Lissoceras monachum (Gemmellaro), a ghost Ammonitida of the Tethyan Bathonian

Giulio PAVIA

G. Pavia, Dipartimento di Scienze della Terra, via Valperga Caluso 35, I-10124 Torino (Italy); giulio.pavia@unito.it

KEY-WORDS - Systematics, Ammonitida, Lissoceras, Bathonian, Tethys.

ABSTRACT - L. monachum has been frequently recorded in the Upper Bajocian and Lower Bathonian, but references in literature differ in morphological details as they are based on a juvenile and poorly-preserved holotype. In addition, the type of L. monachum comes from a bed affected by taphonomical condensation mixing fossils from Early and Middle Bathonian times, i.e. the biostratigraphic meaning of Gemmellaro’s taxon cannot be specified with biostratigraphic criteria from the type-locality. These references are here revised and refuted on the basis of two topotypes recently sampled at Monte Erice in western Sicily, which allow a precise morphological definition of L. monachum by means of architectural and sutural characteristics. The only acceptable biostratigraphic datum comes from a Lower Bathonian specimen from southern France. The differences from L. ferrifex, L. magnun, and L. ventriplanum are discussed. Finally, the suture-line of topotype PU111502 of L. monachum and those specimens from the Upper Bajocian of the Venetian Alps, here named L. aff. monachum, support the phyletic relationships between L. ferrifex and L. magnun through transitional forms of L. monachum aged for the Tethyan Early Bathonian.

RIASSUNTO - Lissoceras monachum (Gemmellaro), un Ammonitida fantasma del Batoniano Tetideo - L’ammonite Lissoceras monachum, della famiglia medio- e tardo-giurassica Lissoceratidae, risulta ripetutamente citata nella letteratura sistematica relativa al Bajociano superiore e al Batoniano inferiore. Quasi tutte le citazioni sono però alterate dalla diversa interpretazione con cui gli autori hanno descritto il taxon; la causa è da ricercare nell’inconsistenza dell’olotipo rappresentato da un esemplare giovane affetto da un cattivo stato di conservazione. Recenti ricerche sulla località-tipo di L. monachum, a Monte Erice in Sicilia Occidentale, hanno fornito due toptipi che rendono possibile la definizione morfologica del taxon; essi sono conservati presso il “Museo di Geologia e Paleontologia” dell’Università di Torino con numeri di catalogo PU111501 e PU111502. Il materiale toptotipico, così come il tipo, proviene da uno strato che presenta forte condensazione tafonomica con mescolamento di fossili del Batoniano inferiore e medio; tale situazione stratigrafica non permette quindi di chiarire il significato biocronologico della specie.


INTRODUCTION

The macroconchiate genus Lissoceras Bayle, 1879, among the Middle Jurassic haploceratids, is a typically Tethyan ammonite; its dimorphism with the microconchiate Microliosoceras Sturani, 1971 was regularly confirmed by authors. The highest taxonomic biodiversity is recorded in the Mediterranean and Submediterranean provinces, although its geographic distribution is wider, ranging from the Central Tethys to many places in the Pacific Realm (see Galácz, 1980 for details). Biochronologically, Lissoceras encompasses a long time span, from the Early Bajocian with L. semicostulatum to the Middle Callovian with L. voutense. Synonymy with the Late Jurassic Lissoceratoides is not yet defined (Galácz, 1980, p. 55), which would further enlarge the stratigraphic range up to the Kimmeridgian. However, this topic is not relevant to the aims of the present study and could only be solved after careful analysis of the Oxfordian haploceratids.

Many species of Lissoceras are commonly recorded from both Bajocian and Bathonian Stages, although their morphologic features are far from being univocally defined and shared by authors. In this respect, it is worth noting that Lissoceras species usually represent a small fraction, if not scattered components, of the Middle Jurassic ammonite assemblages, and this scarcity hinders definition of convincing interspecific differences. To be precise, lissoceratids lie in a systematic limbo, as the consequence of the very simple morphology and the apparent (more or less real) wide
stratigraphic range, which would hinder any biostratigraphic use and also the delineation of any phylogenetic trend. Such a situation is not dissimilar to that of phylloceratids which are essentially treated just for “duty of chronicle”, apart from their paleoecologic and paleobiogeographic implications (Westermann, 1996). It is evident that the absence of a precise systematic revision of lissoceratids proceeds from the morphological characteristics of the platycone shell, whose simplicity in architecture and ornament discourages any biostratigraphic and phylogenetic speculation. On the contrary, my opinion is that a careful study of large samples would improve definition of morphological variability among lissoceratids of the same age and of subsequent stages.

