6		

*dimensions after Jaworski (1940).

Description. — Coiling close to the evolutness/involutness boundary in the case of inner whorls, moderately evolute later (Text-fig. 14*B*). Innermost whorls low-ovate in cross-section, subsequent whorls rapidly becoming high-ovate with the ratio of whorl height/thickness attaining up to 1.5 (Table 17). Whorl sides somewhat flattened (Text-fig. 15).

Ribs strong, sharp-crested, with a marked twist at umbilical wall, markedly prorsiradiate on whorl sides, straight or somewhat concave; number of ribs changing along with shell size (Text-fig. 14*A*). Ribs numerous on inner whorls, initially single and biplicate ,triplicate later, often dischizotomous; intercalatories are common. The ratio of secondary/primary ribs high already at 40—60 mm diameter (about 3.6). Subsequent whorls initially display more widely spaced primary ribs without any distinct change in their subdivision. Next stage of ornamentation, displayed by the holotype of this species, involves decrease in value of the secondaries/primaries ratio whereas the number of ribs per whorl is not more reduced (Table 17, Text-fig. 14*A*). The final part of whorls of this species is hitherto unknown.

Constrictions fairly numerous, shallow, delineated by ribs. On inner whorls they are as a rule followed by two single ribs and later — by one or two single ribs.

Remarks. — The species *Perisphinctes rutteni* Jaw., similarly as *P. cubanensis* O'Con., was usually assigned to the subgenus *Orthosphinctes* (cf. Arkell 1956, Judoley & Furrazola-Bermúdez 1968). However, similarly as in the case of the latter species, such interpretation is difficult to accept. All the representatives of *P. rutteni* have their peristomal part broken off, although several features including rib curve, value of the secondaries/primaries ratio decreasing at larger diameter (Text-fig. 14*A* and Table 17) markedly differ them from typical representatives of the subgenus *Orthosphinctes*. On the other hand the essential features of ornamentation indicate their close affinity with representatives of the subgenus *Cubasphinctes*. The species *Perisphinctes rutteni* differs from all the species allocated in the latter subgenus in a peculiar combination of features — large number of primary ribs per whorl, common dischizotomous ribbing, ribs straight or weakly concave.

The specimen *Perisphinctes cubanensis* mutation *a* (O'Connell 1920, Pl. 34, Figs 3—4) is characterized by markedly concave ribs and supposedly belongs to the species *P. rutteni* (cf. also remarks *in:* Jaworski 1940, p. 107). This species is presumably also represented by two poorly preserved specimens from the collection studied by the present author (specimens No. 2012a and HSA-5); they differ from the holotype of *P. rutteni* in ribs somewhat less densely spaced (*cf.* Text-fig. 14*A*).

The specimen figured by Jaworski (1940, Pl. 5, Fig. 2) markedly differs from typical representatives of *P. rutteni*. At about 50 mm diameter it is characterized by predominance of biplicate ribs which develop instead of irregular costation with

parabolic ribs and nodes on more internal whorls. Systematic status of this specimen is discussed in description of *Perisphinctes (Antilloceras)* spp. Other specimen

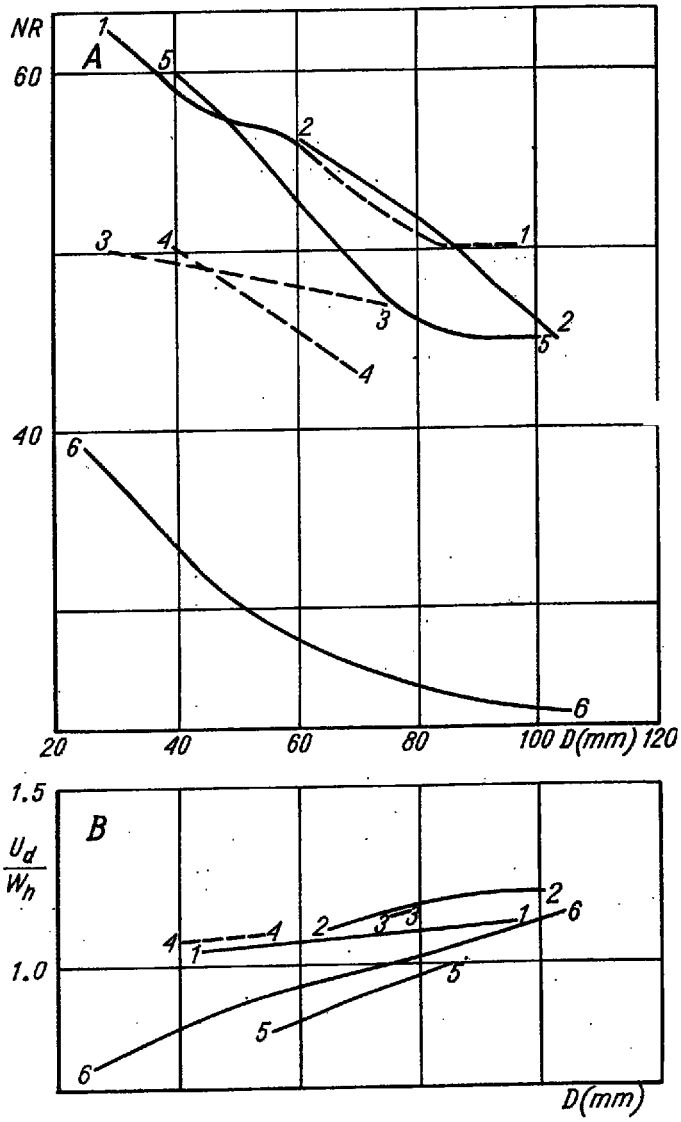

Fig. 14. Rib-curves (A) and character of coiling treated as the ratio of umbilical diameter/whorl height (B) for *Perisphinctes (Cubasphinctes) rutteni* Jaworski and *Perisphinctes (Cubasphinctes) guziki* sp. n.

P. (C.) rutteni Jaworski: 1 holotype (rib-curve constructed after the illustration), 2 specimen No. 2391;

P. (C.) cf. *rutteni* Jaworski: 3 2012a, 4 HSA-5;

P. (C.) guziki sp. n.: 5 holotype (2013), 6 paratype (2041, number of ribs per half of whorl)

figured by Jaworski (1940, Pl. 7, Fig. 2) is insufficiently preserved and too small for unequivocal assignation to *P. rutteni*.

Occurrence. — Sierra de los Organos, Jagua Fm. (Jagua Vieja Member). The holotype was found at Puerta del Ancón and the other specimen at El Hoyo de la

Sierra. The specimens assigned to the species with reservation were found at El Hoyo de San Antonio and La Jutía (collection studied by present author) and in the Viñales area (O'Connell, 1920).

Perisphinctes (Cubasphinctes) guziki sp. n.
(Text-figs 14, 15; Pl. 5, Figs 3—4)

Holotype: specimen No. 2013, presented in Pl. 5, Fig. 3.
Type horizon: Jagua Fm., Jagua Vieja Member (Oxfordian).
Type locality: La Jutía, Sierra de los Organos.
Derivation of the name: in honour of Professor Kazimierz Guzik, who initiated Polish-Cuban cooperation in the field of geology.
Paratype: specimen No. 2401, presented in Pl. 5, Fig. 4.

Dimensions:

Table 18

Locality	Specimen No.	D (mm)	Ud (%)	Wh (%)	Wb (%)	h : b	S/P at D 20—40	40—60	60—80	80—100	100—120
La Jutía	holotype (2013)	85	36.4	36.4	24.7	1.5					
		76	35.5	36.1	27	1.34		3.2	3.4	3.4	
El Hoyo de la Sierra	2401	103	42.2	35.8	?20.8	?1.7					
		76	37.5	37.5	29	1.35					
		38	33.5	39.4	35.5	1.11			3.6		4.6

Description. — Initially moderately involute, subsequently close to the evolutness/involutness boundary and finally moderately evolute (Text-fig. 14B). Whorl section low-ovate, later high-ovate with the ratio of whorl height/thickness attaining 1.5 or somewhat more (Table 18); whorl sides flattened (Text-fig. 15).

Ribs strong, sharp-crested, with a marked twist at umbilical wall, prorsiradiate on whorl sides, flexuous; number of ribs changing along with shell size (Text-fig. 14A). Ribs very numerous on inner whorls; biplicate, single and some intercalatory ribs present; point of furcation situated at about two-thirds of whorl height; at 20—30 mm diameter the number of primary ribs per whorl equals about 65—70 and 80 in the holotype and paratype, respectively.

The ribs on the subsequent whorls become more widely spaced, and the increase in value of the secondaries/primaries ratio is observed (Text-fig. 14A and Table 18). Biplicate, as well as triplicate ribs sometimes with dischizotomous subdivision, and subsequently even bidichotomous ribs (Pl. 5, Fig. 4) are present; intercalatory ribs are fairly common.

At the diameter of 80—100 mm the number of primary ribs is not more reduced and it equals about 45 per whorl; there is some trend to weakening of ribbing at the mid-height of whorl side (Pl. 5, Fig. 4). The final part of whorls of this species is hitherto unknown.

Constrictions fairly numerous, shallow, delineated by distinct ribs.

Remarks. — The two representatives of this species available are supposedly immature. Development of sculpture appears identical as that of the remaining

species of the subgenus *Cubasphinctes*; the lack of the final stage of ornamentation, typical for this subgenus — crowding of ribs and related decrease in value of the secondaries/primaries ratio — may be explained by the incompleteness of the specimens under study. It should be noted that the last known stage of ornamentation of *P. guziki* sp. n. — impeded reduction in number of primary ribs at diameter over 80 mm — is found in other species of *Cubasphinctes* at comparable diameter (*cf.* Text-figs 11 and 13—14).

The species *Perisphinctes (Cubasphinctes) guziki* sp. n. has several features in common with *P. (Cubasphinctes) cubanensis* O'Con. and *P. (C.) jaworskii* Chud. & Fur. The species *P. cubanensis* differs in less densicostate inner whorls (up to 60 ribs per whorl), scarcer dischizotomous ribs, and generally lower ratio of the secondary/primary ribs. The species *P. jaworskii* usually is less densely ribbed throughout the development and it is much more evolute. Similar differences are found between *P. guziki* sp. n. and *P. petrosus* (S. R.).

The species *Perisphinctes (C). rutteni* Jaw. differs from *P. (C.) guziki* sp. n. in straight or weakly concave but never flexuous ribs and in coiling of inner whorls (*cf.* Text-fig. 14*B*).

Occurrence. — Sierra de los Organos, Jagua Fm. (Jagua Vieja Member). The specimens were found at La Jutía (holotype) and El Hoyo de la Sierra (paratype).

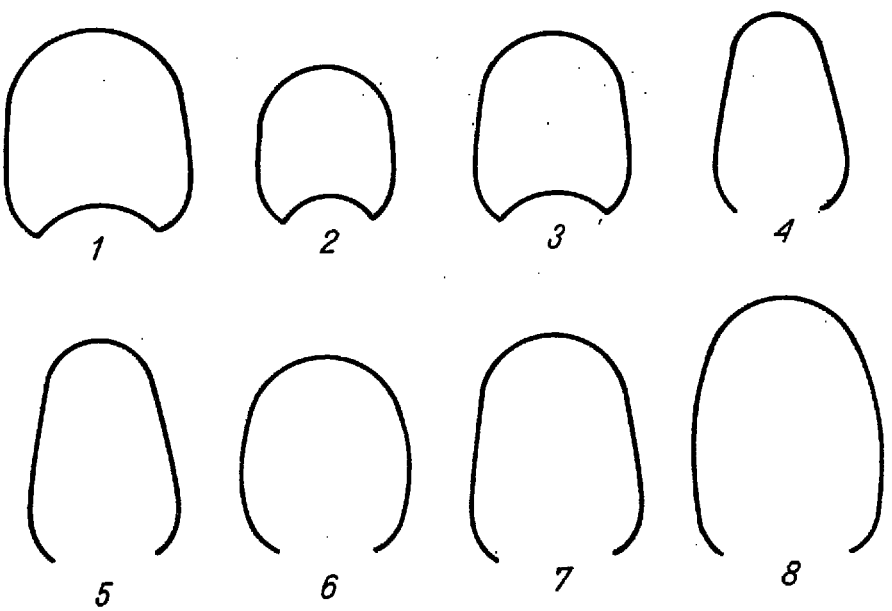

Fig. 15. Whorl sections in the subgenus *Cubasphinctes*

1 — *Perisphinctes (Cubasphinctes) jaworskii* Chudoley & Furrazola, specimen No. P-4 at D = 80 mm; *2* — *P. (C.) cubanensis* O'Connell, HSA-2 at D = c. 60 mm; *3* — *P. (C.) intermedius* Chudoley & Furrazola, HSA-6 at D = c. 70 mm; *4* — *P. (C.) rutteni* Jaworski, 2391 at D = c. 80 mm; *5* — *P. (C.) guziki* sp .n., holotype (2013) at D = c. 80 mm; *6* — *P. (C.) albeari albeari* Chudoley & Furrazola, 2443 at D = 70 mm; *7* — *P. (C.) guanensis* Sánchez Rolg, 2029 at D = c. 90 mm; *8* — *P. (C.) planatus* Sánchez Rolg, HSA-7 at D = c. 85 mm

THE GROUP *PERISPHINCTES (CUBASPHINCTES) ALBEARI*

Perisphinctes (Cubasphinctes) albeari Chudoley & Furrazola-Bermúdez, 1968

This species was previously splitted into three subspecies (*cf.* Judoley & Furrazola-Bermúdez 1968): *Perisphinctes albeari albeari* Chud. & Fur., *P. albeari ampliumbilicatus* Chud. & Fur., and *P. albeari intermedius* Chud. & Fur. The latter is here interpreted as full species and transferred into the *Perisphinctes (Cubasphinctes) jaworskii* group. The remaining two subspecies are here distinguished in accordance with their original definition within *P. albeari*. Dimensions of representatives of these subspecies are given below.

Judoley & Furrazola-Bermúdez (1968) allocated their species *Perisphinctes albeari* in the subgenus *Arisphinctes*. However, the analysis of sculpture development in the nominate subspecies (*cf.* Text-fig. 16*A*) has indicated that this form and thus the species belongs to the subgenus *Cubasphinctes*.

Table 19

Locality	Specimen No.	D (mm)	Ud (%)	Wh (%)	Wb (%)	h : b	S/P at D 20–40	40–60	60–80	80–100	100–120	140–160
Perisphinctes albeari albeari												
	holotype (JF-54)	126	43	32	25	1.28			3.2	3.0	2.6	
Sierra de Guane	2458	103	42.7	34.5								
		70	42.1	34.3					2.6	2.6	2.0	
Sierra de Guane	2443	73	36.4	37.6								
		57	36	38.6			2.0	2.4	2.8			
Perisphinctes albeari ampliumbilicatus												
El Hoyo de la Sierra	holotype (JF-55)	172	49	29							2.6	2.0

Dimensions of the holotypes after Judoley & Furrazola-Bermúdez (1968).

Perisphinctes (Cubasphinctes) albeari albeari Chudoley & Furrazola-Bermúdez, 1968 (Text-figs 15, 16; Pl. 5, Figs 5–6)

1966. *Perisphinctes (Arisphinctes) albeari albeari* Chudoley & Furrazola; Judoley & Furrazola-Bermúdez, pp. 81–82, Pl. 24, Fig. 1a–d (holotype); Pl. 26, Fig. 1a–c; Pl. 32, Fig. 3.

Material. — Two specimens (No. 2443 and 2458).

Description. — Usually moderately evolute but sometimes close to the evolutness/involutness boundary (*cf.* Table 19 — specimen No. 2443; *cf.* also Text-fig. 16*B* and Pl. 5, Fig. 6). Whorl section ovate, whorl sides flattened (Text-fig. 15).

Ribs strong, with a marked twist at umbilical wall, prorsiradiate on whorl sides, flexuous. The style of ribbing changing along with shell size.

Particular specimens do not display any larger changes in number of primary ribs per whorls up to 80–90 mm diameter (Text-fig. 16*A*). The innermost whorls are covered with biplicate, single and some intercalatory ribs; point of furcation marked at about two-thirds of whorl height. Subsequent whorls are primarily ornamented with biplicate ribs accompanied by progressively more numerous intercalatories. Some of the latter display a trend to join the primary ribs but as a rule not at the point of normal furcation. This results sometimes in origin of typical triplicate ribs with dischizotomous subdivision (*cf.* Judoley & Furrazola-Bermúdez 1968, Pl. 32, Fig. 3).

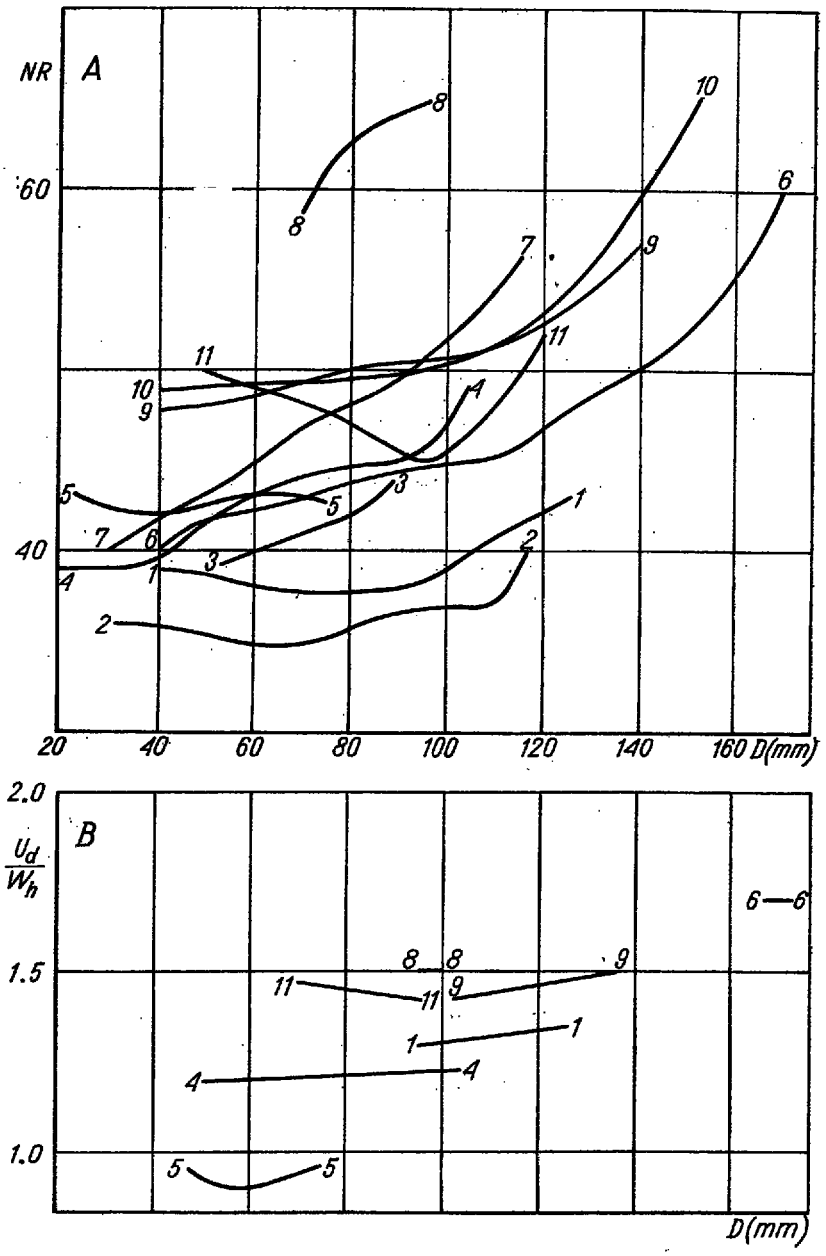

Fig. 16. Rib-curves (A) and character of coiling treated as the ratio of umbilical diameter/whorl height (B) for *Perisphinctes (Cubasphinctes) albeari* Chudoley & Furrazola and *Perisphinctes (Cubasphinctes) guanensis* Sánchez Roig

P. (C.) albeari albeari Chud. & Fur.: *1* holotype (JF-54), *2* paratype (JF-64), *3* paratype (JF-56) *4* specimen No. 2458, *5* 2443;

P. (C.) albeari ampliumbilicatus Chud. & Fur.: *6* holotype (JF-55), *7* JF-58 (= *P. albeari intermedius* in Judoley & Furrazola-Bermúdez 1968, Pl. 29, Fig. 1a—d);

P. (C.) guanensis Sánchez Roig: *8* holotype (JF-60), *9* 2029, *10* rib-curve of *P. guanensis* after Judoley & Furrazola-Bermúdez (1968, Text-fig. 11) most likely referable to the specimen JF-6 of that paper (Pl. 34, Fig. 1);

P. (C.) aff. *guanensis* Sánchez Roig, *11* 2025.

Rib-curves of specimens JF-55, JF-56, JF-58, JF-61 and JF-64 are constructed after the illustrations presented by Judoley & Furrazola-Bermúdez (1968)

Outer whorl, from the diameter 80—90 mm onwards, displays distinct crowding of primary ribs (Text-fig. 16*A*), and decrease of the value of the secondaries/ /primaries ratio (Table 19).

Constrictions fairly numerous, rather narrow and deep on inner whorls, wedge-like, widening and becoming deeper towards the venter later.

Variability fairly high, expressed in differences in number of primary ribs per whorl, coiling, and development of dischizotomous ribs. The holotype of this subspecies and one of the paratypes (Judoley & Furrazola-Bermúdez 1968, Pl. 32, Fig. 3) represent less densicostate and more evolute variety (*cf.* Text-fig. 16*A*-*B*) with distinct dischizotomous subdivision of ribs. The other paratype (Judoley & Furrazola-Bermúdez 1968, Pl. 26, Fig. 1) and all the specimens studied by the present author represent the variety more densicostate and often less evolute (*cf.* Pl. 5, Fig. 6 and Text-fig. 16*A*-*B*) with a some tendency to development of the dischizotomous subdivision of ribs.

The subspecies *Perisphinctes albeari albeari* differs from *P. (Cubasphinctes) planatus* S. R. in less numerous primary ribs especially at larger diameter (*cf.* Text--figs 16*A*-17*A*) and, except some more densicostate representatives (Pl. 5, Fig. 6), in more evolute coiling (*cf.* Text-figs 16*B*—17*B*). The subspecies *Perisphinctes albeari albeari* differs from *P. (Cubasphinctes) guanensis* S. R. in less numerous ribs and their distinct flexuous course.

All the ammonites of the *P. (Cubasphinctes) jaworskii* group differ from *P. albeari albeari* in distinct crowding of ribs on inner whorls. However, it should be added that some species of this group, namely *Perisphinctes jaworskii* Chud. & Fur. and *P. petrosus* (S. R.), are fairly close to less densely ribbed variety of *P. albeari albeari*; in turn, *P. cubanensis* O'Con. appears similar to more densely ribbed variety of that subspecies.

Occurrence. — Sierra de los Organos, Jagua Fm. (Jagua Vieja Member). The specimens studied by the present author are derived from Sierra de Guane; one of the paratypes (Judoley & Furrazola-Bermúdez 1968, Pl. 26, Fig. 1) was found at El Hoyo de la Sierra; the holotype is derived from unknown locality.

Perisphinctes (Cubasphinctes) albeari ampliumbilicatus Chudoley & Furrazola-Bermúdez, 1968
(Text-fig. 16)

1968. *Perisphinctes (Arisphinctes) albeari ampliumbilicatus* Chudoley & Furrazola; Judoley & Furrazola-Bermúdez, pp. 82—83, Pl. 25, Fig. 1a—c and Pl. 26, Fig. 2 (holotype).

?1968. *Perisphinctes (Arisphinctes) albeari intermedius* Chudoley & Furrazola; Judoley & Furrazola-Bermúdez, pp. 83—84 (partim), Pl. 29, Fig. 1a—d; non Pls 27—28.

Remarks. — This subspecies is not represented in the collection under study. Its holotype closely resembles representatives of *P. albeari albeari*, differing in more evolute coiling. The subspecies presumably also comprises one of specimens described as *P. albeari intermedius* by Judoley & Furrazola-Bermúdez (1968, Pl. 29, Fig. 1a—d) which differs from the holotype of *P. albeari intermedius* (here treated as full species *P. intermedius* Chud. & Fur.) in the lack of distinct crowding of ribs on inner whorls. This feature along with the markedly evolute coiling of whorls and the style of ornamentation brings this specimen closer to the holotype of *P. albeari ampliumbilicatus*, from which it differs in higher number of primary ribs per whorl (*cf.* Text-fig. 16*A*).

Occurrence. — Sierra de los Organos, Jagua Fm. (Jagua Vieja Member). The holotype was found at El Hoyo de la Sierra.

Perisphinctes (Cubasphinctes) guanensis Sánchez Roig, 1951
(Text-figs 15, 16; Pl. 5, Fig. 7; Pl. 6, Fig. 1)

1951. *Perisphinctes (Discosphinctes) guanensis* Sánchez Roig; Sánchez Roig, pp. 72—73, Pl. 20, Figs 3—4 (holotype).
1951. *Perisphinctes (Dichotomosphinctes) gregarius* Sánchez Roig; Sánchez Roig, pp. 78—79, Pl. 27, Figs 1—2.
1956. *Perisphinctes (?Arisphinctes) guanensis* Sánchez Roig; Arkell, p. 573.
1968. *Perisphinctes (Arisphinctes) guanensis guanensis* Sánchez Roig; Judoley & Furrazola-Bermúdez, pp. 84—86, Pl. 31, Fig. 1a—d (holotype); Pl. 34, Fig. 1.
1968. *Perisphinctes (Arisphinctes) guanensis multicostatus* Chudoley & Furrazola; Judoley & Furrazola-Bermúdez, pp. 87—88, Pl. 33, Fig. 1a—c; Pl. 34, Fig. 2.

Material. — One specimen (No. 2029) belonging to this species and another (No. 2025), very close to it and identified as *P. aff. guanensis*.

Dimensions:

Table 20

Locality	Specimen No.	D (mm)	Ud (%)	Wh (%)	Wb (%)	h : b	S/P at D 60—80	80—100	100—120	120—140
Perisphinctes guanensis										
Puerta de la Muralla	holotype (JF—60)*	96.5	45	30	22	1.36	3.0	2.6		
La Jutía	2029	136	?45	?30						
		102	?47	?33				3.0		?2.0
Perisphinctes aff. guanensis										
La Jutía	2025	96	46.2	32.3	25	1.3	3.0	3.4		

*dimensions after Judoley & Furrazola-Bermúdez (1968).

Description. — Form markedly evolute; whorl section initially ovate, later trapezoidal; whorl sides flattened; venter weakly convex (Text-fig. 15).

Ribs strong, sharp-crested, with a marked twist at umbilical wall, prorsiradiate on whorl sides, straight, weakly concave or slightly flexuous. The style of ribbing changing along with shell size (Text-fig. 16*A*).

The particular specimens display roughly the same number of ribs on inner and middle whorls; whereas the ribs on the outer whorl gradually become more densely spaced (Text-fig. 16*A*). Middle whorls and initial part of outer whorl are ornamented with bi- and triplicate and some intercalatory ribs; triplicate ribs sometimes show dischizotomous subdivision; point of furcation usually situated at about three-fourths of whorl height or, in case of dischizotomous subdivision, also lower. The ratio of secondary/primary ribs is the greatest (3.0 or somewhat more) on middle whorls or initial part of the outer whorl (Table 20); subsequently, on the outer whorl single and biplicate ribs accompanied by some intercalatories predominate and the ratio diminishes to about 2.6—2.0.

