TITHONIAN AND BERRIASIAN AMMONITES FROM
THE CHIA GARA FORMATION IN NORTHERN
IRAQ

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ABSTRACT. The Chia Gara Formation consists of 125–232 m of thin-bedded limestones, marls and shales in the
area between Zakho and Amadia, Iraqi Kurdistan, north of Mosul. The formation ranges in age from the base
of the Tithonian, where it is overlain by formations that contain a few Kimmeridgian ammonites, up to nearly
the top of the Berriasian, where it is succeeded by the Garagu Formation, which contains uppermost Berriasian
and Valanginian ammonites. The Hybonotum and Darwini Zones at the base of the Tithonian are represented
by single specimens of Hybonoticeras and Dorsoplanioides, then there are the rich, high Lower Tithonian or
basal Upper Tithonian ammonites, described previously by Spath, followed by many examples of crushed
Substeueroceras and Protancyloceras, and finally by well-preserved topmost Tithonian ammonites of the new
genus Chigarooceras, including C. banikense, C. wetzeli and C. planum spp. nov. The base of the Berriasian (and
the base of the Cretaceous) is marked by a single Berriasella jacobi. After an unfossiliferous gap, well-preserved
Berriasian ammonites from the Occitanica and Boissieri Zones, especially the Paramimouna Subzone, include
many Groebericeras rocardi, G. laevigatum sp. nov., Spiticeras spathi sp. nov., Euthymiceras kurdistanense sp.
nov., Dalmasceras (Elemaella) prossiradiatum sp. nov., Berriasella (Malboiscerina) malhosti, Thurmanniceras
(Edemella) isae, Tinnovella alpilensis, and Banikoceras involutum gen. et sp. nov. The Kurdistan ammonites
are all Tethyan rather than Boreal in affinities, and, as well as being similar to ammonites of the same age in
southern Europe and North Africa, there are major similarities with the Tethyan ammonites of Cuba, Mexico
and Argentina.

The Chia Gara Formation forms an unbroken sedimentary succession across the Jurassic/
Cretaceous boundary in northern Iraq. It crops out over a distance of 370 km in the mountain belt
of Iraqi Kurdistan north and north-east of Mosul and Kirkuk, from Zakho near the Turkish border
in the north-west, to the gorge of the Sirwan river near Halabja on the Iranian border east of Kirkuk
(Text-fig. 1). The formation consists of a succession of thin-bedded limestones, marls and shales
varying from 30 m to 290 m in thickness, the thinner developments being due in part to the erosion
of the top of the formation in some areas. It overlies the Kimmeridgian Barsarin Formation
conformably, and ranges in age from the base of the Tithonian up to just below the top of the
Berriasian. It is overlain by the Garagu Formation, which is latest Berriasian and Valanginian in
age. In some sections the Garagu Formation is conformable and the contact is gradational, but in
others, considerable erosion has removed the upper part of the Chia Gara Formation before
deposition of the Garagu Formation.

Ammonites were collected from the Chia Gara Formation in the 1930s and 1940s by the Iraq
Petroleum Company, especially in the later years by R. Wetzel. They were sent to Dr L. F. Spath
for determination and age assessment, and he submitted a number of reports to the Company
between 1949 and 1953. The first collection that Spath considered to be worth describing came from
a single bed 10 m thick near the base of the Chia Gara Formation on Chia Gara (also known as
Jebel Gara), south-west of Amadia. Together with some specimens from the same horizon at
Shiranish Islam, 53 km farther north-west (Text-fig. 1), this collection formed the bulk of the
material for his paper on the Tithonian ammonites of Kurdistan, in which five new genera and twelve
new species were described (Spath 1950). During preparation of his description of these ammonites,
Spath received many more specimens from higher horizons. He gave an account of the stratigraphy
and the identifications of these new ammonites in narrative form at the beginning of his main
description (Spath 1950, pp. 96–97), and said that he hoped to describe the higher Tithonian
ammonites and the many new Berriasian forms in a separate paper. However the only further
reference made to them was in a paper on Cretaceous ammonites from east Greenland, where he
summarized the succession of the Berriasian ammonites in Kurdistan (Spath 1952, p. 31). Though
not stated by Spath, it is now known that this succession occurs in the higher part of the same
section on Chia Gara, south-west of Amadia, from which came most of the Tithonian ammonites
he described earlier. In the same year, Spath received his final collection of ammonites from Kurdistan, from a new locality at Banik, 44 km north-west of Amadia (Text-fig. 1). Spath sent manuscript identifications and age determinations of the many new ammonites from Banik to the Iraq Petroleum Company early in 1953.