Bajocian *Lissoceras* are widely-known from the monographs of Sturani (1964, 1971) and Fernández-López (1985). However, the systematics of Late Bajocian lissoceratids actually seems to be slightly more complicated than their conclusions. With the goal of clarifying their biodiversity, the writer is revising the systematic revision of lissoceratids proceeds from the morphological characteristics of the platycone shell, whose simplicity in architecture and ornament discourages any biostratigraphic and phylogenetic speculation. On the contrary, my opinion is that a careful study of large samples would improve definition of morphological variability among lissoceratids of the same age and of subsequent stages.

Bajocian *Lissoceras* are widely-known from the monographs of Sturani (1964, 1971) and Fernández-López (1985). However, the systematics of Late Bajocian lissoceratids actually seems to be slightly more complicated than their conclusions. With the goal of clarifying their biodiversity, the writer is revising the systematic revision of lissoceratids proceeds from the morphological characteristics of the platycone shell, whose simplicity in architecture and ornament discourages any biostratigraphic and phylogenetic speculation. On the contrary, my opinion is that a careful study of large samples would improve definition of morphological variability among lissoceratids of the same age and of subsequent stages.

Bajocian *Lissoceras* are widely-known from the monographs of Sturani (1964, 1971) and Fernández-López (1985). However, the systematics of Late Bajocian lissoceratids actually seems to be slightly more complicated than their conclusions. With the goal of clarifying their biodiversity, the writer is revising the systematic revision of lissoceratids proceeds from the morphological characteristics of the platycone shell, whose simplicity in architecture and ornament discourages any biostratigraphic and phylogenetic speculation. On the contrary, my opinion is that a careful study of large samples would improve definition of morphological variability among lissoceratids of the same age and of subsequent stages.

Bathonian *Lissoceras* have been less discussed than the older congeneric forms. The most up-to-date studies have been made by Galácz (1880) and Sandoval (1986). Some species seem to occur in both stages (e.g., *L. ferrifex*, *L. psilodiscus*) but morphological analyses are far from uniform, whereas the biochronologic value of other species needs confirmation, such as for *L. magnum* and *L. ventriplanum*. Among these species, *L. monachum* is one of the most frequently recorded taxon, although citations can not often be compared (e.g. Sturani, 1964; Fernández-López, 1985). This is due to the fact that its morphology and biostratigraphic significance are undefined as the type is represented by a poorly preserved and juvenile specimen (holotype in Pavia & Cresta, 2002, p. 201) and was studied by Gemmellaro (1877) from a condensed interval of the Erice succession in western Sicily.

Recent samplings in the type-locality of Monte Erice (Martire & Pavia, 2002) delivered two topotypes which are complete enough to allow definition of *Lissoceras monachum* (Gemmellaro). On the basis of these new data, the present contribution aims to precise the stratigraphic value of this taxon, which, in literature, has always represented a ghost form awaiting taxonomic and biochronologic arrangement.

**BATHONIAN AMMONITE ASSEMBLAGES FROM ERICE**

The succession of Monte Erice was described in detail by Wendt (1971). It consists of a thick sequence of peritidal Lower Jurassic limestones (Inici Fm.) followed by Lower to Upper Jurassic pelagic facies that mark the drowning of the Trapanese Domain carbonate platform. Although Giunta & Liguori (1972, 1973) referred to these pelagic facies as indicative of basinal conditions, recent stratigraphic analyses led Martire & Pavia (2002) to suggest an outer ramp depositional system. The type-level of *Lissoceras monachum* corresponds to a well-defined condensed interval of the middle part of this pelagic unit, which is informally named “Erice formation”.

Some details are needed to frame this type-level within the succession. The Erice Fm. on the southern slope of Monte Erice shows great variation in thickness and facies, mainly in its lower part (Martire & Pavia, 2002, fig. 41). In the Contrada Difali and Rocc site Calderaro sector, the formation reaches its maximum thickness, up to 180 m (Fig. 1). The lower part of the succession is composed of alternating grey cherty limestones and greenish marls; calcareous beds mainly consist of wackestones to packstones, occasional grainstones with glauconite and phosphate grains and abundant filaments, echinoderm debris and sponge spicules. In the upper part the lithology is represented by cherty limestones or by nodular limestones with bioclasts of the same types as below - except for spicules, which are replaced by radiolarians; grainstones frequently show undulose laminae interpreted as hummocky cross-stratification. Martire & Pavia (2002) suggest a middle-inner ramp environment which could justify features such as grain-supported texture, intense bioturbation, abundant sponge spicules and storm beds. In the context of a ramp environment, the deposition of the coarse grainstone to rudstone megabed (150-200 cm thick) at the top of the Erice succession may be interpreted as the product of a single catastrophic event, such as a tsunami.

