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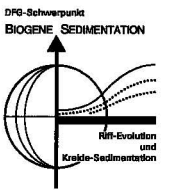

FRANK WIESE, JOHANN BRÜNING & ARMIN OTTO

First record of *Libycoceras ismaelis* (ZITTEL, 1885) (Cretaceous Ammonoidea) in Europe (Campanian of the Santander area, Cantabria, northern Spain)

ABSTRACT: The species *Libycoceras ismaelis* (ZITTEL) is described for the first time from Europe from the Lower Campanian (*Scaphites hippocrepis* Zone) of Arnia, Cantabria (Spain). In the context of Campanian paleogeography, it is also the first record of the genus in high latitudes of the northern hemisphere (around 30° N), all other records being from either the southern hemisphere or close to the paleo-equator. The biostratigraphic data show this specimen to be possibly the earliest accurately dated evidence of the genus *Libycoceras* HYATT, 1900.

INTRODUCTION

The Upper Cretaceous ammonite genus *Libycoceras* is a representative of the so-called pseudoceratites. It is well known from Upper Campanian and Maastrichtian strata of the Middle East and Africa, as well as Madagascar (ZITTEL 1883; QUAAS 1902; ECK 1915; HAUGHTON 1924, 1925; PICARD 1929; PÉRÉBRASKINE 1930; ALBERICI 1940; HOURCQ 1949; SORNAY & TESSIER 1949; COLLIGNON 1957, 1965; REYMENT 1955, 1956, 1957; SORNAY 1959; HOWARTH 1965; AUTUNES & SORNAY 1969; LEWY 1977; KOGBE 1980; ZABORSKI 1982; LUGER & GRÖSCHKE 1989). Obviously, *Libycoceras* was common in warm water environments of the Tethys and the Saharan Seaway. Occurrences outside these areas seem to be extremely rare.

OLSSON (1944) reported the two species *Libycoceras* (*Paciceras*) *gerthi* (OLSSON) and *L.* (*P.*) sp. conspecific with *Libycoceras dandensis* (HOWARTH). Also from Peru, RIVERA (1956) described *Paciceras olssoni*

RIVERA, which might as well be regarded as a *Libycoceras*. From Colombia, KENNEDY (*in*: FÖLLMI & *al.* 1992) figured some specimens of *Libycoceras* sp.; a closer identification was not possible due to the state of preservation and the absence of the suture line. NOETLING (1897) described the genus *Indoceras* sp., another representative of the family Libycoceratidae, from India.

In 1994, one specimen of a *Libycoceras* was found at the village of Arnis near the Cantabrian capital Santander (Spain) in otherwise ammonite-free Campanian marl/limestone alternations. To our knowledge, this is the first find of a *Libycoceras* in Europe. Though these limestones lack any biostratigraphically significant ammonites or other index macrofossils such as inoceramids, both the beds below and above the horizon with *Libycoceras* can be dated quite accurately with ammonites by correlation with adjacent areas.

It is interesting therefore, to describe the first record of this genus in Europe. Since all other well dated occurrences of *Libycoceras* are from the Late Campanian *polyplocum* Zone or later, the biostratigraphic framework might throw light upon the date of the first appearence of the genus.

GEOLOGIC SETTING

In the area of the Cantabrian capital Santander (northern Spain), Upper Cretaceous strata are excellently exposed in coastal outcrops (Textfig. 1), which provide a continuous succession from the Albian to the Tertiary (WILMSEN & *al.* 1995). Campanian rocks are exposed at Arnia, at Cabo Mayor in Santander itself, and to the east of Santander between the villages of Loredo and Langre. They can be correlated without any problems between the localities.

