Notes on Lower Turonian ammonites from Loma el Macho, Coahuila, Mexico

G. R. C. CHANCELLOR, R. A. REYMENT, E. A. TAIT

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Species of *Metoicoceras, Mammites, Pseudaspidoceras, Fagesia, Paravascoceras, Vascoceras, Neoptychites, Bauchioceras* and *Wrightoceras* occur in a recently made collection from the locality originally monographed by Böse (1918), though not treated since then. This material confirms the Early Turonian age given most of the sequence by Böse (1918) but fails to support his determination of Late Cenomanian. There are more definite relationships with the ammonite associations of Nigeria and Brazil than with those of the Iberian Peninsula. This indicates that during this part of Early Turonian time, at least, there was a marine connexion between these regions.

G. R. C. Chancellor, Paleontologiska Institutionen, Uppsala Universitet, Box 558, S-751 22, Uppsala, Sweden and Department of Geology and Mineralogy, University of Aberdeen, AB9 1AS, Aberdeen, U.K.; R. A. Reyment, Paleontologiska Institutionen, Uppsala Universitet, Box 558, S-751 22, Uppsala, Sweden; E. A. Tait, Department of Geology and Mineralogy, University of Aberdeen, AB9 1AS, Aberdeen, U.K., 15th May, 1977.

Introduction

In 1918, Böse described an interesting collection of ammonites from Loma el Macho (called Cerro del Macho by Böse — here, we adhere to the official spelling as used in Mexican literature) in northeastern Mexico. Historically, this report is interesting in that it represent the first published description of a sizeable association of vascoceratids from the Americas. Up to that time, vascoceratids were mainly interpreted in the light of Choffat's (1898) monograph on the Turonian ammonites of Portugal and this has clearly coloured Böse's opinions when determining his material. Pervinquière's (1907) monograph of Tunisian Cretaceous ammonites also had an important influence on Böse's interpretations.

Unfortunately, the state of preservation of the fossils at Loma el Macho is poor indeed and this, aggravated by Böse's bad illustrations, has meant that the true relationship of this critical fauna has remained unresolved. The inaccessibility of the locality and the difficulty of ascertaining its exact location have militated against new material becoming available for study.

In connexion with current research on the mid-Cretaceous events of the world, interest in the Early Turonian of Mexico has re-awakened. Although numerous publications on Mexican Cretaceous fossils have appeared since 1918, nothing new seems to have come to light on Loma el Macho.

Reyment and Tait had the opportunity in November 1975 of spending some time in the Torreón-Gomez Palacio area of northeastern Mexico. Although Böse (1918, p. 179) gave apparently precise indications of the location of the hill (Hacienda del Mohóvano, Municipality of San Pedro, District of Parras, State of Coahuila), the actual task of finding the place turned out arduous and was only made possible thanks to the advice of local ranchers and the skill of our guide, Señor Juan Chispasa.

The Ritter ranch (Mohóvano) of Böse's time is no longer a going concern. The original property seems to have been divided among other ranchers, although the land seems singularly unfit for the

Fig. 1. Location map showing the state boundaries of Mexico.

keeping of livestock, as the whole area is a desert, dominated by inselbergs, such as the Sierra Cipriano. The general location of the locality is shown in Fig. 1. There are no real roads, only tracks, and these change course continually.

Stratigraphical setting

At the beginning of the Cretaceous, an extensive marine transgression resulted in much of Mexico becoming submerged. The western shoreline of this sea is not known in northern Mexico with accuracy, but towards the north, the sea lapped against the southern margin of the Diablo Plateau of Texas and around the Coahuila Peninsula of western Coahuila (Fig. 2). A detailed location map is shown in Fig. 3. A schematic representation of the general distribution of Lower Turonian sediments of North America is given by Hancock (1975, Fig. 1).

Thick, coarse clastic sediments of mainly Berriasian to Hauterivian age have been recorded from Texas, Chihuahua, Durango and Coahuila (Imlay 1944, p. 1079), indicating proximity to the shore.

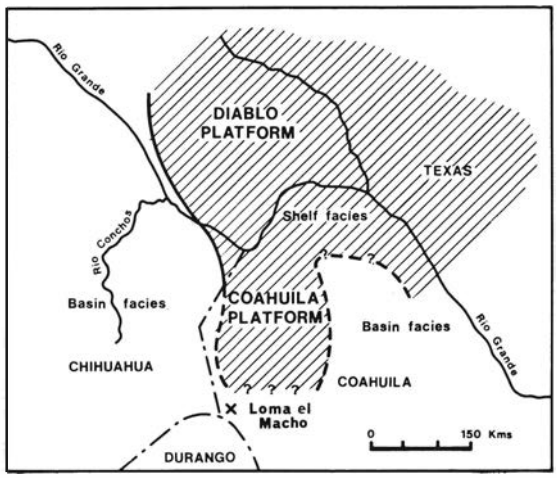


Fig. 2. Location of the Coahuila platform and the extent of the basin and shelf facies. (After Powell 1965)

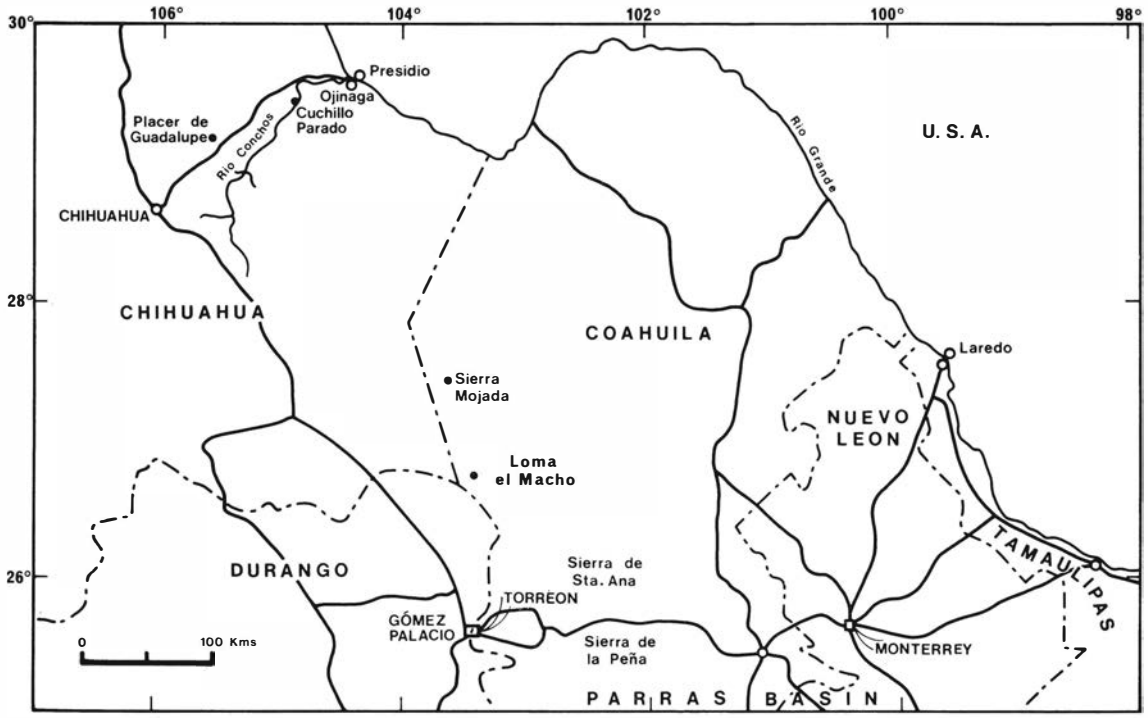


Fig. 3. Detailed location map of northern Mexico.

