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LAST RECORDS OF "ASPIDOCERAS" IN THE MEDITERRANEAN

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Last records of Mediterranean "Aspidoceras" are interpreted in the light of a recent systematic revision of this group. Four species appear at Upper Tithonian-Berriasian, whose evolutive behaviour is interpreted in relation to Upper Kimmeridgian-Lower Tithonian Mediterranean "Aspidoceras". Also, migratory events (perhaps interchange) of this fauna towards the Andean province may be supposed.

Keywords: Jurassic-Cretaceous boundary, Aspidoceras, systematic revision, evolution, migration

Introduction

The "Aspidoceras" represent a standout component among Upper Jurassic ammonite faunas. From their origin (Upper Oxfordian) they constitute a considerable percentage of the association, even though their registry is tied to noticeable fluctuations during the Kimmeridgian and Tithonian. From the Lowermost Tithonian (Albertinum Zone) the "fall" is marked and they become a minoritary component, almost anecdotic, during the rest of the Tithonian.

Registers younger than those referred to the Berriasian are not known.

As far as the records of the group (those attributed to the Lower Tithonian and Berriasian) references are scarce and among them, those of Kilian (1889), Krantz (1928), Arnould-Saget (1951), Judoley y Furrazola-Bermudez (1965), Memmi (1967), Memmi et Salaj (1975), Enay et Geyssant (1975), Tavera (1981) and Leanza (1981) are found.

From their origin, the "Aspidoceras" have behaved as a worldwide ubiquistic fauna, even found in the outermost platforms of Austral Gondwana (New

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Zealand, cf. Arkell, 1956). Concerning the most recent Upper Tithonian and Berriasian records and the work list cited above, near to its disappearance the group retains its ubiquistic character (southern Eurasian slope in western Mediterranean, North Africa, Cuba and Argentina). Possibly, the inexistence of records in other areas is due to sampling deffectiveness as they do not seem to be facies-restricted faunas within the perigondwanian environment and adjacent zones.

On this global geographic distribution and with such an enlarged range as Upper Oxfordian-Berriasian, "Aspidoceras" followed an evolutionary course through which their diversification rate reached a main peak at the Lower Kimmeridgian and another second-order one ("Tithonian renovation" in Checa (1985) and Checa and Oloriz (1985) at the strata with *Hybonoticeras*.

Face to the registry we are treating on, two basic structures are noticed, consisting of bituberculate shells (*A. rogoznicense* (Zeuschner)) and globular, unituberculate or smooth, shells (*Schaireria* gr. *neoburgensis* and related forms).

Perisphinctaceae
Aspidoceratidae
Aspidoceratinae

Genus *Aspidoceras* Zittel

Aspidoceras rogoznicense (Zeuschner)

1846 *Ammonites rogoznicensis* Z. in Zeuschner; Pl. IV/4.
1868 *Ammonites (Aspidoceras) rogoznicensis* Zeuschn. in Zittel. p. 116; Pl. XXIV/4; Pl. XXIV/5; (V) Pl. XXIV/5a, b; (V) Pl. XXIV/5d.
1870 *Aspidoceras zeuschneri* Zitt. in Zittel. p. 87; Pl. VII/4a, b.
1872 *Ammonites catalaunicus* P. De Loriol in Loriol, Royer et Tombeck. p. 44; Pl. IV/1, c.
1875 *Aspidoceras iphiceroides*, Waagen, n. sp. in Waagen. p. 102; Pl. XXIII/2a, b.
1875 *Aspidoceras binodiferum*, Waagen, n. sp. in Waagen. p. 105; Pl. XXIV/1b, c.
1904 *Aspidoceras* sp. cfr. *Aspidoceras rogoznicense* Zeusch. in Del Campana, p. 262; Pl. VII/3, a.
1907 *Aspidoceras gourguechoni* Pervinquiere, 1907 in Pervinquiere. p. 33; Pl. II/2a, b, 3a, b, f. 2.
1928 *Aspidoceras haupti* nov. spec. in Krantz. p. 12; Pl. IV/2a, b.
1931 *Aspidoceras iphiceroides*, Waagen, in Spath. p. 635; Pl. CXXIII/8a, b.
1931 *Aspidoceras subwynnei*, sp. nov. in Spath. p. 640; Pl. LXXIV/2; Pl. CXVII/5; Pl. CXXII/5c, b.