In the Difali-Calderaro section, three fossiliferous layers are described in literature. The first, some 65 m above the base, corresponds to the well-known locality of Fontana Difali. In the past, a huge number of mollusc remains were collected from here, including the Aalenian ammonites recorded by Gemmellaro (1886) and Wendt (1971) and recently revised by Cresta (in Pavia & Cresta, 2002). The second fossiliferous layer, 135 m above the base of the formation, delivered the Bathonian ammonites listed by Wendt (1971). It corresponds to the type-level of *L. monachum* (see below). The third one lies at 150 m from the base, in the Rocc site del Calderaro outcrop. This layer is composed of several beds, delivering Middle Oxfordian ammonites studied by D’Arpa & Meléndez (2004).

The Bathonian fossiliferous bed, 15-20 cm thick, consists of *Bositra* packstones/grainstones with Fe-stained protoglobigerinids. It overlays a hardground surface marked by firm ground burrows penetrating the underlying packstones; both the erosional surface and burrow walls are stained by limonite and glauconite films. The bed crops out at several points along the Monte Erice southern slope. Wendt (1971) described the outcrop present just above the Cappuccini monastery and regarded it as the source of Gemmellaro’s Bathonian ammonites, thus of *Lissoceras monachum* among others. A second outcrop, with similar characteristics, was reported by Wendt at the crossroads to the village of Sant’Anna in the Contrada Difali sector; the same outcrop was studied by Galácz (1999) who enlarged the list of ammonites, all pertaining to the Bathonian. During the stratigraphic survey of
the Erice area, in the frame of compiling the Field-trip Book of the 6th International Symposium of Jurassic System, Martire & Pavia (2002) located some further outcrops at the Rocce del Calderaro which delivered similar ammonite assemblages, with some Lissoceras specimens useful for this note. The Bathonian fossiliferous bed is rich in taphonomically reworked fossils. From the Cappuccini section, Wendt (1971, p. 60) listed many species of ammonites such as Ptychophylloceras flabellatum, Prohecticoceras spp., Cadomites extinctus, Bullatimorphites sp., Choffatia cf. uriniacensis, and indicated an undefined mixing of successive Bathonian taxa. A similar fossil assemblage was recorded by Wendt (1971) at the crossroads to the village of Sant’Anna. Later sampling of the same outcrop by Galácz provided supplementary ammonites, in particular Morphoceras mactrescens and Asphinctites pinguis which would be sufficient, in Galácz’s opinion, to assign an Early Bathonian age to the fossiliferous bed. Nevertheless, his interpretation was not accepted by Martire & Pavia (2002, p. 67) on the basis of taphonomic arguments. In short, the fossiliferous bed shows taphonomic condensation (sensu Gómez & Fernández-López, 1994) associated with the mixing of taxa from late Early Bathonian to at least Middle Bathonian. The consequence of this mixing is that we cannot precisely define the biostratigraphical significance of taxa, such as Lissoceras monachum, not yet biochronologically located in any outcrop of the Tethyan Bathonian.

This conclusion derives from the taphonomic analysis of ammonites collected in the field, according to criteria put forward by Fernández-López (1997). Fossils are embedded without any stratigraphic order, including vertically. Ammonoids are preserved as concretionary internal moulds with calcitic septa and large sectors of the innermost whorls filled with sparry calcite. The sedimentary infill is homogeneous with local phosphatic sectors and discontinuous glauconitic films. It is separated from the matrix by erosive discontinuities, among which the frontal surface is particularly evident. Internal moulds are often broken with rounded surfaces. In general, they show numerous traces of abrasion, i.e. partial disarticulation surfaces along septa with sharp margins, roll abrasion and truncational facets (Pl. 1, fig. 3; Figs. 4d-e; see also Galácz, 1999, pl. 2), interpreted as having developed after the exhumation by sedimentary winnowing (processes of taphonomic reelaboration) and the final burial. These preservational features are common for all the Bathonian ammonites from Erice, whose assemblages - hence - are totally made up of taphonomically reworked fossils (reelaborated elements sensu Fernández-López, 1991).

All the ammonites collected by the writer in the outcrops of Cappuccini, Rocce del Calderaro and Sant’Anna crossroads, as well as any other specimen here described, are inventoried at the ‘Museo di Geologia e Paleontologia’ at the University of Torino (code PU).
SYSTEMATICS

Phylum MOLLUSCA Linnaeus, 1758
Class CEPHALOPODA Leach, 1817
Subclass AMMONOIDEA Hyatt, 1889
Order AMMONITIDA Hyatt, 1889
Superfamily HAPLOCERATAEAE Zittel, 1884
Family HAPLOCERATIDAE Zittel, 1884
Subfamily LISSOCERATINAE Douvillé, 1885
Genus Lissoceras Bayle, 1879

Lissoceras monachum (Gemmellaro, 1877)
Figs. 2a, 3a; Pl. 1, figs. 1-3, 5-6

v 1877 Haploceras monachum Gemmellaro, p. 66, pl. 20, figs. 2-3.

v ? 1964 Lissoceras monachum (Gemmellaro) - STURANI, p. 15, text-figs. 8, 12, pl. 2, figs. 2-3.

v non 1964 Lissoceras monachum (Gemmellaro) - STURANI, p. 16, text-figs. 9, 13 (= L. magnum).