These sediments grade upwards into a series of limestones and marls of impressive geographical homogeneity.

The Lower Aptian is represented by grey, compact, thick to medium bedded limestones which, near the shore of the Coahuila Peninsula, may contain considerable shaly material with interbedded gypsum. During the Late Aptian, the sea spread westwards into eastern Sonora and northwards to cover the Coahuila Peninsula. Upper Aptian and Lower Albian are represented by a widespread unit of shaly to thin-bedded limestone of the La Peña (or Cuchillo) Formation.

Lower Aptian has been identified faunally at only a few places, but its extent over large areas is indicated by the overlying fossiliferous Upper Aptian, characterized by ammonites of the genera *Dufrenoya*, *Cheloniceras*, *Procheloniceras, Pediocera*s, *Ammonitoceras*, and *Pseudohaploceras.*

From late Early Albian to the close of the Turonian, carbonate rocks were formed in northern Mexico. Imlay (1944) has described seven distinct facies in the middle Albian, three in the Upper Albian to Lower Cenomanian, and a further five in the Upper Cenomanian to Turonian. Later workers (Powell 1965) have preferred to subdivide the rocks into sediments of shallow-water origin over the Jurassic-Early Cretaceous positive areas (Coahuila Peninsula), a basin facies assumed to represent sediments of deeper origin and a transitional facies between the two. An alternative interpretation of the bathymetrical relationships has recently been made by Frush & Eicher (1975).

In the Middle Albian, the platform, or shallow-water facies, is marked by thick rudistid limestones, known generally as the Aurora Limestone. The transition to thin-bedded limestone and cherts is rapid, indicating that the rudistid reefs terminate abruptly on their seaward side.

Towards the close of Early Cenomanian time, there seems to have been a slight regression, to which witness several disconformities in marginal areas in Chihuahua and Coahuila (Powell 1965).

The Coniacian and Santonian were marked by a considerable restriction of the sea, which is attributed to broad uplift in western and central Mexico. Thick sandstones and sandy shales occur near Ojinaga in northeastern Chihuahua and the Indidura Formation, where exposed arround the Parras Basin, shows a significant increase in shale content in its upper parts. It is overlain by the Parras Shale, more than 1500 m of black, calca-

Table 1. Fossils identified from Loma el Macho by Böse (1918), with some modernization of the nomenclature.

Horizon III (youngest level)
Paravascoceras angermanni (Böse)
"*Vascoceras* aff. *gamai* Choffat"
Vascoceras ? sp.
Mammites mohovanensis Böse
Neoptychites aff. *xetriformis* Pervinquière
Wrightoceras aff. *mirabile* (Pervinquière)
Inoceramus labiatus Schlotheim?
Avicula aguilerae Böse
Trigonia sp.
Crassatella sp.
Tylostoma aff. *ovatum* Sharpe

Horizon II
Mammites mohovanensis Böse
Pseudaspidoceras sp.
Pseudaspidoceras aff. *pedroanum* (White)
"*Vascoceras* aff. *adonense* Choffat"
Fagesia haarmanni Böse
Fagesia? pervinquierei Böse

Horizon I
Metoicoceras aff. *whitei* Hyatt
Metoicoceras n. sp.
Exogyra haarmanni Böse
Exogyra cf. *olisiponensis* Sharpe
Hemiaster sp.

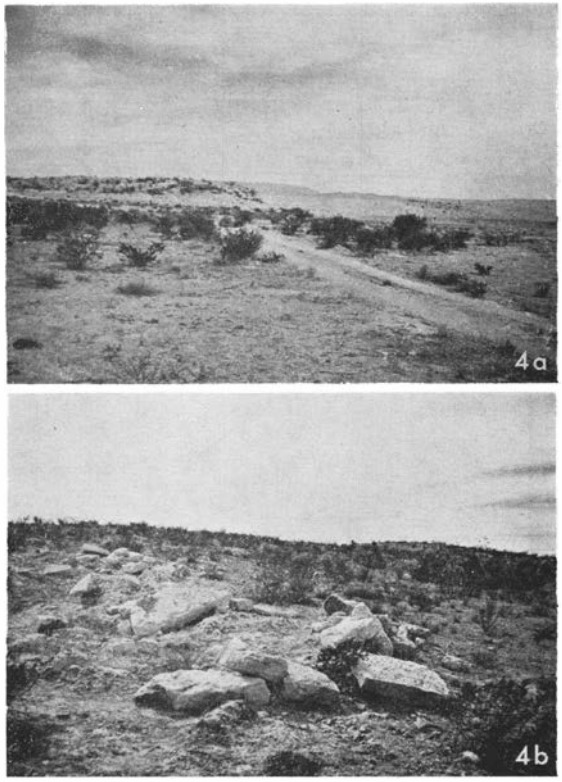


Fig. 4a. View towards hill in "Horizon II" of Böse (1918), adjacent to a wet-season dam; *4b.* Limestones of Böse's "Horizon III", near the highest point of Loma el Macho.

reous marine shale and siltstone. Uplift seems to have continued until the end of the Cretaceous by which time only the Parras Basin remained under water. At this time, the shoreline of the Gulf of Mexico was near Monterrey and the Parras Basin extended westward as an embayment (see also McBride et al. 1974).

Loma el Macho. — Loma el Macho is a low hill in the eastern part of the former Hacienda del Mohóvano (Fig. 3) which is formed of buff limestones of Early Turonian age (Fig. 4a, b). At the time of its deposition, the locality was in a shallow-water zone on the so-called Coahuila Platform. Böse's analysis of the fossils supplied him led him to divide the section into three levels (Böse 1918, p. 183). Uppermost, grey, hard limestone; then grey to bluish marls; finally, yellow and red marls with argillaceous limestone. For the purpose of aiding subsequent investigators, we provide here road details for finding the hill.

Table 2. The immediate relationship between the locality at Loma el Macho and parts of northern Mexico and Texas.