V 1958 *Aspidoceras zeuschneri* Zittel in Buck. p. 98; Pl. 8/1c, b.
V 1959 *Aspidoceras* aff. *binodum* Opp. in Collignon; Pl. CXXIX/482.
V 1959 *Aspidoceras bussierei* nov. sp. type in Collignon; Pl. CXXIX/483.
V 1959 *Aspidoceras* cf. *iphiceroides* Waag. in Collignon; Pl. CXXX/485.
V 1959 *Aspidoceras subwynnei* Spath in Collignon; Pl. CXXXI/491.
V 1959 *Aspidoceras spinosum* nov. sp. type in Collignon; Pl. CXXXI/492
? 1973 *Aspidoceras* cf. *A. andinum* Steuer, 1897 in Verma and Westermann. p. 191; Pl. 36/1.
1973 *Aspidoceras haupti* Krantz, 1928 in Verma and Westermann. p. 193; Pl. 36/2, Pl. 37/1.
1973 *Aspidoceras* cf. *A. haupti* Krantz, 1928 in Verma and Westermann. p. 194; Pl. 35/3.
. 1976 *Aspidoceras rogoznicense* (Zeuschn.) in Fülöp. p. 75; Pl. XXXV/7.
V 1976 *Aspidoceras* sp. aff. *A. longispinum* (Sowerby) in Oloriz. p. 293; Pl. 24/1.
1980 *Aspidoceras euomphalum* Steuer in Leanza. p. 41; Pl. 8/1a, b, f. 10e.
1984 *Aspidoceras iphiceroides* Waagen in Verma and Westermann. p. 66; Pl. 15/3a, b; Pl. 16/1a, b.
1985 *Aspidoceras rogoznicense* (Zeuschner) Zittel in Checa p. 98; Pl. 16/1, Pl. 16/2; Pl. 16/3; Pl. 16/4.

Material: 8 specimens.

Description: Large semiinvolute. Rounded, more or less depressed whorl section. Ornamentation compounded by two rows of coarse tubercles, very near from each other (two fifths of whorl height). Occasionally the existence of an inner unituberculate stage can be noticed, being the ornamental scheme exclusively constructed by upper row elements.

Suture consists of eight lobes, showing the characteristic features of the genus.

Affinities: With respect to *A. binodum* (Oppel), section is more depressed, both rows are closer on the flank and stratigraphic level is higher. *A. rafaeli* (Oppel) shows a well developed ribbing, although other shell features are common.

Paleogeographic and biostratigraphic distribution: Upper Kimmeridgian-Berriasian (upper Beckeri Zone-basal Jacobi Zone) of the Betic Cordillera. Lower Tithonian of the Carpathian Mountains, external Appennines and southern Alps. Lower Tithonian (upper Gigas Zone) of Aquitaine bassin. Lower Tithonian of Tunisia. Lower Tithonian (Middle Katrol beds) of Cutch (India). Lower Tithonian (Hybonotum Zone) of Madagascar. Lower Tithonian (middle Hybonotum Zone) of Mombassa (Kenya). Upper Middle Tithonian (Internispinosum Zone) of Neuquen (Argentina). Lower Middle Tithonian (Virgathosphinctinae beds) of Mexico.

Aspidoceras taverai Checa

1985 *Aspidoceras taverai* sp. nov. in Checa p. 109; Pl. 19/1, Pl. 19/2, Pl. 19/3, Pl. 19/4, Pl. 20/1.

Material: 13 specimens.

Description: Large to medium sized, semiinvolute species. Rounded, equidimensional or something depressed section. Ornamentation consists of two rows of coarse tubercles, both being separated by a distance equivalent to half height of the flank. Sometimes, an inner exclusively outer-tuberculate stage may be made out.

Suture-line develops just five umbilical lobes, U_5 being almost insinuated.

Affinities: *A. taverai* Checa is almost identical to *A. longispinum* (Sowerby) from which it differs by a greater size and the unituberculate inner stage. Anyway, stratigraphical criterium is definitive. *A. rogoznicense* (Zeuschner) shows both rows of tubercles less separated on the flank, larger umbilicus and more compressed section than *A. taverai* Checa.

Paleogeographic and biostratigraphic distribution: Berriasian (Jacobi Zone) of the Betic Cordillera.

Genus *Schaireria* Checa

Schaireria longaeva (Leanza)

1945 *Aspidoceras longaevum* n. sp. in Leanza. p. 26; Pl. II/1, 15.

1985 *Schaireria longaeva* (Leanza) in Checa p. 203; Pl. 42/2, Pl. 42/4, Pl. 42/5, Pl. 42/6

Material: 11 specimens.

Description: Middle sized, involute forms. Section is rounded, rather depressed. Somewhat above the umbilical edge a row of coarse tubercles develops. Towards inner whorls, these elements may disappear so that a completely smooth inner stage is evident.

Suture-line consists of nine lobes (six umbilical lobes), its design being very close to that of stratigraphically higher species of this genus *(avellana, neoburgensis)*.

Affinities: *Sch. avellana* (Zittel) differs from *Sch. longaeva* (Leanza) through its closer umbilicus, the more internal position of tubercles on the flank and the non-existence of a smooth inner stage. In *Sch. pipini* (Oppel) ornamentation is placed more externally and the inner non-tuberculate stage is absent.

Paleogeographic and biostratigraphic distribution: Berriasian (Jacobi Zone—Andrussowi Zone) of the Betic Cordillera. Berriasian (Koeneni Zone) of Mendoza province (Argentina).

Final remarks

Among the previously mentioned quotations concerning Upper Tithonian and Berriasian "Aspidoceras", either bituberculate and unituberculate or smooth forms are reported. As far as bituberculate ones, references of Arnould-Saget (1951) and Memmi et Salaj (1975) are significant. According to the systematic considerations previously developed it may be considered as feasible that references of *A.* cf. *binodum* (Oppel) and *A. cieneguitense* Steuer could be but the record of *A.* gr. *rogoznicense* (Zeuschner) in North Africa (Tunisia)*.