The name Chia Gara Formation was formally proposed in the Iraq volume of the *Lexique stratigraphique internationale* (Wetzel 1959). In naming the formation, Wetzel (1959, pp. 72–77) designated the section on Chia Gara, south-west of Amadia, as type section. The formation is 232 m thick there, and the ammonite identifications listed by Wetzel were taken from Spath’s determinations in his Company reports. The different series of bed numbers and letters that were used for the Chia Gara Formation in the papers published by Spath (1950, 1952, p. 31) and Wetzel (1959, pp. 72–73) are a potential source of confusion. Another different series is Wetzel’s original field bed numbers, which were used in his manuscript report on the Chia Gara succession. The equivalence of these series of bed numbers is shown in Text-figure 4. All the ammonites from the Chia Gara and adjacent formations on Chia Gara and at Banik, and several smaller collections, were presented to the Palaeontology Department of the British Museum (Natural History) between 1949 and 1963. They form a collection of about 600 specimens, originally with field specimen numbers, but with no other details. Several years later stratigraphical and locality details were obtained, and the whole collection was sorted and redetermined according to modern ammonite nomenclature. These new ammonite determinations are listed in the successions of Chia Gara and Banik given below, and vertical sections for the two localities and correlation between them is shown in Text-figure 4.

**AMMONITE ZONATION AND CORRELATIONS**

Ammonite zones and subzones, and correlation of the Tethyan Tithonian and Berriasian Stages are shown in Text-figure 2. The nearest developments of Berriasian rocks to northern Iraq are those in the Crimea, the Caucasus Mountains and the Mangyshlak Peninsula (on the eastern side of the Caspian Sea), and zonal schemes for those three areas are also given in Text-figure 2. The zonal position of the Chia Gara and Banik strata are shown by their bed numbers in the right hand columns. Many papers have been published in recent years on the zonation, the correlation and the taxonomy of the ammonites in the Tithonian and Berriasian, and several choices have to be made between conflicting views on the position of the base of the Cretaceous, the top and bottom boundaries of the Berriasian, and the correlation between Europe and South America. There is no Boreal element in the Iraq ammonites, so discussion is not necessary here of the major controversies concerning correlation between the Jurassic/Cretaceous boundary stages in the Tethyan and Boreal Provinces.

The boundary between the Jurassic and Cretaceous differs from many other system boundaries in having no natural, world-wide change or break in any of the fossil faunas. So the placing of that boundary can only be an arbitrary decision to be settled by mutual agreement. A colloquium to discuss these problems, held at Lyon and Neuchâtel in September 1973, was attended by leading workers in the subject. After lengthy discussion it was decided: (1) that the base of the Cretaceous should coincide with the base of the Berriasian Stage (recognized as a full stage, not a Substage); (2) that this should be at the base of the Jacobi/Grandis Zone (now = Euxinus Zone); and (3) that the base of the Valanginian Stage (and therefore the top of the Berriasian) should be at the base of the Pertransiens Zone (Flandrin 1975, p. 393). A stable zonal system should have resulted from these decisions, but unfortunately, in a major study on a large number of ammonites collected from known horizons in southern Spain, Hoedemaeker (1982, 1983) chose to place both top and bottom boundaries of the Berriasian at horizons other than those agreed at the colloquium. Jeletzky (1984, p. 177) was right to complain that the biochronological changes in the ammonites in the Mediterranean faunal province that are not present elsewhere in the world are not adequate justification for the boundary changes that Hoedemaeker proposed. In agreeing with this view, the base of the Cretaceous is placed at the base of the Jacobi/Grandis Zone (= Euxinus Zone) in
TEXT-FIG. 2. Zone and subzones of the Tithonian and Berriasian stages, correlation between the European and South American schemes, and correlation of the fossiliferous horizons in the Chia Gara Formation in Iraq.
Text-figure 2 in accordance with the 1973 decisions. This position is not affected by the change of the index species of this basal zone of the Berriasian to *Pseudosubplanites euxinus* (Retowski), a change that was first proposed by Wiedmann (1975a, p. 16, 1975b, p. 361). The zone was then used to embrace the subzones of *Berriasella jacobi* (lower) and *Pseudosubplanites grandis* (upper), as shown in Text-figure 2, by Hoedemaeker (1982, p. 66) and Zeiss (1983, p. 431). Jeletzky (1984, p. 178) concluded that Hoedemaeker's (1982) data from southern Spain showed that *Berriasella jacobi* first occurred with *Paraaulacosphinctes transitorius* in the Durangites Zone at the top of the Tithonian, before accompanying *Pseudosubplanites grandis* in the overlying beds. *Berriasellas jacobi* is not an entirely satisfactory index ammonite, therefore, and it is used merely to characterize a subzone lying the lower half of the Euxinus Zone. The top of the Berriasian is placed at the base of the Pertransiens Subzone.