Inner whorls of the holotype of *P. guanensis* are obscure; number of primary ribs equals 59 at 70 mm diameter, increasing later, on the outer whorl to about 65 at 95 mm diameter. The increase in number of primary ribs is accompanied by decrease in value of the secondaries/primaries ratio (Text-fig. 16*A* and Table 20). Other representatives of this species (cf. Text-fig. 16*A*) have about 48—50 primaries on inner as well as middle whorls, and the crowding of ribs on the outermost whorl begins not before the 100—110 mm diameter. These differences may be attributed to intraspecific variability.

Constrictions fairly numerous, delineated by distinct ribs, initially narrow, later wide and shallow. Some constrictions continue from the venter to umbilical

margin without marked change in width. Such constrictions are sometimes followed by two single ribs. Other constrictions are wedge-like, wider at the venter and obliquely cut towards the dorsal side by the succeeding rib of the parabolic type.

The form referred to as *P.* aff. *guanensis* (Text-fig. 16*A–B*, Table 20 and Pl. 5, Fig. 7) differs from *P. guanensis* in some crowding of ribs on inner whorls, which brings it closer to some species of the *P. (Cubasphinctes) jaworskii* group (*cf.* also remarks below).

Remarks. — Sánchez Roig (1951) distinguished two separate species, *Perisphinctes guanensis* and *P. gregarius*, which were subsequently interpreted by Judoley & Furrazola-Bermúdez (1968) as two subspecies, *P. guanensis guanensis* and *P. guanensis multicostatus* Chud. & Fur. (erroneous new name for *P. gregarius* — cf. A. Torre 1973; it should be noted that the holotypes of *P. gregarius* and *P. guanensis multicostatus* are specimens very close to each other). The nominate subspecies, according to Judoley & Furrazola-Bermúdez (1968), had to differ from the latter in being less densicostate and in more rectiradiate ribs. However, the holotype of *P. guanensis* is relatively denser ribbed than other representatives of this species (Text-fig. 16*A*) as well as those allocated in the subspecies *P. guanensis guanensis* by Judoley & Furrazola-Bermúdez (1968, Fig. 11). On the other hand *P. gregarius* (= *P. guanensis multicostatus*) does not seem to be denser ribbed on inner and middle whorls than the holotype of *P. guanensis* (cf. relevant figures in: Sánchez Roig 1951, and Judoley & Furrazola-Bermúdez 1968). Judoley & Furrazola-Bermúdez (1968) estimated the number of ribs per half of whorl of *P. guanensis multicostatus* at 41; however, this seem to be the case of a last half of the outer whorl, characterized by extremely strong crowding of ribs. Estimations made for the whole last whorl have given values of the order of 70—75 ribs, i.e. not much different from those found for the holotype and other representatives of *P. guanensis* (cf. Text-fig. 16*A*). Moreover, there seems to be no difference in course of ribs in *P. gregarius* (= *P. guanensis multicostatus*) and the holotype and other representatives of *P. guanensis;* and all the other features seem to be in common. Therefore it is concluded that *P. gregarius* (= *P. guanensis multicostatus*) is a junior synonym of *P. guanensis.*

Judoley & Furrazola-Bermúdez (1968) have also proposed a third subspecies within the species *P. guanensis*, based on the holotype of *P. planatus* Sánchez Roig, 1951, and incorrectly named *P. guanensis angustiumbilicatus* Chud. & Fur. However, *Perisphinctes (Cubasphinctes) planatus* Sánchez Roig is here treated as full species.

Subgeneric status of *P. guanensis* was a subject of controversy (*cf.* synonymy), and Judoley & Furrazola-Bermúdez (1968) assigned it to the subgenus *Arisphinctes.* According to the present author the style of ornamentation appears typical of the subgenus *Cubasphinctes*, whereas ribs not crowded on inner whorls indicate its affiliation with the *P. (Cubasphinctes) albeari* group.

The species *Perisphinctes guanensis* is more evolute than *P. planatus* (cf. Text-figs 16*B*, 17*B* and Tables 20—21) and has different course of ribs.

The species *Perisphinctes guanensis* markedly differs from the species of the *P. (Cubasphinctes) jaworskii* group in ribs not crowded on inner whorls. The species *P. rutteni* Jaw. of that group appears somewhat similar, especially to *P.* aff. *guanensis* showing some crowding of ribs on the inner whorls (*cf.* Table 20, Text-fig. 16*A–B* and Pl. 5, Fig. 7); however, *P.* aff. *guanensis* is much more evolute than the former and its whorls are much thicker, which is typical feature of *P. guanensis.* The form *Perisphinctes* aff. *guanensis* differs from *P. (Cubasphinctes) intermedius* Chud. & Fur. in higher ratio of secondary/primary ribs, and fairly common occurrence of dischizotomous ribs.

Occurrence. — Sierra de los Organos, Jagua Fm. (Jagua Vieja Member). The holotype was found at Puerta de la Muralla nearby Guane; the type specimens of *P. gregarius* and *P. guanensis multicostatus* were found at Loma La Cutuna nearby Viñales; the specimen No. 2029 was found in the basal part of the Jagua Vieja Member at the transition to the Zacarías Member in La Jutía section; the specimen determined as *P.* aff. *guanensis*, was found also at La Jutía.

Perisphinctes (Cubasphinctes) planatus Sánchez Roig, 1951
(Text-figs 15, 17; Pl. 6, Figs 2—4)

1951. *Perisphinctes (Dichotomosphinctes) planatus* Sánchez Roig; Sánchez Roig, pp. 82—83, Pl. 25, Figs 1—2 (holotype).
1956. *Perisphinctes (?Arisphinctes) planatus* Sánchez Roig; Arkell, p. 373.
1968. *Perisphinctes (Arisphinctes) guanensis angustiumbilicatus* Chudoley & Furrazola; Judoley & Furrazola-Bermúdez, pp. 86—87 (partim), Pl. 30, Fig. 1a—d (holotype); Pl. 31, Fig. 2; Pl. 32, Fig. 2, ?Fig. 1a—c.

Material. — Five specimens (No. 2381, 2459, HSA-7 HSA-8 and P-2); moreover one specimen (No. P-5), close to this species and determined as *P.* aff. *planatus*.

Dimensions:

Table 21

Locality	Specimen No.	D (mm)	Ud (%)	Wh (%)	Wb (%)	h : b	S/P at D 20—40	40—60	60—80	80—100
Perisphinctes planatus										
Caiguanabo	holotype (JF-59)*	100	39.7	33	22.5	1.46				2.6
El Hoyo de la Sierra	2381	71	37.3	37.3	26.7	1.4	2.0	2.6	2.6	
Sierra de Guane	2459	70	38.5	37.8	28.5	1.32		2.6	2.6	
El Hoyo de S. Antonio	HSA-7	63	34.9	40						
		85	34.7	40	30	1.33		2.2	2.6	
El Hoyo de S. Antonio	HSA-8	55	36.3	39.1						
		87	38	37	28.7	1.29		2.0		2.6
El Hoyo de S. Antonio	P-2	80	37.5	37.5	27.5	1.36	2.0	2.4		
Perisphinctes aff. planatus										
El Hoyo de S. Antonio	P-5	71	40	35						
		96	40	36.5				2.0	2.2	2.8

*dimensions after Judoley & Furrazola-Bermúdez (1968).

Description. — Coiling initially moderately evolute, later close to the evolutness/involutness boundary, and finally again more evolute (Text-fig. 17*B*); whorl section initially ovate, later high-ovate, sometimes almost trapezoidal, thickest somewhat above umbilical wall (Text-fig. 15). Whorl sides flattened. Thickness of whorl variable (Wb ranging from 22.5% to 30% at D = 80—100 mm; *cf.* Table 21).

Ribs strong, with a marked twist at umbilical wall, prorsiradiate on whorl sides, somewhat flexuous. The style of ribbing changing along with shell size (Text-fig. 17*A*). Inner whorls covered with biplicate, single and some intercalatory ribs; point of furcation situated high, at two-thirds to three-fourths of whorl height. Number of primary ribs per whorl ranges from 43 to 51 at about 30 mm diameter (Text-fig. 17*A*), increasing on middle and outer whorls to 50—65 at 80—90 mm diameter. The middle and outer whorls covered with biplicate and triplicate ribs,

the latter sometimes with dischizotomous subdivision; occasionally bidichotomous ribs are present; some intercalatories occur.

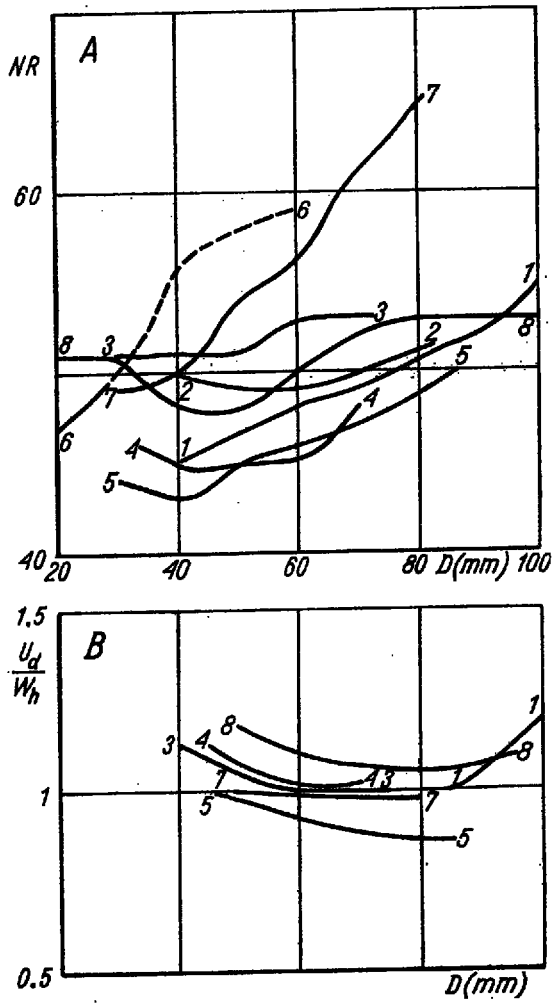

Fig. 17. Rib-curves (A) and character of coiling treated as the ratio of umbilical diameter/whorl height (B) for *Perisphinctes (Cubasphinctes) planatus* Sánchez Roig

1 holotype (JF-59), 2 specimen No. JF-61 (= *P. guanensis angustiumbilicatus* in Judoley & Furrazola-Bermúdez 1968, Pl. 31, Fig. 2), 3 2361, 4 2459, 5 HSA-7, 6 HSA-8, 7 P-2; 8 *P.* aff. *planatus* Sánchez Roig, P-5. Rib-curves of specimens JF-59 and JF-61 are constructed after the illustrations presented by Judoley & Furrazola-Bermúdez (1968)

Constrictions fairly numerous, narrow, deep and uniform in width on inner whorls; often wedge-like, widening and deepeing towards the venter later, as in *P. guanensis*. They are followed by one or two single ribs.

The specimen No. *P-5*, determined as *P.* aff. *planatus*, differs from typical representatives of this species in more evolute coiling and some crowding of ribs on inner whorls (*cf.* Table 21, Text-fig. 17 and Pl. 6, Fig. 4).

Remarks. — The holotype of *P. planatus* Sánchez Roig, 1951, was refigured by Judoley & Furrazola-Bermúdez (1968, Pl. 30, Fig. 1a—d) and, in contradiction with the rules of the ICZN, chosen as the holotype of new subspecies *P. guanensis angustiumbilicatus* Chud. & Fur., 1968. Thus the latter name is invalid (*cf.* also A. Torre 1973). Moreover, it should be added that *P. planatus* markedly differs from *Perisphinctes guanensis* S. R. and should be treated as a separate species.

The species *Perisphinctes planatus* most probably belongs to the subgenus *Cubasphinctes*. The type of sculpture appears close to that of the *P. (Cubasphinctes) albeari* group, and especially to the species *P. albeari* Chud. & Fur. However, all the representatives of *P. planatus* hitherto known display more or less distinct increase in number of primary ribs on outer whorl, whereas the ratio of secondary/primary ribs remains rather high (*cf.* Table 21, Text-fig. 17*A*); and the ammonites of the subgenus *Cubasphinctes* are characterized sooner or later by increase in number of primary ribs on outer whorl accompanied by decrease in the value of the secondaries/primaries ratio. Unfortunately, these specimens of *P. planatus* which seem to be almost fully grown have near-peristomal part broken off; their final sculpture remains therefore unknown. On the other hand it should be remembered that the increase in the value of the secondaries/primaries ratio along with increasing size, coiling weakly evolute to involute, and high-ovate section of outer whorl bring *P. planatus* close to the Cuban representatives of the genus *Discosphinctes*.

Other differences between *P. planatus* and the remaining species of the *P. (Cubasphinctes) albeari* group were given above. The species in question differs from representatives of the *P. (C.) jaworskii* group primarily in the lack of any distinct crowding of ribs on inner whorls. However, the form *P.* aff. *planatus* (Pl. 6, Fig. 4; Text-fig. 17*A*) displays some crowding of ribs, and it resembles some species of this group, and especially *P. intermedius* Chud. & Fur., in dimensions and, partly, in the style of sculpture.

Occurrence. — Sierra de los Organos, Jagua Fm. (Jagua Vieja Member). The holotype was found in the Caiguanabo area (Sánchez Roig 1951), possibly at El Hoyo de la Sierra and not at Puerta de la Muralla nearby Guane as it was erroneously stated by Judoley & Furrazola-Bermúdez (1968, *cf.* explanations to their Pls 30—31, where are transposed names of type localities of *P. planatus* and *P. guanensis*). The remaining representatives of this species were found at El Hoyo de la Sierra, El Hoyo de San Antonio and Sierra de Guane.

Perisphinctes (Cubasphinctes) spp.

In all localities of the Jagua Formation (Jagua Vieja Member) in Sierra de los Organos there were found whorl fragments or incomplete specimens referable to the subgenus *Cubasphinctes* but specifically unidentifiable. The majority of these forms most probably represent the species described above, and only some of them display somewhat different combinations of features. Attention should be paid to the specimen No. 2463 from San Carlos Valley, very close to *P. ruttenі* Jaw. and differing from it only in the lower ratio of secondary/primary ribs (about 2.6 at 70 mm diameter), as in *P. guanensis* S. R.

Some ammonites from Sierra de los Organos (Jagua Fm., Jagua Vieja Member), inadequately illustrated and erroneously identified by Sánchez Roig (1920) also belong to the subgenus *Cubasphinctes* but their actual specific status is very difficult to establish. This is the case of the following ammonites: *Perisphinctes durangensis* (Sánchez Roig 1920, Pl. 1, Fig. 2—2A; Pl. 2, Fig. 4), *P. delgadoi* (ibidem, Pl. 4, Fig. 2—2A), *P.* aff. *elisabethae* (ibidem, Pl. 4, Fig. 3—3A), *P.* cf. *biplex* (ibidem, Pl. 5, Figs 3—4) and *Idoceras soteloi* (ibidem, Pl. 11, Fig. 2). Also a fragment of whorls described from the same beds as *Perisphinctes (Arisphinctes)* aff. *petrosus* by Judoley & Furrazola-Bermúdez (1968, pp. 89—90, Pl. 36, Fig. 1a—d) belongs to this subgenus. It differs from *P. (Cubasphinctes) petrosus* (S. R.) in more massive and less protruding ribs, and more dense ribbing on inner whorls; it is not excluded that it represents a new species or subspecies of *Cubasphinctes*.

In the lower part of the Jagua Formation (Zacarías Member) in Sierra de los Organos, the present author found several strongly deformed and incomplete, fairly large ammonites with occasional dischizotomous ribs, similar to those of *Cubaspinctes*. Some of these forms display distinct crowding of ribs on inner whorls and may belong to the *P. (C) jaworskii* group.

Subgenus *ANTILLOCERAS* subgen. n.
(Type species: *Perisphinctes antillarum* Jaworski, 1940)

Derivation of the name: from the Antilles.

Diagnosis. — Microconchs from about 40 mm to 100 mm in diameter. Aperture with a small lappets preceded by final constriction. Body chamber about a whorl long. Coiling from moderately involute to markedly evolute. Whorl section ovate (Text-fig. 20). Ribs visible on the whole whorl surface; they begin with a marked twist on umbilical wall, becoming prorsiradiate on whorl sides, straight, somewhat concave or flexuous. Inner whorls ornamented with fairly numerous biplicate and single ribs. On the initial part of outer whorl the primary ribs become more widely spaced (Text-figs 18—19), or the density of ribs is similar to inner whorls (Text-fig. 21); the biplicate and single ribs may be accompanied here by triplicate, sometimes dischizotomous ribs as well as some intercalatories. Last part of the outer whorl usually displays a more densely spaced biplicate and single ribs; the ribs are sometimes weaker than on the initial part of that whorl. Constrictions fairly numerous throughout the development, usually followed by 1—2 single ribs.

Remarks. — The type species of *Antilloceras* subgen. n. was originally described by Jaworski (1940) under the subgeneric name *Discosphinctes* Dacqué. The latter taxon was established on the basis of incomplete east-African material, and it remains the subject of remarkable controversies. Cuban ammonites here accommodated in the genus *Discosphinctes* markedly differ from those assigned to *Perisphinctes antillarum* Jaw., primarily in somewhat different style of ornamentation and trend of rib curve (steeply rising along with increasing size in the microconchs of the former and *U*-shaped in the latter — *cf.* Text-figs 22 and 18, respectively).

Other species allocated in *Antilloceras* subgen n., e.g. *Perisphinctes spathi* S. R. and *P. plicatiloides* O'Con., were usually placed in subgenus *Dichotomosphinctes* Buckman (*cf.* Jaworski 1940, Sánchez Roig 1951, Arkell 1956, Judoley & Furrazola-Bermúdez 1968). All these species including the type species of *Antilloceras* somewhat resemble *Dichotomosphinctes*, differing from typical representatives of the latter in generally smaller size, presence of dischizotomous ribs, somewhat different trend of rib curve and especially its initial part. Moreover, it should be added that *Dichotomosphinctes* is primarily based on European material of Middle Oxfordian age and it comprises microconchs with simple perisphinctoid sculpture which represent dimorphic counterparts of ammonites of the subgenera *Perisphinctes* and *Arisphinctes* (cf. Enay 1966). However, this name was often used for Oxfordian ammonites representing the same or roughly the same simple morphotype and derived from distant areas (e.g. *Dichotomosphinctes* recorded from Mexico) wherefrom there was no record of their dimorphic counterparts. Besides some Cuban ammonites misidentified as *Dichotomosphinctes* and the part of which may be allocated in *Antilloceras* subgen. n., there were recorded some ammonites referred to *Arisphinctes* which actually represent subgenus *Cubasphinctes*. It may be added that there is some evidence that the subgenera *Antilloceras* (m) and *Cubasphinctes* (M) comprise dimorphic counterparts (*cf.* remarks in description of *Cubasphinctes*).

Some Cuban species such as *Perisphinctes diversicostatus* S. R. and *P. anconensis* S. R. were allocated in subgenus *Dichotomosphinctes* by Judoley & Furrazola-Bermúdez (1968). However, the material on which these species are based is insufficient for unequivocal interpreting their subgeneric status. The species *Perisphinctes diversicostatus* was misinterpreted as a synonym of *P. spathi* by Judoley & Furrazola-Bermúdez (1968); according to the present author, it may represent either *Antilloceras* or *Cubasphinctes* (cf. remarks in description of *P. spathi*). The species *Perisphinctes anconensis* represented by a single incomplete specimen about 65 mm in diameter is characterized by simple ornamentation consisting of densely spaced single and biplicate ribs, and its subgeneric identification is difficult.

Occurrence. — Oxfordian, western Cuba, Sierra de los Organos (Jagua Fm.) and Sierra del Rosario (Francisco Fm.); northern Mexico, San Pedro del Gallo area (La Gloria Fm.).

Species assigned to the subgenus: *Perisphinctes (Antilloceras) antillarum* Jaworski, *P. (A.) spathi* Sánchez Roig, *P. (A.) plicatiloides* O'Connell.

Perisphinctes (Antilloceras) antillarum Jaworski, 1940) (Text-figs 18, 20; Pl. 6, Figs 5—7)

1940. *Perisphinctes (Discosphinctes) antillarum* Jaworski; Jaworski, pp. 114—117, Pl. 3, Fig. 7; Pl. 4, Fig. 3a—b; Pl. 5, Figs 4, 6; Pl. 7, Fig. 3a—b.
1956. *Perisphinctes (Discosphinctes) antillarum* Jaworski; Arkell, p. 573.
1961. *Perisphinctes (Discosphinctes) carribeanus* Jaworski; Imlay, Pl. 3, Fig. 12; non Pl. 3, Fig. 11.
1968. *Perisphinctes (Discosphinctes) antillarum* Jaworski; Judoley & Furtrazola-Bermúdez, Table (Text-fig. 10).
Lectotype (designated here): Jaworski (1940, Pl. 5, Fig. 4 and Pl. 3, Fig. 7).
Material. — Five specimens (No. 2009, 2382a, 2394, 2442 and 2690).

Dimensions:

Table 22

Locality	Specimen No.	D (mm)	Ud (%)	Wh (%)	Wb (%)	h : b
Puerta del Ancón	lectotype*	46	43.9	32.6		1.1
La Jutía	2009	32	37.5	37.5	30	1.25
Altos de S. Francisco	2690	40	40	33.7		
El Hoyo de la Sierra	2394	46	41.7	36		
Sierra de Guane	2442	48	37.5	40	30	1.33
		60	35	41.6		

*dimensions after Jaworski (1940).

Description. — Relatively small-sized; maximum diameter ranging from 40 to 70 mm or possibly somewhat more. Aperture with lappets. Body chamber somewhat under a whorl long. Coiling variable; usually evolute or sometimes close to the evolutness/involutness boundary in the case of inner whorls; evolute to moderately involute in the case of outer whorl (Text-fig. 18*B*). Whorl section ovate, later high-ovate; whorl sides flattened (Text-fig. 20).

Ribs usually strong, sharp-crested, with a marked twist at umbilical wall, prorsiradiate and somewhat flexuous on whorl sides. The style of ribbing changes along with shell size (Text-fig. 18*A*).

The ribbing dense on inner whorls, generally consisting of single and biplicate ribs. On the outer whorl the primary ribs become initially more widely spaced; biplicate and single ribs are here accompanied by triplicate ribs, sometimes even with dischizotomous subdivision, as well as some intercalatories. The ratio of secondary/primary ribs is here the highest, attaining up to 2.5. Close to the end of the outer whorl, biplicate and single ribs predominate and the ribbing becomes more dense; the ribs are somewhat thinner than on initial part of the whorl.

The individuals of this species at comparable growth stages markedly differ in number of primaries, up to 20 per whorl (Text-fig. 18*A*).

Constrictions numerous, strong, delineated by distinct ribs, followed by 1—2 single ribs. A rounded lappets developed above the mid-height and preceded by final constriction (*cf.* Jaworski 1940, Pl. 5, Fig. 4; also Pl. 6 Figs 5—6 here).

Remarks. — According to Judoley & Furrazola-Bermúdez (1968, p. 33) one of the three specimens of *P. antillarum* figured by Jaworski (1940, Pl. 7, Fig. 3a—b) represents inner whorls of the subgenus *Arisphinctes*. It should be added that the ammonites misidentified as *Arisphinctes* by Judoley & Furrazola-Bermúdez (1968)

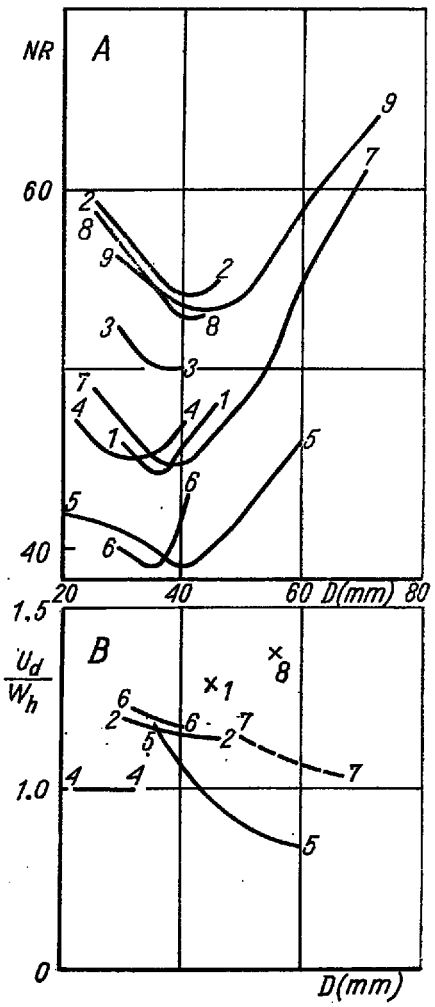

Fig. 18

P. (A.) antillarum Jaworski: *1* lectotype (cf. Jaworski 1940, Pl. 5, Fig. 4), *2* specimen No. 2394, *3* 2382a, *4* 2009, *5* 2442, *6* 2690, *7*, *8* paralectotypes (cf. Jaworski 1940, Pl. 4, Fig. 3a—b; Pl. 7, Fig. 3a—b), *9* (= *P. carribeanus* in Imlay 1961, Pl. 3, Fig. 12);

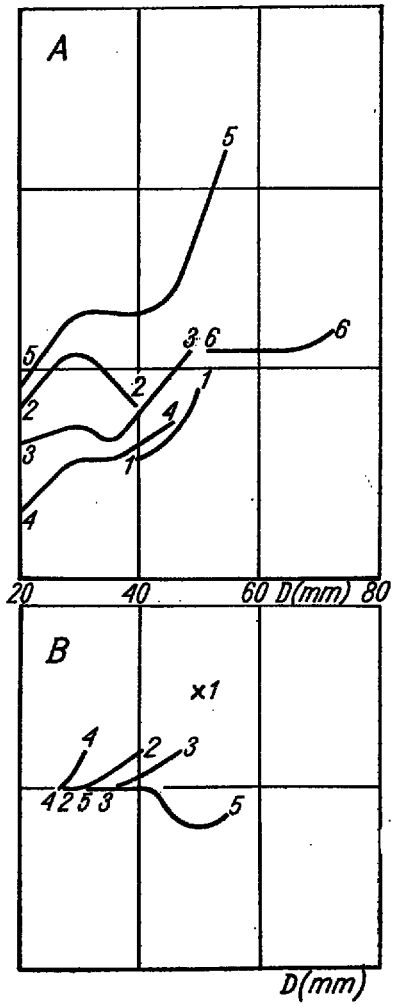

Fig. 19

P. (A.) spathi Sánchez Roig: *1* holotype, *2* specimen No. 2435, *3* 2479a, *4* 2447, *5* 2473b; For comparison: *6* — *Perisphinctes diversicostatus* Sánchez Roig, holotype JF-73 (cf. Sánchez Roig 1951, Pl. 26, Figs 1—3, cf. Judoley & Furrazola-Bermúdez 1968, Pl. 39, Fig. 1a—c)

Rib-curves (A) and character of coiling treated as the ratio of umbilical diameter/whorl height (B) for *Perisphinctes (Antilloceras) antillarum* Jaworski (Fig. 18) and *Perisphinctes (Antilloceras) spathi* Sánchez Roig (Fig. 19)

Rib-curves of specimens presented by Jaworski (1940), Sánchez Roig (1951) and Imlay (1961) are constructed after the illustrations

are macroconchs here placed in the subgenus *Cubasphinctes*. The lectotype of *P. antillarum*, designated here (*cf.* Jaworski 1940, Pl. 5, Fig. 4 and Pl. 3, Fig. 7), has aperture with lappets, whereas the remaining two specimens of type series (*ibidem*, Pl. 4, Fig. 3a—b and Pl. 5, Fig. 6; Pl. 7, Fig. 3a—b), although incomplete, appear to be very similar to the lectotype in the style of ribbing and rib-curves (*cf.* also Text-fig. 18*A*). All these specimens display markedly crowded biplicate and single ribs as early as 40—50 mm diameter, replacing somewhat less densely spaced ribs with more complex subdivision on the initial part of their outer whorl. The crowding of biplicate and single ribs, typical of the last stage of ornamentation, is never marked so early in the representatives of the subgenus *Cubasphinctes*. Thus it may be concluded that all the illustrated representatives of the type series of *P. antillarum* are conspecific microconchs which cannot be allocated in the subgenus *Cubasphinctes*.