European Stages	Texas and Mexico	Rio Couchos Chihuahua	Sierra de la Peña, Coahuila	Parras Basin Coahuila	Loma el Macho
Turonian	Eagle Ford	Ojinaga Fmn	Indidura Fmn	Indidura Fmn	"Horizon III" "Horizon II" "Horizon I"
Cenomanian	Woodbine	Aurora Lst		Cuesta del Cura Lst	

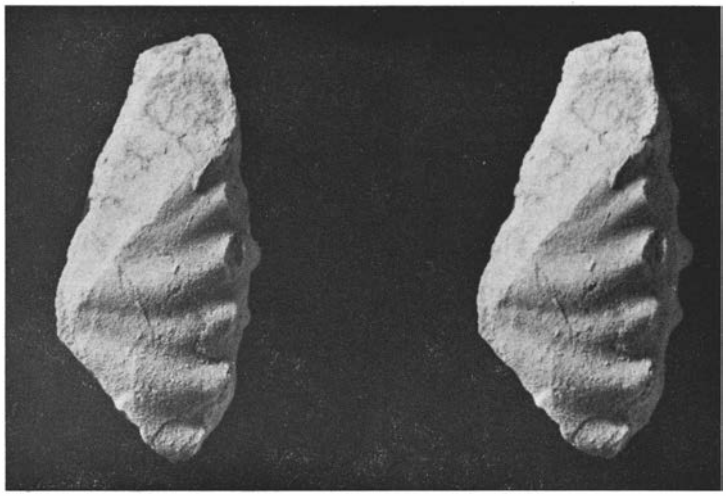


Fig. 5. Metoicoceras aff. *whitei* Hyatt. MA1. Length of fragment = 28 mm.

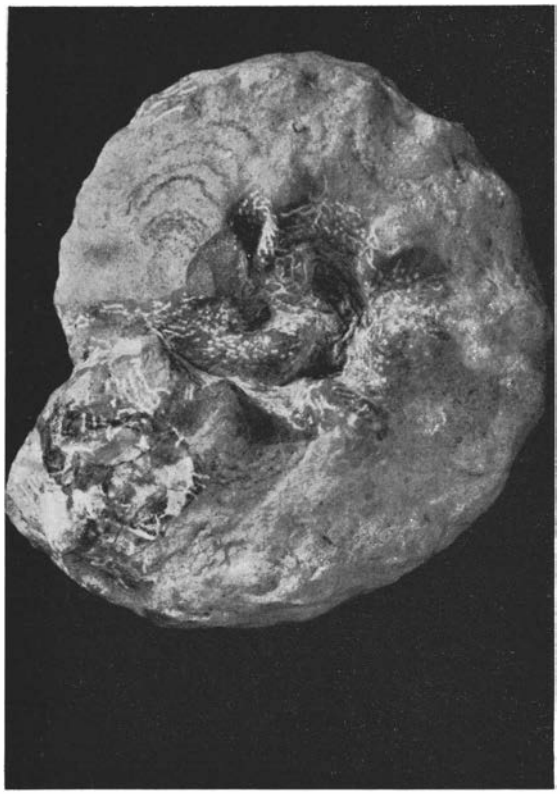


Fig. 6.

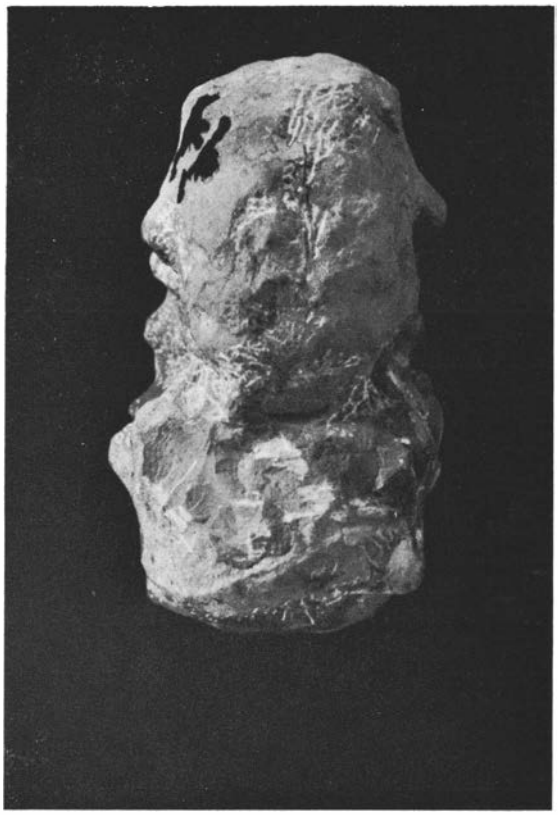


Fig. 7.

Figs. 6—7. Mammites mohovanensis Böse. MA2. Maximum diameter = 101 mm.

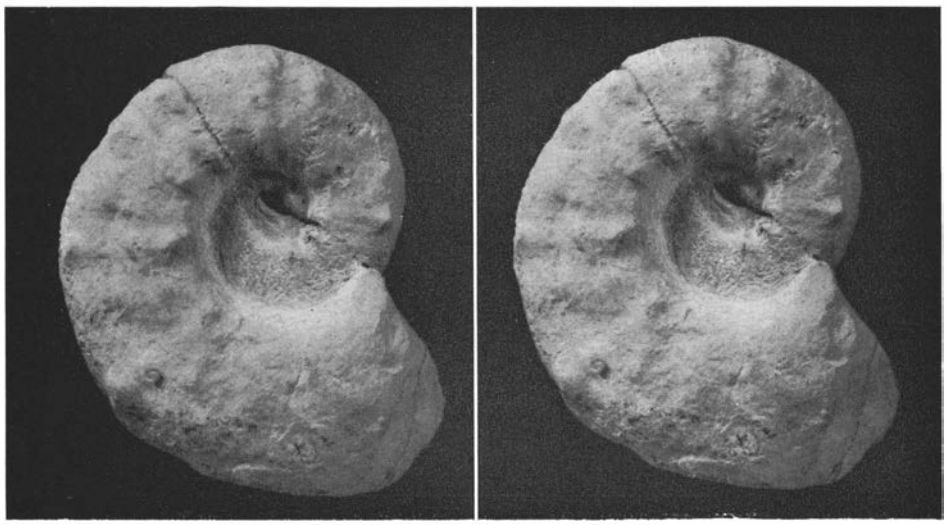


Fig. 8.

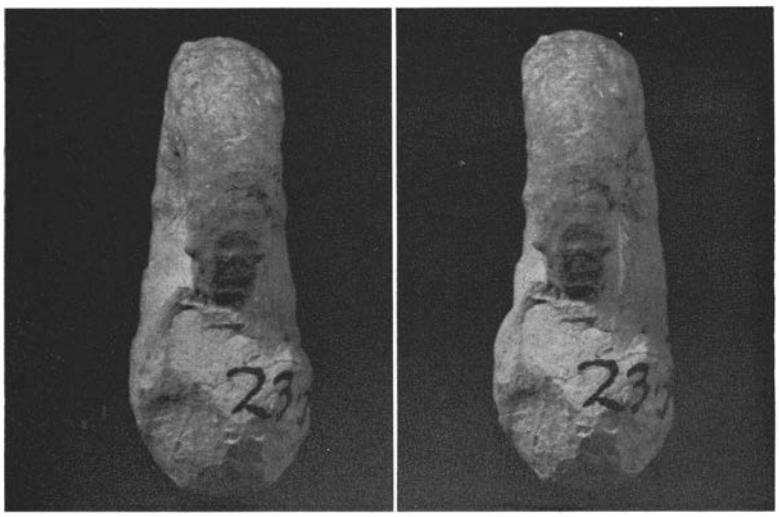


Fig. 9.