? 1972 Lissoceras monachum (Gemmellaro) - KRAYSTYN, p. 249, text-figs. 17, pl. 6, fig. 4.

v non 1985 Lissoceras monachum (Gemmellaro) - Fernández-López, p. 166 (pars), text-figs. 16B, 16C, 16G, pl. 15, figs. 6-7 (= L. ferriferix).

v non 1985 Lissoceras monachum (Gemmellaro) - Fernández-López, p. 166 (pars) (= L. haugi).

v non 1994 Lissoceras monachum (Gemmellaro) - Pavia, p. 166 (= L. ferriferix, L. haugi).

v 2002 Lissoceras monachum (Gemmellaro) - Pavia in Pavia & Cresta, p. 201, text-fig. 133 (holotype).

Holotype - Gemmellaro described a single specimen, which is the holotype by monotypy. The holotype is kept in the ‘Museo Gemmellaro’ at the University of Palermo under inventory number MGUP-016.26 (Pl. 1, fig. 2). Its dimensions are recorded in Tab. 1.

Stratum typicum - The holotype was reported by Gemmellaro from the “calcare grigio della contrada Cappuccini”, a well-known outcrop on the southern slope of Monte Erice which delivered a rich assemblage of Bathonian ammonites (Wendt, 1971) with evidence of biochronologic mixing.

Diagnosis - A subsequent diagnosis was summarized by Pavia (in Pavia & Cresta, 2002) as follows: Subtrapezoidal whorl-section with maximum breadth on the inner flanks. Funnel-shaped umbilicus with rounded periumbilical margin. Whorl sides slightly convex and convergent to the rounded ventrolateral shoulders. Venter arched to depressed, never flattened.

Topotype material - Though the type-level of Lissoceras monachum is cropping out in several points of the Monte Erice, Wendt (1971) did not list any lissoceratid from the outcrops where he dug, whereas Galácz (1999) recorded three incomplete specimens identified as L. cf. ventriplanum at the crossroads to the village of Sant'Anna. In the Rocce di Calderaro outcrop, on the other hand, several specimens of Lissoceras were collected by the writer. They are ascribed to L. monachum (Gemmellaro) and L. ventriplanum Wendt.

The new collection contains two specimens of L. monachum, which are to be regarded as topotypes. They are inventoried with numbers PU111501 and PU11502. The two topotypes are calcareous internal moulds with parts of the bodychamber, although their state of preservation is very different, and separate notes are necessary.

Topotype PU111501 (Pl. 1, fig. 3) - Incomplete bodychamber on one half of the last preserved whorl. Near-adult specimen with slight approximation of the last two suture lines. The internal mould shows a local fracture, evident on the right side with a sharp step; it produces an oval outline of the fossil but does not modify the section. Such a discontinuous deformation has to be connected to a post-exhumation phase, during reworking of the mould on the bottom or before the final burial. However, signs of taphonomic reworking (reelaboration) are clear in the truncational facets on the venter and the frontal discontinuity of the internal mould. The state of preservation prevents any precise measurement. The maximum diameter approximates