The specimen described as *P. (Discosphinctes) carribeanus* Jaw. by Imlay (1961, Pl. 3, Fig. 12) is characterized by U-shaped rib curve (Text-fig. 18*A*) very close to that of *P. antillarum* and entirely different from that of *Discosphinctes carribeanus* (Jaw.). It presumably belongs to *P. antillarum*.

Occurrence. — Sierra de los Organos, Jagua Fm. (Jagua Vieja Member) and Sierra del Rosario (Francisco Fm.). In Sierra de los Organos the specimens were found at Puerta del Ancón (Jaworski 1940), La Jutía, El Hoyo de la Sierra, Sierra de Guane and Pan de Azúcar (Imlay 1961), and in Sierra del Rosario — at Altos de San Francisco.

Perisphinctes (Antilloceras) spathi Sánchez Roig, 1951
(Text-figs 19, 20; Pl. 6, Figs 8—9)

1951. *Perisphinctes (Dichotomosphinctes) spathi* Sánchez Roig; Sánchez Roig, pp. 78—80, Pl. 13, Figs 3—4, A (holotype).
1956. *Perisphinctes (Dichotomosphinctes) spathi* Sánchez Roig; Arkell, p. 573.
1968. *Perisphinctes (Dichotomosphinctes) spathi* Sánchez Roig; Judoley & Furrazola-Bermúdez, pp. 94—95 (partim); non Pl. 39, Fig. 1a—c.

Material. — Four specimens (No. 2435, 2447, 2473a and 2473b).

Dimensions:

Table 23

Locality	Specimen No.	D (mm)	Ud (%)	Wh (%)	Wb (%)	h : b
Jagua Vieja	holotype*	49	43	33.7	25.5	1.32
Sierra de Guane	2435	40	38.7	35		
Sierra de Guane	2447	31	40	35.5		
S. Carlos Valley	2473a	36	36	36	30	1.18
		46	39	36	27.2	1.32
S. Carlos Valley	2473b	42	37	37		
		50	36	41		

*dimensions after Sánchez Roig (1951).

Description. — Relatively small, 40—55 mm in diameter when fully grown. Aperture with lappets. Body chamber almost a whorl long. Coiling variable, initially close to the involutness/evolutness boundary and finally moderately evolute to

moderately involute (Text-fig. 19*B*). Whorl section ovate, becoming high-ovate later; whorl sides flattened (Text-fig. 20).

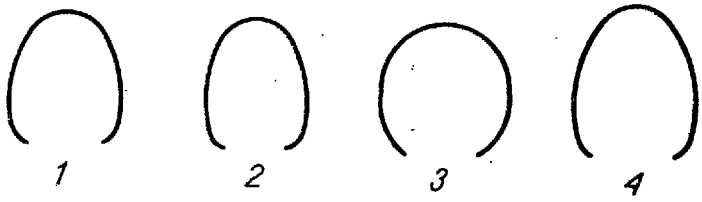

Fig. 20. Whorl sections in the subgenus *Antilloceras*
1 — *Perisphinctes (Antilloceras) antillarum* Jaworski, specimen No. 2442, at D = c. 45 mm; *2* — *P. (A.) spathi* Sánchez Roig, 2473a at D = c. 45 mm; *3* — *P. (A.) plicatiloides* O'Connell, 2403b at D = c. 50 mm; *4* — *P. aff. plicatiloides* O'Connell, 2480a at D = c. 55 mm

Ribs strong, sharp-crested, with a marked twist at the umbilicus, markedly prorsiradiate on whorl sides, straight or weakly concave, and as a rule flexuous close to the peristome. Point of furcation high, at about 2/3 of whorl height. The style of ribbing changing along with shell size (Text-fig. 19*A*).

Single and biplicate ribs predominate on inner whorls. Number of primary ribs gradually increasing up to 45—55 per whorl at about 30 mm diameter (Text-fig. 19*A*). The ribbing on the outer whorl tends initially to be somewhat less dense; the biplicate and single ribs are accompanied by some triplicate, usually dischizotomous ribs as well as by intercalatories. The ratio of secondary/primary ribs is here the highest, attaining up to 2.5. Close to the end of the outer whorl the ribbing becomes more dense; the ribs are mostly biplicate and single, and as a rule thinner than on earlier part of that whorl.

Constrictions numerous, deep, delineated by distinct ribs, usually followed by 1—2 single ribs. A small, rounded lappets situated somewhat above the mid-height and preceded by the final constriction (*cf.* the holotype and also Pl. 6, Figs 8—9 here).

Remarks. — Judoley & Furrazola-Bermúdez (1968) regarded *Perisphinctes diversicostatus* Sánchez Roig, 1951, as the subjective synonym of *P. spathi*, but at the same time they misinterpreted the holotype of *P. diversicostatus* as the holotype of *P. spathi*. However, both these forms are not comparable. The species *Perisphinctes diversicostatus* was based on a single specimen (Sánchez Roig 1951, Pl. 26, Figs 1—3; Judoley & Furrazola-Bermúdez 1968, Pl. 39, Fig. 1a—c), 72 mm in diameter, but originally much larger (which is evidenced by attached fragments of subsequent whorl), incomplete, and displaying traces of healed scar at the venter. The available part of the individual does not reveal any signs of maturity as e.g. increase in density of ribbing (*cf.* Text-fig. 19*A*). Thus the systematic position of *P. diversicostatus* remains debatable and it is only possible to assume that this form is affined either with *Cubasphinctes* or *Antilloceras*.

The species *Perisphinctes (Antilloceras) spathi* appears similar to *P. (A.) antillarum* differing in:

(i) less distinct decrease in density of ribbing at the beginning of the outer whorl and thus in somewhat different trend of rib curve (*cf.* Text-figs 18*A*—19*A*);

(ii) straight or even weakly concave ribs except for the part of the outer whorl close to the peristome where they are flexuous; whereas in *P. antillarum* the ribs are usually somewhat flexuous throughout the development.

Occurrence. — Sierra de los Organos, Jagua Fm. (Jagua Vieja Member); localities: Jagua Vieja (type locality), Sierra de Guane and San Carlos Valley (near El Junco).

Perisphinctes (Antilloceras) plicatiloides O'Connell, 1920
(Text-figs 20, 21; Pl. 7, Figs 1—4)

1912. *Perisphinctes* cf. *rota* Sinzow; Burckhardt, p. 21, Pl. 3, Fig. 3.
1920. *Perisphinctes plicatiloides* O'Connell; O'Connell, pp. 670—680, Pl. 36, Figs 1—2 (holotype).
1940. *Perisphinctes (Dichotomosphinctes) plicatiloides* O'Connell; Jaworski, pp. 118—124 (partim), ?Pl. 5, Fig. 5a—b; ?Pl. 6, Fig. 1a—b; non Pl. 4, Fig. 4.
1951. *Perisphinctes (Dichotomosphinctes) cubanianus* Sánchez Roig; Sánchez Roig, p. 75, Pl. 19, Figs 1—2.
1956. *Perisphinctes (Dichotomosphinctes) plicatiloides* O'Connell; Arkell, p. 573.
1968. *Perisphinctes (Dichotomosphinctes) plicatiloides* O'Connell; Judoley & Furrazola-Bermúdez, pp. 92—93 (partim), Pl. 23, Fig. 4; Pl. 39, Fig. 2; Pl. 40, Figs 1—2, 3a—c; non Pl. 39, Fig. 3; non Pl. 40, Fig. 4.

Material. — Seven specimens (No 2018, 2388, 2392, 2397, 2403b, 2410 and P-6); and two others (No. 2480a and 2480b), determined as *P. aff. plicatiloides* O'Con.

Dimensions:

Table 24

Locality	Specimen No.	D (mm)	Ud (%)	Wh (%)	Wb (%)	h : b
Perisphinctes plicatiloides						
Viñales	holotype*	45.6	46	31	30	1.1
		51.2	46	30	29	1.1
		62.8	49	28	27	1.1
El Hoyo de la Sierra	2392	57	45.6	33	28	1.18
El Hoyo de S. Antonio	P-6	55	43.6	31	29	1.06
El Hoyo de la Sierra	2397	57	45.6	31.6		
		71	45.8	32.4	29	1.1
La Jutía	2018	55	42	32.7		
El Hoyo de la Sierra	2388	49	43	33.6	31.6	1.06
El Hoyo de la Sierra	2403b	41	41.5	36.5		
		53	42.3	33	31	1.03
El Hoyo de la Sierra	2410	55	41.8	34.5	32.7	1.05
		70	42.8	34.3		
Perisphinctes aff. plicatiloides						
S. Carlos Valley	2480a	54	40	37	31.5	1.2
S. Carlos Valley	2480b	42	40.5	35.7		

*dimensions after O'Connell (1920).

Description. — Relatively small, from about 50 to 100 mm in diameter when fully grown, evolute (Text-fig. 21*B*). Aperture with lappets (*cf.* also remarks.) Whorl section low-ovate; whorl sides weakly flattened (Text-fig. 20).

Ribs strong, with a twist at the umbilicus especially well-marked at the end of the last whorl. The ribs prorsiradiate and as a rule somewhat flexuous on whorl sides. Ribbing biplicate, sometimes single or, occasionally triplicate; intercalatories rare. Point of furcation high, at two-thirds or three-fourths of the whorl height. Number of primary ribs per whorl changing along with shell size; it is roughly constant on inner whorls usually up to initial part of outer whorl, ranging from about 33 to 45 in particular specimens (Text-fig 21*A*); and as a rule gradually increasing on the outer whorl up to 40—60. The primary ribs become more densely spaced close to the peristome, where they are somewhat weaker than on earlier part of the outer whorl.

Constrictions fairly numerous, strong, delineated by distinct ribs, followed by 1—2 single ribs, becoming often more numerous close to the peristome, where they are accompanied by distinct increase in whorl height and width.

The intraspecific variability concerning the coiling and the density of ribbing, enables differentiations of two varieties. A less densicostate variety is as a rule more evolute than the more densicostate variety; however, there seems to be a grad transition between them (*cf.* Text-figs 21*A*—*B* and Table 24).

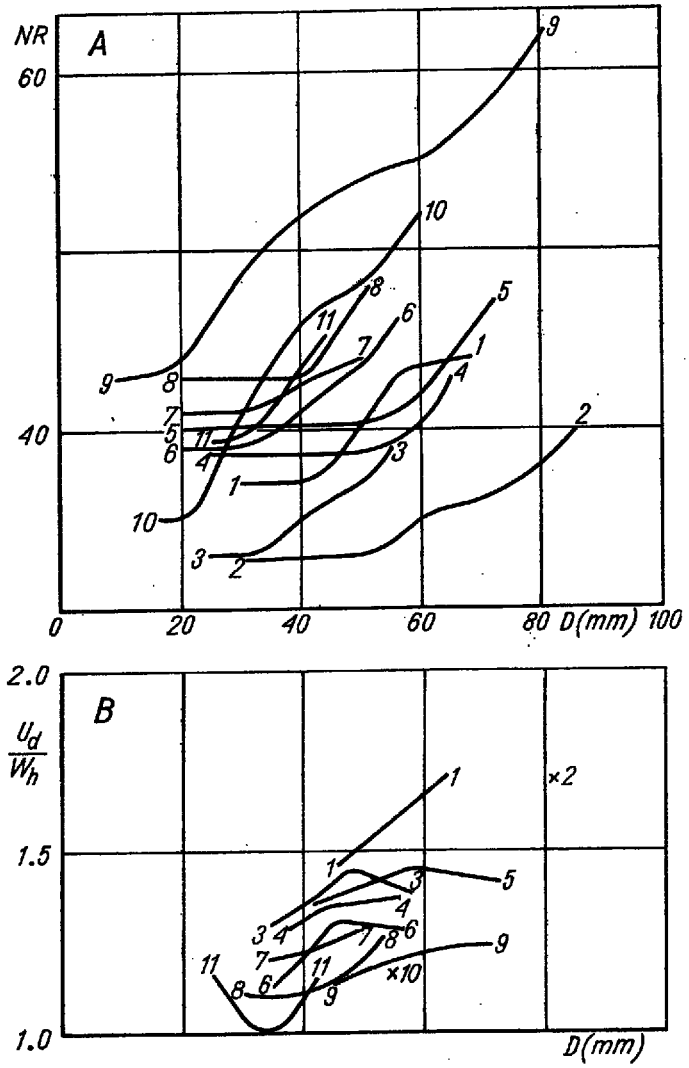

Fig. 21. Rib-curves (A) and character of coiling treated as the ratio of umbilical diameter/whorl height (B) for *Perisphinctes (Antilloceras) plicatiloides* O'Connell
1 holotype, *2* specimen No. JF-53 (cf. Judoley & Furrazola-Bermúdez 1968, Pl. 23, Fig. 4), *3* 2392, *4* P-6, *5* 2397, *6* 2018, *7* 2388, *8* 2403b, *9* 2410; *10*, *11* *P.* aff. *plicatiloides* O'Connell, 2480a; 2480b Rib-curves of specimens presented by O'Connell (1920) and Judoley & Furrazola-Bermúdez (1968) are constructed after the illustrations

The two specimens identified as *P.* aff. *plicatiloides* (Pl. 7, Fig. 4) differ from those assigned to the species in more ovate whorl section (*cf.* Text-fig. 20), relatively higher difference in density of ribbing of inner and outer whorls (*cf.* Text-fig. 21*A*) and in generally less evolute coiling (*cf.* Table 24 and Text-fig 21*B*).

Remarks. — Only one specimen known so far has final aperture with lappet preserved (Judoley & Furrazola-Bermúdez 1968, Pl. 39, Fig. 2; not illustrated side of the specimen, inspected recently by Dr. R. Myczyński). Other, fairly numerous individuals (*ibidem*, Pl. 40, Fig. 3; Sánchez Roig 1951, Pl. 19, Figs 1–2; and Pl. 7, Figs 1–2 here) display some crowding and weakening of ribbing on the last part of outer whorl, which seems to indicate that they are mature. Other, less complete specimens (*e.g.* No. 2388) are also fully grown, which is evidenced by approximated sutures. This along with some evidences given by Jaworski (1940) would indicate that this species comprises relatively small forms, up to 50–100 mm in diameter.

The species *Perisphinctes plicatiloides* along with other Cuban species was previously assigned to the subgenus *Dichotomosphinctes*. However, it cannot be referred to that subgenus (*cf.* remarks in description of the subgenus *Antilloceras*). The simple ornamentation of *P. plicatiloides* shows its close affinity with the representatives of the subgenus *Antilloceras*, *P. (A.) antillarum* Jaw. and *P. (A.) spathi* S. R.

It may be concluded that *P. plicatiloides* should be treated as a microconch species and can be easily accommodated in *Antilloceras*. This allocation is supported by the possible dimorphic connection of this species (*cf.* remarks on the dimorphism given in discussion of the subgenus *Cubasphinctes*).

The species *Perisphinctes plicatiloides* differs from *P. antillarum* and *P. spathi* in usually more evolute coiling (*cf.* Text-figs 18*B*, 19*B*, 21*B*), whorl section (*cf.* Text-fig. 20), ribs not crowded on inner whorls, somewhat different trend of rib curve (*cf.* Text-figs 18*A*, 19*A*, 21*A*) and generally lower ratio of secondary/primary ribs for the outer whorl.

Some representatives of *Vinalesphinctes (Roigites)* of the *catalinensis* group with predominant biplicate ribbing somewhat resemble *P. plicatiloides*, which resulted in a remarkable confusion. For example, *"Berriasella" catalinensis* Sánchez Roig [= *Vinalesphinctes (Roigites) catalinensis* (S. R.)] was placed into the synonymy of *P. plicatiloides* by Judoley & Furrazola-Bermúdez (1968) after the suggestion of Arkell (1956, p. 573). Other specimen misidentified as *P. plicatiloides* (cf. Jaworski 1940, Pl. 4, Fig. 4) is *Vinalesphinctes* possibly close to *V. (Roigites) catalinensis* (cf. remarks in description of *Vinalesphinctes* spp.), differing from *P. plicatiloides* in less numerous primary ribs, the lack of marked twist of the ribs on umbilical wall, and more numerous intercalatories.

The specimen from the Oxfordian of Mexico, described as *P.* cf. *rota* by Burckhardt (1912, Pl. 3, Fig. 3) presumably belongs to *P. plicatiloides*. Two other Mexican forms described as *P.* cf. *plicatilis* and *P.* aff. *plicatilis* by Burckhardt (1912, Pl. 4, Figs 1–2, 4–5, 10) seem to be close to *P. plicatiloides* (cf. O'Connell 1920), differing in secondary ribs passing through the venter in the zig-zag manner.

Occurrence. — Sierra de los Organos, Jagua Fm. (Jagua Vieja Member including its basal part at the transition to Zacarías Member); Viñales area (holotype), Laguna de Piedra, El Hoyo de la Sierra, El Hoyo de San Antonio and La Jutía; the specimens identified as *P. aff. plicatiloides* were found in San Carlos Valley, near El Junco. The species is known also from northern Mexico, San Pedro del Gallo area, Perisphinctes Beds (Burckhardt 1912, 1930) of the La Gloria Fm.

Perisphinctes (Antilloceras) spp.
(Pl. 6, Fig. 10)

Small, incomplete perisphinctids referable to *Antilloceras* or representing inner whorls of *Cubasphinctes* were found in all the exposures of the Jagua Vieja Member of the Jagua Fm. in Sierra de los Organos. Some specimens from these strata, unsatisfactorily figured and

erroneously named by Sánchez Roig (1920), may also belong to *Antilloceras*. This is the case of *Perisphinctes* aff. *alterniplicatus* (op. cit., Pl. 3, Figs 1, 4—5) and lappeted *Idoceras* sp. (op. cit., Pl. 11, Fig. 4).

Several deformed, specifically unidentifiable specimens referable to *Antilloceras* were found in the Zacarías Member of the Jagua Fm., Sierra de los Organos. The specimens are relatively small, up to 50—60 mm in diameter, ornamented primarily with biplicate and single ribs, 40—50 in number per whorl, markedly crowded close to the end of outer whorl. Some of them (*e.g.* No. 2030) have lappets.

Attention should be paid to two well-preserved specimens (No. 2012b, and 2445; Pl. 6, Fig. 10) of uncertain systematic position, derived from the Jagua Vieja Member of the Jagua Fm. Their dimensions are as follows:

specimen No. 2012b (from La Jutía): at D = 36 mm — Ud = 40%, Wh = 36.1%, Wb = 30%, h : b = 1.2, at D = 28 mm — Ud = 41%, Wh = 34%; number of primary ribs: 51 at D = 20 mm, 50 at D = 30 mm, 54 at D = 36 mm;

specimen No. 2445 (from Sierra de Guane): at D = 50 mm — Ud = 36%, Wh = 37% Wb = 33%, h : b = 1.12, at D = 42 mm — Ud = 34.5%, Wh = 38.1%; number of primary ribs: 48 at D = 35 mm, 49 at D = 40 mm, 48 at D = 45 mm, 51 at D = 54 mm.

The specimens are immature (sutures not approximated) and ornamented with sharp-crested, biplicate and single ribs, as well as fairly numerous parabolic ribs with more or less distinct parabolic nodes close to the venter. It should be noted that the parabolic nodes were not found on any representatives of *Antilloceras* studied. Jaworski (1940, p. 120) found the nodes in one of nonillustrated specimens assigned by him to *P. plicatiloides*. In turn, the parabolic nodes may be noted on the specimen misidentified as *P. rutteni* by Jaworski (1940, p. 107, Pl. 5, Fig. 2a—b). The latter appears similar in ornamentation to the two specimens described above. All these specimens somewhat resemble *P. (Antilloceras) spathi* S. R. in sculpture, dimensions and trend of rib curve but the lack of comparative material precludes unequivocal determination of their systematic position.

Genus *DISCOSPHINCTES* Dacqué, 1914
(Type species: *Perisphinctes arussiorum* Dacqué, 1905)

DESCRIPTION OF CUBAN *DISCOSPHINCTES*

Peristome unknown. Inner whorls usually subquadrate to subtrapezoidal, outer whorls more or less compressed, trapezoidal to ovate in cross section (Text-fig. 23). Whorl sides flattened, venter narrow; whorls thickest somewhat above umbilical wall. Coiling more or less involute, occasionally evolute. Two groups, presumably corresponding to micro- and macroconchs of this genus, may be distinguished on the basis of differences in ornamentation.

Microconchs attain 50—80 mm in diameter or somewhat more. Ornamented with sharp, usually biplicate and single ribs; triplicate, mono- or dischizotomous ribs are occasional. Some intercalatories may be noted. Number of primary ribs increases along with shell diameter; close to the aperture, the ribs become crowded (Text-fig. 22, curves No. *4—5, 9*).

Macroconchs attain 100—160 mm in diameter. Inner whorls covered with sharp, mainly biplicate and single ribs; triplicate and intercalatory ribs few. Primary ribs initially increase in number along with shell size up to 40—70 mm diameter, becoming progressively wider spaced thereafter (Text-fig. 22, curves No. *2—3, 7, ?8, 10—11, ?12, 14*). Outer whorl usually covered with triplicate, often dischizotomous ribs and with numerous intercalatories; only in few species biplicate ribs are dominant (cf. *Discosphinctes subguanensis* in: Judoley & Furrazola-Bermúdez 1968, Pl. 43, Fig. 1; Pl. 44, Fig. 1). The ratio of secondary/primary ribs ranges from about 2.5 to 3.5 for the outer whorl.

The micro- and macroconchs bear fairly numerous, narrow constrictions, usually deeper at the venter, and followed by 1—2 single ribs.

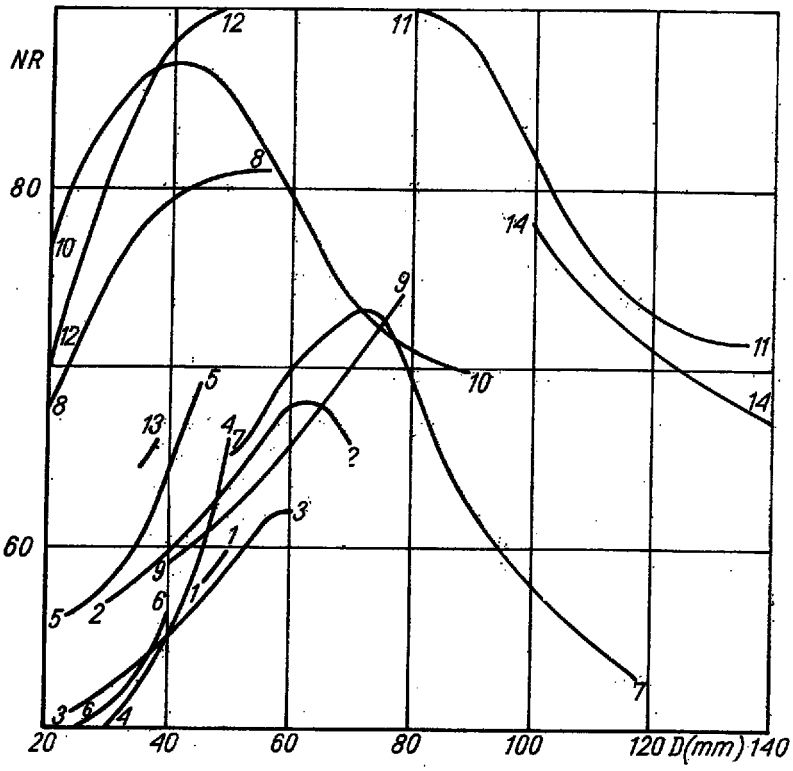

Fig. 22. Rib-curves of Cuban *Discosphinctes*

Discosphinctes carribeanus (Jaworski): *1* holotype, *2* specimen No. P-7, *3* P-8, *4* 2017, *5* 2461, *6* paratype (cf. Jaworski 1940, Pl. 8, Fig. 2);

D. aguayoi (Sánchez Roig): *7* holotype (JF-84), *8* 2389, *9* JF-80 (= *Ataxioceras virgulatus* in Sánchez Roig 1920, Pl. 8, Figs 1—3; cf. Judoley & Furrazola-Bermúdez 1968, Pl. 48, Fig. 4);

D. aff. *aguayoi* (Sánchez Roig), *10* 2024;

D. furrazolai sp. n.: *11* holotype (JF-85), *12* paratype (2409b);

D. subguanensis (Arkell): *13* holotype (JF-82), *14* JF-81 (cf. Judoley & Furrazola-Bermúdez 1968, Pl. 43, Fig. 1, Pl. 44, Fig. 1)

Rib-curves of specimens presented by Jaworski (1940), as well as of specimens JF-81, JF-82, JF-85, JF-90 (cf. Judoley & Furrazola-Bermúdez 1968) are constructed after the illustrations

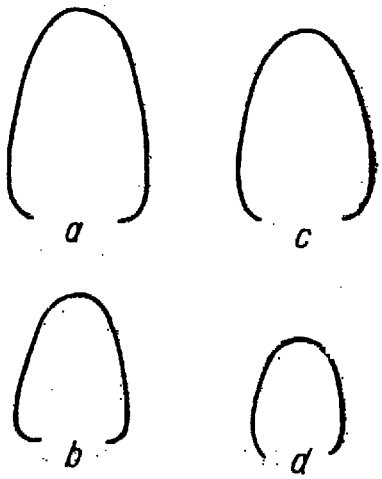

Fig. 23. Whorl sections of Cuban *Discosphinctes*

a — *Discosphinctes carribeanus* (Jaworski), specimen No. P-7 at D = c. 70 mm; b — ibidem, 2017, at D = c. 50 mm; c — *D.* aff. *aguayoi* (Sánchez Roig), 2024, at D = 70 mm; d — *D. furrazolai* sp. n., paratype (2409b) at D = 40 mm

DIMORPHISM IN CUBAN SPECIES OF *DISCOSPHINCTES*

The holotypes of the majority of species are represented by inner whorls, which makes their dimorphic interpretation difficult or even impossible. An attempt was made to identify micro- and macroconchs of the species using more complete specimens when possible (*cf.* descriptions of species). Presumable micro- and macroconch pairs were identified within *Discosphinctes carribeanus* (Jaw.) and *D. aguayoi* (S. R.), whereas only macroconchs were identified in the case of *Discosphinctes furrazolai* sp. n. and *D. subguanensis* (Ark.). The species *D. acandai* (Chud. & Fur.) and *D. pichardoi* (Chud. & Fur.) are represented by specimens so incomplete or badly preserved that it was impossible to identify dimorphic forms.