Figs. 8—9. Pseudaspidoceras aff. *pedroanum* (White). MA3. Stereopairs of the right lateral aspect (Fig. 8) and venter (Fig. 9). Maximum diameter = 122 mm.

The bird's flight distance of Loma el Macho from Cebollos is approximately 70 km (Cebollos lies on the nearest tarred road). Drive to the ranch La Flor and from there to ranch San Ignacio. From San Ignacio follow the track to the ranch Santa Maria. Pass Santa Maria, taking the track furthest to the left. This takes one into the former Ritter Estate and leads directly to Loma el Macho. There are a multitude of hills of similar appearance. Loma el Macho is the one located close to a wet-season dam. The sketch of the section given in Böse (1918 p. 183) is reasonably accurate and the strike and dip measurements of Haarmann more accurate than those of Angermann (Böse 1918, p. 184).

The fossils obtained from this locality by Angermann and Haarmann and described by Böse (1918) are listed, in revised form, in Table 1. The fossils from the deepest level were too few in number to permit an exact age determination, but Böse opted for Late Cenomanian from the presence of *Metoicoceras*. The present work shows this age determination to lack sufficient backing. The fossils from the two higher levels are characteristic for the Early Turonian.

The immediate relationship of the beds at Loma

el Macho with other areas in northern Mexico is show in Table 2.

Taxonomic Section

The collection comprises 40 specimens of ammonites, all poorly preserved internal casts. All specimens are kept in the type collection of Paleontologiska Institutionen, Uppsala. The material also comprises a small number of gastropods and pelecypods, which are not considered in the present connexion.

Metoicoceras aff. *whitei* Hyatt
Fig. 5.

A single fragment (MA1) was discovered during the development of a specimen of *Paravascoceras carteri* (Barber), and it seems therefore very likely that this *Metoicoceras* is Early Turonian in age. As noted earlier, Böse (1918) gave a Late Cenomanian dating to his "Horizon I" because it lacked obvious Turonian fossils. It was thought at the time that *Metoicoceras* was probably diagnostic of Late Cenomanian and these beds had yielded *M.* aff. *whitei* as well as a further specimen, identified as *Metoicoceras* sp. nov., later referred to *M. boesei* sp. nov. by Jones (1938).

Mammites mohovanensis Böse
Figs. 6, 7.

The collection contains three specimens of this species, one of which is better preserved than the holotype (Böse 1918, pl. 12, figs. 6, 8). This specimen is figured here (MA2). This form is fairly strongly tuberculate and seems to fall well within what is normally considered *Mammites.*

Powell (1963) described a collection from Chihuahua similar to the mammitids of Loma el Macho, referring his material to *M. nodosoides* (Schlotheim).

Pseudaspidoceras aff. *pedroanum* (White)
Figs. 8, 9, 10.

Our collection contains several specimens of this ammonite of which the two most complete are figured here (Figs. 8, 9, stereopairs, MA3; Fig. 10, MA4). The material displays considerable variation which, coupled with its poor state of preservation, precludes precise determination. The specimens agree closely with Böse's single individual determined as *Pseudaspidoceras* aff.*pedroanum* (Böse 1918, p. 209, pl. 13, fig. 1; pl. 15, fig. 1). There is a clear resemblance to the type species of *Pseudaspidoceras, P. footeanum* (Stoliczka). *P. flexuosum* Powell differs in having a less depressed whorl section and finer costation. We wish, however, to note that on some parts of the shell, the ribbing may vary in shape from rectiradiate to flexuous, becoming in some cases parallel to the growth lines and thus according with the ribbing pattern of *flexuosum.*

Fig. 10. Pseudaspidoceras aff. *pedroanum* (White). MA4. Maximum diameter = 211 mm.

A specimen from Sidi Hajaj, Middle Atlas, Morocco in the collections of Paleontologiska Institutionen (Af 531) seems to be identical to the species here under review. The specimen of *P. pedroanum* figured by Reyment & Tait (1972, figs. 12, a—f) from Sergipe, Brazil, is slightly more strongly tuberculated than the Mexican ammonites. The specimen figured by Freund & Raab (1969, pl. 1, figs. 10, 11) from Israel as *P.* cf. *pseudonodosoides* (Choffat) bears a resemblance to the present material. Adkins (1931) recorded several species of *Pseudaspidoceras* from Chispa Summit, Jeff Davis County, Texas. This locality was later restudied by Powell (1965) but without adding much to the association already known.

Böse had two specimens of *Pseudaspidoceras*, both from his Horizon II. The other specimen was not figured.

Fagesia haarmanni Böse

Our collection includes a single fragment (MA13), not figured, of a fairly large whorl, which seems

Fig. 11.

Fig. 12.

Figs. 11—12. Fagesia ? pervinquierei Böse. MA5. Lateral (Fig. 11) and ventral (Fig. 12) views of a small specimen. Maximum diameter = 72 mm.

to accord well with the relevant portion of Böse's figure (Böse, 1918, pl. 14, figs. 1, 2). Böse's two specimens came from his Horizon II. Powell (1963) was able to give a full account of the species on the basis of a large collection.

Fagesia ? pervinquierei Böse
Figs. 11—14.

The four specimens at our disposal agree well with Böse's holotype (Böse 1918, pl. 14) from Horizon II. Our most complete specimen is shown in Figs. 11 and 12 (MA5). Stereopairs of the inner whorls of another specimen, MA6, are shown in Figs. 13 and 14.

There is some doubt about the generic location of the species. The suture displays rather shallow, weakly indented elements, more suggestive of *Vascoceras* or *Plesiovascoceras* than of *Fagesia* (a point noted by Barber 1957). Although there is a distinct resemblance to *Vascoceras douvillei* Choffat, we do not share Freund's and Raab's opinion that *F. ? pervinquierei* is close to *V. durandi* (Thomas & Peron), as figured by Pervinquière (1907, pl. 21, figs. 1, a—b).

Paravascoceras carteri (Barber)
Figs. 15—17.

1918 *Vascoceras angermanni*, Böse, p. 217, pl. 16, figs. 1, 3, *non* 2, 4.
1957 *Vascoceras globosum carteri*, Barber, p. 25, pl. 8, fig. 2.

We believe that the small individual figured by Böse (1918) as *V. angermanni* should be referred to *Paravascoceras carteri*, assuming that it lacks umbilical tubercles (cf. Schöbel 1975). The lectotype and other material referred to *angermanni* by Böse came from his Horizon III. We have selected the specimen in figures 2 and 4 of plate 16 of Böse's monograph as the lectotype of *Vascoceras angermanni* Böse, which we refer below to the genus *Paravascoceras* Furon. In conformity with the results of Schöbel (1975), we refer all inflated vascoceratids lacking umbilical tuberculation at any stage to *Paravascoceras*.