<table>
<thead>
<tr>
<th>Taxon</th>
<th>D</th>
<th>H</th>
<th>HD</th>
<th>W</th>
<th>D</th>
<th>U</th>
<th>U/D</th>
<th>W/H</th>
</tr>
</thead>
<tbody>
<tr>
<td>Lissoceras monachum</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>MGUP-016.26 (holotype)</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>PU111502 (topotype)</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>34.0</td>
<td>16.3</td>
<td>0.48</td>
<td>12.3</td>
<td>0.39</td>
<td>8.5</td>
<td>0.25</td>
<td>0.81</td>
<td></td>
</tr>
<tr>
<td>57.5</td>
<td>27.5</td>
<td>0.49</td>
<td>22.9</td>
<td>0.40</td>
<td>13.1</td>
<td>0.23</td>
<td>0.83</td>
<td></td>
</tr>
<tr>
<td>47.6</td>
<td>23.2</td>
<td>0.49</td>
<td>18.7</td>
<td>0.29</td>
<td>10.5</td>
<td>0.22</td>
<td>0.81</td>
<td></td>
</tr>
<tr>
<td>84.2</td>
<td>41.0</td>
<td>0.49</td>
<td>32.0</td>
<td>0.39</td>
<td>19.3</td>
<td>0.23</td>
<td>0.78</td>
<td></td>
</tr>
<tr>
<td>59.6</td>
<td>30.0</td>
<td>0.50</td>
<td>24.0</td>
<td>0.40</td>
<td>13.4</td>
<td>0.22</td>
<td>0.80</td>
<td></td>
</tr>
<tr>
<td>52.7</td>
<td>25.3</td>
<td>0.48</td>
<td>20.8</td>
<td>0.39</td>
<td>11.4</td>
<td>0.22</td>
<td>0.82</td>
<td></td>
</tr>
<tr>
<td>39.7</td>
<td>18.5</td>
<td>0.47</td>
<td>15.8</td>
<td>0.49</td>
<td>9.6</td>
<td>0.24</td>
<td>0.85</td>
<td></td>
</tr>
<tr>
<td>Lissoceras ventriplanum</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Cr 123016 (holotype)</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>PU11503</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>55.0</td>
<td>27.0</td>
<td>0.49</td>
<td>18.7</td>
<td>0.34</td>
<td>13.2</td>
<td>0.24</td>
<td>0.69</td>
<td></td>
</tr>
<tr>
<td>52.5</td>
<td>24.3</td>
<td>0.46</td>
<td>16.3</td>
<td>0.31</td>
<td>12.5</td>
<td>0.24</td>
<td>0.68</td>
<td></td>
</tr>
<tr>
<td>33.8</td>
<td>16.9</td>
<td>0.50</td>
<td>11.8</td>
<td>0.35</td>
<td>7.2</td>
<td>0.21</td>
<td>0.70</td>
<td></td>
</tr>
<tr>
<td>Lissoceras magnus</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>J9281 (holotype)</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>PU11406</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>175.0</td>
<td>76.0</td>
<td>0.44</td>
<td>62.0</td>
<td>0.35</td>
<td>41.0</td>
<td>0.24</td>
<td>0.82</td>
<td></td>
</tr>
<tr>
<td>109.6</td>
<td>50.7</td>
<td>0.46</td>
<td>41.6</td>
<td>0.38</td>
<td>26.8</td>
<td>0.25</td>
<td>0.82</td>
<td></td>
</tr>
<tr>
<td>79.2</td>
<td>37.9</td>
<td>0.48</td>
<td>31.2</td>
<td>0.39</td>
<td>19.4</td>
<td>0.25</td>
<td>0.82</td>
<td></td>
</tr>
</tbody>
</table>

Tab. 1 - Measures of the specimens discussed in the text. Dimensions are taken according to standard measurements, with ratio of whorl-height (H), whorl-width (W) and umbilicus (U) on D.

Fig. 2 - Whorl-sections. a) Lissoceras monachum (Gemmellaro), topotype PU111502. b) Lissoceras ventriplanum Wendt, specimen PU111504. c) Comparison monachum-ventriplanum by superposition of their whorl-sections. Both specimens from the Lower to Middle Bathonian mixed fossil assemblage, Rocce del Calderaro outcrop.
Topotype PU111502 (Pl. 1, fig. 1) - The internal mould ends at the beginning of the bodychamber. The last two septa show slight approximation. The ventral truncational facet, stained by hematite film, is a clear sign of reelaboration, whereas the absence of deformation allows the taking of the measurements summarised in Tab. 1.

Description - Relatively large form with a moderate narrow umbilicus, at least on high diameters. The umbilical wall is high and vertical with a rounded umbilical edge. The whorl-sides are slightly and regularly convex. The venter is rounded and well-connected to the flanks, without any angularity at the ventro-lateral margin. The whorl-section (Fig. 2a) is nearly oval with maximal width at the lower fourth of the whorl-height. This change in lateral outline causes a sort of periumbilical funnel particularly evident on the inner whorls, as on the holotype. At maximal diameters (topotype PU111501: Pl. 1, fig. 3), the section becomes rounded-subtriangular due to enlargement of the inner flank. All the moulds on study are smooth.

The haploceratid suture-line (Fig. 3a) is relatively well-divided. E broad and short; L wide, roughly trifid and very deep, more than twice as deep as E; U₂ shortened and gently rotated towards the umbilicus. The ventro-lateral saddle ES is asymmetrically trifid as if laterally suspended on the short ventral saddle; the lateral saddle LS is higher than the former, finely divided and pseudo-symmetric at the top.