REMARKS ON THE GENUS *DISCOSPHINCTES*

The name *Discosphinctes* was originally proposed by Dacqué (1914) at the subgeneric rank within the genus *Perisphinctes*. This taxon was based on east African material (from Somaliland, Abyssinia, and Kenya), including the type species as well as *Perisphinctes fraasi* Dacqué (*cf.* Dacqué 1910, Pl. 4, Fig. 3), *P. aeniformis* Dacqué, 1914 [= *P. choffati* of Dacqué, 1905, Pl. 17, Fig. 3] and possibly some forms assigned to *P. mombassanus* Dacqué (*cf.* Dacqué 1910, Pl. 3, Fig. 4), as discussed by Dacqué (1914), Spath (1931, 1933), Arkell (1937, 1956). These ammonites are characterized by involute coiling, high-ovate or trapezoidal whorl section, narrowed ventral side, and ornamentation consisting of biplicate, densely-spaced ribs predominating on inner whorls and often replaced by bi-, triplicate, sometimes dischizotomous, wider-spaced ribs on outer whorl; some intercalatories appear on outer whorls. However, not numerous and incomplete material available precluded any more complete characteristics of this taxon, which resulted in controversies concerning its interpretation. The interpretation was additionally complicated by the fact that the stratigraphic range of these ammonites in the typical area of occurrence is still inadequately known. It was assumed that the ammonites occur in the Upper Oxfordian (Dacqué 1910, 1914; Arkell 1956), Oxfordian and Kimmeridgian (Spath 1933) or Kimmeridgian (Dacqué 1905). The recent study on Abyssinian faunas (Zeiss 1971) has shown that the stratigraphic range of these ammonites at least partly corresponds to the Kimmeridgian. It should be stated that the type species of this genus, *Perisphinctes arussiorum*, was reported by Dacqué (1905) from the beds yielding also *Simaspidoceras argobbae* and *S. irregulare*, i.e. species typical of the Lower Kimmeridgian (the Simaspidoceras argobbae Zone of Zeiss, 1971) of Abissynia.

The genus *Discosphinctes* was sometimes regarded as close to the Tithonian genus *Lithacoceras* Hyatt, 1900. Some authors considered that the two taxa cannot be separated (Schindewolf 1925, Spath 1931), whereas others interpreted *Discosphinctes* as subgenus of the latter (Geyer 1961, Enay 1966, Brochwicz-Lewiński 1972). In turn, some others regarded *Discosphinctes* as a taxon independant of *Lithacoceras* and comprising derivatives of Oxfordian *Dichotomosphinctes* (cf. Arkell 1937, 1957; Spath 1933); in this case *Discosphinctes* was interpreted as either subgenus of *Perisphinctes* (cf. Arkell 1937, 1956, 1957) or a separate genus (Spath 1933).

From the very beginning *Discosphinctes* was thought as a taxon comprising also some Oxfordian ammonites from Europe (*cf.* Dacqué 1914). Later this interpretation became very popular and exerted the decisive influence on systematic position of this taxon. It should be mentioned that, particularly in Europe, some Oxfordian (especially Middle Oxfordian) ammonites resembling *Lithacoceras* in morphology, were up to now assigned to this very genus. These Middle Oxfordian

ammonites were sometimes placed in subgenus *Discosphinctes* (e.g. Geyer 1961, Enay 1966, Malinowska 1972a, Brochwicz-Lewiński 1972), in subgenus *Lithacoceras* (cf. Brochwicz-Lewiński 1971) or in the new subgenus *Subdiscosphinctes* recently proposed by Malinowska (1972b). The relationship between these ammonites and Tithonian genus *Lithacoceras* is in contradiction with phylogenetic data (*cf.* Zeiss 1968) and the apparent similarity presumably results from homeomorphy. On the other hand, their affinity with African *Discosphinctes* is an open question, and they are placed in the genus *Subdiscosphinctes* by J. H. Callomon in the new edition of *Treatise on Invertebrate Paleontology*. The full diagnosis of the genus *Subdiscosphinctes* is given by Brochwicz-Lewiński (1975, p. 90).

The name *Discosphinctes* in subgeneric rank was also used in the case of some Cuban Perisphinctidae of the Jagua Formation (*cf.* Jaworski 1940; Imlay 1942, 1961; Arkell 1956; Judoley & Furrazola-Bermúdez 1968). Some of them, as e.g. *Perisphinctes antillarum* Jaworski, are at present translocated into *Antilloceras* subgen. n. of the genus *Perisphinctes*, while others are here described under the generic name *Discosphinctes*. The reasons of that decision are as follows:

(i) The characteristics of Cuban *Discosphinctes* and European *Subdiscosphinctes* indicate their similarity. Both groups are characterized by the occurrence of similar type of microconchs [10], characterized by predominance of biplicate and single ribs increasing in number along with diameter. In turn, macroconchs of both groups are characterized by outer whorls ornamented with more loosely spaced primary ribs and fairly numerous secondaries. Moreover, stratigraphic position of Cuban *Discosphinctes* and European *Subdiscosphinctes* is very similar. However, there are some important differences: Cuban *Discosphinctes* are markedly smaller, their macroconchs do not display blunt primaries on outer whorl and the ratio of secondary/primary ribs is there relatively low. The Cuban *Discosphinctes* and European *Subdiscosphinctes* may be phylogenetically related and in the future they should be probably assigned to the same genus but with a separation on the subgeneric level.

(ii) Cuban *Discosphinctes* appear to be similar to African *Discosphinctes* proper. However, on account of inadequate knowledge of the latter it is impossible to state whether they are phylogenetically related or simply homeomorphs.

(iii) The extension of the genus *Subdiscosphinctes* range to cover the Cuban forms seems now unjustified. Moreover, establishment of a new subgenus for the Cuban forms seems premature on account of scarcity and incompleteness of the material.

(iiii) In that situation the leaving of the Cuban forms in the genus *Discosphinctes* seems to be a better solution as it will not complicate the taxonomy when further its changes appear necessary.

(v) The Cuban ammonites, similarly as east-African *Discosphinctes* and European *Subdiscosphinctes* should not be placed in the genus *Perisphinctes* nor in *Lithacoceras*.

Cuban species assigned to this genus: *Discosphinctes carribeanus* (Jaworski), *D. aguayoi* (Sánchez Roig), *D. furrazolai* sp. n., *D. subguanensis* (Arkell), *D. acandai* (Chudoley & Furrazola-Bermúdez), *D. pichardoi* (Chudoley & Furrazola-Bermúdez).

Occurrence of the genus *Discosphinctes* in the Americas: Oxfordian of western Cuba, Sierra de los Organos (Jagua Fm.); northern Mexico, San Pedro del Gallo area (La Gloria Fm.). Moreover, poorly preserved ammonites presumably close to Cuban *Discosphinctes* are known from southern part of the United States (Imlay 1945, 1961). Ammonites of the genus *Discosphinctes* were also reported from the Oxfordian of Chile (Hillebrandt 1970).

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[10] Besides undoubtful *Subdiscosphinctes* microconchs with ornamentation of the isocostate type, Brochwicz-Lewiński (1974, 1975) distinguished within this genus a group of microconchs with ornamentation of the variocostate type with typical form *Subdiscosphinctes cracoviensis* (Siemiradzki 1891, Pl. 3, Fig. 1). Unfortunately, the aperture of the latter is unknown so its dimorphic interpretation may be questionable.

Discosphinctes carribeanus (Jaworski, 1940)
(Text-figs 22, 23; Pl. 7, Figs 5—7)

†1912. *Perisphinctes virgulatus* Quenstedt; Burckhardt, pp. 35—38, Pl. 7, Figs 4—14.
1940. *Perisphinctes (Planites) virgulatus* Quenst. var. *carribeana* Jaworski; Jaworski, pp. 109—114 (partim), Pl. 4, Fig. 5 and Pl. 7, Fig. 6 (holotype); Pl. 3, Fig. 2; non Pl. 3, Fig. 1.
1956. *Perisphinctes (Discosphinctes) carribeanus* Jaworski; Arkell, p. 573.
1961. *Perisphinctes (Discosphinctes) carribeanus* Jaworski; Imlay, Pl. 3, Fig. 11; non Pl. 3, Fig. 12.
1968. *Perisphinctes (Discosphinctes) carribeanus* Jaworski; Judoley & Furrazola-Benmúdez, pp. 96—98 (partim); non Pl. 44, Fig. 2; non Pl. 45, Fig. 1a—d; non Pl. 46, Fig. 1; non Pl. 48, Fig. 4.

Material. — Four specimens (No. 2017, 2461, P-7 and P-8).

Dimensions:

Table 25

Locality	Specimen No.	D (mm)	Ud (%)	Wh (%)	Wb (%)	h : b
Puerta del Ancón	holotype*	49	34.7	38.7		1.3
Sierra de Guane	2461	40	36.2	38.8	26.2	1.4
La Jutía	2017	47	36.1	40.4	31	1.3
El Hoyo de S. Antonio	P-7	52	31.7	40	29	1.38
		69	32.6	40	29	1.38
El Hoyo de S. Antonio	P-8	52	34.6	40.4		

*dimensions after Jaworski (1940).

Description. — The holotype and other specimens hitherto figured (*cf.* synonymy) are relatively small-sized, incomplete and presumably representing inner whorls. Two specimens at the author's disposal (No. *2017* and *2461*; Pl. 7, Fig. 7), attaining about 50 mm in diameter, are fairly complete, mature; however, the peristome is not preserved. The remaining two specimens (No. *P-7* and *P-8*; Pl. 7, Figs 5—6), attaining about 60 mm and 70 mm, respectively, are highly incomplete and represent phragmocone and initial part of body chamber. The differences in size and in trends of rib curves imply that these two groups of specimens may represent micro- and macroconchs of the same species.

The coiling initially close to the involutness/evolutness boundary, involute later (Table 25); whorls initially subquadrate in cross-section, later trapezoidal and high-trapezoidal, thickest somewhat above the umbilical wall (Text-fig. 23). Umbilical wall steep. Whorl sides flattened; ventral side narrow and weakly convex.

Ornamentation consisting of numerous sharp-crested, single, bi- or triplicate ribs and some intercalatories; ribs at umbilical wall with strong forward twist, markedly prorsiradiate on whorl sides and more or less flexuous; subdivision usually monoschizotomous at two-thirds of whorl height or somewhat lower; dischizotomous, triplicate ribs with sometimes markedly lowered point of first furcation are sometimes found.

Number of primary ribs per whorl changes along with shell diameter; moreover, it is possible to distinguish two types of rib curves, presumably corresponding to micro- and macroconchs of this species. Microconchs (Text-fig. 22, curves No. *4* and *5*, corresponding to specimens No. *2017* and *2461*, respectively; Pl. 7, Fig. 7) are characterized by a distinct increase in number of ribs along with diameter; close to the end of shell the ribs become crowded. Macroconchs (Text-fig. 22, curves No. 2 and 3, corresponding to specimens No. *P-7* and *P-8*, respectively; Pl. 7,

Figs 5—6) initially show some increase in number of ribs along with diameter; thereafter, from the diameter of about 60 mm the ribs become more widely spaced.

All the specimens display numerous narrow constrictions, usually deeper at the venter. Constrictions almost always followed by 1—2 simple ribs.

Remarks. — The variety *Perisphinctes virgulatus* Quenst. var. *carribeana*, distinguished by Jaworski (1940), was subsequently recognized as a full species, *P. (Discosphinctes) carribeanus* Jaworski, by Arkell (1956). The holotype of that species and one of the specimens figured by Jaworski (1940, Pl. 4, Fig. 5 and Pl. 3, Fig. 2) are presumably conspecific, whereas the other specimen of Jaworski (1940, Pl. 3, Fig. 1), differs from the former ones in smaller number of primary ribs and different trend of rib curve. This specimen presumably belongs not to the genus *Discosphinctes*, but rather to *Perisphinctes (Antilloceras* subgen. n.).

The specimens described as *Perisphinctes virgulatus* by Burckhardt (1912, Pl. 7, Figs 4—14) were commonly allocated in the synonymy of *Discosphinctes carribeanus* (Jaw.). However, the specimens are too incomplete and inadequately preserved for unequivocal assignation to this species.

According to Imlay (1961, p .D-24), the species *D. carribeanus* (Jaw.) may be identical with *"Perisphinctes" virgulatiformis* Hyatt, 1894, known from the Oxfordian Mariposa Formation (California, Sierra Nevada); however, the latter was based on fragmentary and poorly preserved paleontological material, insufficient for any reliable comparison.

The specimens described as *P. (Discosphinctes) carribeanus* Jaw. by Judoley & Furrazola-Bermúdez (1968) actually represent the species *Discosphinctes aguayoi* (S. R.) and *Discosphinctes furrazolai* sp. n.

The species *Discosphinctes carribeanus* (Jaw.) differs from *D. furrazolai* sp. n. and *D. subguanensis* (Ark.) in smaller number of ribs per whorl and less involute coiling. The species *Discosphinctes aguayoi* (S. R.) is characterized by straight or weakly concave ribs, whereas the ribs of *D. carribeanus* are more or less flexuous. The species *Discosphinctes acandai* (Chud. & Fur.) differs from *D. carribeanus* primarily in markedly higher number of ribs per whorl; *D. pichardoi* (Chud. & Fur.) differs from *D. carribeanus* in markedly less numerous ribs on inner whorls.

Occurrence. — Sierra de los Organos, Jagua Fm. (Jagua Vieja Member). The holotype was found in Puerta del Ancón, and the other specimens — in the same locality, as well as in La Jutía, Sierra de Guane, El Hoyo de San Antonio and Pan de Azúcar mogote. ?Northern Mexico, San Pedro del Gallo area, Ochetoceras Beds (Burckhardt 1912, 1930) belonging to the La Gloria Fm.

Discosphinctes aguayoi (Sánchez Roig, 1951)
(Text-figs 22, 23; Pl. 7, Figs 8—9)

1920. *Ataxioceras virgulatus* (Quenstedt); Sánchez Roig, pp. 23—25 (partim), Pl. 3, Figs 1—3; non Pl. 3, Figs 5—5A.

1951. *Perisphinctes (Dichotomosphinctes) aguayoi* Sánchez Roig; Sánchez Roig, pp. 77—78, Pl. 18, Fig. 3 and Pl. 19, Fig. 3 (holotype).

1956. *Perisphinctes (?Arisphinctes) aguayoi* Sánchez Roig; Arkell, p. 573.

1968. *Perisphinctes (Discosphinctes) carribeanus* Jaworski; Judoley & Furrazola-Bermúdez, pp. 96—98 (partim), Pl. 45, Fig. 1a—d (holotype); Pl. 48, Fig. 4.

Material. — One specimen (No. 2369); moreover, the other specimen (No. 2024) described as *D.* aff. *aguayoi*.

Description and remarks. — The holotype of *Discosphinctes aguayoi* was refigured and assigned by Judoley & Furrazola-Bermúdez (1968, Pl. 45, Fig. 1a—d; specimen No. JF-84) to *D. carribeanus*. This specimen is incomplete, 115 mm in

diameter; inner whorls moderately involute, outer whorl evolute (according to Judoley & Furrazola-Bermúdez 1968, Ud = 42% and Wh = 34% at 115 mm diameter); the outer whorl high-trapezoidal in cross-section, thickest just above umbilical wall (Wb = 20% and h : b = 1.7 at 115 mm diameter). Ribs numerous, sharp, with marked twist at umbilical wall and strongly prorsiradiate on whorl sides, straight or somewhat concave; outer whorl displays commonly bi- or triplicate, sometimes dischizotomous ribbing with some intercalatories; rib curve of the holotype of *D. aguayoi* reflects initially an increase in number of ribs along with diameter and later, from a diameter of about 70 mm, gradual decrease (Text-fig. 22, curve No. 7). The rib curve of such type implies that this specimen represents a macroconch.

In the material studied by the present author there is an incomplete specimen (Pl. 7, Fig. 8), about 60 mm in diameter, comparable with inner whorls of the holotype of *D. aguayoi*. The specimen is involute (Ud = 31% and Wh = 40% at 53 mm diameter) and ornamented with straight or somewhat concave ribs. Its rib curve (Text-fig. 22, curve No. 8) appears similar to that of the holotype, reflecting somewhat denser ribbing of the former.

The above characteristics of the two specimens indicates their certain resemblance to *D. carribeanus* (Jaw.). However, they differ from the latter species primarily in ribs straight to somewhat concave, and not flexuous. This feature separates also these two specimens from all the hitherto known Cuban species of *Discosphinctes*. Therefore the present author decided to separate *D. aguayoi* from *D. carribeanus* as a different species. However, it is not excluded that along with supply of new material it will be necessary to treat *D. aguayoi* as a subspecies of *D. carribeanus*.

The species *D. aguayoi* presumably also comprises the specimen described as *Ataxioceras virgulatus* (Quenstedt) by Sánchez Roig (1920, Pl. 8, Figs 1—3) and subsequently assigned to *D. carribeanus* by Judoley & Furrazola-Bermúdez (1968, Pl. 48, Fig. 4). This specimen, about 80 mm in diameter, displays ornamentation typical of *D. aguayoi* except for the end part of the outer whorl ornamented with crowded, flexuous ribs. The rib curve (Text-fig. 22, curve No. 9) appears typical of microconchs of the genus *Discosphinctes*. It should be mentioned that the flexuous ribs are fairly common close to the aperture in microconchs of Cuban Perisphinctidae, even in the case of those with inner whorls ornamented with straight or concave ribs (e.g. *Perisphinctes (Antilloceras) spathi* S. R.). Therefore the present author is inclined to interpret this specimen as a microconch of *Discosphinctes aguayoi*.

There is some similarity in ornamentation of *D. aguayoi* and one of specimens studied by the present author (Text-figs 22—23; Pl. 7, Fig. 9). However, the latter is markedly evolute throughout the development (Ud = 44.8% and Wh = 34.4% at 58 mm diameter; Ud = 43.3% and Wh = 33.3% at 90 mm diameter), and appears to be more densicostate, especially on inner whorls (Text-fig. 22, curve No. 10). The zone of crowded growth lines, observable after a constriction at the end of specimen, does not represent final aperture as the form is immature (sutures are not approximated). Such zones of crowded growth lines following constrictions were found in some other Cuban Perisphinctidae, e.g. *Perisphinctes (Cubasphinctes) cubanensis* O'Con. and *P. (C.) intermedius* Chud. & Fur.

Occurrence. — Sierra de los Organos, Jagua Fm. (Jagua Vieja Member). The holotype was found in Jagua Vieja area; the other specimens are derived from Puerta del Ancón and El Hoyo de la Sierra; from the latter locality is derived the specimen No. 2024, determined as *D.* aff. *aguayoi*.

Discosphinctes furrazolai sp. n.
(Text-figs 22, 23; Pl. 7, Fig. 10)

1920. *Simbirskites mexicanus* Burckhardt; Sánchez Roig, pp. 41—43, Pl. 9, Figs 1, 3.
1920. *Ataxioceras virgulatus* (Quenstedt); O'Connell, pp. 689—690, Pl. 38, Figs 4—5.
1968. *Perisphinctes (Discosphinctes) carribeanus* Jaworski; Judoley & Furrazola-Bermúdez, pp. 96—98 (partim), Pl. 46, Fig. 1; Pl. 44, Fig. 2a—d.

Holotype: specimen No. JF-85 (= *Perisphinctes carribeanus* Jaw. *in:* Judoley & Furrazola-Bermúdez, 1968, Pl. 46, Fig. 1).
Type horizon: Jagua Fm., Jagua Vieja Member (Oxordian).
Type locality: Sierra de los Organos.
Derivation of the name: in honour of Ing. Gustavo Furrazola-Bermúdez, the student of Upper Jurassic faunas of Cuba.
Material in the collection. — One specimen (No. 2406b) designated as the paratype.

Description. — All the specimens available are more or less incomplete, and the majority of them represent inner whorls. The holotype is the largest known representative of this species, with preserved outer whorl, it is presumably a macroconch.

Innermost whorls somewhat evolute or approaching the evolutness/involutness boundary; subsequent whorls involute; the coiling of outermost whorl again at the evolutness/involutness boundary. Whorl section initially subquadrate, later trapezoidal (Text-fig. 23), similar as in *D. carribeanus*.

Ornamentation consisting of very numerous, sharp-crested, single, bi- and later also triplicate ribs; intercalatories are common at larger diameter; ribs with marked forward twist at umbilical wall, strongly prorsiradiate on whorl sides, flexuous. Division of ribs monoschizotomous and, sometimes, dischizotomous, such as in *D. carribeanus*.

Ribs initially increasing in number along with shell size, becoming more loosely spaced on outer whorl of macroconchs (Text-fig. 22, curve No. *11* for the holotype od *D. furrazolai*).

Constrictions numerous, narrow, as a rule deeper at the venter, followed by 1—2 single ribs.

Remarks. — The specimens here assigned to *D. furrazolai* sp. n. were previously either described as *D. carribeanus* or placed in its synonymy (Judoley & Furrazola-Bermúdez 1968, and also Jaworski 1940). However, they differ from typical representatives of the latter species in being markedly more densicostate (*cf.* Text-fig. 22). At comparable diameters (c. 50—70 mm), number of ribs per whorl of *D. carribeanus* and *D. furrazolai* equals about 60—70 and 90, respectively. Moreover, *D. furrazolai* is often somewhat more involute than *D. carribeanus*, but it should be remembered that the innermost whorls of the representatives of the two species are very similar in coiling.

The species *Discosphinctes furrazolai* is similarly densicostate as *D. subguanensis* (Ark.), differing from the latter in less slender whorl section (at 40—55 mm diameter h : b = 1.35—1.46 in *D. furrazolai* sp. n., and at 52 mm diameter h : b = 1.77 in *D. subguanensis*) and in being less involute. Moreover, outer whorl of macroconchs of *D. subguanensis* is ornamented mainly by biplicate, sometimes also bidichotomous ribs, in comparison with that of *D. furrazolai*, ornamented with both bi- and triplicate (the latter sometimes dischizotomous) and numerous intercalatory ribs.

The species *Discosphinctes furrazolai* differs from *D. pichardoi* (Chud. & Fur.) primarily in being more densicostate on inner whorls. In turn, *D. furrazolai* is less densicostate than *D. acandai* (Chud. & Fur.).

Occurrence. — Sierra de los Organos, Jagua Fm. (Jagua Vieja Member); the holotype is derived from unknown locality in this region; the remaining specimens are derived from Viñales area (Puerta del Ancón and other localities) and El Hoyo de la Sierra.

Discosphinctes subguanensis (Arkell, 1956) (Text-fig. 22)

1951. *Perisphinctes (Planites, Discosphinctes) virgulatus guanensis* Sánchez Roig; Sánchez Roig, pp. 71—72, Pl. 16, Fig. 3 (holotype).
1956. *Perisphinctes (Discosphinctes) subguanensis* Arkell; Arkell, p. 573.
1968. *Perisphinctes (Discosphinctes) subguanensis* Arkell; Judoley & Furrazola-Bermúdez, pp. 98—99, Pl. 43, Fig. 2a—d (holotype); Pl. 43, Fig. 1; Pl. 44, Fig. 1.

Description and remarks. — The original name *Perisphinctes virgulatus guanensis* Sánchez Roig, 1951, as a homonym in relation to *Perisphinctes guanensis* Sánchez Roig, 1951, was replaced with the new name *Perisphinctes subguanensis* by Arkell (1956). The holotype of *P. subguanensis* is fragmentary specimen about 60 mm in diameter. It is fairly involute (Ud = 25% and Wh = 44% at 52 mm diameter, according to Judoley & Furrazola-Bermúdez, 1968), and with whorl section high-trapezoidal, thickest somewhat above the umbilical wall (Wb = 25%, h : b = 1.77 at 52 mm diameter). Ribs are sharp-crested and numerous (Text-fig. 22, curve No. *13*), with a marked twist on umbilical wall, strongly prorsiradiate on whorl sides, initially straight, later markedly flexuous. Ribbing remains single and biplicate up to the end of whorls preserved; point of furcation usually at about two-thirds of whorl height or, sometimes, in the mid-height. Intercalatories scarce.

The only (besides the holotype) representative of this species was described by Judoley & Furrazola-Bermúdez (1968, Pl. 43, Fig. 1; Pl. 44, Fig. 1); in comparison of the two specimens only the inner whorls of the latter may be taken into account as the holotype has about one whorl less. The outer whorl of this specimen at 80—160 mm diameter is initially moderately involute, approaching involutness/ /evolutness boundary later (Ud = Wh = 36% at 149.4 mm diameter, according to Judoley & Furrazola-Bermúdez, 1968); whorl section high-trapezoidal (Wb = 23% and h : b = 1.6 at 149.4 diameter); ornamentation consisting of biplicate, some simple, and, occasional, bidichotomous ribs; intercalatories not numerous. This specimen has no peristomal part preserved but the course of its rib curve (Text--fig. 22, curve No. *14*) appears rather typical of those of macroconchs of *Discosphinctes*. Therefore the previous statement (Brochwicz-Lewiński 1972, p. 484) that it represents a microconch seems to be unsubstantiated.

The species *Discosphinctes subguanensis* differs from *D. pichardoi* (Chud. & Fur.) primarily in more densicostate inner whorls; *D. acandai* (Chud. & Fur.) is markedly less densicostate. The differences between *D. subguanensis* and other Cuban *Discosphinctes* species as given above.

Occurrence. — Sierra de los Organos, Jagua Fm (Jagua Vieja Member). The holotype was found near the Guane (Puerta de la Muralla).

Discosphinctes pichardoi (Chudoley & Furrazola-Bermúdez, 1968)

1968. *Perisphinctes (Discosphinctes) pichardoi* Chudoley & Furrazola; Judoley & Furrazola--Bermúdez, pp. 100—101 (partim), Pl. 48, Fig. 1a—d (holotype); non Pl. 48, Fig. 2.

Remarks. — Judoley & Furrazola-Bermúdez (1968) assigned to this species two specimens: holotype (No. *JF-87*) and the specimen No. *JF-88* of the same collection. However, it is doubtful whether these forms are conspecific.

The holotype is represented by a half of whorls about 85 mm in diameter. Its characteristics (after description by Judoley & Furrazola-Bermúdez, 1968) may be given as follows: specimen initially somewhat evolute, later at involutness/ /evolutness boundary (Ud = Wh = 38% at D = 83 mm); whorl section trapezoidal, thickest somewhat above umbilical wall (Wb = 24% and h : b = 1.57 at D = 83 mm). Ribs appear on umbilical wall, with distinct twist; prorsiradiate on whorl sides and flexuous; the preserved part of the outer whorl ornamented primarily with biplicate ribs branching somewhere in two-thirds of whorl height, with some single ribs as well as with some intercalatories. Inner whorls of the holotype have about 24 ribs per half of whorl, and the outer — about 42—44 ribs per half of whorl. The ribbing so distant on inner whorls and markedly closer on the outermost whorl preserved differs the holotype *D. pichardoi* from all the other Cuban species of *Discosphinctes* (Judoley & Furrazola-Bermúdez 1968). However, such statement is based only on the analysis of the holotype, and the lack of any conspecific forms in the material studied by the present author precludes evaluation of intraspecific variability.

The other specimen assigned to this species by Judoley & Furrazola-Bermúdez (1968, Pl. 48, Fig. 2) markedly differs from the holotype. This specimen attains about 60 mm in diameter; ribs are fairly numerous on inner whorls, becoming initially more widely spaced on outer whorl, and markedly crowded subsequently; the ribs on inner whorls and the initial part of the outer whorl are straight or weakly concave, later becoming somewhat flexuous. Unfortunately, the figure of this specimen is insufficient for its univocal interpretation. This specimen differs in character of ornamentation (and in trend of rib curve) from the ammonites of the genus *Discosphinctes*, being possibly closer to *Antilloceras* subgen. n. of the genus *Perisphinctes*.