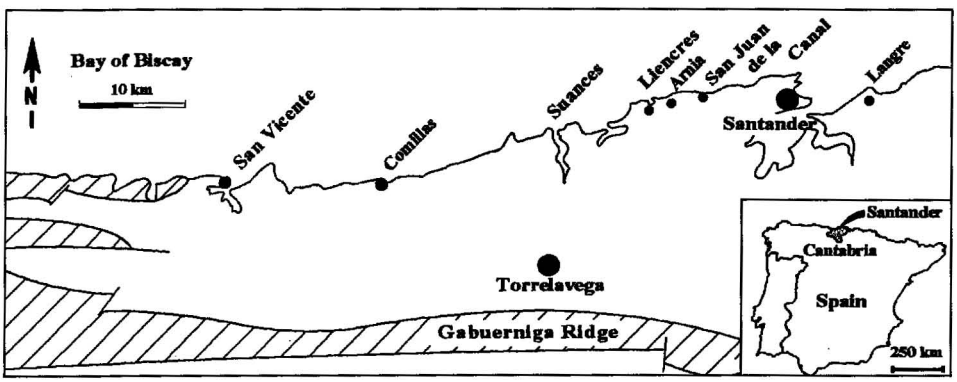

Fig. 1. Sketch-map of the Santander area with the location of Campanian outcrops

According to WILMSEN & *al.* (1995), the Campanian succession (Text-fig. 2) can be subdivided into two litho-units. The basal unit consists of the ammonite-bearing *Holaster similis* Marls and the Sponge Rhythmites (REHFELD & OTTO 1995). A bed correlation of these rhythmically bedded strata is easily possible throughout the area. This permits the use of index fossils from any of the localities for stratigraphic subdivision. A detailed correlation will be given by OPPERMANN & *al.* (*in prep.*). Separated by a sequence boundary, a major turnover in sedimentation led to the deposition of the second unit: The *Globator* Beds (named after the mass occurrence of the echinoid *Globator petrocoriense* (DESMOULINS), followed by the *Ceratostreon* Beds, a tempestitic facies with abundant *Ceratostreon pliciferum* (COQUAND).

This lithological subdivision, however, requires revision. Additional fieldwork (BRÜNING, *in prep.*; OTTO, *in prep.*) has shown that the *Globator* Beds still belong to the strata below the sequence boundary, permitting a threefold lithological subdivision of this lower unit, i. e. *Holaster similis* Marls, Sponge Rhythmites, and *Globator* Beds in ascending order. With the *Ceratostreon* Beds, the real turnover in sedimentation can be detected which makes the sequence boundary shift some 12 m higher. The *Ceratostreon* Beds show strong lateral facies differentiation in their basal part. The higher, ammonite-bearing beds are again correlatable between any of the localities.

In a sequence stratigraphic context (Text-fig. 2), the *Holaster similis* Marls represent a transgressive pulse (Transgressive Systems Tract), overlying the Santonian strata on a flooding surface. The Sponge Rhythmites are interpreted as to document prograding marl/nodular limestone alternations of the Highstand Systems Tract that terminate in the rhythmically bedded shallow water limestones of the Late Highstand (*Globator* Beds). The major sequence boundary that separates the *Globator* Beds below and the *Ceratostreon* Beds above, is interpreted to represent the Spanish equivalent of the Peine tecto-eustatic event (Early/Late Campanian boundary) *sensu* RIEDEL (1940; *see* WILMSEN & *al.* 1995).

The specimen of *Libycoceras* was found close the base of the *Globator* Beds at Arnia. According to the biostratgraphic data and the above interpretation an Early Campanian age is inferred.

LOCATION OF SPECIMENS

All but one figured specimens are hosted in the *Naturkunde Museum* in Berlin. The specimen of *Scaphites gibbus* is from the M. DIAZ Collection, Santander.