Unituberculate forms have been reported by Memmi et Salaj (1975) -*Physodoceras* cf. *avellanum* (Zittel). Having in mind both the stratigraphic level and morphological convergences existing in the group we are treating on, this reference may be reinterpreted as the record of *Sch. longaeva* (Leanza) in North Africa (Tunisia). Smooth forms are represented by quotations of *A. neoburgense* (Oppel) and *A. cyclotum* (Oppel)—synonymous after Checa (1985). In this case we are unequivocally dealing with last records of *Sch. neoburgensis* (Oppel) in the western Mediterranean.

Remaining quotes in Argentina (Leanza, 1981), Cuba (Judoley and Furrazola-Bermúdez, 1965) and New Zealand (Arkell, 1956) cannot be interpreted in an accurate way for they are references without systematic precision at all and given that, not including figurations, it is not possible to know the alluded morphology.

As far as evolutive questions, the interpretation as related with identical or similar lowermost Tithonian forms is ineludible. Given this and having regard to the systematic ordering here presented, it can be said that, even close to their extinction, the "Aspidoceras" maintain both basic lines before mentioned: bituberculate forms and globular, unituberculate or smooth, forms.

Through the Lower Tithonian the most representative bituberculate forms are *A. rafaeli* (Oppel). *A. rogoznicense* (Zeuschner) and *Psh. steinmanni* (Haupt). From among them, only *A. rogoznicense* (Zeuschner) reaches the top of the Lower Tithonian, so that its evolutive relation with *A. taverai* Checa is immediate. This relation is but a repetition of the model observed at the Kimmeridgian for the relay *A. binodum* (Oppel)—*A. longispinum* (Sowerby), even though this occasion has a more successful evolutive repercussion (Checa, 1985).

A remarkable interest have the records of *Sch. longaeva* (Leanza) and *Sch. neoburgensis* (Oppel) at the Berriasian. The evolutive relation is also evident, for, at this level, Oppel species is the only one that could allow to the origin of longaeva. In this case, and according to the record, what we detect is the inversion of the successfully tried morphological change model at the Tithonian base: at the lowermost Hybonotum Zone, *Sch. avellana* (Zittel), last represen-

* It is convenient to make a joint commentary from the fact that Memmi et Salaj (1975) consider *A. cieneguitense* Steuer in Arnould-Saget's (not exactly Steuer's) sense.

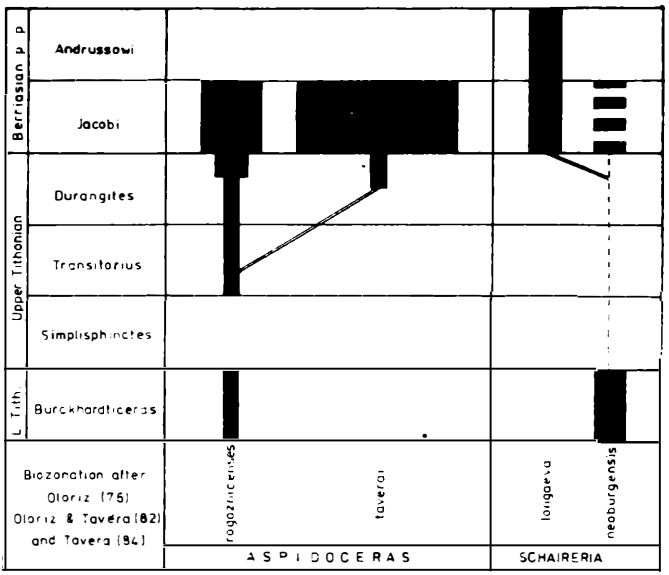

Fig. 1. Biostratigraphical distribution and phylogenetic relations of last Mediterranean "Aspidoceras". Presence of *Sch. neoburgensis* (Oppel) in the Jacobi Zone supposed after Kilian (1889) and Enay et Geyssant (1975)

tative of unituberculate forms, gives rise to *Sch. neoburgensis* (Oppel), which, together with *Sch. episa* (Oppel) expresses the evolutive possibilities of smooth forms of *Schaireria*. Evolutive stability ("success") shown by these forms in an accentuated decadence of "Aspidoceras" contrasts with the inversion of the evolutive model in these most recent registers.

On the basis of records allowing an accurate systematic determination, it should be remarked how the last evolutive manifestations of "Aspidoceras" can be recognized within Mediterranean associations s.s. and, more concretely, within the environment that seems to configurate as dispersal center for this group. In this context, the meaning of Central American and Andean records* should be considered as the result of Mediterranean faunas moving across an Atlantic way. Predictably, further research could harmonize this hypothesis and configurate a more accurate image of the last manifestations of this group dynamics.

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* The gap in the record that the Upper Tithonian supposes, though the existing record should be considered as representative, must possibly be interpreted as sampling hazard, for we are dealing with a very scarce fauna and it is unlikely the "emptiness" of these forms in the Mediterranean association to have occurred.

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