Occurrence. — Sierra de los Organos, Jagua Fm. (Jagua Vieja Member). The holotype is derived from unknown locality in that region.

Discosphinctes acandai (Chudoley & Furrazola-Bermúdez, 1968) (Pl. 7, Fig. 11)

1968. *Perisphinctes (Discosphinctes) acandai* Chudoley & Furrazola; Judoley & Furrazola-Bermúdez, pp. 98—100, Pl. 47, Fig. 1a—d (holotype); Pl. 48, Fig. 3.

Material. — One specimen (No. 2402).

Description. — All representatives of this species hitherto recorded are incomplete and aperture is unknown. Whorls initially somewhat evolute, becoming somewhat involute or close to the involutness/evolutness boundary later (in the case of the specimen No. 2402 — Ud = 35.1% and Wh = 40% at D = 37 mm). More outer whorl, observable in the case of the holotype only, displays evolute coiling (according to Judoley & Furrazola-Bermúdez 1968, Ud = 44% and Wh = 31% at D = 112 mm). Deformations usually preclude accurate evaluation of whorl section but it seems to be high-ovate.

Ornamentation consisting of very numerous, thin ribs; the ribs appear with a marked twist on umbilical wall; are strongly prorsiradiate on whorl sides, straight or weakly flexuous. The ribs are single or biplicate; point of furcation, usually above the two-thirds of whorl height. Intercalatory ribs may be sometimes noted. Number of ribs equals about 120—125 per whorl at 40—60 mm diameter (Pl. 7, Fig. 11; *cf.* also Judoley & Furrazola-Bermúdez 1968, Pl. 48, Fig. 3). The number of ribs of holotype at comparable diameter is difficult to establish, but tends to be smaller; it equals about 130 at 110 mm diameter. The ribs are so densely spaced

that they sometimes merge with one another near the ventral side (Pl. 7, Fig. 11; *cf.* also Judoley & Furrazola-Bermúdez 1968, Pl. 48, Fig. 3).

Constrictions numerous, narrow, usually wider at the venter, very often followed by two single ribs.

Remarks. — The differences in density of ribbing of the holotype and two remaining specimens assigned to this species may be attributed to intraspecific variability.

The species *Discosphinctes acandai* markedly differs from the remaining species of this genus in much denser ribbing.

Occurrence. — Sierra de los Organos, Jagua Fm. (Jagua Vieja Member); the holotype and the specimen No. 2402 are derived from El Hoyo de la Sierra.

Discosphinctes spp.

In all the exposures of the Jagua Vieja Member of the Jagua Formation from Sierra de los Organos there were found whorl fragments or nuclei of specifically undeterminable representatives of the genus *Discosphinctes*. To this genus presumably belong the ammonites derived from the same beds and misidentified as *Ataxioceras virgulatus* (Qu.) by Sánchez Roig (1920, Pl. 8, Fig. 4), *Simbirskites mexicanus* Burck. (op. cit., Pl. 9, Fig. 2) and *Simbirskites* sp. (op. cit., Pl. 9, Fig. 4). However their more detailed identification is precluded by poor quality and uncertain scale of figures as well as too generalized description.

The lower part of the Jagua Formation — the Zacarías Member (Sierra de los Organos), yields strongly deformed, involute and densely-ribbed ammonites, some of which presumably belong to the genus *Discosphinctes*.

Family **Aspidoceratidae** Zittel, 1895
Subfamily **Euaspidoceratinae** Spath, 1931
Genus *EUASPIDOCERAS* Spath, 1931
(Type species: *Ammonites perarmatus* Sowerby, 1822)

Occurrence of the genus in the Oxfordian in the Americas. — Western Cuba, Sierra de los Organos, Jagua Fm. (Jagua Vieja Member; and Pimienta Member, *cf.* Myczyński 1976); Sierra del Rosario (Francisco Fm., *cf.* Myczyński 1976); northern Mexico, San Pedro del Gallo area, La Gloria Fm. (*cf.* Burckhardt 1912, Pl. 7, Figs 18—22); northern Chile and Argentina, La Manga Fm. and the transition to younger gypsum strata of Auquilco Fm. (*cf.* Steinmann 1881, Pl. 11, Figs 1—2; Leanza 1947, Pl. 1, Figs 2—4; Stipanicic 1966; Hillebrandt 1970).

Cuban species assigned to this genus: *Euaspidoceras oconnellae* (Sánchez Roig), *E. vignalense* Spath.

Euaspidoceras oconnellae (Sánchez Roig, 1920)
(Pl. 8, Fig. 11)

1920. *Aspidoceras o'connelli* Sánchez Roig; Sánchez Roig, pp. 30—31, Pl. 13, Figs 1, 1A (holotype).
1951. *Euaspidoceras o'connelli* Sánchez Roig; Sánchez Roig, pp. 70—71, Pl. 8, Fig. 3; Pl. 11; Pl. 12, Figs 1—3; Pl. 13, Figs 1 (holotype), 2.
1968. *Euaspidoceras o'connelli* Sánchez Roig; Judoley & Furrazola-Bermúdez, pp. 114—115, Pl. 71, Fig. 2a—c (holotype).

Material. — One specimen (No. 2023).

Description. — All the representatives of this species known are incomplete, represented by phragmocone or a phragmocone with a part of body chamber. The specimen studied by the present author is the largest recorded so far — about 150 mm in diameter and with partly preserved body chamber (somewhat deformed) a quarter of whorl long. Dimensions: holotype — Ud = 42%, Wh = 37% and Wb = 34% at 73 mm diameter (Sánchez Roig 1920); the specimen studied — Ud = 39.2%, Wh = 37.2% and Wb — 35.3% at 102 mm diameter. Whorl section subquadrate, whorl sides and venter flattened, umbilical wall steeply inclined.

Ornamentation consisting of two rows of distinct, strong tubercles (spines on shell surface); number of tubercles roughly the same in each row; tubercles of the outer row usually stronger. Inner and outer tubercles connected by broad, single ribs; weaker, markedly more numerous ribs marked on ventral side of whorl. Number of tubercles per whorl changing along with shell size; in the specimen studied it equals 14 at 40 mm diameter, 15 at 50 mm D, 17 at 75 mm D, 20 at 100 mm D and 23 at 150 mm D; and in the holotype — 14 at 75 mm D, and in the other specimen (Sánchez Roig 1951, Pl. 11) — 25 at 130 mm D.

Occurrence. — Sierra de los Organos, Jagua Fm. (Jagua Vieja Member). The specimens were found at Puerta del Ancón (holotype), Loma de la Catuna, Laguna de Piedra and La Jutía.

Euaspidoceras sp. (? *E. vignalense* Spath, 1931)
(Pl. 8, Fig. 12)

Material. — One specimen (No. 2476).

Description. — Incomplete form, 80 mm in diameter, representing phragmocone and a small part of body chamber; Ud = 40.7%, Wh = 35.7% and Wb = 34.3% at 70 mm diameter. Whorl section subquadrate, whorl sides flattened, venter weakly convex, umbilical wall steeply inclined.

Ornamentation consisting of two rows of distinct, rather small tubercles (spines on shell surface); number of tubercles roughly the same in each row; tubercles of the outer row usually stronger. Inner and outer tubercles connected by narrow, single ribs; weaker, markedly more numerous ribs marked on the venter. Number of tubercles per whorl changing along with shell size; equalling 18 at 40 mm diameter, 19 at 50 mm D and about 22 at 75 mm D. From about 50 mm diameter there is marked certain trend to fading or reduction of inner tubercles and ribs, as well as weakening of outer tubercles, which brings this specimen somewhat closer to the representatives of the genus *Clambites* Rollier, 1922.

Remarks. — This specimen differs from the representatives of *E. oconnellae* (S. R.) in convex venter, denser and finer tuberculation and in some trend to fading of sculpture at larger diameters. It seems to match the diagnosis of *E. vignalense* Spath (*cf.* description *in*: Sánchez Roig 1951, pp. 69—70; also Spath 1931, p. 592).

The species *E. vignalense* was proposed by Spath (1931) for the specimen described as *Aspidoceras* aff. *laevigatus* by Sánchez Roig (1920, pp. 29—30, Pl. 13, Fig. 2). Unfortunately, all the illustrations of the holotype are very poor (including that *in*: Sánchez Roig 1951, Pl. 28) and the holotype seems to be lost (*cf.* also Judoley & Furrazola-Bermúdez 1968, p. 115). The species *Euaspidoceras vignalense* was said to differ from *E. oconnellae* in denser tuberculation and more convex venter resulting in some shift of the outer tubercles from ventral margin (Sánchez Roig 1951); moreover, the former was said to be characterized by "*perarmatus*-like inner whorls and weakening of the bituberculation as in *E. eucyphum* (Opp.) — of equal

proportions but more rapid change in ornamentation" (Spath 1931, p. 592). The above mentioned differences between *E. vignalense* and *E. oconnellae* are actually of the same character as between the specimen in author's disposal and *E. oconnellae*. However, *E. vignalense* cannot be unequivocally identified until its holotype is rediscovered and refigured or the neotype selected (after analyzing a richer assemblage of forms from the Jagua Formation).

Two specimens identified as *E. vignalense* Spath by Judoley & Furrazola-Bermúdez (1968, Pls 72—76) presumably do not belong to that species. These forms, about 170 mm and 250 mm in size, respectively, are heavily tuberculated throughout the development, which is in contradiction with the diagnosis of this species as given by Spath (1931), and they seem to be relatively close to *E. oconnellae*. Assumption made by Judoley & Furrazola-Bermúdez (1968, p. 114) that the number of tubercles per whorl is relatively constant and equals 19—20 and 13—14 for *E. vignalense* and *E. oconnellae*, respectively, is erroneous. As it was shown above, the number of tubercles closely depends on size of specimen.

Occurrence. — Sierra de los Órganos, Jagua Fm. (Jagua Vieja Member). The specimen studied was found at El Junco in San Carlos Valley. The holotype of *E. vignalense* was found at Puerta del Ancón.

Family **Oppeliidae** Bonarelli, 1894
Subfamily **Ochetoceratinae** Spath, 1928
Genus *OCHETOCERAS* Haug, 1885
(Type species: *Ammonites canaliculatus* von Buch, 1832)

Remarks. — The range of this genus was recently discussed in European literature (Geyer 1960, Christ 1961, Höroldt 1964). The discussions primarily concerned the systematic position of ammonites from the Oxfordian of Europe, which exhibit features transitional between the genera *Ochetoceras* Haug, 1885, and *Neocampylites* Callomon, 1973 [11]. These forms characterized by tricarinate venter (sometimes only on more inner whorls) were assigned to the subgenus *Neoprionoceras* Spath, 1928, of the genus *Neocampylites*, and distinctly separated from the ammonites of the genus *Ochetoceras*, having only one, always serrated keel (Christ 1961, Höroldt 1964).

In the case of Cuban as well as Mexican faunas the name *Ochetoceras* was often used for tricarinate ammonites (*cf.* diagnosis of the genus *Ochetoceras* in: Judoley & Furrazola-Bermúdez 1968, p. 61). However, such interpretation of Mexican forms was questioned (Christ 1961, pp. 311—312; *cf.* also Höroldt 1964, p. 98).

A peculiar problem in the case of Cuban faunas was the definition of "endemic" taxon *Cubaochetoceras* Arkell, 1957, and separation of that genus from *Ochetoceras*. Judoley & Furrazola-Bermúdez (1968, pp. 61, 65—66) believed that the falcate ribs were typical of *Ochetoceras* but not of *Cubaochetoceras*, which was characterized by rectiradiate or biconcave ribs. However, this distinction was not carried out consequently, as some ammonites allocated in *Cubaochetoceras* by those authors are characterized by typical falcate ribs (*cf.* Judoley & Furrazola-Bermúdez 1968, Pl. 13, Figs 1—2). Moreover, the presence of typical falcate ribs does not appear to be important feature of *Ochetoceras* as several undoubtful European species of that genus, including *O. hispidum* (Opp.), *O. raixense* Fradin, *O. basseae*

[11] The name *Campylites* Rollier, 1922, used in those papers, was recently shown to be a junior homonym of the name *Campylites* Eichwald, 1856, and replaced by *Neocampylites* Callomon, 1973 (cf. Callomon 1973).

Fradin, *O. hispidiforme* (Font.) and *O. montapinense* Panth., display almost straight, *S*-shaped or very weakly concave outer ribs which cannot form element of falcate ribs *sensu* Judoley & Furrazola-Bermúdez (1968). Thus the distinction between Cuban representatives of *Cubaochetoceras* and *Ochetoceras* was not carried out accurately up to now. Here this distinction is made with the following premises:

(i) Ammonites of the genus *Ochetoceras* have one keel and only occasionally poorly marked ventrolateral edges; representatives of the genus *Cubaochetoceras* have phragmocone with three keels (with median keel markedly dominating), and one keel accompanied by ventrolateral edges on body chamber.

(ii) Keel of the representatives of *Ochetoceras* is always serrated; median keel of *Cubaochetoceras* is serrated or smooth, and the ventrolateral keels are always smooth.

Moreover it should be mentioned that in *Ochetoceras* lateral groove usually passes somewhat below the mid-height; and in *Cubaochetoceras* — sometimes also at the mid-height of whorls. In Cuba the genus *Ochetoceras* is up to now represented by few, relatively small and usually incomplete specimens. European representatives of this genus attain up to 120 mm in diameter, but usually they are smaller, up to 65 mm in diameter (Höroldt 1964). Fully grown *Cubaochetoceras* seem to be larger, attaining usually from 80 mm to 130 mm in diameter. Ventral side of body chamber of *Ochetoceras* is sometimes somewhat widened, as in *O. canaliculatum* (cf. Höroldt 1964); which is common and distinct phenomenon in representatives of *Cubaochetoceras*. Both genera are characterized by weakening or fading of sculpture (lateral groove and ribs) on the body chamber.

The genus *Ochetoceras*, similarly as *Cubaochetoceras*, comprises macroconchs, which dimorphic counterparts are presumably some ammonites of the genus *Glochiceras* (cf. remarks in the description of the latter genus).

Cuban species assigned to the genus *Ochetoceras*: *Ochetoceras vignalense* Sánchez Roig, *O. subvignalense* (Chudoley & Furrazola-Bermúdez).

Occurrence of the genus *Ochetoceras* in the Oxfordian of the Americas: western Cuba, Sierra de los Organos (Jagua Fm.); northern Chile, Caracoles area and Cordillera Domeyko, La Manga Fm., and transition to younger gypsum strata of the Auquilco Fm. (*cf.* Stehn 1923, Pl. 5, Fig. 2; Leanza 1947, Pl. 1, Fig. 1a—b; Stipanicic 1966; Hillebrandt 1970).

Ochetoceras vignalense Sánchez Roig, 1951
(Pl. 7, Fig. 12)

1951. *Ochetoceras vignalensis* Sánchez Roig; Sánchez Roig, p. 68, Pl. 5, Fig. 4 (holotype).
1956. *Ochetoceras (Cubaochetoceras) vignalense* Sánchez Roig; Arkell, p. 573.
1968. *Cubaochetoceras vignalensis* Sánchez Roig; Judoley & Furrazola-Bermúdez, pp. 68—69, Pl. 11, Fig. 1a—d (holotype).

Material. — Two specimens (No. 2022 and 2478).

Description. — In the holotype — Ud = 18%, Wh = 53% and Wb = 32% at D = 56 mm (Judoley & Furrazola-Bermúdez 1968); in other specimens — Ud = 18% and Wh = 53% at D = 36 mm (No. 2022) and Ud = 15% and Wh = 56% at D = 40 mm (No. 2478).

Whorl section high-ovate, whorl sides convex; maximum whorl thickness just below lateral groove. Umbilicus deep; umbilical wall steep; umbilical edge marked. Lateral groove deep, situated below the mid-height. Ribs strong; at 40—55 mm diameter the numbers of inner and outer ribs equal about 6—9 and 19—23 per half of whorl, respectively. Inner ribs prorsiradiate, somewhat swollen close to lateral groove. Outer ribs strongly rursiradiate, straight or weakly concave, single or

biplicate. All the outer ribs widening and thickening close to the venter. Ventral side narrow, bordered sometimes by ventrolateral edges, with minutely serrated keel; number of denticles equals 9 per 5 mm of keel in the holotype (Sánchez Roig 1951) and about 12 per 10 mm of keel at D = 35 mm in one of the specimens studied (No. 2022).

Remarks. — This species was recently allocated in the genus *Cubaochetoceras;* however, it is characterized by a single well-marked keel, typical of *Ochetoceras.* The holotype of *O. vignalense* differs from the two specimens studied in weak ventrolateral edges continuing along the keel, but such a feature is found in some species of the genus *Ochetoceras,* as in *O. canaliculatum* (cf. Höroldt 1964).

Occurrence. — Sierra de los Organos, Jagua Fm. (Jagua Vieja Member, as well as its basal part at the transition to Zacarías Member). The holotype is derived from Puerta del Ancón, and the other specimens — from La Jutía and San Carlos Valley nearby El Junco.

Ochetoceras subvignalense (Chudoley & Furrazola-Bermúdez, 1968)

1968. *Cubaochetoceras subvignalensis* Chudoley & Furrazola; Judoley & Furrazola-Bermúdez, pp. 69—71, Pl. 11, Fig. 3a—d (holotype); ?Pl. 9, Fig. 2.

Remarks. — An incomplete specimen selected as the holotype for this species (No. JF-33) displays a single distinct keel typical of *Ochetoceras.* The species differs from *O. vignalense* in more regularly developed and more numerous outer ribs.

Occurrence. — Sierra de los Organos, Jagua Fm. (Jagua Vieja Member).

Genus *CUBAOCHETOCERAS* Arkell, 1957
(Type species: *Ochetoceras (Cubaochetoceras) imlayi* Sánchez Roig, 1951)

Introductory remarks. — The name was introduced by Sánchez Roig (1951) unfortunately without selecting the type species. The latter was designed by Arkell (1957, p. L278) who became the author of the genus-group name according to the Rules of I C Z N (art. 13). *Cubaochetoceras* was sometimes treated as a subgenus of *Ochetoceras,* or more frequently as an independant genus (Arkell 1957, Judoley & Furrazola-Bermúdez 1968). The diagnosis given by Judoley & Furrazola-Bermúdez (1968, pp. 65—66) needs some revision at present. Differences between *Cubaochetoceras* and *Ochetoceras* were discussed above.

Diagnosis. — Macroconchs about 80 to 130 mm in diameter; body chamber occupying a half of whorl or somewhat more. Umbilicus deep, narrow, with steep wall; umbilical edge more or less distinct. Whorl section high-ovate, tapering towards the venter, often becoming ovate with widened venter and more convex sides on the body chamber. Lateral groove situated at about the mid-height or just below, distinct on the phragmocone and gradually fading at the body chamber. Ribs well-marked on phragmocone; inner ribs straight or concave, simple or biplicate, sometimes grouped into sets of 2—3 ribs; outer ribs almost straight or slightly to markedly concave, single or biplicate; the ribs becoming wider but less distinct or almost completely fading on the body chamber. As the lateral groove disappears at the body chamber, the inner and outer ribs may join together forming uninterrupted falcate ribs. Median keel, minutely serrated or smooth, accompanied by two low, smooth keels on phragmocone; the latter pass into ventrolateral edges and finally disappear on the body chamber. The suture is characterized by external lobe always shorter than lateral lobe (Judoley & Furrazola-Bermúdez 1968).

Some ammonites of the genus *Glochiceras* are supposed to be sexual counterparts of *Cubaochetoceras* (cf. remarks in description of the former).

Discussion. — The relation of *Cubaochetoceras* to *Ochetoceras* is similar to that of some European forms recently discussed by Christ (1961) and assigned by him to *Neoprionoceras* Spath, and *Ochetoceras.* In his studies on European material

Christ (1961) recognized the name *Neoprionoceras* as a presumable senior synonym of the names *Canaliculites* Jeannet, 1951, and *Fehlmannites* Jeannet, 1951, and he treated *Neoprionoceras* as a subgenus of the genus *Neocampylites* Callomon, 1973 (*cf.* footnote to description of the genus *Ochetoceras*). However, it should be noted that the type species of *Neoprionoceras, Oppelia girardoti* Loriol, 1902, is represented only by a single undoubtful specimen up to the present. That specimen is small, incomplete and with ornamentation partly obliterated (*cf.* Loriol 1902, pp. 40—41, Pl. 3, Fig. 8a—b); (?) serrated median keel and the presence of lateral groove presumably differ that species from typical representatives of the genus *Neocampylites*. Originally distinguished as a full-genus *Canaliculites* (cf. Jeannet 1951, p. 90), was based on *Canaliculites argoviensis* Jeannet as the type species. However, the holotype of that species is small and incomplete but it displays tricarinate venter, serrated median keel and well marked lateral groove (Jeannet 1951, Pl. 20, Fig. 10; Pl. 27, Fig. 5). The representatives of type series of *Fehlmannites jurensis* Jean., the type species of *Fehlmannites*, are larger but similarly incomplete (*cf.* Jeannet 1951, Pl. 20, Figs 8—9); lateral groove disappears at larger diameters, at first there are three keels and later only one accompanied by ventrolateral edges at the sides. Of the other European forms recently assigned (Christ 1961) to the subgenus *Neoprionoceras*, attention should be paid to "*Ochetoceras mexicanum*" (cf. Gérard 1936, Pl. 11, Fig. 6) and "*Ochetoceras* cf. *mexicanum*" (cf. Jeannet 1951, Pl. 21, Fig. 12). The latter is relatively complete, about 90 mm in diameter and the body chamber partly preserved; lateral groove fades at the phragmocone-body chamber boundary; outer ribs are strong, concave, biplicate and single on phragmocone; typical falcate ribs, with low relief appear on the body chamber; venter at first tricarinate, later with single keel and ventrolateral edges.

According to the present author any direct connection of at least some of these European forms with *Neocampylites* is questionable. These forms display several features transitional between those of *Neocampylites* and *Ochetoceras* (cf. Christ 1961), and sufficient for separation at the generic rank. Presumably one of the above discussed names, *Neoprionoceras, Canaliculites* or *Fehlmannites*, should be used as generic name for them in the future. However, the material of the type species of these taxa is still unsatisfactory.

Cuban forms here assigned to *Cubaochetoceras* are presumably close to some European forms discussed above. It should be mentioned that some Mexican species were previously compared with European ones (Christ 1961, pp. 311—312). However, the latter are highly incomplete which makes difficult the comparisons. Occasionally, a fairly complete European form ("*Ochetoceras* cf. *mexicanum*" in: Jeannet 1951) does not significantly differ from Cuban and Mexican representatives of *Cubaochetoceras*. It follows that in the future the name *Cubaochetoceras* may appear to be a junior synonym of one of these European names.

Cuban species assigned to the genus *Cubaochetoceras: Cubaochetoceras imlayi* (Sánchez Roig), *C. brevicostatum* Chudoley & Furrazola-Bermúdez (? = *C. constanciae* (Sánchez Roig), *C. pinarense* Chudoley & Furrazola-Bermúdez, *C. submexicanum* (Chudoley & Furrazola-Bermúdez), *C. burckhardti* (O'Connell), *C. chudoleyi* nom. n. (= *Ochetoceras burckhardti* Chudoley & Furrazola-Bermúdez), *C. diversicostatum* Chudoley & Furrazola-Bermúdez, *C. mexicanum* (Burckhardt), *C. pedroanum* (Burckhardt).

Occurrence of the genus *Cubaochetoceras* in the Americas: Oxfordian, western Cuba, Sierra de los Organos (Jagua Fm.), Sierra del Rosario (Francisco Fm.); northern Mexico, San Pedro del Gallo area (La Gloria Fm.). Supposedly similar forms are also known from the uppermost part of the La Manga Formation of northern Chile (Hillebrandt 1970).

Cubaochetoceras imlayi (Sánchez Roig, 1951)
(Pl. 7, Fig. 13)

1951. *Ochetoceras (Cubaochetoceras) imlayi* Sánchez Roig; Sánchez Roig, pp. 66—67, Pl. 5, Figs 1—2 and Pl. 6 (holotype); Pl. 9.
?1951. *Phylloceras lagunasensis* Sánchez Roig; Sánchez Roig, pp. 65—66, Pl. 8, Fig. 2.
1956. *Ochetoceras (Cubaochetoceras) imlayi* Sánchez Roig; Arkell, p. 573 (partim); non *"Neoprionoceras girardoti"* Jaworski, 1940.
1957. *Cubaochetoceras imlayi* (Sánchez Roig); Arkell, p. L278, Fig. 326, 2a—b (holotype).
1968. *Cubaochetoceras imlayi* Sánchez Roig; Judoley & Furrazola-Bermúdez, pp. 66—67, Pl. 7, Fig. 1a—b and Pl. 8, Fig. 1a—b (holotype); Pl. 8, Fig. 2a—b; ?Pl. 9, Fig. 1a—b.

Material. — Two specimens (No. 2023a and 2403c).

Description. — Large form attaining up to about 120 mm in diameter. Body chamber presumably about a half of whorl long or somewhat more.

Measurements taken on body chambers of a few mature or almost mature specimens gave the following results: Ud = 12—13.5%, Wh = 51.5—53% and Wb = 25—31% at 90—117 mm diameters. Measurements taken at the boundary of the phragmocone and body chamber (specimen No. 2023a) gave: Ud = 14% and Wh = 55.7% at D = 70 mm.

Inner whorls high-ovate in cross-section; section of body chamber ovate, with convex sides and maximum thickness somewhat below the mid-height. Umbilicus deep, umbilical wall steep. Lateral groove situated at about the mid-height. The groove is well-marked to the end of phragmocone, shallowing and finally disappearing on the body chamber.

Inner and outer ribs are strong on the phragmocone; sometimes they are connected across the lateral groove with some weakening; the number of inner and outer ribs equals 10 and 24, respectively, per half of whorl at 60 mm diameter (specimen No. 2023a). Inner ribs are prorsiradiate, somewhat swollen close to lateral groove. Outer ribs are slightly rursiradiate, weakly concave or almost straight, sometimes bifurcating usually somewhere in the middle of ventrolateral area.

There is a change in ornamentation on the body chamber of mature individuals. The ribs become wider and less distinct. The lateral groove disappears and the inner and outer ribs join together forming uninterrupted falcate ribs.

Ventral side narrow on the phragmocone, with prominent, minutely serrated, median keel. The keel is accompanied by two lower, smooth keels. The venter gradually becomes wider on the final body chamber and the ventrolateral keels pass into edges which soon disappear. Median keel becomes markedly lower and less-accentuated. There is about 15 denticles per 10 mm of median keel at 80 mm diameter in the two specimens available. Fine, weakly marked, thin riblets are marked at the extension of denticles down to the base of keel or even further down.

Remarks. — The species *"Phylloceras" lagunasensis* Sánchez Roig, 1951, is undoubtedly close to *Cubaochetoceras imlayi* and it was recognized as a subjective synonym of the latter by Judoley & Furrazola-Bermúdez (1968). However, it should be noted that the holotype of *"Phylloceras" lagunasensis* is characterized by single outer ribs at least on the final part of the phragmocone, whereas the phragmocone of *C. imlayi* is characterized by more or less frequent biplicate ribs.