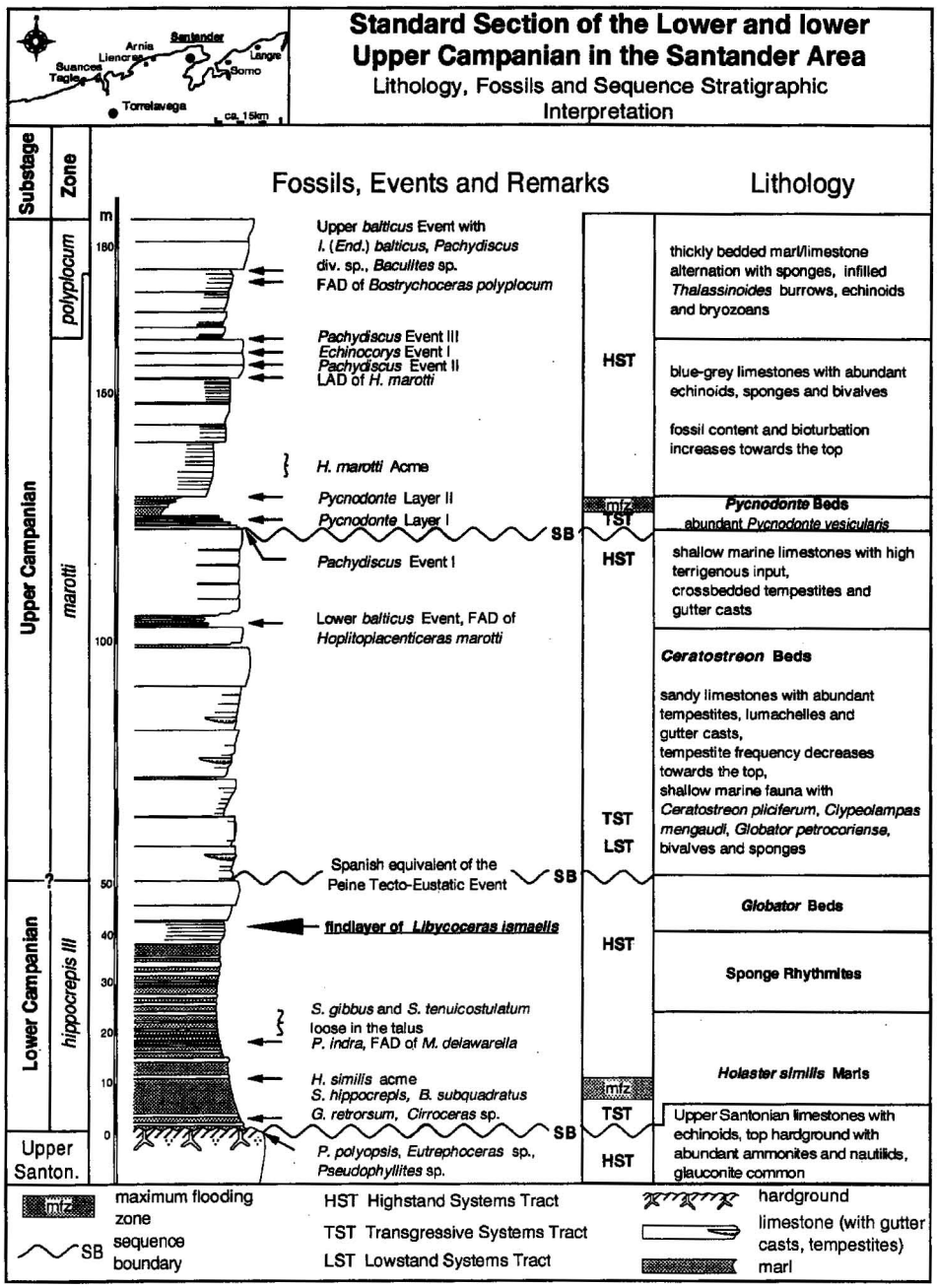

Fig. 2. Generalized standard section of the Lower Campanian and lower Upper Campanian in the Santander area

SYSTEMATIC ACCOUNT

Order **Ammonoidea** ZITTEL, 1884
Suborder **Ammonitina** HYATT, 1889
Superfamily **Acanthocerataceae** GROSSOUVRE, 1894
Familiy **Libycoceratidae** ZABORSKI, 1982
Genus *Libycoceras* HYATT, 1900

TYPE SPECIES: *Engonoceras ismaelis* (ZITTEL, 1885; p. 451, Fig. 631)

REMARKS: ZABORSKI (1982, p. 306) erected the family Libycoceratidae on the basis of his investigation of sphenodiscid ammonites from Nigeria: "This family includes involute, compressed ammonites with or without pronounced mediolateral and ventrolateral tubercels or rib-like ornament. The venter is tabulate to sharply rounded in the adult. The sutures have wide to narrow-necked saddles which are entire to moderately frilled. The first lateral saddle is divided by one or two adventitious lobes." This characteristics is accepted here.

OCCURRENCE: The genus *Libycoceras* is known from Angola, Colombia, Egypt, India (?), Israel, Jordan, Lebanon, Mali, Madagascar, Nigeria, Peru, Senegal, Spain, the Sudan, and Tunisia. It ranges from Early Campanian to Late Maastrichtian.

Libycoceras ismaelis (ZITTEL, 1883 *nomen nudum*; 1885)
(Pl. 2, Fig. 1)

nomen nudum 1883. *Ammonites ismaelis*; K.A. ZITTEL, p. 74.
1885. *Sphenodiscus ismaelis* (ZITTEL); K.A. ZITTEL, p. 451, Fig. 631.
1902. *Libycoceras ismaeli* (ZITTEL); A. QUAAS, p. 302, Pl. 29, Figs 3-7, Pl. 30.
1915. *Sphenodiscus ismaelis* (ZITTEL); O. ECK, p. 185, Pl. 10.
1931. *Libycoceras ismaeli* (ZITTEL); V. PÉRÉBRASKINE, p. 130, Pl. 11, Figs 3a,b.
1940. *Indoceras ismaeli* var. *libycum* SORRENTINO; E. ALBERICI, Pl. 19, Figs 5a-5b.
1977. *Libycoceras ismaele* (ZITTEL); Z. LEWY, p. 251, Pl. 1, Figs 9-12.