We dispose of three well preserved specimens

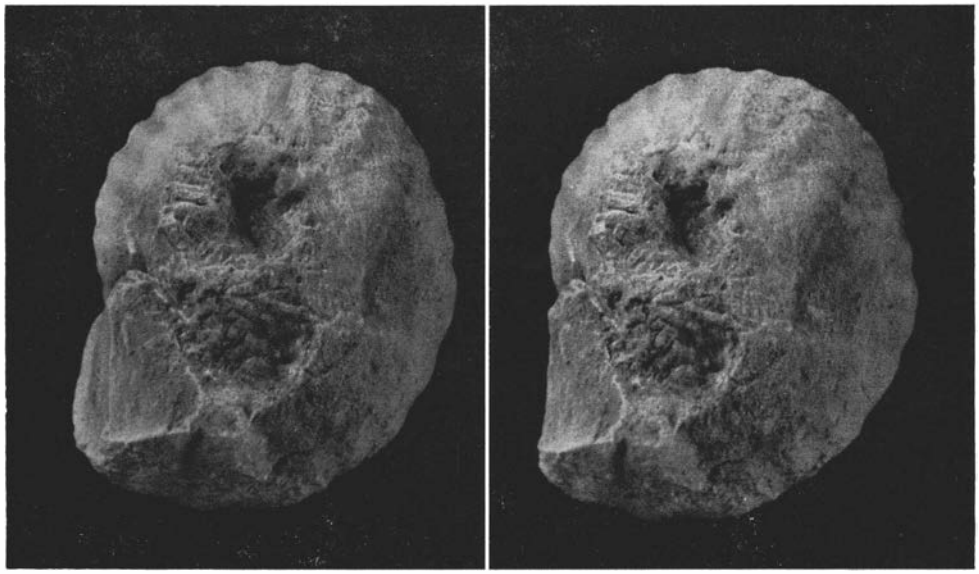


Fig. 13.

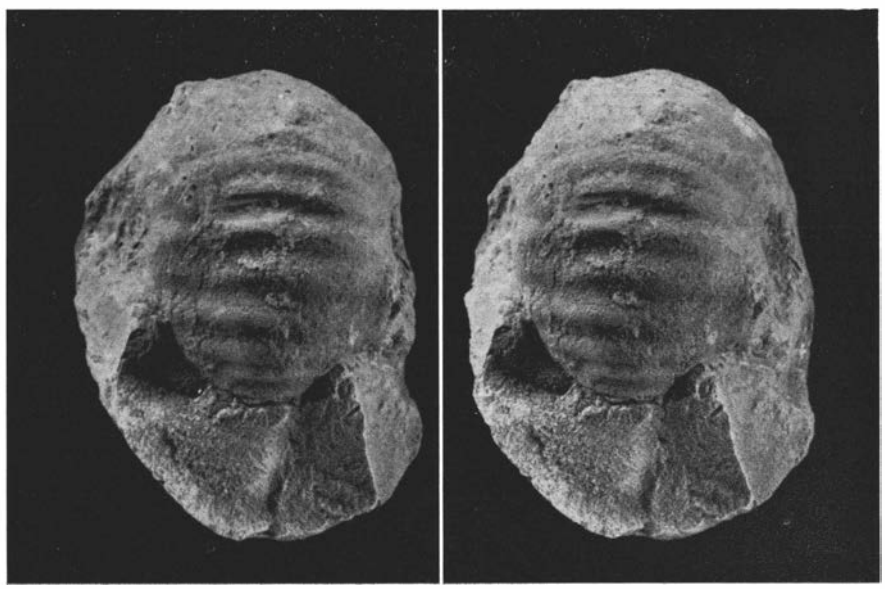
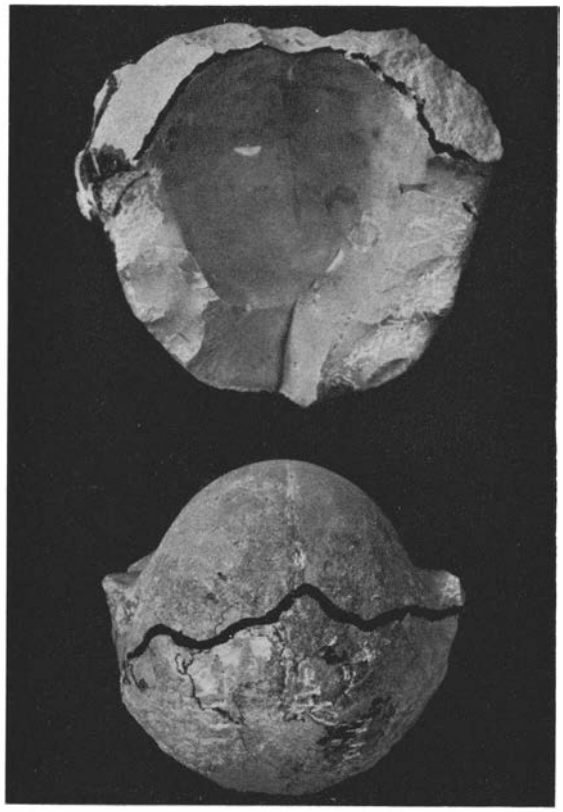


Fig. 14.

Figs. 13—14. Fagesia? pervinquierei Böse. MA6. Two stereoviews of a specimen showing well developed ventral ribs. Maximum diameter = 70 mm.

of *P. carteri,* of which the best is figured (MA7). Comparison with the holotype of the species in the British Museum of Natural History (BM C 47630) shows close agreement to exist. Barber (1957, p. 25) stated his form to be about ten per cent thicker than its diameter. Our specimens are more spherical but inasmuch as the holotype is slightly crushed we feel confident that we are dealing with the same species.

Offodile and Reyment (1977) report finds of *P. carteri* from the middle Benue Valley of Nigeria, some two hundred kilometers from the area in which Barber obtained his material. They consider the Nigerian material to be specifically identical with specimens collected by P. Bengtson from Sergipe, Brazil. All of these fossils are in the collections of Paleontologiska Institutionen, Uppsala.



Figs. 15—17. Paravascoceras carteri (Barber). MA7. A well preserved specimen of which an exploded view (Fig. 15) shows how the whorl section becomes progressively more depressed with growth and two stereo-views (Figs. 16 and 17). Maximum diameter = 94 mm.

Fig. 15.

Fig. 16.

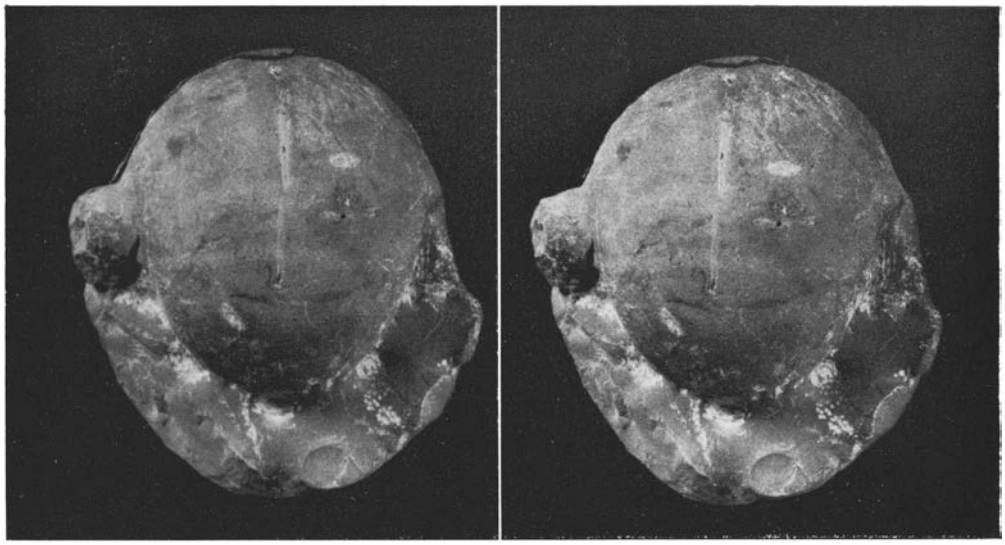


Fig. 17.