The species *Cubaochetoceras imlayi* differs from *C. constanciae* (S. R.) in ribbed body chamber and in whorl section. In turn, *Cubaochetoceras brevicostatum* Chud. & Fur., known only from inner whorls and possibly being a junior synonym of the latter, differs from corresponding whorls of *C. imlayi* in weaker ornamentation and occurrence of single outer ribs.

Occurrence. — Sierra de los Organos, Jagua Fm. (Jagua Vieja Member, as well as its basal part at the transition to Zacarías Member). The holotype was found at Laguna de Piedra. The specimens studied are derived from La Jutía and El Hoyo de la Sierra.

Cubaochetoceras brevicostatum Chudoley & Furrazola-Bermúdez, 1968 (Pl. 7, Fig. 14)

1951. *Ochetoceras canaliculatum* var. *burckhardti* O'Connell; Sánchez Roig, Pl. 5, Fig. 6.
1968. *Cubaochetoceras brevicostatum* Chudoley & Furrazola; Judoley & Furrazola-Bermúdez, p. 72, Pl. 6, Fig. 1a—d (holotype).
Material. — One specimen (No. 2466).

Description and remarks. — Judoley & Furrazola-Bermúdez (1968) selected an incomplete specimen 70 mm in diameter as the holotype. The specimen very close to the holotype, originally determined as *O. canaliculatum* var. *burckhardti* O'Con. by Sánchez Roig (1951), represents phragmocone only, similarly as that studied by the present author. Dimensions of the holotype and the latter (given in brackets): Ud = 12% (12.2%), Wh = 55% (55.6%) and Wb = 25% at 69.8 mm diameter (at 53 mm D).

Whorl section high-ovate; whorl sides weakly convex. Umbilicus deep, with steep umbilical wall and weakly marked umbilical edge. Lateral groove fairly shallow, becoming markedly weaker at the end of the phragmocone preserved. Inner and outer ribs moderately strong, sometimes connected across the lateral groove with distinct weakening. At about 60 mm diameter there are 9—11 inner and 15—19 outer ribs per half of whorl. The former are prorsiradiate and the latter — very weakly concave to almost straight, rectiradiate, as a rule single. Ventral side narrow tricarinate, with prominent, median keel which seems to be smooth; ventrolateral keels weakly marked, smooth.

The species *Cubaochetoceras brevicostatum* appears very similar to *C. constanciae* (Sánchez Roig). The holotype of the latter is a fully or almost fully grown specimen, about 130 mm in diameter, and with nearly smooth body chamber over a half of whorl long (Sánchez Roig 1951, Pl. 7; *cf.* also Judoley & Furrazola-Bermúdez 1968, Pl. 10, Fig. 1a—b); its inner whorls are hardly visible but the end part of phragmocone displays weak, single, almost rectiradiate ribs distinctly continuing across the fading-out lateral groove, comparable to those displayed by the outermost parts preserved of *C. brevicostatum*. The species *Cubaochetoceras constanciae* and *C. brevicostatum* are also very similar in whorl outline. However, the material available is insufficient for accurate comparison of these forms but it is not excluded that *C. brevicostatum* is a junior synonym of *C. constanciae*.

Occurrence. — Sierra de los Organos, Jagua Fm. (Jagua Vieja Member). The type locality is unknown; the specimen studied by the present author was found at San Carlos Valley (near El Junco). The holotype of *C. constanciae* is derived from the Jagua Vieja area.

Cubaochetoceras pinarense Chudoley & Furrazola-Bermúdez, 1968 (Pl. 8, Figs 1—2)

1968. *Cubaochetoceras pinarensis* Chudoley & Furrazola; Judoley & Furrazola-Bermúdez, p. 71, Pl. 11, Fig. 2a—d (holotype); Pl. 13, Figs 1, 2a—b, 4—5.
Material. — Two specimens (No. 2436 and 2462).

Description. — All available representatives of this species are incomplete and with aperture broken-off. The specimens studied by the author are relatively large as they attain about 80 mm in diameter. They are fully or almost fully grown as their last sutures are approximated. The part of the body chamber preserved occupies about a half of whorl. Dimensions taken at the body chamber: Ud = 14.3%, Wh = 50% and Wb = c. 30% at 77 mm diameter (specimen No. 2462) and Ud = 16%, Wh = 51.5% and Wb = 30% at 68 mm diameter (specimen No. 2436).

Whorl section initially high-ovate, tapering towards the venter; becoming ovate, with widened venter and more convex sides later, close to the end of the body chamber. Whorls thickest in the dorsolateral area, below the lateral groove. Umbilicus deep, umbilical wall steep. Lateral groove situated somewhat below the mid-height, relatively wide and shallow on the phragmocone, becoming weaker and finally disappearing on the body chamber.

Inner and outer ribs relatively weak on the phragmocone; the former are somewhat prorsiradiate and often are grouped into sets of 2—3 closely spaced ribs; the latter are fairly irregular in development, straight or weakly concave, single and biplicate with point of furcation usually situated at the middle of ventrolateral area. The ribs become wider but less distinct on the body chamber; here the outer ribs are as a rule concave and, as the lateral groove fades, they join the inner ribs forming uninterrupted falcate ribs.

A minutely serrated, prominent keel continues along the venter of phragmocone; it is accompanied on both sides by low, smooth keels. The median keel becomes markedly lower and weaker on the final body chamber, whereas the ventrolateral keels pass into edges and finally disappear. A number of denticles from the median keel equals about 15—20 per 1 cm (at 40 mm diameter) in the specimens under study. Thin, weak riblets are marked at the extension of the denticles downwards to the base of the keel.

Remarks. — The species *Cubaochetoceras pinarense* differs from *C. imlayi* (S. R.) in weaker ornamentation, particularly on phragmocone, more irregular development of outer ribs, and presumably in smaller ultimate size. The species differs from *C. brevicostatum* Chud. & Fur. primarily in frequent branching of outer ribs.

Occurrence. — Sierra de los Organos, Jagua Fm. (Jagua Vieja Member). The type locality is unknown. The specimens studied by the present author were found at Sierra de Guane.

Cubaochetoceras submexicanum (Chudoley & Furrazola-Bermúdez, 1968) (Pl. 8, Fig. 3)

1968. *Ochetoceras submexicanum* Chudoley & Furrazola; Judoley & Furrazola-Bermúdez, pp. 63—64, Pl. 6, Fig. 2a—d (holotype).

Material. — One specimen (No. P-9).

Description. — The specimen studied by the author is fairly large, fully grown, with peristome partly preserved and body chamber a half of whorl long. Measurements taken at the body chamber at 101 mm diameter: Ud = 15.8%, Wh = 48% and Wb = 28.7%; and those taken at the phragmocone/body-chamber boundary at 76 mm diameter: Ud = 16.4%, Wh = 54% and Wb = 28.3%. The holotype of this species is incomplete, about 70 mm in diameter but, nevertheless, comparable with phragmocone of that fully grown specimen. Dimensions of the holotype (after Judoley & Furrazola-Bermúdez, 1968): Ud = 15%, Wh = 58% and Wb = 27% at 66 mm diameter.

Whorl section initially high-ovate, tapering towards the venter; close to the end of the final body chamber ovate with widened venter; whorl is the thickest in dorsolateral area, somewhat below the lateral groove. Umbilicus deep, umbilical wall steep, umbilical edge fairly marked. Lateral groove situated at about the mid-height (somewhat below on the phragmocone), initially markedly deep, becoming shallower and vanishing on the final body chamber.

Phragmocone ornamented with strong inner and outer ribs; the former are prorsiradiate; the holotype is ornamented mainly with single inner ribs, whereas the phragmocone of the specimen studied is characterized by markedly less regular costation of the dorsolateral area with frequent biplicate and intercalatory ribs. Outer ribs are always markedly concave and very often biplicate; point of furcation is usually situated in the middle of ventrolateral area. The number of outer ribs counted at the ventral side equals about 25 (at 55 mm diameter) and about 30 (at 70 mm diameter) per half of whorl in the holotype and the specimen studied, respectively. Body chamber of mature individual displays a change in ornamentation — the ribs become wider but less distinct and they join into falcate ribs as the lateral groove disappears.

The median keel, prominent and accompanied by two lower keels, continues along the venter of phragmocone. On the final body chamber the median keel becomes markedly lower and weaker and the ventrolateral keels pass into edges and finally fade away. The median keel seems to be smooth in the holotype (Judoley & Furrazola-Bermúdez 1966), whereas it displays minute, poorly-developed denticles about 15 in number per 10 mm (at D = 70 mm) in the specimen studied by the author. Weak, thin riblets are marked at the extension of these denticles downwards to the base of the keel.

Remarks. — The differences between the holotype and specimen studied by the author may be explained in terms of intraspecific variability. An irregular dorsolateral sculpture similar to that of the latter specimen is found in representatives of *Cubaochetoceras diversicostatum* Chud. & Fur. which differ in almost straight to weakly concave, single outer ribs. The species *Cubaochetoceras submexicanum* markedly differs from all the remaining Cuban species of that genus in the type of ribbing of ventrolateral area.

Occurrence. — Sierra de los Organos, Jagua Fm. (Jagua Vieja Member). The type locality is unknown, and the specimen studied is derived from El Hoyo de San Antonio.

Cubaochetoceras burckhardti (O'Connell, 1920)
(Pl. 8, Figs 4—5)

1920. *Ochetoceras canaliculatum* (von Buch) var. *burckhardti* O'Connell; O'Connell, pp. 681—686, Pl. 37, Figs 1—3 (holotype).

non 1920. *Ochetoceras canaliculatum* d'Orb.; Sánchez Roig, pp. 25—26, Pl. 16, Figs 1—1A, 2—2A.

1922. *Ochetoceras canaliculatum burckhardti* O'Connell; O'Connell, p. 400.

1940. *Ochetoceras canaliculatum* v. Buch; Jaworski, pp. 93—95 (partim).

non 1951. *Ochetoceras canaliculatum* var. *burckhardti* O'Connell; Sánchez Roig, Pl. 5, Fig. 3.

1956. *Ochetoceras canaliculatum* var. *burckhardti* O'Connell; Arkell, p. 573.

1966. *Ochetoceras canaliculatum* var. *burckhardti* O'Connell; Judoley & Furrazola-Bermúdez, p. 62, Pl. 5, Fig. 1a—d.

Material. — Two specimens (No. 2386 and 2434).

Description. — All the representatives of the species are incomplete. The holotype represents part of phragmocone whereas the remaining forms attain 60—75 mm in diameter and display more or less complete body chamber (Pl. 8, Figs 4—5;

and Judoley & Furrazola-Bermúdez 1968, Pl. 5, Fig. 1a—d). Dimensions of the holotype: Ud = 13%, Wh = 56% and Wb = 23% at D = 55.8 mm; other specimens (measurements taken on the body chamber): Ud = 14.5—16%, Wh = 53—54% and Wb = 24—25% at D = 50—72 mm.

Whorl section high-ovate, tapering towards the venter; maximum whorl thickness at, or slightly below lateral groove. Umbilicus deep, umbilical wall steep and umbilical edge distinct. Lateral groove somewhat below the mid-height; shallow and fairly wide on the phragmocone, gradually fading away on the body chamber of larger specimens. Ribs rather weakly marked, fairly wide, sometimes in the form of wide folds composed of riblet sets. The ornamentation gradually disappears at larger diameters. Inner ribs prorsiradiate, almost straight to weakly concave; outer ribs more or less concave, fading away at the venter. The specimens at the author's disposal display fine riblets at the venter, continuing up to the median keel. Median keel prominent, accompanied by two low keels, passing into ventrolateral edges at larger diameters. The median keel is minutely serrated (Judoley & Furrazola-Bermúdez 1968); however, denticles are obscure on the specimens available, possibly being worn out.

Remarks. — The name *"burckhardti"*, originally used as a name for a new variety (O'Connell 1920) is valid in zoological nomenclature. The separation of *Ochetoceras canaliculatum* var. *burckhardti* O'Connell, 1920, = *Cubaochetoceras burckhardti* (O'Connell, 1920) and *Ochetoceras canaliculatum* (v. Buch) on the specific (and generic) level is based on the following premises: *Cubaochetoceras burckhardti* (O'Con.) appears to be very close to the representatives of the genus *Cubaochetoceras* and, similarly as other species of this genus, it is characterized by tricarinate venter of phragmocone, whereas *Ochetoceras canaliculatum* (v. Buch) is the type species of the genus *Ochetoceras* and similarly as other species of that genus has only one keel. It should be added that *C. burckhardti* differs from *O. canaliculatum* also in weaker and less regular costation (especially in ventrolateral area) and shallower lateral groove.

The species *Cubaochetoceras burckhardti* (O'Con.) differs from other species of that genus in less prominent ribs being concave in ventrolateral area. It appears somewhat similar to the form *C.* aff. *burckhardti* (O'Con.) described below.

The name *Ochetoceras burckhardti* Chudoley & Furrazola-Bermúdez, 1968, appears to be a junior homonym of *Cubaochetoceras burckhardti* (O'Connell, 1920). The former also belongs to the genus *Cubaochetoceras* and is here described under a new name, *C. chudoleyi* nom. n. (*cf.* also remarks in description of that species).

Occurrence. — Sierra de los Organos, Jagua Fm. (Jagua Vieja Member). The holotype was derived from the Viñales area, and the specimens studied by the present author — from El Hoyo de la Sierra and Sierra de Guane.

Cubaochetoceras aff. *burckhardti* (O'Connell, 1920)

1912. *Ochetoceras canaliculatum* d'Orb.; Burckhardt, pp. 5—7, Pl. 1, Figs 1—7.
1940. *Neoprionoceras girardoti* de Lorlol; Jaworski, pp. 96—97, Pl. 3, Fig. 5a—b; Pl. 6, Fig. 3.
?1968. *Ochetoceras burckhardti* Chudoley & Furrazola; Judoley & Furrazola-Bermúdez, pp. 62—63 (partim), Pl. 7, Fig. 2a—b; non Pl. 5, Fig. 2a—d.

Remarks. — The specimens from the Oxfordian of Mexico, described as *Ochetoceras canaliculatum* d'Orb. by Burckhardt (1912) were often linked with *O. canaliculatum* var. *burckhardti* O'Con. (*cf.* O'Connell 1920, 1922; Imlay 1939). Sometimes the two forms were treated as unseparable from typical *Ochetoceras canaliculatum* (v. Buch) (*cf.* Dorn 1931, Jaworski 1940). As it was shown above, *O. canaliculatum*

var. *burckhardti* O'Con. actually belongs to the genus *Cubaochetoceras* and must be treated as the separate species *C. burckhardti*. The form *"Ochetoceras canaliculatum* d'Orb." of Burckhardt (1912), is also tricarinate and it cannot be placed in *Ochetoceras* (cf. Christ 1961, p. 312). It appears to be very close to *C. burckhardti* (O'Con.), differing from the latter in biplicate outer ribs (Judoley & Furrazola-Bermúdez 1968). This form is here described as *C.* aff. *burckhardti* (O'Con.) because of the lack of any comparative material in the collection studied.

A Cuban morphotype close to the form in question was described as *Neoprionoceras girardoti* by Jaworski (1940); it is relatively weakly ornamented with markedly biplicate outer ribs very close to those displayed by a Mexican specimen (*cf.* Burckhardt 1912, Pl. 1, Fig. 1). One of the *"Ochetoceras burckhardti"* of Chudoley & Furrazola-Bermúdez (1968, Pl. 7, Fig. 2a—b) appears also very close to that form, differing from the holotype of *Ochetoceras burckhardti* Chudoley & Furrazola-Bermúdez, 1968 [= *Cubaochetoceras chudoleyi* nom. n.] in biplicate outer ribs and possibly in better-pronounced lateral groove on the body chamber.

Occurrence. — Sierra de los Organos, Jagua Fm. (Jagua Vieja Member), Puerta del Ancón (Jaworski 1940); northern Mexico, San Pedro del Gallo area, beds with *Ochetoceras* (Burckhardt 1912, 1930) belonging to the La Gloria Fm.

Cubaochetoceras chudoleyi nom. n.
(Pl. 8, Fig. 6)

1968. *Ochetoceras burckhardti* Chudoley & Furrazola; Judoley & Furrazola-Bermúdez, pp. 62—63 (partim), Pl. 5, Fig. 2a—d (holotype); non Pl. 7, Fig. 2a—b.

The name: The species *Ochetoceras burckhardti* Chudoley & Furrazola-Bermúdez, 1968, belongs to the genus *Cubaochetoceras* similarly as *Cubaochetoceras burckhardti* (O'Connell 1930), thus these two names are homonyms. The former as the junior secondary homonym, is here replaced by *Cubaochetoceras chudoleyi* nom. n., taken from the name of co-author of the preoccupied name.

Holotype: The specimen (No. JF-17) presented by Judoley & Furrazola-Bermúdez 1968, Pl. 5, Fig. 2a—d). Specimen about 90 mm in diameter, without aperture; Ud = 47%, Wh = 47% and Wb = 27% at D = 89 mm (after Judoley & Furrazola-Bermúdez, 1968). Ornamentation preserved only on the last three-quarters of the outer whorl, it consists of single, wide and weakly protruding falcate ribs. The ribs pass across faint lateral groove which soon disappears. Whorl section ovate, with widened venter close to the end of specimen. Median keel smooth (?), initially accompanied by two keels passing into ventrolateral edges thereafter.

Remarks. — Unknown sculpture on inner whorls of the holotype precludes giving the full diagnosis of this species. The species differs from other representatives of this genus in relatively weak ornamentation, lateral groove fading rather early, and the outer whorl ornamented with fairly densely spaced, single falcate ribs.

The other specimen assigned to this species by Judoley & Furrazola-Bermúdez (1968, Pl. 7, Fig. 2a—b) markedly differs from the holotype in biplicate outer ribs on the body chamber, and it is presumably close to *C.* aff. *burckhardti* (O'Con.).

One of specimens from the collection studied (No. 2409c, Pl. 8, Fig. 6) may be referred to *C. chudoleyi* with reservation. The specimen, 95 mm in diameter, is fully grown (approximated sutures) but, unfortunately, incomplete and somewhat deformed. Approximate dimensions: Ud = 12% and Wh = 50% at D = 94 mm; umbilicus deep, with steep wall and marked umbilical edge. Lateral groove shallow and wide on the phragmocone, soon fading away on the body chamber. Inner ribs weakly marked on the phragmocone; outer ribs stronger and somewhat concave, single or biplicate; body chamber ornamented with feeble falcate ribs. The phragmocone with high, (?)smooth median keel delineated by two low keels; the median

keel gradually lowers on the body chamber and the ventrolateral keels pass into edges which soon fade away. The style of sculpture of body chamber appears similar to that of the holotype of *C. chudoleyi* nom. n. whereas the style of ornamentation of phragmocone cannot be compared as it is obscure in the latter. It should be added that the style of ornamentation of inner whorls (weak inner ribs and somewhat stronger outer ribs which are single and biplicate and weakly concave) differs this specimen from all other species of *Cubaochetoceras* except for *C.* aff. *burckhardti* (O'Con.), which has more numerous biplicate outer ribs.

Occurrence. — Sierra de los Organos, Jagua Fm. (Jagua Vieja Member). The type locality is unknown; the specimen referred to as *C.* cf. *chudoleyi* was found at El Hoyo de la Sierra.

Other species of the genus *Cubaochetoceras*

The analysis of other species is limited to descriptions and illustration given by previous authors, because of the lack of adequate comparative material in the collection. The analysis primarily concerns the generic status and specific features.

The species *Cubaochetoceras diversicostatum* Chudoley & Furrazola-Bermúdez as presented by Judoley & Furrazola-Bermúdez (1968, p. 73, Pl. 12, Figs 1a—d, 2a—d) is characterized by strong ribbing on the phragmocone; outer ribs very weakly concave to almost straight, single; inner ribs irregular in development — single, biplicate and intercalatory; it occurs in Sierra de los Organos, Jagua Fm., Jagua Vieja Member.

The species *Cubaochetoceras mexicanum* (Burckhardt) and *C. pedroanum* (Burckhardt) were originally described as *Ochetoceras mexicanum* (cf. Burckhardt 1912, pp. 7—9, Pl. 1, Figs 8—12) and *O. pedroanum* (cf. Burckhardt 1912, pp. 9—10, Pl. 1, Figs 13—17). The two species cannot be accommodated in the genus *Ochetoceras* as they display tricarinate venter (Christ 1961, pp. 311—312; Höroldt 1964). *Cubaochetoceras mexicanum* and *C. pedroanum* are represented by single, incomplete specimens and the relationship between the two species is still an open question. They were either considered (Jaworski 1940) or supposed to be synonyms (O'Connell 1922), or they were treated as a separate species (*e.g.* Christ 1961, Höroldt 1964). The species were described from the Ochetoceras Beds, La Gloria Fm., San Pedro del Gallo area from northern Mexico (Burckhardt 1912, 1930).

Some Cuban ammonites were previously assigned to *"Ochetoceras" mexicanum* Burckhardt (*cf.* O'Connell 1920, 1922; Sánchez Roig 1920; Jaworski 1940). These specimens were commonly small, poorly preserved, somewhat incomplete and some of them were not figured. Thus their systematic status is very difficult for interpretation. Recently, several Cuban specimens were described as *Ochetoceras mexicanum* var. *cubensis* by Judoley & Furrazola-Bermúdez (1968, pp. 64—65, Pl. 6, Fig. 3a—d; Pl. 13, Figs 3a—b, 6a—b, 7—8). They are very similar to *Cubaochetoceras mexicanum* (Burck.), differing from typical representatives of that species in smaller number of ribs in dorsolateral area as well as in development of sets of 2—3 closely spaced ribs (Judoley & Furrazola-Bermúdez 1968). However, such development of inner ribs is typical of *Cubaochetoceras pedroanum* (Burck.) and these Cuban ammonites seem closer to the latter species. The name *"cubensis"* used in the sense "varietas" by Judoley & Furrazola-Bermúdez (1968) is not applicable in official nomenclature (Rules 15 and 45. e. II of the ICZN). The discussed Cuban ammonites were found in the Jagua Fm., Jagua Vieja Member, in Sierra de los Organos. The fragmentary specimen (No. 2506) from the author's collection was found in the Francisco Fm. in Brujito area, Sierra del Rosario.

Other forms were distinguished by O'Connell (1922, pp. 405—406) as *"Ochetoceras" vicente* and *"O." vicente* var. *dentatum* with holotypes selected but unfigured. Subsequently Jaworski (1940, p. 93) and Sánchez Roig (1951, p. 58) referred to these forms. The forms were reported from San Vicente area from Sierra de los Organos, possibly from Jagua Fm. The "tricarinate venter" (O'Connell 1922) seems to indicate that they belong to *Cubaochetoceras* but their relation to the species described above remains obscure.

Ochetoceras spp. and/or *Cubaochetoceras* spp.

There are several small, incomplete specimens with ventral side damaged, which cannot be unequivocally assigned to any of these genera. They were found in several exposures of the Jagua Fm. (both in Zacarías, and Jagua Vieja members) in Sierra de los Organos. Illustration presented by Sánchez Roig (1920, Pl. 15, Fig. 5) is also insufficient for further discussion; other specimens figured in that paper (Sánchez Roig 1920, Pl. 15 Figs 1—1A, 2—2A, 4) may represent *Cubaochetoceras*.

?Family **Oppeliidae** Bonarelli, 1894
Genus *GLOCHICERAS* Hyatt, 1900
Subgenus *GLOCHICERAS* Hyatt, 1900
(Type species: *Ammonites nimbatus* Oppel, 1863)

Remarks. — The genus *Glochiceras* comprises microconchs with generally simple ornamentation. Nevertheless, there is some differentiation sufficient for distinguishing 4 subgenera: *Glochiceras* Hyatt, 1900, *Coryceras* Ziegler, 1958, *Lingulaticeras* Ziegler, 1958, and *Paralingulaticeras* Ziegler, 1958. The systematic position of the genus *Glochiceras* is still debatable and the problem of recognition of dimorphic counterparts of this genus is of primary importance.

Arkell (1957) placed *Glochiceras* in the family Haploceratidae Zittel, 1894. The genus *Lissoceratoides* Spath, 1923, also allocated in that family, was interpreted as a possible dimorphic counterpart of *Glochiceras* by Makowski (1962): dimorphic pair *Glochiceras (Coryceras) cornutum* Ziegler — *Lissoceratoides erato* (d'Orb.).

Another interpretation may be suggested in the case of some species of the subgenus *Glochiceras*. European species *Glochiceras (Glochiceras) subclausum* (Opp.), *G. (Glochiceras) tectum* Ziegler and *G. (Glochiceras) nimbatum* (Opp.) are characterized by ventral side sharpened in the form of a keel and bordered with ventrolateral edges. These forms, except for their subperistomal part, appear to be markedly similar to inner whorls of the genus *Ochetoceras* (cf. also Ziegler 1958, p. 109). All these three species represent the same lineage (Ziegler 1958, 1959a, 1971a).

Among the Cuban ammonites of the genus *Glochiceras* undoubtedly were stated representatives of the nominate subgenus only. The species *G. (Glochiceras) amplicanaliculatum* sp. n. and other closely related forms described from Cuba are very similar to European species *G. (Glochiceras) subclausum* and *G. (Glochiceras) tectum*. The Cuban *Glochiceras* except for their subperistomal part resemble the innermost whorls of the representatives of *Ochetoceras* and *Cubaochetoceras* in coiling and the development of lateral groove and the character of ventral side. It should be mentioned that the rich ammonite assemblage of the Oxfordian of Cuba does not comprise any other ammonites resembling those discussed above.

A separate dimorphic status of Cuban *Glochiceras* (m) and *Cubaochetoceras* (M) — *Ochetoceras* (M) makes their relationship highly probable. It should be added

that the possibilities of making distinction between dimorphic counterparts of *Cubaochetoceras* and *Ochetoceras* are rather small as the two genera are related and their innermost whorls are presumably similar. Of the European material is also probable that the *Glochiceras subclausum* — *G. tectum* — *G. nimbatum* group (m) may represent dimorphs of *Ochetoceras* (M) as well as some related forms of European genus *Neoprionoceras* (M). Such interpretation bears important implications for the taxonomy as it requires to allocate the type species of the genus *Glochiceras, Glochiceras nimbatum* (Opp.), in the same family as the genus *Ochetoceras*, viz. in the Oppeliidae *.

Cuban species assigned to this genus: *Glochiceras (Glochiceras) amplicanaliculatum* sp. n., *Glochiceras* sp. n.

Occurrence of the genus *Glochiceras* in the Oxfordian of the Americas: western Cuba, Sierra de los Organos (Jagua Fm.), Sierra del Rosario (Francisco Fm.); northern Chile, Cordillera Domeyko (Hillebrandt 1970).

Glochiceras (Glochiceras) amplicanaliculatum sp. n.
(Pl. 8, Figs 7—8)

?1940. *Oppelia subclausa* Oppel; Jaworski, pp. 89—90.
Holotype: the specimen (No. 2001); presented in Pl. 8, Fig. 7.
Type horizon: Jagua Fm. (Jagua Vieja Member), Oxfordian.
Type locality: La Jutia, Sierra de los Organos.