MATERIAL: One specimen from the base of the *Globator* Beds, Arnia, Cantabria (northern Spain), deposited at the *Naturkunde Museum* in Berlin under the registration number MB. C. 1891.

DESCRIPTION: The find from Santander is an internal mould of an adult specimen (D: 207 mm), one side is abraded due to seawater erosion, the other side is moderately well preserved with the suture lines visible (Pl. 2, Fig. 1a). The incompletely preserved and compressed body chamber occupies a bit more than half of the last whorl. The specimen is oxycone and strongly involute with a tiny, funnel-like umbilicus; the phragmocone (Whorl breadth: 33 mm, Whorl height: 82 mm, Wb/Wh: 0.4) is virtually uncompacted and has a sharp to narrowly arched venter and a slightly trapezoidal whorl section with maximum thickness midflank. At the beginning of the body chamber, a keel develops and the flanks become convex (Pl. 2, Fig. 1b). However, it seems that ventrolateral shoulders of some kind were present, but these are indistinct as a result of having been overprinted by compaction. No ornament is preserved. The suture lines are crowded towards the beginning of the body chamber, indicating that the

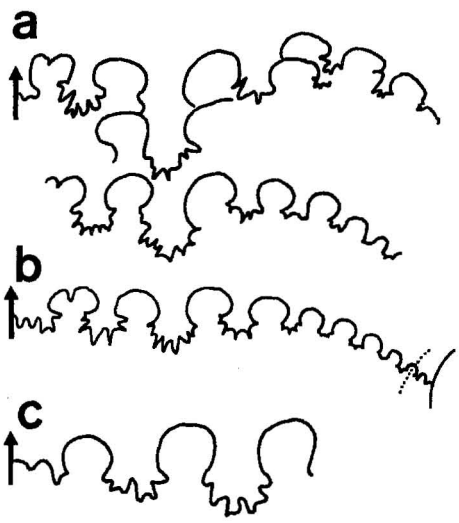

Fig. 3. Suture lines of *Libycoceras ismaelis* (ZITTEL, 1885)

a — Specimen No. MB. C. 1891, Santander area, × 0.7; **b** — Specimen HU-29960 from Sinai, *after* LEWY (1977, Text-fig. 3j), no scale given; **c** — Unregistered specimen from Libya, *after* ALBERICI (1940, Fig. 26), × 0.7

specimen was an adult. The suture pattern (Text-fig. 3a) is pseudoceratitic with a bifid first lateral saddle, the external branch of which can be slightly indented, the necks of the branches are comparably thick. The internal branch of the first lateral saddle is smaller than the second saddle. Five entire auxillary saddles are visible. However, the umbilicus could not be entirely developed and the exact number of auxillary saddles is therefore unknown.

DISCUSSION: The specimen was first mistakenly identified as a badly preserved *Placenticeras*. However, after developing, the umbilicus and the suture line became more clearly visible. Analysis of the suture line demonstrates that the specimen belongs to *Libycoceras* (Text-fig. 3a).

Though the general shape is similar to that of *Libycoceras dandense* of HOWARTH (1965, p. 437, Fig. 2; p. 439, Fig. 1), our specimen differs in having a bifid first lateral saddle while *L. dandense* shows trifurcation of the first lateral saddle (HOWARTH 1965, p. 398, Figs 18-23).

The adult *Libycoceras crossense* (ZABORSKI, 1982) differs in having a broadly rounded venter, which is also true for *Libycoceras afikpoense* (REYMENT, 1955) (*cf.* LEWY 1977, p. 250, Pl. 1, Figs 1-6; ZABORSKI 1982, p. 310, Figs 4-13). The latter species reaches a diameter of 120 mm (ZABORSKI 1982), the body chamber occupies less than half the last whorl and strong ventrolateral tubercles border the venter of adult specimens. These features make it different from the Santander specimen.

The overall shape of *Libycoceras chargense* (BLANCKENHORN, 1900) is similar; however, it has a lanceolate whorl section throughout ontogeny without ventrolateral shoulders.