Remarks - The holotype clearly represents an immature specimen or, at least, the inner whorls of a phragmocone comparable to those of the topotypes here described. This sentence is based on the funnel-shaped umbilicus and the shortness of the umbilical walls, which become modified on the large diameters of both topotypes. For other morphological parameters, such as H, W, U and whorl-section, holotype and topotypes match very well and represent conspecific individuals.

Other lissoceratids here assigned to *Lissoceras monachum* are unpublished specimens from the Lower Bathonian of Monti Lessini in the Venetian Alps (PU111512: Pl. 1, fig. 5) and Bas Auran in south-eastern France (PU111513: Pl. 1, fig. 6). Both share shell architecture and dimensions (Tab. 1) with the Sicilian type-specimens.

On the contrary, the ammonite figured by Krystyn (1972) from the Lower Bathonian of the Vienna Basin fits the shell architecture of *L. monachum* topotype material, but differs for sutural details such as the stout ES and the deeper U₂. Its taxonomic pertinence among Bathonian lissoceratids is uncertain.

The specimens described by Sturani (1964) from the uppermost Bajocian of the Venetian Alps show significant differences with typical specimens of *L. monachum*. Their elliptical whorl-section and the large, rounded venter (Sturani, 1964, text-fig. 8) actually recall the architecture of *L. ferrifex*. Nevertheless, the enlargement of the section at the periumbilical edge is characteristic of *L. monachum*, and the suture-line (Sturani, 1964, text-fig. 12) is similar to that of Gemmellaro’s taxon reproduced in the present paper. In short, more material from the Venetian Alps is needed to conclude this taxonomic aspect, and thus Sturani’s specimens are kept in open nomenclature as *L. aff. monachum*. For the time being, I limit myself to outlining the intermediate position of these Upper Bajocian specimens between *L. ferrifex* and *L. monachum*.

Taking into account the stratigraphic range till now checked for Gemmellaro’s species, such a transitional stage, if confirmed, would mean that the two taxa are phylogenetically linked with derivation of *L. monachum* from *L. ferrifex* at the beginning of Bathonian.

*Lissoceras monachum* is also recorded from the Upper Bajocian of the Submediterranean Province (Fernández-López, 1985; Pavia, 1994). All these Bajocian specimens differ in shape from the type material and belong to different species. It is the case, for instance, of specimens studied from the Bajocian of Normandy (Pavia, 1994) which must be assigned to *Lissoceras haugi* (Pl. 1, fig. 4) and *Lissoceras ferrifex* (Pl. 1, fig. 7).
Discussion - The taxonomic distinction among Late Bajocian to Middle Bathonian lissoceratids is far from clear because of the simple morphology, in which the whorl-section more or less ovoid to subtrapezoidal and rounded, the convex to vertical umbilical wall, and the ventral outline are not sufficient to produce precise taxonomic definition. It is the case of *L. ferrifex*, *L. monachum*, *L. ventriplanum*, *L. magma* which were thought as possible synonyms (Sandoval, 1986). The two *L. monachum* topotypes from Erice could result decisive in distinguishing these taxa, as follows.

- **Lissoceras ferrifex** (Zittel) - The lectotype comes from a condensed layer of Swinitza (Romania) which mixes ammonites from Early to Middle Bathonian (Galácz, 1994). In comparison with *L. monachum*, *L. ferrifex* shows broad and regularly rounded venter, a flared umbilical area due to the short umbilical wall and ovate whorl-section with maximum width near the mid-flank (cf. Pl. 1, fig. 7). The suture-line has a narrower L and a more asymmetric lateral saddle than that of *L. monachum*.

Zittel’s taxon is typically represented in the Upper Bajocian successions of the Iberian Chain (Fernández-López, 1985), Normandy (Pavia, 1994) and Sengenthal in Franconian Alb (Görlich & Pavia, personal data, on the basis of Callomon et al., 1987). It is also reported from the Lower Bathonian of Sengenthal (ibidem), western Sicily (Wendt, 1963; Galácz, 1985), the Venetian Alps (Sturani, 1964) and south-eastern France (Sturani, 1967; non Torrens, 1987, pl. 3, fig. 1 which constitutes a big microconch of uncertain identification).

The persistence of *L. ferrifex* above the Lower Bathonian is doubtful as the citation of Dieni et al. (1966, p. 102) from the Upper Bathonian of Sardinia needs confirmation, and the specimens figured by Galácz (1980) from the Middle Bathonian of the Bakony Mountains have to be referred to as *L. ventriplanum* (see also Sandoval, 1986). Indeed, the latter show a whorl-section very similar to that of *L. ventriplanum* and the suture-line (Galácz, 1980, text-fig. 48) fits very well with those of the holotype (Wendt, 1963) and topotype PU111504.