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* *Note added in the proof:*

Recently B. Ziegler in "Über Dimorphismus und Verwandtschaftsbeziehungen bei "Oppelien" des oberen Juras (Ammonoidea: Haploceratacea)", *Stuttgarter Beitr. Naturk.*, Ser. B, 11, 1—62 (1974), discusses the similarities and differences between *Ochetoceras canaliculatum* and *Glochiceras subclausum* (and also between *Ochetoceras* and the nominate subgenus of *Glochiceras*) in morphology and phylogeny, and he states that these ammonites cannot be interpreted as dimorphic counterparts. According to Ziegler the inner whorls of *O. canaliculatum* and *G. subclausum* are very similar: the innermost whorls are smooth up to 10 mm diameter, then the lateral groove appears, *Wh* and *Ud* are practically the same up to 20 mm diameter, the venter is sharpened in the keel-like form in *G. subclausum* by 10 mm diameter and resembles the ventral side of inner whorls in *O. canaliculatum*. However, in the latter species at 15 mm diameter there appears the hollow floored keel, and at the same time (*cf.* Höroldt 1964) or somewhat earlier, the outer ribs; in *G. subclausum* the venter is sharpened up to the initial part of the body chamber, and the typical keel, as well as distinct ribs are never found.

Rather early changes in the morphological development of the two species do not necessarily evidence against their dimorphic interpretation, as there is a close similarity of inner whorls of the species up to about 15 mm diameter. It should be mentioned that all the ammonites of the subgenus *Glochiceras* represent the same simple morphological type which may be generally compared with the early growth stages of *Ochetoceras*. Thus, if *Ochetoceras* and *Glochiceras* were counterparting macro- and microconchs (as suggested by the present author), and they displayed the early differentiation of sculpture, some of the evolutionary changes in macroconchs would be "simplified" or "omitted" in microconchs. It may be also assumed that a particular species of the subgenus *Glochiceras* could be interpreted as dimorphic counterpart of a group of *Ochetoceras* species. Some parallel changes of the shell size in *Ochetoceras* and *Glochiceras* may be observed through their phylogenetic development. Middle Oxfordian *Ochetoceras* are often greater than those of Upper Oxfordian and Kimmeridgian age (*cf.* Höroldt 1964, p. 38). The same tendency in the subgenus *Glochiceras* is recorded by Ziegler. The stratigraphic ranges of *Ochetoceras* (and some related forms of *Neoprionoceras* with distinct lateral groove) and *Glochiceras (Glochiceras)* are also very similar (*cf.* Ziegler 1958, Fig. 65; Christ 1961, p. 315; Höroldt 1964, Fig. 36).

The genera *Ochetoceras, Neoprionoceras* and their allies, as well as *Glochiceras* (especially the subgenus *Glochiceras*) should be probably included in the family Glochiceratidae Hyatt, 1900, as it is proposed by Ziegler. It seems to be a better solution than the here presented interpretation of their belonging to the Oppeliidae.

Derivation of the name: Lat. *ample* — widely, *canaliculatus* — grooved.
Paratypes: three specimens (No. 2010, 2395b, 2453).

Description. — The mature individuals range from about 17 to 29 mm in diameter. Body chamber about 2/3 to 3/4 of whorl long. Aperture marked with constriction; peristome concave in ventrolateral part, with small rostrum on ventral side ;oblique, pointed backwards in dorsolateral part. Lappets long, with terminal part broken off.

Umbilicus moderately wide, fairly shallow, with steep umbilical wall; umbilical edge not developed. Some uncoiling observable close to the aperture. Dimensions close to the aperture : Ud = 24.5% and Wh = 42% in the holotype, Ud = 24—25% and Wh = c.45% in other specimens; in the middle of body chamber: Ud = 23% and Wh = 48% in the holotype, Ud = 21—25% and Wh = 47.5—50% in other specimens.

Whorl section subovate, somewhat narrowing towards the venter; maximum whorl thickness below lateral groove (Wb = 26—32% on the body chamber). Ventral side moderately wide, sharpened in the form resembling keel and with ventrolateral edges; close to the aperture the venter becomes rounded.

Lateral groove situated at the mid-height or somewhat below, well-marked only on the body chamber; it is very wide but shallow, usually occupying about 15—20% of whorl side, or even 25% of whorl side close to the aperture. At the peristome it joins the final constriction somewhere above the outlet of lappet groove (towards the ventral side). The lateral groove usually displays some small depressions formed between sets of riblets passing across it. Thin riblets are sometimes visible on shell surface outside the lateral groove. Feather structures (*"Streifenbüschel"* sensu Hölder, 1955) are sometimes found in ventrolateral area.

Remarks. — This species appears very similar to European species *Glochiceras tectum* Zieg. and *G. subclausum* (Opp.), differing from them mainly in wider lateral groove.

The Cuban specimens described as *Oppelia subclausa* Opp. by Jaworski (1940) appear very close to *G. amplicanaliculatum* sp. n.; however, the lack of illustrations precludes unequivocal establishment of their specific status.

Occurrence. — Sierra de los Organos, Jagua Fm. (Jagua Vieja Member). The specimens were found at La Jutía, El Hoyo de la Sierra and Sierra de Guane. The specimens described by Jaworski (1940) were found at Puerta del Ancón.

Glochiceras (Glochiceras) aff. *amplicanaliculatum* sp. n.
(Pl. 8, Fig. 9)

Remarks. — One specimen (No. 2670), with peristome preserved (lappet partly damaged); at the aperture D = 16 mm, Ud = 27%, Wh = 40.7%; in the middle of body chamber D = 11.5 mm, Ud = 22%, Wh = 47.8%, Wb = 35%. The specimen appears markedly similar to the representatives of *G. (G.) amplicanaliculatum* sp. n., differing in larger body chamber, 8/9 of whorl long, and longer lateral groove observable along the whole last whorl. The lack of comparative material precludes stating whether it represents a variety of *G. amplicanaliculatum* or a separate species (or subspecies).

Occurrence. — Sierra del Rosario, Francisco Fm., Brujito locality.

Glochiceras sp. n.
(Pl. 8, Fig. 10)

Description. — One damaged specimen (No. 2005a), 21 mm in diameter with almost complete lappet. Body chamber about a half whorl long. Aperture marked with shallow constriction; ventrolateral part of the peristome concave; ventral side and dorsolateral part of the peristome damaged. Lappet long, grooved, with its terminal part widening dorsally.

Umbilicus moderately wide, deep; umbilical wall steep, umbilical edge not developed. Some uncoiling marked close to the aperture. At the aperture D = 20 mm, Ud = 22.8%, Wh = 45.8%; in the middle of the body chamber D = 17 mm, Ud = 20.6%, Wh = 48.5%.

Whorl section subovate, somewhat narrowing towards the venter; maximum whorl thickness below the lateral groove. Ventral side sharpened in the keel-like form and with ventrolateral edges.

Lateral groove situated at about the mid-height, wide, very shallow, visible along the whole last whorl, connected directly with lappet groove at the aperture. Thin riblets visible in ventrolateral part of whorl as well as in the lateral groove.

Remarks. — This form differs from *G. (G.) amplicanaliculatum* sp. n. in deeper umbilicus, shorter body chamber and in lateral groove directly connected with lappet groove. The two latter features are often found in the subgenus *Coryceras* Ziegler, 1958, whereas the shape of venter (its keel-like form, ventrolateral edges) is closer to that of the subgenus *Glochiceras*. The distinction of these subgenera is primarily based on the character of dorsolateral part of peristome (Ziegler 1958); however, the aperture of this specimen is insufficiently preserved for unequivocal determining its subgeneric status.

Occurrence. — Sierra de los Organos, Jagua Fm. (Jagua Vieja Member), La Jutía locality.

Glochiceras spp.

Incomplete specimens referable to this genus were found in all the exposures of the Jagua Fm. (Jagua Vieja and Zacarías members) in Sierra de los Organos as well as in the Francisco Fm. in Sierra del Rosario. Some of them, with partly preserved peristomes, may be assigned to subgenus *Glochiceras*.

Some of the specimens misidentified as *Haploceras* aff. *fialar* Opp. by Sánchez Roig (1920, Pl. 14, Figs 3—5) may also belong to the genus *Glochiceras*, similarly as those described by Jaworski (1940, pp. 97—98) as *Haploceras (Glochiceras)* cf. *microdomum* Opp. The latter were not illustrated, but as it follows from the original description their affinity to *Glochiceras (Coryceras) microdomum* (Opp.) is doubtful.

REMARKS ON THE PHYLOGENY

The described Cuban older ammonite fauna represents a short time-interval of the Oxfordian, and it does not reflect any greater differentiation through the profile. A younger Oxfordian assemblage from Cuba described by Myczyński (1976) and Kutek & al. (1976) supplies new data on the evolutionary trends of some Euaspidoceratinae, as the genus *Cubaspidoceras* Myczyński, 1976, recorded in this assemblage has probably evolved from the earlier *Euaspidoceras*. The other Oxfordian

ammonite faunas of the Americas, older or younger than the discussed, are generally very poorly known, except of the Boreal ones, and not of much help for phylogenetic considerations. Otherwise for the latter purpose some observations on European material appear to be useful.

The genera *Cubaochetoceras* and *Ochetoceras* are undoubtedly closely related. Similar ammonites known from Europe are placed in the one lineage leading from tricarinate *Neoprionoceras* s.l. to unicarinate *Ochetoceras* (cf. Geyer 1960, Christ 1961, Höroldt 1964). In Cuba, the ammonites of the genera *Cubaochetoceras* and *Ochetoceras* occur in the same beds and they are represented by well-defined morphotypes. This would indicate a separation of the two genera in the older Oxfordian. The unicarinate *Ochetoceras* presumably evolved from some tricarinate forms (supposedly very close to *Cubaochetoceras*).

The Cuban Perisphinctidae are represented only by three groups: genus *Vinalesphinctes* with *subgenera Vinalesphinctes* (**M**), *Subvinalesphinctes* (**M**) and *Roigites* (**m**); genus *Perisphinctes* with subgenera *Cubasphinctes* (**M**) and *Antilloceras* (**m**); and genus *Discosphinctes* (**M, m**). The genera *Vinalesphinctes* and *Perisphinctes (Cubasphinctes, Antilloceras*), as well as *Perisphinctes (Cubasphinctes, Antilloceras)* and *Discosphinctes* seem to be rather closely related. In the first case, the affinity is suggested by the similarity of some heavily ribbed representatives of *Vinalesphinctes (Subvinalesphinctes, Roigites* ex gr. *R. catalinensis)* to less densicostate, heavily ribbed *Perisphinctes* (cf. remarks on the genus *Vinalesphinctes*). In the second case, it is suggested by the similarity of some *Perisphinctes*, e.g. *P. (Cubasphinctes) planatus* S. R., to Cuban *Discosphinctes*.

The three Cuban groups of Perisphinctidae seem to represent the branches of the same lineage. A differentiation of these genera presumably took place during the early Oxfordian; their ancestors cannot, however be identified because of insufficient knowledge of the early Oxfordian faunas of the Americas.

The discussed three groups of Cuban Perisphinctidae are more or less similar to some European forms. The genus *Perisphinctes (Cubasphinctes)* seems to be very similar to European *Platysphinctes* Tintant, 1961, which is close to *Liosphinctes* Buckman, 1925 (*cf.* Enay 1966; Brochwicz-Lewiński 1972, 1974; *cf.* also remarks in description of subgenus *Cubasphinctes*). The genus *Vinalesphinctes* is similar to European *Decipia* Arkell, 1937 (*cf.* Arkell 1939, 1957), the status and range of which are still controversial (*cf.* Enay 1966; Brochwicz-Lewiński 1972; Wright 1973, p. 451). In turn, the Cuban *Discosphinctes* is similar to European *Subdiscosphinctes* Malinowska, 1972 (*cf.* remarks in description of the former).

The affinity of the European genera *Decipia* and *Liosphinctes* was suggested by Arkell (1937, p. 45), or even in extreme opinion (Brochwicz-Lewiński 1972) these two generic names were treated as synonyms; the

affinity of *Platysphinctes* and *Subdiscosphinctes* was indicated by Enay (1966).

The occurrence of morphologically similar genera of the family Perisphinctidae in the Oxfordian both of Cuba and of Europe, and their affinity in each of these regions, seem to indicate that the genera known from Cuba and other parts of the Americas, and those discussed from Europe may represent related parallel lineages.

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A. WIERZBOWSKI

LA FAUNA DE LOS AMMONITES Y ESTRATIGRAFIA DEL OXFORDIANO DE CUBA OCCIDENTAL

(Resumen)

Este trabajo presenta la litoestratigrafía de los depositos oxfordianos en la Sierra de los Organos y en la Sierra del Rosario en la provincia de Pinar del Rio (*comp.* Fig. 1 y Tab. 1). En el esquema litoestratigrafico se diferencia el Miembro Zacarías como una nueva unidad de la Formación Jagua en la Sierra de los Organos (*comp.* Fig. 2–3).

Se ofrece también la revisión de la clasica fauna de ammonites del Oxfordiano de Cuba, ya conocida del Miembro Jagua Vieja de la Formación Jagua en la Sierra de los Organos y ultimamente encontrada en la Formación Francisco en la Sierra del Rosario (Tab. 1–2, Fig. 4). Estos ammonites pertenecen a los géneros y subgéneros siguientes: *Vinalesphinctes* Spath (con los subgéneros *Vinalesphinctes, Subvinalesphinctes subgen. n., Roigites* subgen. n.), *Perisphinctes* Waagen (con los subgéneros *Cubasphinctes* Chudoley & Furrazola, *Antilloceras* subgen. n.), *Discosphinctes* Dacqué, *Euaspidoceras* Spath, *Ochetoceras* Haug, *Cubaochetoceras* Arkell, *Glochiceras* Hyatt (*comp.* Tab. 4–25, Fig. 5–23, Lam. 1–8). Al referirse a los estudios paleontologicos anteriores (*comp.* sobre todo Sánchez Roig 1951, Arkell 1956, Judoley & Furrazola-Bermúdez 1968) se pone en duda la existencia en éste conjunto de ammonites de los géneros y subgéneros siguientes: *Arisphinctes, Pseudarisphinctes, Dichtomosphinctes, Orthosphinctes, Prososphinctes, Ampthillia* y *Decipia.*

Las capas que contienen la fauna estudiada corresponden a la zona Gregoryceras transversarium y eventualmente a la parte de la zona Perisphinctes bifurcatus del Oxfordiano Medio en la subdivisión submediterránea (Tab. 3) utilizada aqui. El conjunto más joven de los ammonites oxfordianos ha sido encontrado ultimamente en Cuba (*comp.* Myczyński 1976, Kutek & al. 1976) en el Miembro Pimienta de la Formación Jagua en la Sierra de los Organos y en la parte más alta de la Formación Francisco, así como en las capas más inferiores de la Formación Artemisa en la Sierra del Rosario. Este conjunto de ammonites indica la edad Oxfordiano Medio más alto (zona P. bifurcatus) y eventualmente el Oxfordiano Superior más bajo.

Los datos señalados permitierón realizar la correlación estratigráfica de los sedimentos oxfordianos de la Sierra de los Organos y de la Sierra del Rosario (*comp.* Tab. 1).

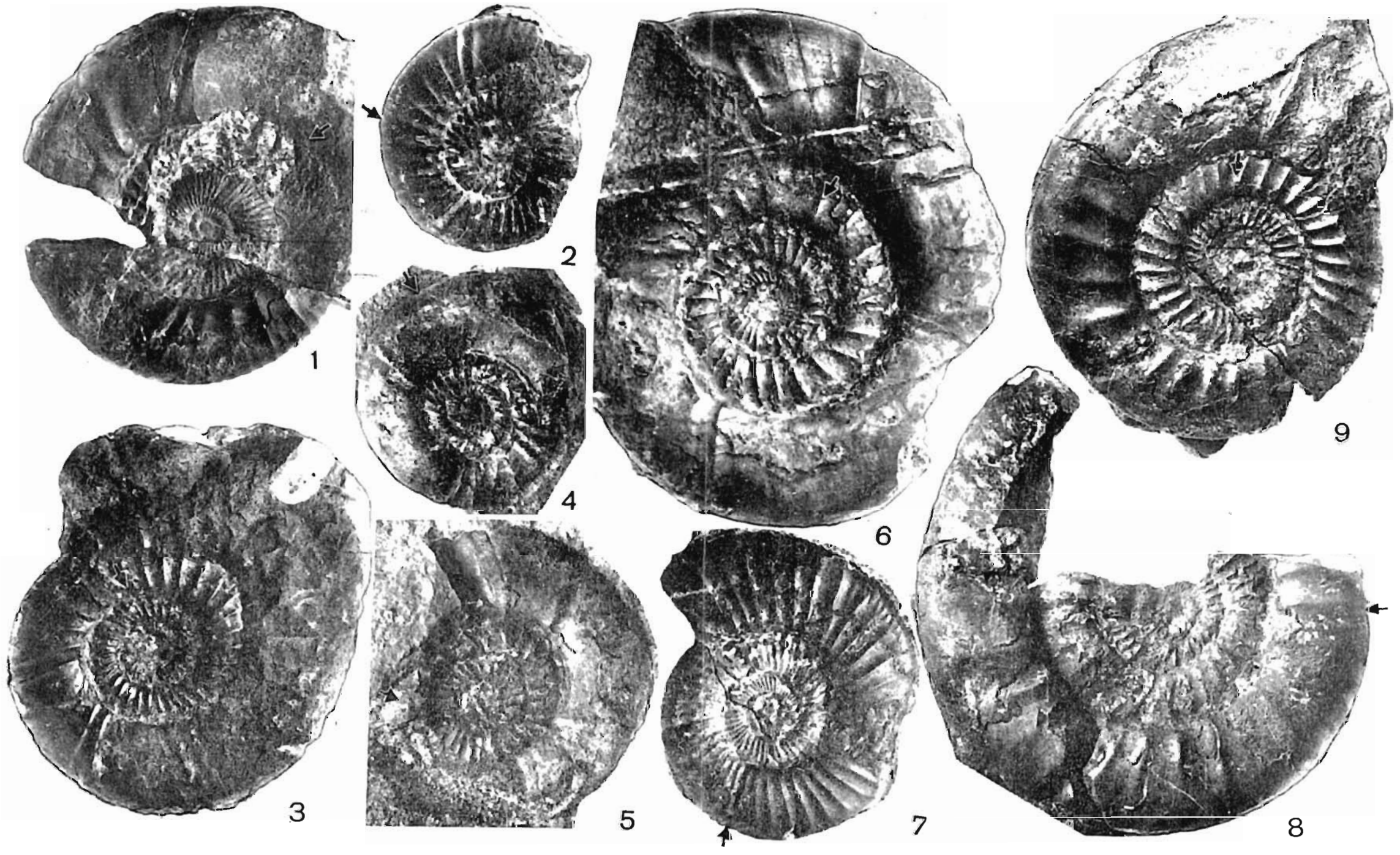
La fauna de los ammonites oxfordianos de Cuba se acerca a los ammonites conocidos en México, en la parte meridional de los Estados Unidos y en América del Sur (Chile, Argentina, Perú). Se discute también la posición paleobiogeografica de las faunas mencionadas, en los limites de Tethys. Parece ser posible la relación de dichas faunas americanas con las faunas del área indopacífico.

A. WIERZBOWSKI

OKSFORDZKA FAUNA AMONITOWA ZACHODNIEJ KUBY

(Streszczenie)

Przedmiotem pracy jest rewizja klasycznej fauny amonitowej z oksfordu zachodniej Kuby, znanej dotychczas (O'Connell 1920; Sánchez Roig 1920, 1951; Jaworski 1940; Judoley & Furrazola-Bermúdez 1968) zwłaszcza z ogniwa Jagua Vieja formacji Jagua w Sierra de los Organos, a ostatnio także z formacji Francisco w Sierra del Rosario (tab. 1—2 oraz fig. 1 i 4). Fauna ta reprezentowana jest (*por.* tab. 4—25, fig. 5—23 oraz pl. 1—8) przez następujące rodzaje i podrodzaje: *Vinalesphinctes* Spath (z podrodzajami *Vinalesphinctes*, *Subvinalesphinctes* subgen. n., *Roigites* subgen. n.), *Perisphinctes* Waagen (podrodzaje *Cubasphinctes* Chudoley & Furrazola oraz *Antilloceras* subgen. n.), Discosphinctes Dacqué, *Ewaspidoceras* Spath, *Ochetoceras* Haug, *Cubaochetoceras* Arkell oraz *Glochiceras* Hyatt. Warstwy zawierające badaną faunę odpowiadają poziomowi Gregoryceras transversarium i ewentualnie części poziomu Perisphinctes bifurcatus oksfordu środkowego (tab. 3). Opracowanie tej fauny, odkrycie młodszego zespołu amonitów oksfordzkich (*por.* Myczyński 1976; Kutek, Pszczółkowski & Wierzbowski 1976), a także obserwacje litostratygraficzne (fig. 2—3) umożliwiły przedstawienie korelacji pomiędzy osadami oksfordu Sierra de los Organos i Sierra del Rosario (tab. 1). Fauna oksfordzkich amonitów Kuby jest zbliżona do faun amonitowych znanych z innych obszarów Ameryki Środkowej i Południowej. W pracy dyskutowana jest także pozycja paleobiogeograficzna tych faun w obrębie prowincji tetydzkiej.



1–3 *Vinalesphinctes (Vinalesphinctes) roigi* Spath; specimens No. 2494, 2496 and 2497, San Carlos Valley, El Junco; 4–6 *Vinalesphinctes (Vinalesphinctes) imlayi* (Sánchez Roig); 2471, 2470 and 2495, ibidem; 7 *Vinalesphinctes (Vinalesphinctes) sagrai* Chudoley & Furrazola; 2681, Loma Calabrote; specimen immature — sutures not approximated; 8 *Vinalesphinctes (Vinalesphinctes) niger* Spath; 2493, San Carlos Valley, El Junco; 9 *Vinalesphinctes (Vinalesphinctes) subroigi* Chudoley & Furrazola; 2492, ibidem

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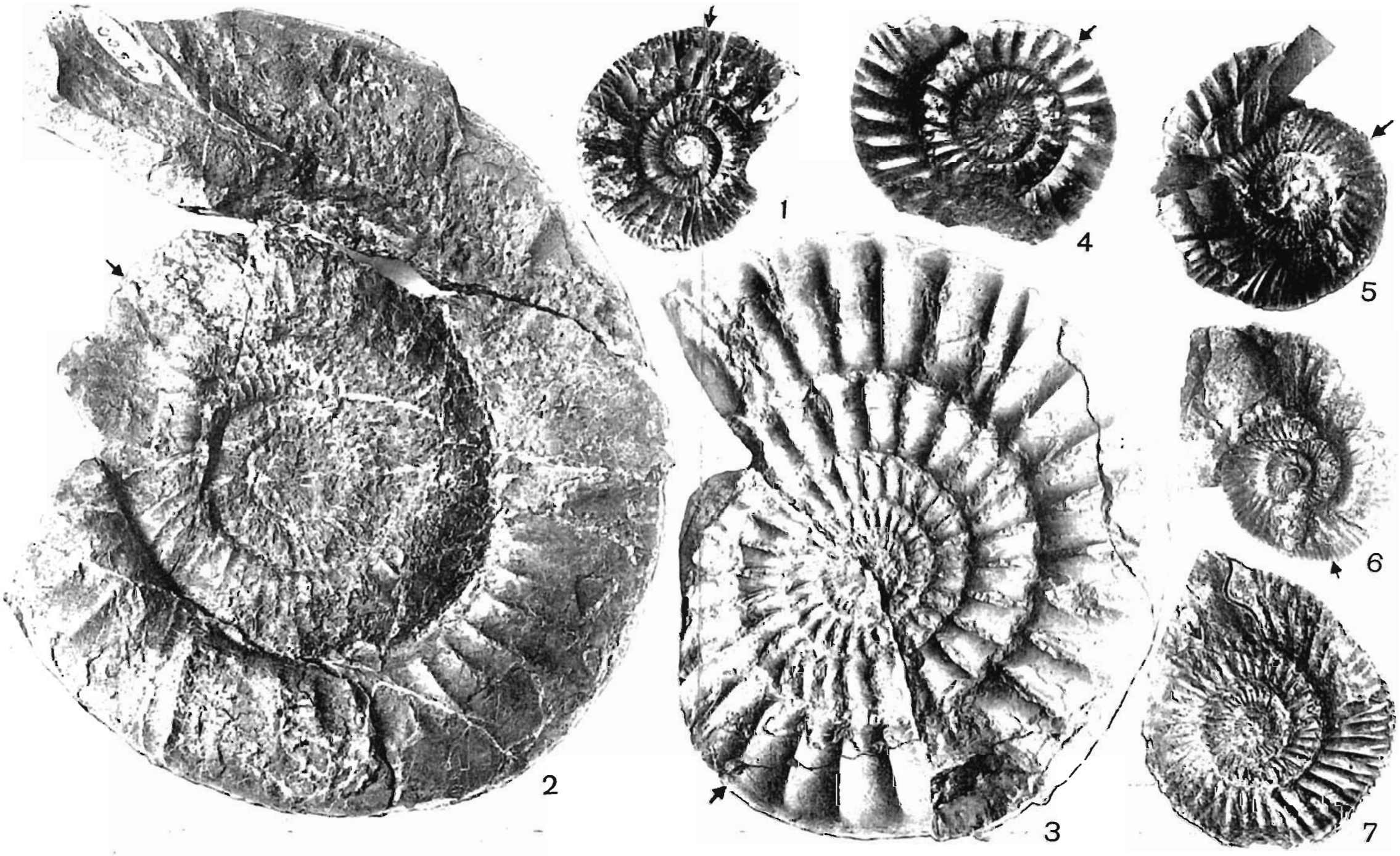

1 *Vinalesphinctes (Vinalesphinctes)* cf. *parvicostatus* Chudoley & Furrazola; specimen No. 2504, Brujito; inner whorls of immature specimen — sutures not approximated; **2** *Vinalesphinctes (Vinalesphinctes)* sp. n.; 2500, San Carlos Valley, El Junco; specimen fully grown — sutures strongly approximated; **3** *Vinalesphinctes (Subvinalesphinctes) corrali* (Chudoley & Furrazola); 2016b, La Jutia; **4** *Vinalesphinctes (?Subvinalesphinctes)* sp.; 2515a, Brujito; specimen immature — sutures not approximated; **5–6** *Vinalesphinctes (Roigites) subconsociatus* (Spath); 2398, El Hoyo de la Sierra; 2490, San Carlos Valley, El Junco; **7** *Vinalesphinctes (Roigites)* aff. *subconsociatus* (Spath); 2449, Sierra de Guane; specimen fully grown with lappets