The species *Manambolites piveteaui* HOURCQ, 1949, differs in its different whorl section with maximum breadth close to the ventro-lateral shoulders and a suture line with a strongly incised bifid first lateral saddle. The external auxillary saddles also tend to be indented (*cf.* HOURCQ 1949, p. 25, Fig. 20 *and* p. 26, Figs 21-22). These sutural characters show that

the species belongs to the Sphenodiscidae rather than to the Libycoceratidae *sensu* ZABORSKI (1982).

HAUGHTON (1924) erected the species *Libycoceras angolense* HAUGHTON on three specimens from Angola (HAUGHTON 1924, p. 87; Pl. 3, Figs 1-5). This publication in French was published in Lisboa (Portugal) and is little known. HAUGHTON (1925) presented an English translation of his original paper in South Africa without any changes and without citing his 1924 paper. This led to the confusing situation that the species *L. angolense* was erected by HAUGHTON (1925, p. 269; Pl. 14, Figs 1-5), and several authors (*e.g.* HOWARTH 1965, ZABORSKI 1982) erroneously referred only to this later paper when mentioning *L. angolense*. This species shows similarities with *L. ismaelis* but is keeled throughout ontogeny and the second lateral saddle is markedly smaller than in *L. ismaelis*.

Our specimen is closest to *Libycoceras ismaelis*, figured by QUAAS (1902, Pl. 30, Figs 1, 1a, 1b), ECK (1915, p. 185, Pl. 10), ALBERICI (1940, Pl. 19, Figs 5a-5b) or LEWY (1977, p. 250, Figs 6-12). It shows no ornament, but this might be due to preservation. The whorl section of the adult body chamber (QUAAS 1902, Pl. 30, Figs 1a-1b) and the general pattern of the suture lines as figured by ALBERICI (1940, p. 185, Text-fig. 25; *comp.* Text-fig. 3c in the present paper) and LEWY (1977, p. 248, Text-figs 3a-c,f,g,j; *comp.* Text-fig 3b in the present paper), seem to match those of *Libycoceras ismaelis*. Therefore, we would regard the find from Santander as a *Libycoceras ismaelis* rather than any other species of *Libycoceras*.

From Egypt, *Libycoceras phosphaticus* (AWAD & NAIM, 1964) and *Libycoceras berisense* (AWAD & NAIM, 1964) were recorded by AWAD, NAIM & ABDOU (1964). LEWY (1977) discussed whether or not these species were conspecific, since the differences seemed to be small. However, he came to no conclusion because "the description of the Egyptian material by AWAD & NAIM (1964) is insufficient and the precise stratigraphic position of these two specimens is unknown to them" (LEWY 1977, p. 247).

OCCURRENCE: The *Scaphites hippocrepis* Zone of the Early Campanian in Spain. Where well dated elsewhere, Late Campanian (*Bostrychoceras polyplocum* Zone) to Maastrichtian of Israel, Egypt, Jordan, Tunesia, Libya, and the Sudan.

STRATIGRAPHY

The *Holaster similis* Marls/Sponge Rhythmites start with a sharp contact above Santonian strata that yield *Placenticeras polyopsis* (DUJARDIN) (Pl. 1, Fig. 2) and *Pseudophyllites* sp. The find of *Scaphites hippocrepis* III (DEKAY) (Pl. 2, Fig. 3) [which is well known from Spain, *comp.* WIEDMANN 1962, 1979; KÜCHLER & KUTZ 1989; GISCHLER & *al.*

1994] at Langre only 50 cm above the contact indicates a considerable hiatus. The species *Scaphites hippocrepis* III forms the end member of a phylogenetic lineage beginning with *Scaphites leei* REESIDE (*see* COBBAN 1967), and marks the upper part of the Lower Campanian (KENNEDY 1984, 1986; HANCOCK 1991; KENNEDY & COBBAN 1993).

Also at Langre, a poorly preserved ammonite fauna was found at the base of the unit, consisting of *Scaphites hippocrepis* III (DEKAY), *Glyptoxoceras* cf. *retrorsum* (SCHLÜTER), *Bevahites subquadratus* COLLIGNON, *Cirroceras* sp., and *Placenticeras* sp. in the lower parts. Further upsection, *Menabites* (*Delawarella*) *delawarensis* (MORTON) (Pl. 1, Fig. 1) and *Pseudophyllites* cf. *indra* (FORBES) enter. The species *Submortoniceras tenuicostulatum* COLLIGNON and *Scaphites gibbus* (SCHLÜTER) (Pl. 2, Fig. 2) were found even higher in the talus at the level of the lowermost Sponge Rhythmites, well below the *Globator* Beds. Various *Pachydiscus* occur scattered throughout the entire section.