- **Lissoceras ventriplanum** Wendt - The type series (Wendt, 1963) is made up of four syntypes from condensed layers in western Sicily which delivered mixed fossil assemblages of Early to Middle Bathonian ammonites. The holotype comes from Monte Bonifato (Ce 1230/16, cf. Tab. 1), two paratypes from Monte Erice i.e. from the same bed source of *L. monachum* (see also Galácz, 1999, pl. 1, fig. 2). During the survey at the Rocce di Calderaro outcrop, associated with the two *L. monachum* topotypes, nine *L. ventriplanum* specimens were collected (inventory numbers PU111503-PU111511). A very short description of the best preserved examples (Figs. 2b, 3b-c, 4a-e) could help in the distinction between the taxa *monachum* and *ventriplanum*. Measurements in Tab. 1.

According to the new Erice specimens, which fit very well the holotype, *L. ventriplanum* shows: discoid internal moulds; umbilicus with short vertical wall and rounded edge; narrow subtriangular whorl-section with flattened flanks; narrow and flattened to slightly arched venter with a clear angularity at the ventro-lateral shoulder; suture-line (Figs. 3b-c) with large and deep L, very deep U₂, stout and nearly trifid ES saddle, and stout and asymmetric LS.

The suture-lines of both Erice specimens correspond to those of the holotype (Wendt, 1963, pl. 23, f. 12) and Galácz’s specimen (1999, text-fig. 2). An identical suture-line was reproduced by Sturani (1964, text-fig. 13), which confirms the broad diffusion of *L. ventriplanum*, within the Tethyan areas, from Sicily to the Venetian Alps, Subbetic Zone (Sandoval, 1986) and Hungary (Galácz, 1980, as *L. ferrifex*). Wendt’s taxon is possibly present also in the Lower Bathonian of the Western Carpathians (Schlögli et al., 2005) with the new taxon *Lissoceras compressum*, whose compressed whorl-section, narrow venter and suture-line (Schlögli et al., 2005, text-fig. 9c) actually fit the characteristics of *L. ventriplanum*. On the contrary, the two specimens figured by Schlögli et al. (2005) as *L. ventriplanum* cannot be referred to Wendt’s taxon because of the subtriangular whorl-section enlarged at the periumbilical edge, and the suture-line with greater suspended U₂; they are to be identified as *L. magma*.

EXPLANATION OF PLATE 1

figs. 1-3, 5-6 - *Lissoceras monachum* (Gemmellaro).
1. Topotype PU111502 (x 1). Lower to Middle Bathonian mixed fossil assemblage, Rocce del Calderaro outcrop.
2. Holotype MGUP-016.26 (x 1.8). Lower to Middle Bathonian mixed fossil assemblage, Cappuccini outcrop.
3. Adult topotype PU111501 (x 0.9). Lower to Middle Bathonian mixed fossil assemblage, Rocce del Calderaro outcrop.
5. Specimen PU111512 (x 1). Lower Bathonian unknown locality of the Monti Lessinia area, Venetian Alps.

fig. 4 - *Lissoceras hangi* Sturani. Specimen PU111514 (x 1). Upper Bajocian, bed 5, Bayeux, Normandy (cf. Pavia, 1994).

fig. 7 - *Lissoceras ferrifex* (Zittel). Specimen PU111515 (a: x 0.8; b: x 1). Upper Bajocian, bed 5, Bayeux, Normandy (cf. Pavia, 1994).

Arrows indicate truncational facets testifying taphonomic reworking of fossils. Asterisks mark the beginning of the bodychamber.
G. Pavia - Lissoceras monachum of the Tethyan Bathonian
As to the differences to *L. monachum*, *L. ventriplanum* is defined by a narrower whorl-section (cf. Fig. 2c), flat flanks, narrow venter with angular edges and sutural characteristics, i.e. stout saddles and deep U₂. - *Lissoceras magnum* Galácz - The holotype (J9281, cf. Tab. 1) and the two paratypes were described by Galácz (1980) from the Lower Bathonian of Gyenespuszta in the Bakony Mountains. Its general shape is similar to that of *L. monachum* in terms of the umbilical wall and whorl width. Nevertheless, *L. magnum* differs as a result of the subtriangular section with flattened flanks, narrower venter and somewhat wider umbilicus. *L. magnum* is surely present in the Bathonian of the Venetian Alps (Sturani, 1964, text-fig. 9, ex *L. monachum* transition to *L. ventriplanum*) and in the Western Carpathians (Schlögl et al., 2005 as *L. ventriplanum*).