Fig. 18.

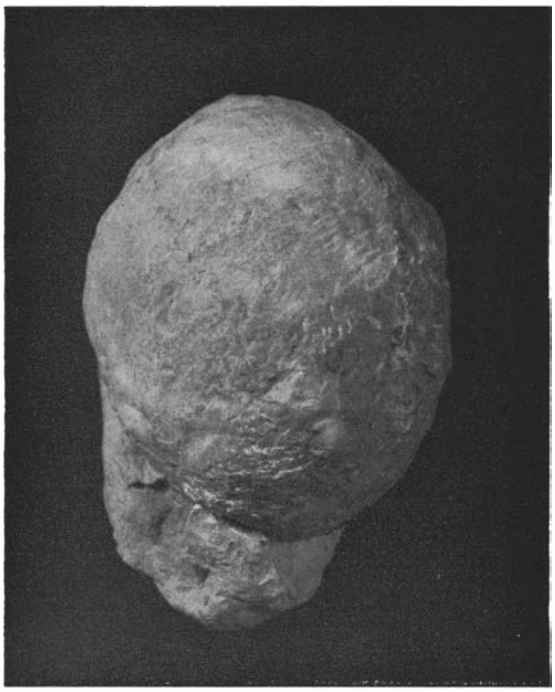


Fig. 19.

Figs. 18—19. Paravascoceras angermanni (Böse). MA8. Lateral (Fig. 18) and ventral (Fig. 19) views. Maximum diameter = 112 mm.

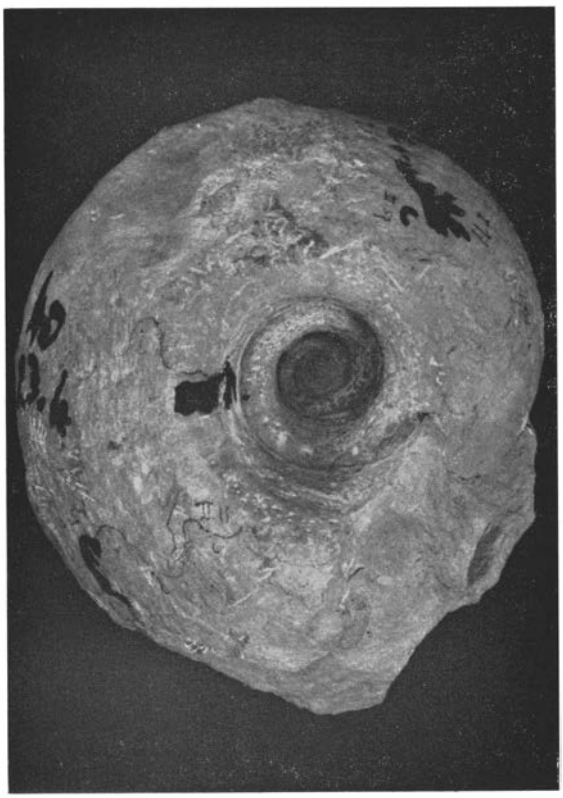


Fig. 20. Paravascoceras hartti (Hyatt). MA9. Maximum diameter = 113 mm.

Paravascoceras angermanni (Böse)
Figs. 18, 19.

1918 *Vascoceras angermanni*, Böse, p. 217, pl. 16, figs. 2, 4, non 1, 3; pl. 17, fig. 1.
1918 *Vascoceras* sp., Böse, p. 216, pl. 18, fig. 12.

Five ammonites of our collection are here referred to this species; the most complete specimen is the one figured (MA8). We reiterate, that the determinations made here depend on the assumption that Böse's material lacks umbilical tubercles at any stage of growth, a detail which is not discussed in his original descriptions. Our specimens agree well with Böse's material, particularly close agreement being noted for the individual figured on pl. 17 of his monograph. All of Böse's specimens derive from his "Horizon III".

Finally, we note that the specimen identified by Powell (1963, p. 322, pl. 33, fig. 7) as *Vascoceras* sp. (from near Dos Alamos, Chihuahua) may belong here.

Paravascoceras hartti (Hyatt)
Fig. 20.

1870 *Ceratites harttii*, Hyatt, p. 386.
1875 *Buchiceras harttii* Hyatt, Hyatt, p. 370.
1887 *Ammonites harttii* (Hyatt), White, p. 226, pl. 19, figs. 1, 2; pl. 20, fig. 3.
1898 *Vascoceras* (?) *harttii* (Hyatt), Choffat, p. 62, pl. 20, fig. 3.
1903 *Vascoceras hartti* (Hyatt), p. 103, pl. 14, fig. 16.
1969 *Vascoceras harttiforme* Choffat, Freund & Raab, p. 31, text-fig. 6j.
1972 *Pachyvascoceras harttii* (Hyatt), Reyment & Tait, pl. 5, figs. 26, a—c.

The best specimen of our collection is figured as Fig. 20 (MA9). It is apparently identical with Hyatt's *Vascoceras hartti*, although with the proviso that we do not know whether this bears umbilical tubercles or not. Our material is identical with specimens from Sergipe, Brazil in the collections of Paleontologiska Institutionen, Uppsala.

Neoptychites aff. *xetriformis* Pervinquière
Figs. 21, 22.

A single specimen (MA10) agrees well with the original *N. xetriformis* (Pervinquière 1907, p. 398, pl. 27, figs. 5, a—b), except that the ribbing on our specimen is strongest on the venter; in the figured holotype, the ribbing weakens or disappears at this point. Böse (1918) stated the ribbing on his *N.* aff. *xetriformis* to be strongest around the ventrolateral angle (this is by no means clear from the figures). His specimen derives from Horizon III. Böse also recorded *Neoptychites* aff. *cephalotus* Courtiller from Horizon III.

Bauchioceras cf. *nigeriense* (Woods)
Figs. 23, 24.

One small specimen (diameter = 77 mm), MA11, completely micritized, occurs in our collection. Some of the suture can be made out and it agrees well with that of *B. nigeriense*. Our individual is involute and laterally compressed, with a truncated venter which seems to have three keels on earlier whorls which in places bear minute tubercles.

We note here that the collection also contains two very poorly preserved specimens of *Wrightoceras*.

Bauchioceras (*Discovascoceras*) *adkinsi* (Kummel and Decker)
Figs. 25, 26.