With reference to the proposed subdivision of KÜCHLER & KUTZ (1989) or HANCOCK (1991), the ammonite assemblage indicates a late Early Campanian age for these strata. This is also confirmed by the entry of *M.* (*D.*) *delawarensis* which is indicative of the upper part of the Lower Campanian in the Gulf Coast region, U.S.A. (YOUNG 1963), as well as in the Aquitaine Basin (KENNEDY 1984, 1986). WIEDMANN (1979) established the *delawarensis* Zone in the Middle Campanian of Spain, but this concept was abandoned in the recent paper of GISCHLER & *al.* (1994). The latter authors established a basal Zone of *Bevahites subquadratus* and a topmost Assemblage Zone of *Eupachydiscus levyi*/*Scaphites hippocrepis*/*Neocrioceras riosi* for the Lower Campanian. Since *N. riosi* does not occur in the Santander area and the only *Bevahites subquadratus* occurs after *S. hippocrepis*, this subdivision cannot be adopted.

The occurrence of *Scaphites gibbus* at Santander is, to our knowledge, the first record of this species in Spain. In Germany, it enters in the *conica*/*gracilis* Zone, the time equivalent of the upper *hippocrepis* Zone.

The topmost Sponge Rhythmites and the *Globator* Beds, respectively, yielded no ammonites, neither did the bed with *Libycoceras ismaelis*.

About 60 m above the *Libycoceras* horizon, the first *Hoplitoplacenticeras* cf. *marotti* was found at Arnia, indicating a Late Campanian age (KENNEDY 1984, KÜCHLER & KUTZ 1989, HANCOCK 1991). The species *Bostrychoceras polyplocum* (SCHLÜTER), the index of the succeeding ammonite zone occurs some 70 m higher.

In a sequence stratigraphic context, further statements are possible: The Peine tecto-eustatic Event is located close to or at the Early/Late Campanian boundary in Germany (RIEDEL 1940, SCHÖNFELD 1990, NIEBUHR 1995), which also fits with the "global" cycle chart of HAQ & *al.*

(1987). It is followed by the so-called *mucronata transgression* in the upper part of the *gracilis/mucronata* Zone, which corresponds in terms of ammonite biostratigraphy to the uppermost *hippocrepis* III Zone of the late Early Campanian (or the *delawarella* Zone of the "Middle Campanian"). Since the *Libycoceras* horizon still is located well below the sequence boundary at the base of the *Globator* Beds and still 60 m below the appearance level of *H. marotti*, there is no other possibility but to date the findlayer of *Libycoceras* as late Early Campanian. This interpretation might be supported indirectly by the geologic situation near Bóveda (syncline of Bóveda, Province Alava, Spain), where the *Globator* Facies (with a comparable biofacies) still yielded *S. hippocrepis* III (RADIG 1973). Even if this interprataion is not followed, the *Libycoceras* has to come from close to the Early/Late Campanian boundary and is therefore still older than all other well-known occurrences.

CONCLUSIONS

The find of the genus *Libycoceras* in Spain is unusual. All species of *Libycoceras* have so far been reported from the southern areas of the Tethys, from the Trans-Saharan Seaway or from Madagascar and India which were only relatively closely situated in Campanian times. This is also true for Peru and Colombia, where there are scarce reports of *Libycoceras*. However, it is not clear whether or not this obvious scarceness really reflects the situation in these countries or is a subjective impression caused by the records in available literature.

With respect to the Campanian paleogeography, all these occurrences are either from the southern hemisphere or from near to the paleo-equator. The find in Spain, therefore, is the first record of the genus in higher latitudes of the northern hemisphere (around 30° N).

Since the entry of other well-dated *Libycoceras* sp. in the stratigraphic record is in the late Late Campanian *polyplocum* Zone, our find seems to be the earliest record of the genus worldwide. As a consequence, the diagram of ZABORSKI (1982, p. 327, Fig. 36), showing the phylogenetic relationship of the Sphenodiscidae and Libycoceratidae needs comment. All his material came from the Late Campanian *polyplocum* Zone, and he therefore concluded that all the inferred phylogenetic development of the Libycoceratidae happened during that time; *Indoceras* sp. was said to have split off from the main lineage of *Libycoceras* in the "Middle Campanian", before *L. ismaelis* developed from a stock that ZABORSKI named the *Libycoceras* group *A*. Our find in a layer well below the *polyplocum* Zone shows that this phylogenetic scheme must be revised. However, a single specimen does not allow further statements.