It is worth noting that Sandoval (1986) indicated the synonymy of *L. magnum* with *L. ventriplanum*, which I cannot confirm due to the rounded shape of the ventral area, the enlarged whorl section and the wider umbilicus of Galácz’s taxon. These differences are confirmed by a specimen from the mid-Lower Bathonian of the Bas Auran section in south-eastern France, never described by Sturani (1967). This fossil is very similar to the holotype in terms of shape and measurements (Tab. 1; Fig. 5). Its characteristics can be summarised as follows: large calcareous internal mould, fully septate, with subtriangular whorl-section, enlarged at the perumbilical edge; high vertical umbilical wall with rounded edge swiftly passing to the flanks which are slightly convex in the inner whorls and flattened in the outer half of the last preserved whorl; umbilicus relatively open; venter arched, except at the end of the fossil, possibly because of diagenetic compaction.

As regards the differences with *L. monachum*, *L. magnum* is characterized by the larger whorl-section at the perumbilical edge, flat flanks and thus narrower venter. Nevertheless, the *L. magnum* holotype suture-line (Galácz, 1980, text-fig. 46), compared with that of topotype PU111502 of *L. monachum*, indicates strict relationships between the two taxa. It is uncertain if it reflects a phyletic derivation of *L. magnum* from *L. monachum* as a subsequent step of the already-discussed lineage ferrifex-monachum. A real possibility is that *L. magnum* and *L. monachum* are morphologically linked as they share the common ancestor *L. ferrifex*.

Stratigraphic range - The holotype and the two topotypes of *L. monachum* come from a condensed interval which contains only reaberrated ammonites whose biochronologic meaning encompasses the late Early to Middle Bathonian. Such a mixed fossil assemblage cannot assure any chronostratigraphic definition of the *Lissoceras monachum* type-bed.

The short list of synonyms here reported allows the biochronologic position of *L. monachum* to be confirmed, for the time being, as only for the Tethyan Lower Bathonian of the Venetian Alps and south-eastern France. The extension of the species to the Middle Bathonian cannot be assured due to the taphonomic reworking detected in the Monte Erice type-level. On the other hand, the occurrence of *L. monachum* in the uppermost Bajocian requires comparison with supplementary specimens from the Venetian Alps, which could help to clarify the phyletic relationships with *L. ferrifex*.

CONCLUSIONS

In condensed intervals (sensu Gómez & Fernández-López, 1994), it is difficult to state the bio- and chronostratigraphic significance of fossil taxa due to the mixing of biochronologic indicators. Unfortunately this is the case of many ammonite species described from the classic European sites of Middle Jurassic, whose types pertain to condensed fossil assemblages suffering taphonomic condensation within the respective type-levels. One means of overcoming this restriction is both to proceed with the morphologic revision of typical material (type-series or topotypes) and, secondly, to find other auxiliary sections where a more continuous biostratigraphic record could assure the biochronologic role of that species. This is the case of the Early Bathonian *Lissoceras monachum* (Gemellaro), whose type is represented by a poorly preserved internal mould from a thin condensed interval.
of Monte Erice, in western Sicily. This situation resulted in *L. monachum* being considered from time to time either a conspecific or a distinct taxon from other Late Bajocian to Bathonian lissoceratids such as *L. ferrifex* (Zittel), *L. magnum* Galácz, and *L. ventriplanum* Wendt.

The recent finding of two fully grown topotypes of *L. monachum* from Erice enables the architectural and sutural parameters of this taxon to be defined and they show clearly distinguishing characteristics from the above-mentioned taxa. As far as the chronostratigraphic value of *L. monachum* is concerned, the Monte Erice type-level allows reference only to a minimal age, i.e. the lower part of the Bathonian Stage. Other references from the Venetian Alps, the Vienna Basin and southeastern France restrict the chronostratigraphic range to Early Bathonian. The taxon, however, might possibly occur from the uppermost Bajocian according to Sturani’s material (1964). Regardless of the taxonomic definition of the Venetian specimens, however, it is worth noting that they seem to state the origin of *L. monachum* from *L. ferrifex* in the Late Bajocian. A similar Bajocian lissoceratid, *L. magnum*, seems to be placed within this phyletic stem; nevertheless, it is still impossible to define its derivation from *L. monachum* or an indirect relationship starting with a Bajocian stock of *L. ferrifex*.

ACKNOWLEDGEMENTS

I am indebted to the colleagues of the Torino University, Luca Martire for implementation of stratigraphic data and Marco Pavia for discussion on the theme and help in iconography. Sixto Fernández-López of the Madrid University has given valuable advice to taphonomic interpretation. The two reviewers, F. Cecca (Paris Univ.) and A. Galácz (Budapest Univ.), were useful in the preparation of the final version of the paper.

REFERENCES


Fig. 5 - *Lissoceras magnum* Galácz. Specimen PU31406 (x 0.9). Bas Auran section, bed 8, Lower Bathonian, *Ziggajcuria zigzag* Zone, *Morphoceras macrescens* Subzone.