1954 *"Hoplitoides" adkinsi* n. sp., Kummel & Decker, p. 326, pl. 32, fig. 6; pl. 33, fig. 3; text-figs. 7, 8.

This species was not represented in Böse's collection. It was first recorded by Adkins (1931, p. 59) under the name of "*Hoplitoides mirabilis*" in material from Piedra de Lumbra, a locality originally noted by Böse & Cavins (1928, p. 28) as being "much more important" than Loma el Macho. Barber (1957, pp. 45, 47, 51) referred the species here under discussion to *Bauchioceras*.

Our ammonite, MA12, agrees reasonably closely

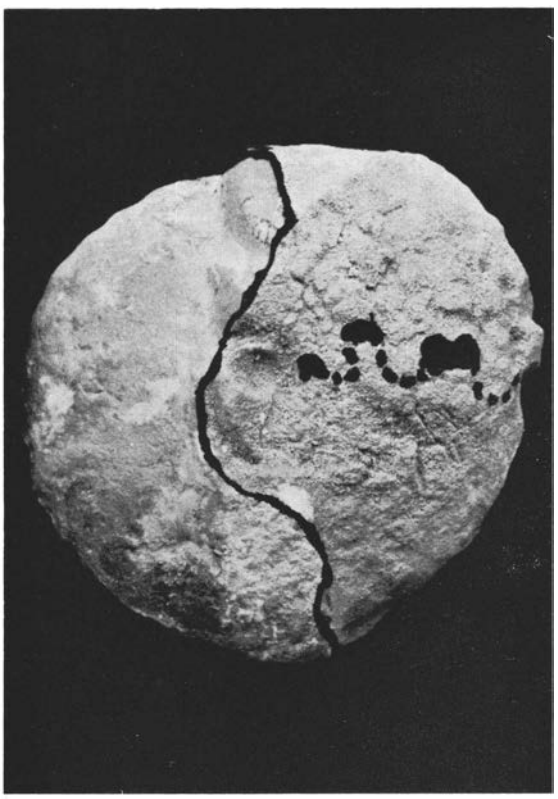


Fig. 21.

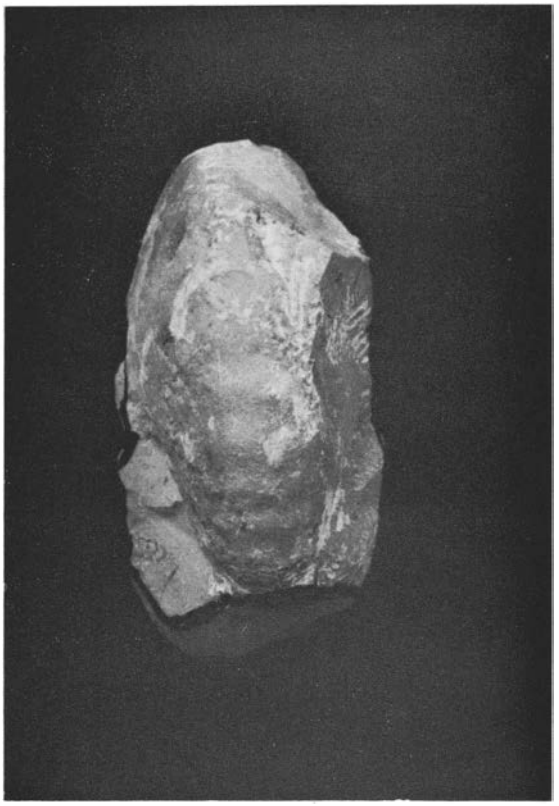


Fig. 22.

Figs. 21—22. Neoptychites aff. *xetriformis* Pervinquière. MA10. Lateral view (Fig. 21) and ventral view (Fig. 22). Maximum diameter = 113 mm.

with the original description given by Kummel & Decker although it is smaller than the holotype and has not reached the stage at which the venter becomes smooth and rounded (around 100 mm). The inner umbilical walls of the specimen overhang slightly beyond the vertical. This species has an extraordinarily wide umbilicus, a feature which seems unique among the bauchioceratids.

Characteristically, *Bauchioceras* is marked by its high degree of involution. Kummel & Decker (1954, p. 326), when comparing their new form with *Bauchioceras nigeriense* (Woods), made special reference to the breadth of its umbilicus. The present form conforms closely with the properties of the subgenus *Discovascoceras* Collignon of *Bauchioceras*.

Palaeobiogeographical implications

The collection from Loma el Macho is of considerable palaeobiogeographical importance. Reyment & Tait (1972) based their dating of the appearance of open oceanic conditions in the Atlantic during the Middle Turonian on the following considerations:

1. The differences in Early Turonian ammonite faunas north and south of the Maranhão — Gulf of Guinea region; the Early Turonian ammonite association of Tarfaya, southern Morocco, lacks the characteristic vascoceratids of the South Atlantic.
2. The Middle Turonian of Tarfaya, southern Morocco contains the same ammonite association as found in Nigeria.
3. The pelecypod faunas of the North and South Atlantic are remarkably different until after Coniacian time, when a modern distributional aspect begins to appear.
4. The lack of differentiation in Early Turonian ostracods of the eastern and western margins of the South Atlantic for the Early Turonian, a situation which is quite different from that which pertains today.
5. The seeming lack of faunal evidence for

Fig. 23.

Fig. 24.

Figs. 23—24. Bauchioceras cf. *nigeriense* (Woods). MA11. Lateral (Fig. 23) and ventral (Fig. 24) aspects of a poorly preserved specimen. Maximum diameter = 77 mm.

elements typical of the Lower Turonian of the South Atlantic in the Carribean.

Nigerian elements in northern Mexico and Texas were recorded by Powell (1963), who described and figured *Vascoceras globosum* (Reyment) and *V. compressum* Barber from Lower Turonian deposits. In addition, *Wrightoceras* and *Bauchioceras* had been figured, but not identified as such, by various workers. Reyment & Tait (1972) thought that the few species involved could have been introduced via the western coast of South America, and there is some evidence for the existence of such a migrational route in Cretaceous times (Peru and Colombia).

The distribution of typical vascoceratids north of the postulated land connexion — Portugal and Spain (with some Nigerian elements according to Wiedmann (1960)) was explained by Reyment & Tait (1972) as being a result of migration along the trans-Saharan epicontinental sea, which connected the South Atlantic, for a geologically brief period, with the Tethys. The fact that a rather typical fauna of vascoceratids (but without *Bauchioceras*) occurs some hundreds of kilometers north of Tarfaya, at Sidi Hajaj (Settat) in Morocco was thought to reflect a short maximum transgressional thrust from the east.

The evidence available for Mexico-Texas has up to the present not been such as to provide a contra-indication to the hypothesis of a permanent seaway through the Atlantic until the Middle Turonian.

The present analysis has, however, disclosed that the number of southern Atlantic elements in northern Mexico is relatively high. Böse's (1918) indications of a Portuguese connexion with Mexico have been proved to be largely unfounded and the closest relationships of the association at Loma el Macho lie undoubtedly with Nigeria and northeastern Brazil. There seems little chance that the occurrences of southern Atlantic elements represent random drifts from the south and it must be

Fig. 25.