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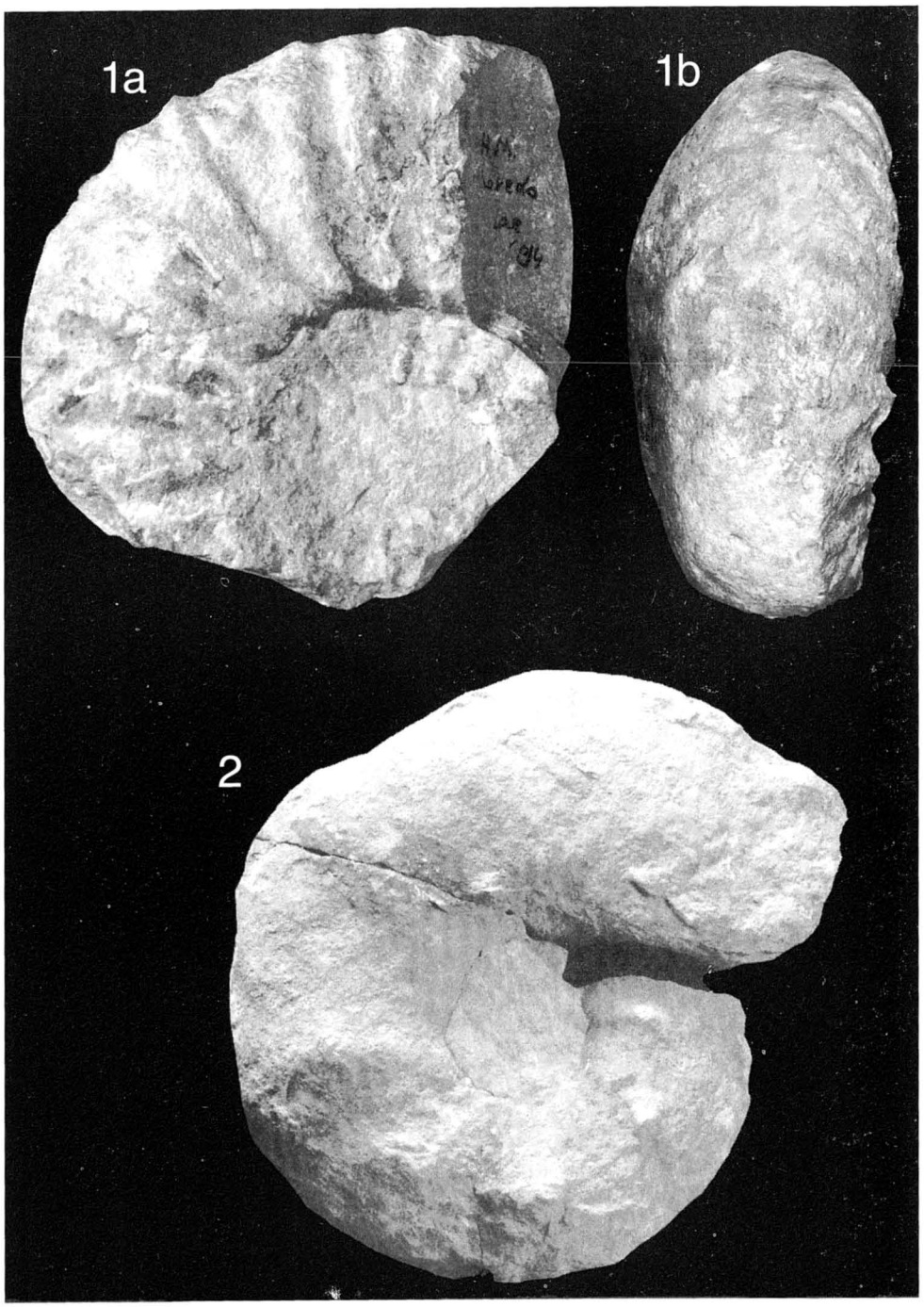
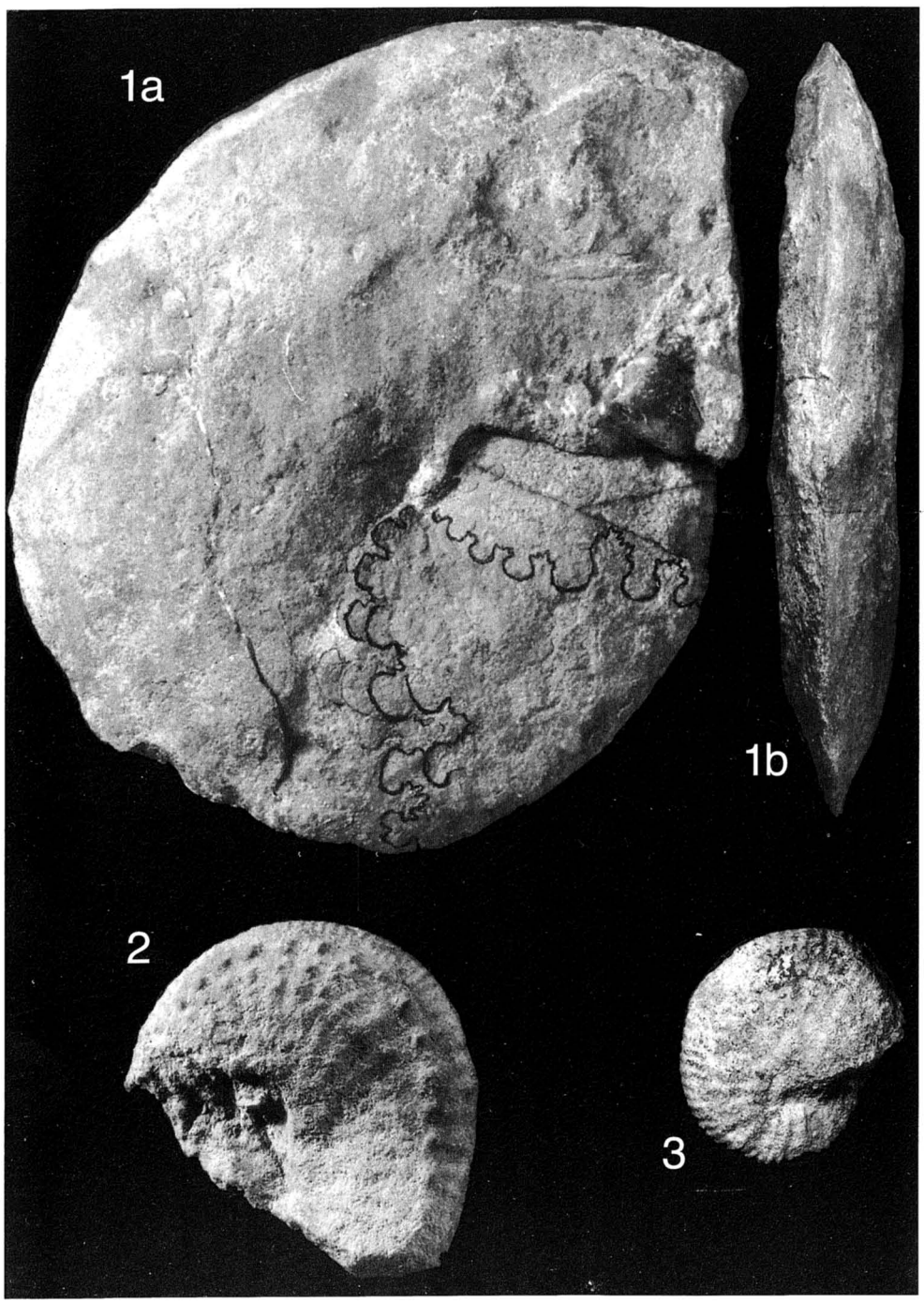


1a-1b — *Menabites* (*Delawarella*) *delawarensis* (MORTON, 1830); Specimen No. MB. C. 1893; talus below the higher *Holaster similis* Marls, Langre; × 0.5

2 — *Placenticeras polyopsis* (DUJARDIN); Specimen No. MB. C. 1895; top of the Upper Santonian Hardground, Langre; × 0.7



1a-1b — *Libycoceras ismaelis* (ZITTEL, 1885); Specimen No. MB. C. 1991; lower *Globator* Beds, Lower Campanian of Arnia; × 0.5

2 — *Scaphites gibbus* (SCHLÜTER, 1872); Unregistered specimen hosted in the M. DIAZ collection, Santander; talus, probably from the basal Sponge Rhythmites, Langre; nat. size

3 — *Scaphites hippocrepis* III (DEKAY, 1828); Specimen No. MB. C. 1892, phragmocone; *Holaster similis* Marls, Langre; nat. size