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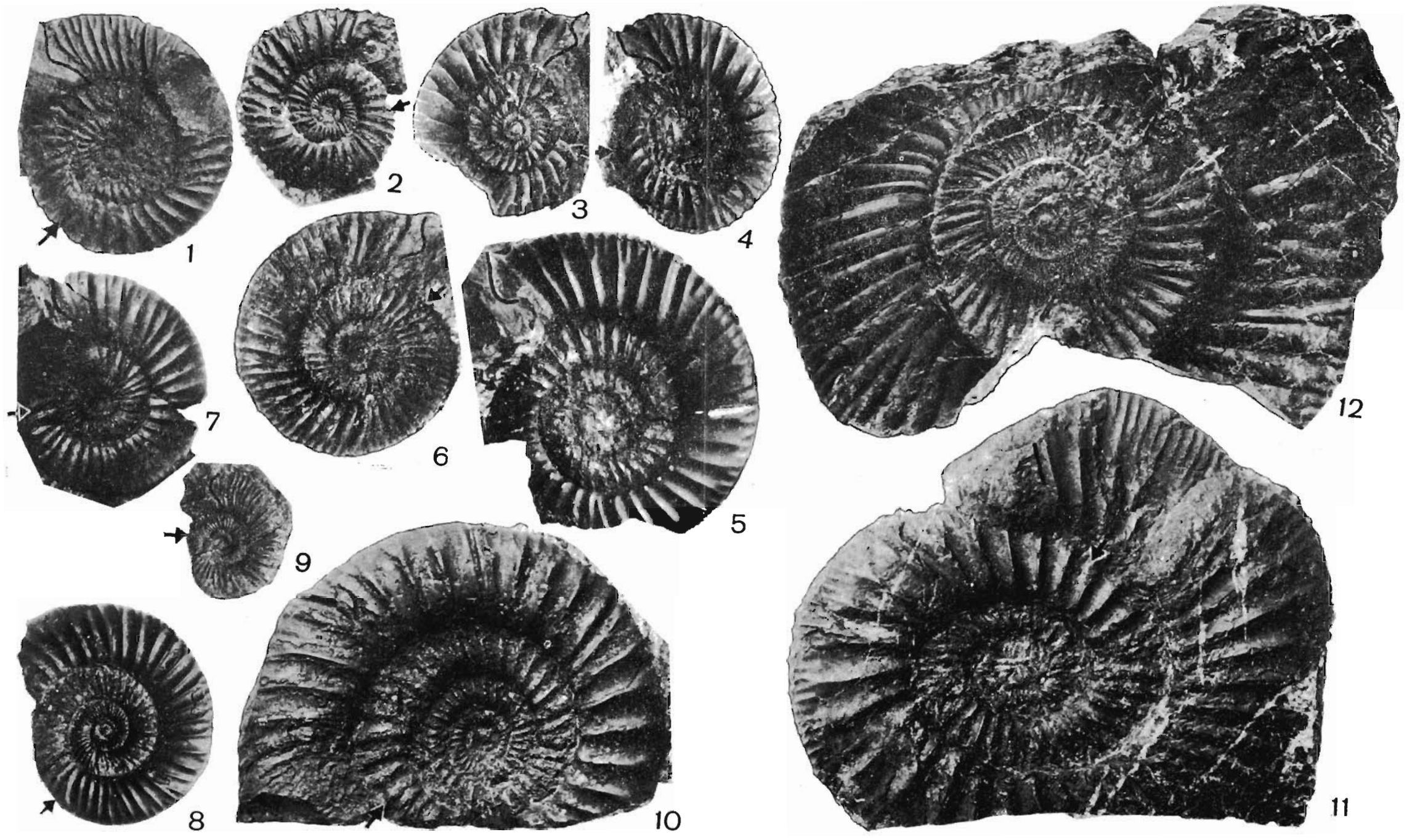

1 *Vinalesphinctes (Roigites) catalinensis* (Sánchez Roig); specimen No. 2387, fully grown with lappets; El Hoyo de la Sierra; **2** *Vinalesphinctes (Roigites)* aff. *catalinensis* (Sánchez Roig), 2020, La Jutia; specimen fully grown with one lappet preserved on the non-illustrated side; **3—5** *Vinalesphinctes (Roigites) rosariensis* sp. n.; 2671 (holotype), Brujito; 2485 (paratype), San Carlos Valley, El Junco; 2512 (paratype), Brujito; all specimens fully grown with lappets; **6—8** *Vinalesphinctes (Roigites) simplicior* sp. n.; 2499 (holotype), San Carlos Valley, El Junco; 2505 and 2515b (paratypes), Brujito; all specimens fully grown — sutures approximated, the first two (presented in Figs 6—7) bear apertures with lappets; **9** *Vinalesphinctes (Roigites)* sp.; 2004, La Jutia; specimen fully grown with lappets; **10** *Perisphinctes (Cubasphinctes)* cf. *poeyi* Chudoley & Furrazola; 2403a, El Hoyo de la Sierra; specimen probably immature; **11** *Perisphinctes (Cubasphinctes) jaworskii* Chudoley & Furrazola; 2399a, ibidem; specimen presumably fully grown — sutures approximated; simple peristome partly preserved; **12** *Perisphinctes (Cubasphinctes) intermedius* Chudoley & Furrazola; HSA-6, El Hoyo de San Antonio; phragmocone/body-chamber boundary at the missing part of the outer whorl

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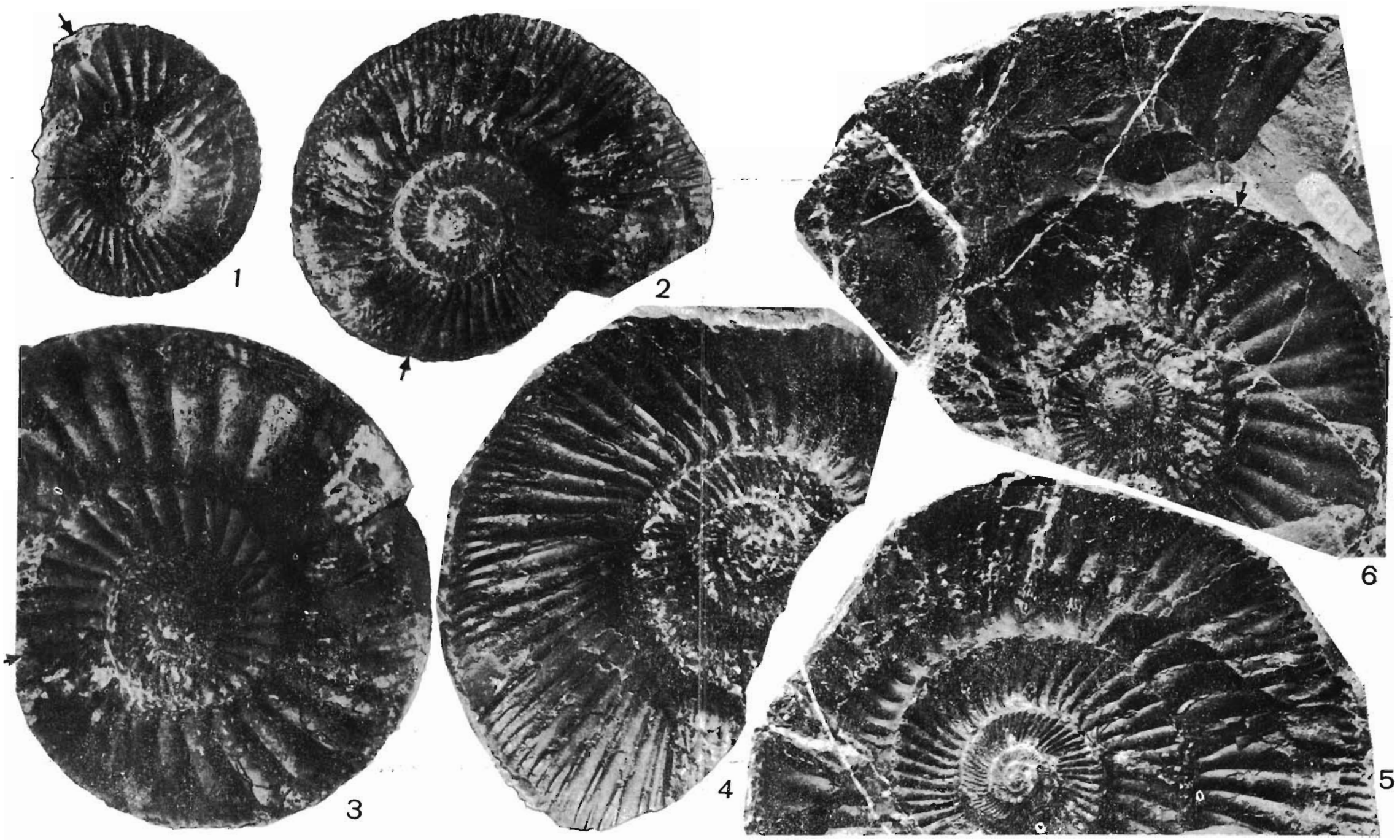

1–6 *Perisphinctes (Cubasphinctes) cubanensis* O'Connell; Fig. 1 — specimen No. HSA-2, El Hoyo de San Antonio, inner part of mature specimen — sutures approximated; Fig. 2 — specimen No. 2450, Sierra de Guane, specimen immature — sutures not approximated; Figs 3–6 — specimens No. 2379, 2409a, 2406 and 2407, El Hoyo de la Sierra; in Fig. 4, phragmocone/body-chamber boundary at the missing part of outer whorl

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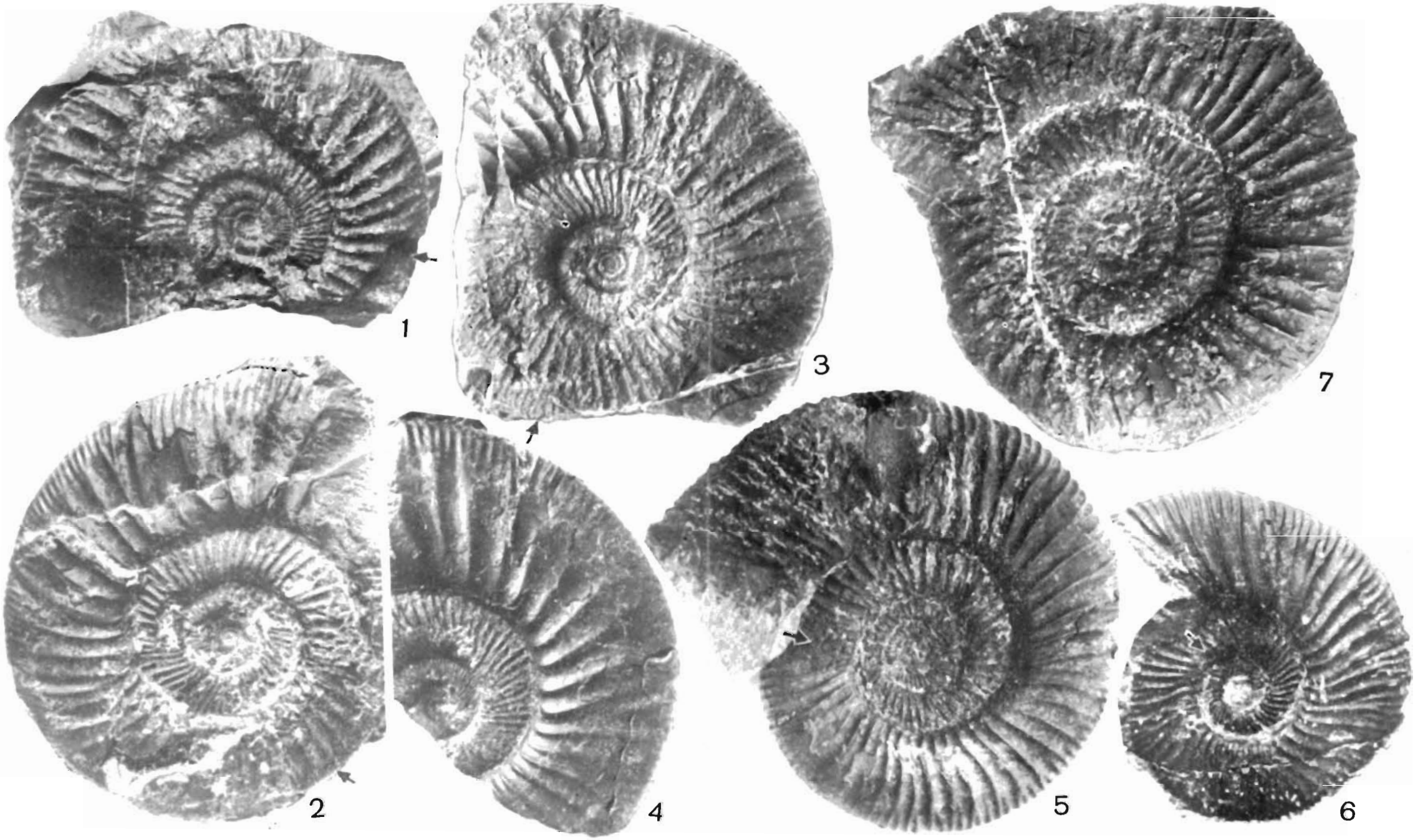

1 *Perisphinctes (Cubasphinctes)* aff. *cubanensis* O'Connell; specimen No. 2014, La Jutia; 2 *Perisphinctes (Cubasphinctes) rutteni* Jaworski; 2391, El Hoyo de la Sierra; 3–4 *Perisphinctes (Cubasphinctes) guziki* sp. n.; 2013 (holotype), La Jutia; 2401 (paratype), El Hoyo de la Sierra, phragmocone/body-chamber boundary at the missing part of outer whorl; 5–6 *Perisphinctes (Cubasphinctes) albeari albeari* Chudoley & Furrazola, 2458, 2443, Sierra de Guane; specimens immature — sutures not approximated; 7 *Perisphinctes (Cubasphinctes)* aff. *guanensis* Sánchez Roig; 2025, La Jutia

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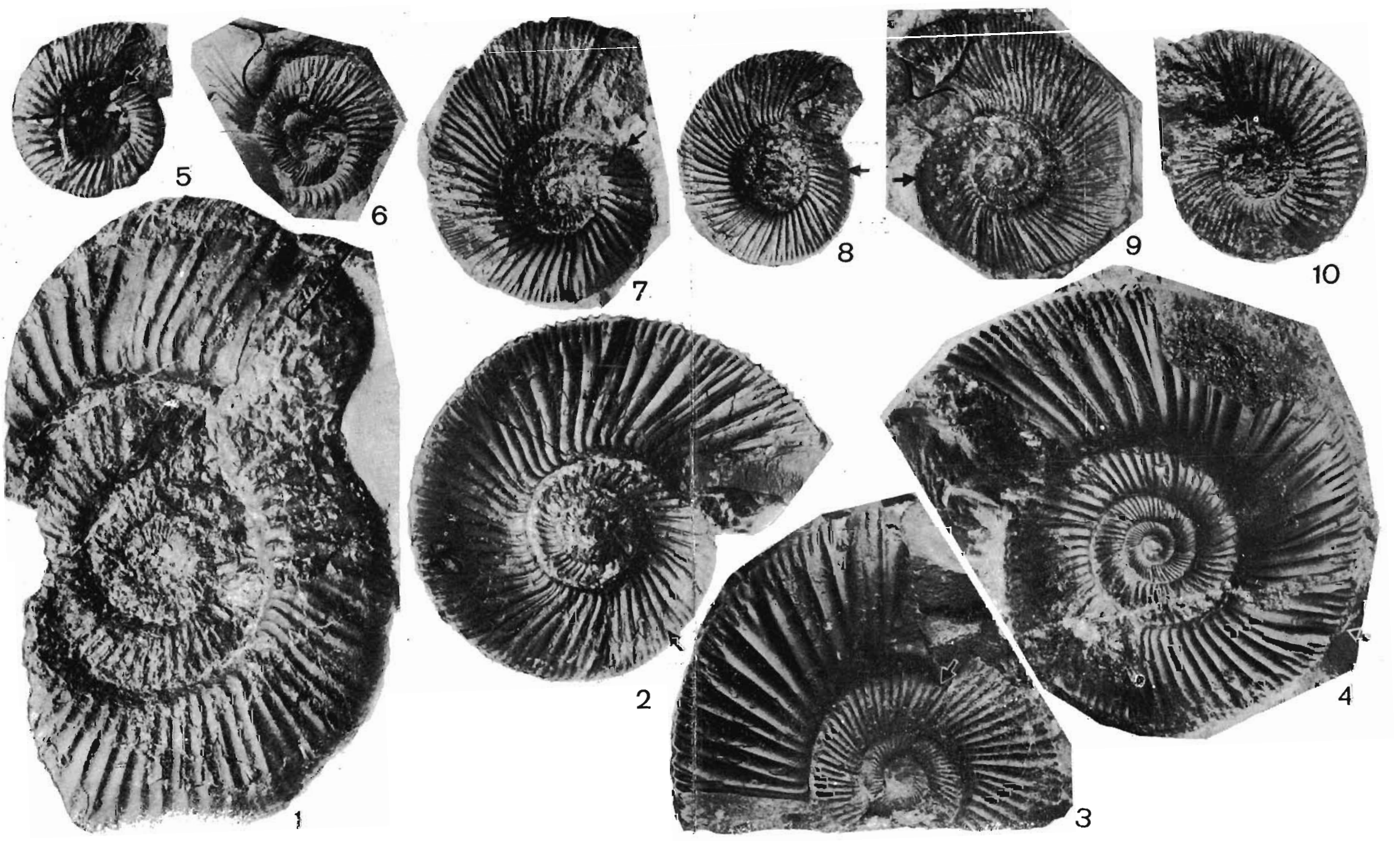

Perisphinctes (Cubasphinctes) guanensis Sánchez Roig; specimen No. 2029, presumably fully grown, peristome simple; body chamber about one whorl long, La Jutia; **2–3** *Perisphinctes (Cubasphinctes) planatus* Sánchez Roig; HSA-7, HSA-8, El Hoyo de San Antonio; specimens fully grown or almost fully grown — sutures approximated; **4** *Perisphinctes (Cubasphinctes)* aff. *planatus* Sánchez Roig; P-5, ibidem; **5–7** *Perisphinctes (Antilloceras) antillarum* Jaworski; 2690, Altos de San Francisco; 2382a, El Hoyo de la Sierra; 2442, Sierra de Guane; the first two specimens are fully grown with lappets; **8–9** *Perisphinctes (Antilloceras) spathi* Sánchez Roig, 2473a and 2473b, San Carlos Valley, El Junco; specimens fully grown with lappets, **10** *Perisphinctes (?Antilloceras)* sp.; 2445, Sierra de Guane; specimen immature — sutures not approximated

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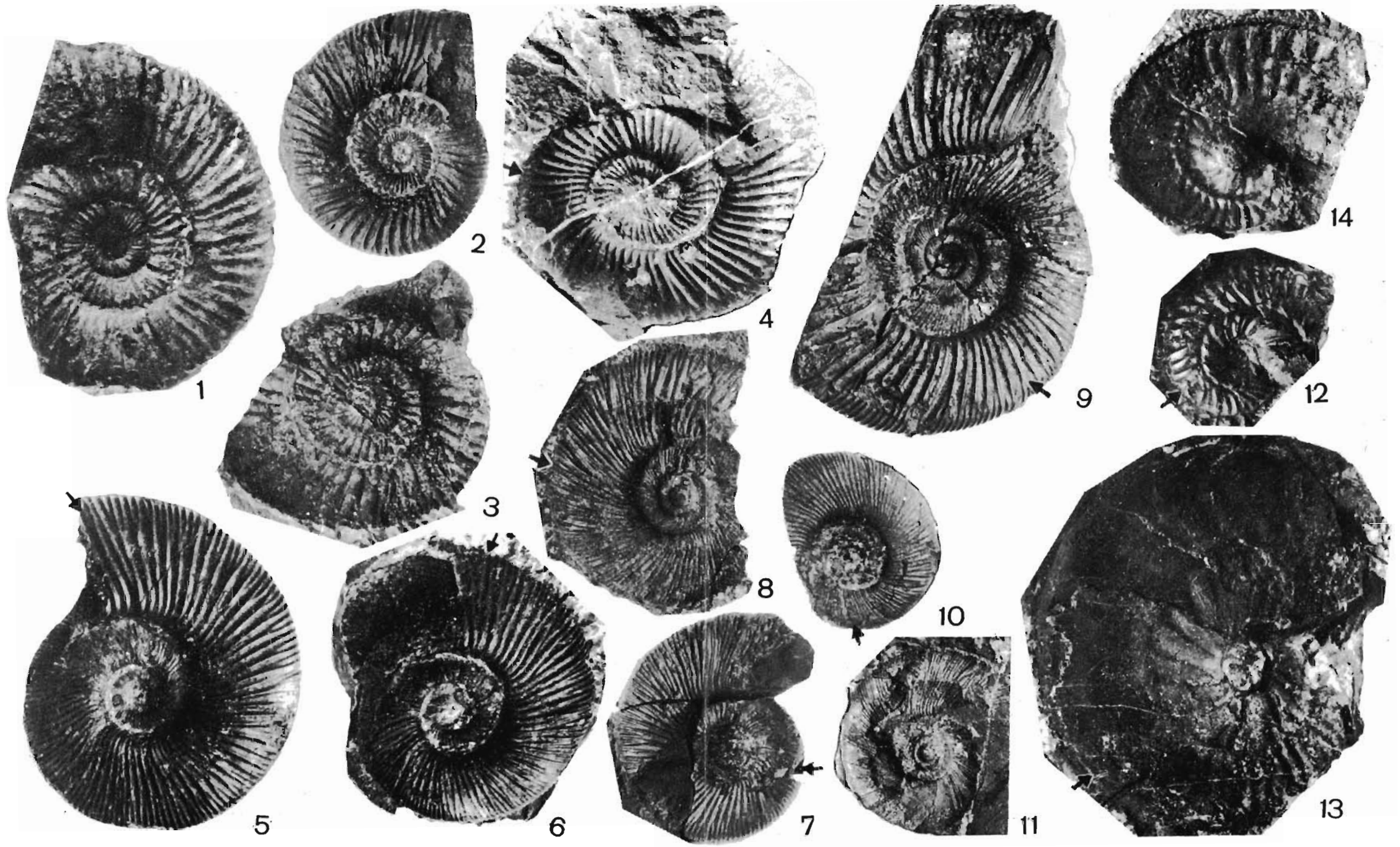

1–3 *Perisphinctes (Antilloceras) plicatiloides* O'Connell; specimens No. 2397, 2403b and 2392, El Hoyo de la Sierra; body chamber about 3/4 of the whorl; **4** *Perisphinctes (?Antilloceras)* aff. *plicatiloides* O'Connell; 2480a, San Carlos Valley, El Junco; specimen immature — sutures not approximated; **5–7** *Discosphinctes carribeanus* (Jaworski); Figs 5–6 — specimens No. P-7 and P-8, El Hoyo de San Antonio; macroconchs, phragmocones with initial part of the body chamber; Fig. 7 — specimen No. 2017, La Jutia, fully grown microconch — sutures approximated; **8** *Discosphinctes aguayoi* (Sánchez Roig); 2389, El Hoyo de la Sierra; **9** *Discosphinctes* aff. *aguayoi* (Sánchez Roig); 2024, ibidem; specimen immature — sutures not approximated; **10** *Discosphinctes furrazolai* sp. n.; 2409b (paratype), ibidem; specimen immature; **11** *Discosphinctes acandai* (Chudoley & Furrazola); 2402, ibidem; **12** *Ochetoceras vignalense* Sánchez Roig; 2022, La Jutia; **13** *Cubaochetoceras imlayi* (Sánchez Roig); 2023a, ibidem; **14** *Cubaochetoceras brevicostatum* Chudoley & Furrazola; 2466, San Carlos Valley, El Junco; phragmocone

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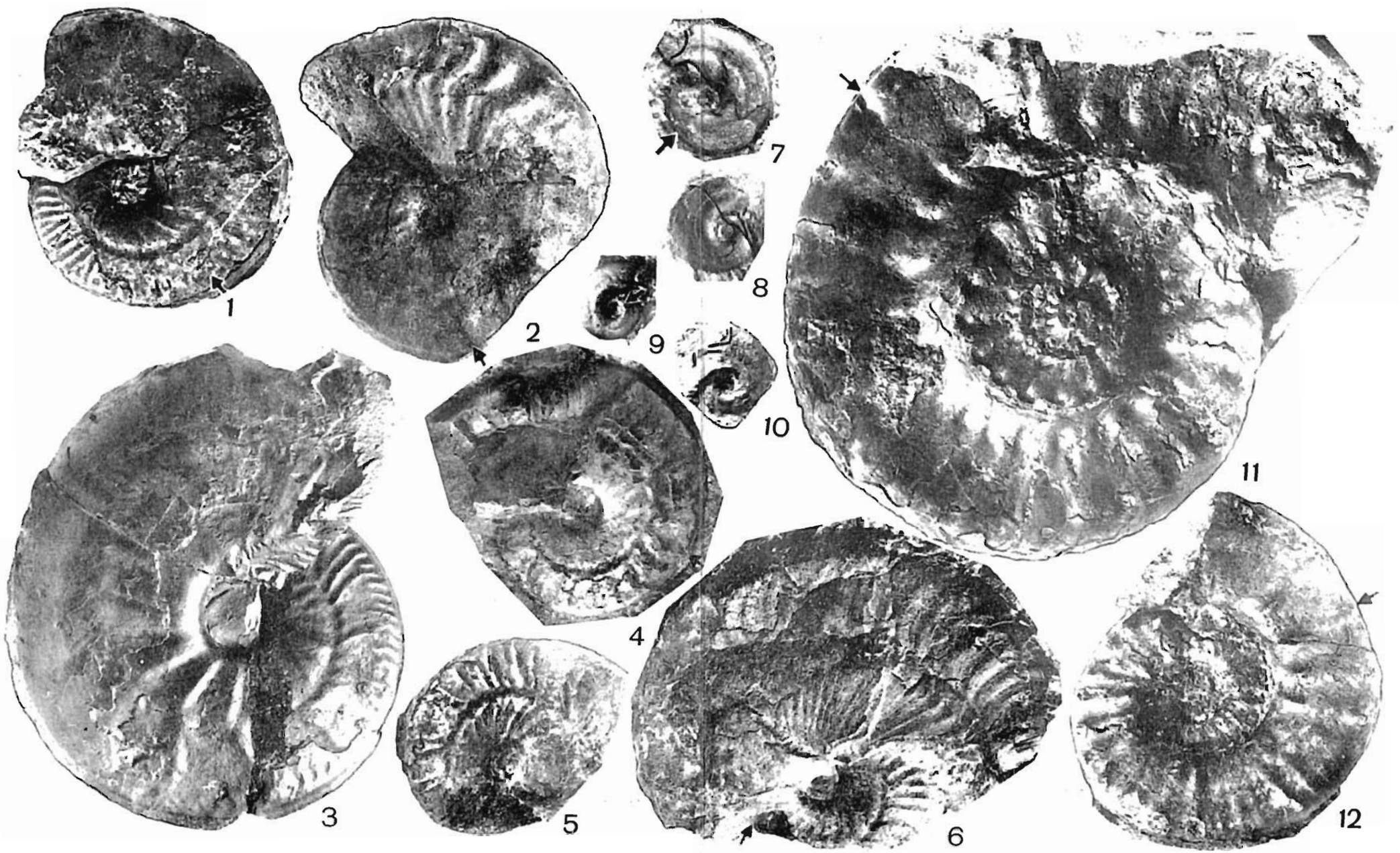

1–2 *Cubaochetoceras pinarense* Chudoley & Furrazola; specimens No. 2436 and 2462, presumably fully grown — sutures approximated; Sierra de Guane; 3 *Cubaochetoceras submexicanum* (Chudoley & Furrazola); P-9, El Hoyo de San Antonio; specimen fully grown with peristome partly preserved; body chamber about half-whorl long; 4–5 *Cubaochetoceras burckhardti* (O'Connell); 2386, El Hoyo de la Sierra; 2434, Sierra de Guane; 6 *Cubaochetoceras* cf. *chudoleyi* nom. n.; 2409c, El Hoyo de la Sierra; specimen fully grown, sutures approximated; 7–8 *Glochiceras (Glochiceras) amplicanaliculatum* sp. n.; 2001 (holotype), 2010 (paratype), La Jutia; 9 *Glochiceras (Glochiceras)* aff. *amplicanaliculatum* sp. n.; 2670, Brujito; 10 *Glochiceras* sp. n.; 2005a, La Jutia; 11 *Euaspidoceras oconnellae* (Sánchez Roig); 2028, ibidem; 12 *Euaspidoceras* sp. (?*E. vignalense* Spath); 2476, San Carlos Valley, El Junco

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