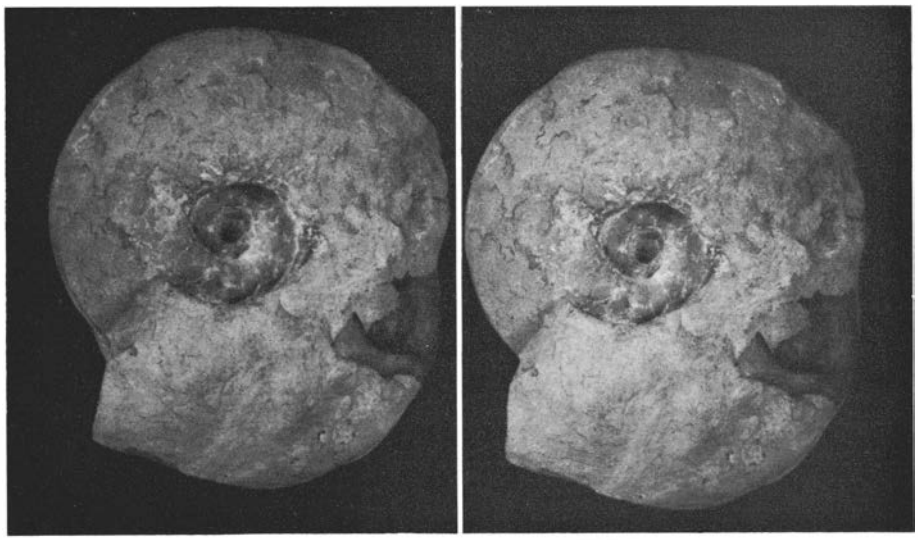
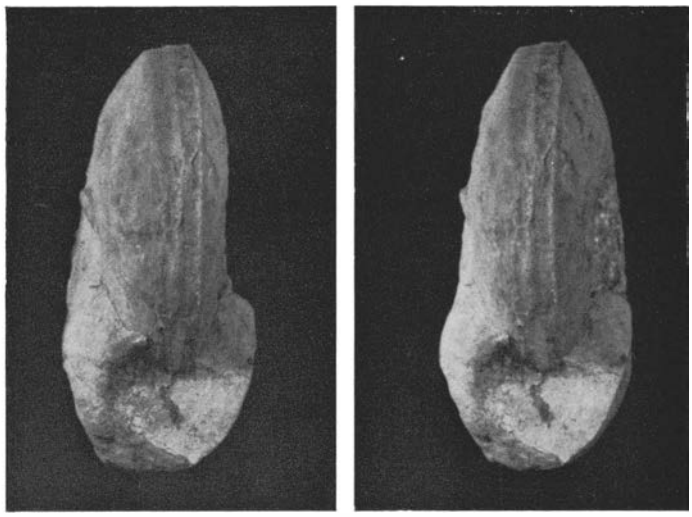


Fig. 26.



Figs. 25—26. Bauchioceras (Discovascoceras) adkinsi (Kummel and Decker). Stereoviews to show the semi-evolute shape of the shell (Fig. 25) which also presents several suture lines and an oyster encrusting part of the last whorl) and the three keels on the venter (Fig. 26). Maximum diameter = 62 mm.

accepted that the ammonites derive from animals that once lived in the immediate vicinity of where they were collected.

Reyment (1969) realized that the gradually diminishing contact between West Africa and Maranhão-Pernambuco would have been susceptible to eustatically controlled inundations and he pointed out the probable occurrence of such an episode in the middle Late Albian. Kennedy & Cooper (1975) and Kennedy & Cobban (1976) have fully investigated the extent of this episode. Reyment & Mörner (1977) connected it with a phase of tectono-eustasy. The evidence, such as it appears at the present, points to a further, more extensive phase of tectono-eustasy in the Late Cenomanian to Early Turonian (Reyment & Mörner 1977). This led to the remarkable trans-Saharan shallow epicontinental transgression and the swamping of what remained of the Maranhão-Guinea zone of contact. The proximity of the two continents ensured that this narrow marine connexion was shallow. During this geologically short period, southern Atlantic elements were free to range into the central Atlantic.

Did the Maranhão-Guinea connexion emerge briefly once again at the close of this eustatic episode? There is no way at present of deciding what the situation was at this transitional point in time. By Middle Turonian, however, a modern oceanic circulatory system had begun to appear.

Work on the Walvis Ridge and Rio Grande Rise (cf. account in Dingle & Simpson (MS)) has brought out the possibility of there having been a more or less continuous dam across the southernmost South Atlantic during phases of negative tectono-eustasy during part of the Late Cretaceous. It is therefore no longer necessary to have to try to explain Late Cretaceous palaeobiogeographical anomalies by recourse to an hypothesis of closure of the South Atlantic across the Gulf of Guinea and northeastern Brazil. The existence of an uneven somewhat intermittent kind of bridge across the ocean would aid in explaining the continued agreement in the compositions of benthonic faunas well into the Late Cretaceous. (Neufville (1973) has demonstrated this relationship to have persisted until the Danian for certain ostracods.)

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Según las conclusiones de Reyment y Tait (1972), la comunicación terrestre entre Africa Occidental y el nordeste de Brasil existió hasta el Cenomaniense Superior — Turoniense Inferior, pero fue menos extensa que en el Albiense Superior, como resultado de la deriva de los continentes. El máximo de la transgresión tuvo lugar en el limite Cenomaniense — Turoniense, cuando se terminó, temporalmente, la comunicación terrestre entre Africa y América del Sur. Durante este corto episodio, los ammonites y foraminíferos planctónicos pudieron distribuirse entre los dos brazos del Atlántico.

A contribution to
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Resumen

En el presente trabajo se hace un estudio de una fauna de ammonites proveniente de México, que presenta unos caracteres únicos en el Atlántico Central. Este trabajo representa un análisis de los fósiles hallados por Reyment y Tait en Octubre 1975.

En 1918, Böse describió una colección de fósiles que fue hallada en la localidad "Loma el Macho" en la Provincia de Coahuila por los geólogos Angermann y Haarmann. Böse consideró que esta asociación, compuesta principalmente de Vascoceratidae (*Fagesia*, *Paravascoceras*, *Neoptychites*, *Bauchioceras*, *Wrightoceras*, *Mammites*, *Pseudaspidoceras*, *Metoicoceras*), pertenece al Turoniense Inferior y Cenomaniense Superior. Nuestra investigación muestra que la asociación, en conjunto, es referible al Turoniense Inferior.

Desde el punto de vista de la paleogeografía del Atlántico, notamos que existen estrechas relaciones entre México septentrional, Nigeria y Brasil, pero no se encuentran especies de la Península Ibérica (lo que es contrario a la conclusión de Böse). Las especies siguientes tienen un gran significado:

Pseudaspidoceras aff. *pedroanum* (White)
Paravascoceras carteri (Barber)
Paravascoceras hartti (Hyatt)
Bauchioceras cf. *nigeriense* (Woods)
Wrightoceras aff. *mirabile* (Pervinquière)

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