The zones and subzones in the column for south-west Europe (i.e. south-east France and south-east Spain) are based on Le Hégarat (1973, Hoedemaeker 1982, p. 66, 1983, Jeletzky 1984, 1989, Wiedmann 1975b, p. 361) and Zeiss (1979, 1986). The Tithonian zones in this column are those originated by Enay and Geyssant (1975) in south-east Spain, while the somewhat different scheme of zones for south-east France used by Enay (1971, p. 99) has more in common with the Tithonian zones for southern Germany that are shown in the column for central Europe. The Berriasian zones and subzones in south-east Europe are those of Le Hégarat (1973, p. 294) for the type area in south-east France, differing only by Hoedemaeker's (1982, p. 50) substitution of *Zanovella alpilensis* as index species for the top subzone (to which it is nearly confined), instead of the much longer-ranging *Berriasella callista*. The central Europe column is based on the Berriasian zones and subzones in the Crimea according to the latest work of Druschits (1975, p. 341), Kvataliany and Lyssenko (1979a, 1979b), Bogdanova et al. (1981), and Bogdanova and Kvataliany (1983), as interpreted by Jeletzky (1984, p. 240). This area includes significant representatives of the more northern ammonites *Tauriococeras* (which is closely related to *Riusanites*) and *Euthymiceras*. The Tithonian part of this column uses the zones of the classic areas of southern Germany and Austria after Zeiss (1968, 1977, 1979, 1983, 1986) and Jeletzky (1984, 1989), which are also applicable to the Tithonian of the Crimea. In the column for the Caucasus Mountains, the Berriasian rocks differ only in detail from those of Crimea, and are based on Sakharov (1976), again with commentary by Jeletzky (1984, p. 239). The Tithonian zonal scheme of southern Germany is used for the Caucasus. The Mangyshlak Peninsula column is included for comparison with Iraq, and shows another development dominated (as in the Caucasus and Crimea) by *Euthymiceras* and *Riusanites* in the upper part of the Berriasian.

It is based on Luppov et al. (1975, 1979) and Jeletzky (1984, p. 238). The Tithonian and much of the lower part of the Berriasian is missing at Mangyshlak.

Correlation with South America presents many difficulties, due to the different views of Jeletzky and Zeiss. Two columns are included because of the major occurrences of *Groebhericeras* in Argentina and Iraq, and the date equivalence which is probably implied. The column after Jeletzky is based on the correlation table in his 1984 paper (Jeletzky 1984, pp. 177–187, fig. 5), while the column after Zeiss is based on discussion in the same paper (Zeiss in Jeletzky 1984, pp. 250–255) and on a later correlation table of Zeiss (1986). Both columns use the standard Argentinian zones of Leanza (1981a, 1981b), and both use correlation evidence from Boreal ammonites and species of *Buchia* traced through the Boreal Province between North America and Europe, together with a comparison of the calcipelid zonations (calcaceous nannoplankton) of those areas. The main difference between these centres on the rich South American assemblages of *Substeueroiceras*, because most of the other Berriasian and Upper Tithonian index ammonites are confined to the South American area. Jeletzky's placing of the *Substeueroiceras koeneni* Zone at the top of the Tithonian is more in keeping with the age of the few known occurrences of that genus in Europe (see p. 638), as well as the commoner, but poorly preserved, specimens from Iraq described here. Zeiss's correlation of the *S. koeneni* Zone with the whole of the lower half of the Berriasian is not in accordance with this distribution. On the other hand, the main occurrences of *Groebhericeras* are in the Paramimouma, Picteti and Alpillensis Subzones in Kurdistan and south-east Spain, and in the *Argentiniceras noduliferum* Zone in Argentina. If these two are to be correlated, Zeiss's placing of
the Noduliferum Zone high in the Berriasian is to be preferred to Jeletzky's placing of that zone as representing the whole of the lower half of the Berriasian, which is entirely below the occurrence of Groebericeras in Spain and Kurdistan. Further work is necessary on these correlation problems.

THE SECTION ON CHIA GARA

Wetzel measured the whole succession on Chia Gara from the top of the Qara Chauq Limestone, of Eocene–Miocene age, down to the Baluti Shale, of probable Rhaetian (Triassic) age, at the base. The contact with the overlying Miocene 'Fars formation' was not seen, and beds below the Baluti Shale were not exposed. The Garagu, Chia Gara, Sarki and Baluti Shale Formations were defined formally by Wetzel (1959) from four parts of this succession on Chia Gara (see Text-fig. 3), following proposals in his earlier unpublished reports on the Chia Gara section. One of the reports, dated 1 October 1948, gave the full succession, the bed numbers, the lithology and the field numbers of the specimens collected. The following summary of the succession is taken from that report:

Succession on Chia Gara, near Garagu, Gara and Baluti, about 10 km south-west of Amadia

(Text-figs 1, 3):

<table>
<thead>
<tr>
<th>Bed nos.</th>
<th>Succession</th>
</tr>
</thead>
<tbody>
<tr>
<td>8–64.</td>
<td>Sarki Formation. Limestone, shale, massive dolomites at top and base. Lower Jurassic.</td>
</tr>
</tbody>
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All the ammonites from the locality Chia Gara described here came from the type section of the Chia Gara Formation which is described in detail below. The bed numbers, the lithology and the thicknesses are from Wetzel's unpublished report. New determinations are given of all the ammonites (the figures in brackets are numbers of specimens). The determinations in square brackets are Spath's identifications of the same specimens, as listed in Spath (1950, 1952, pp. 30–32), Wetzel (1959, pp. 57–59, 72–77, 103–106, 211–215) and Spath's reports to the Iraq Petroleum Company; they include Spath's and Wetzel's comments on the age determinations of beds 85, 104 and 141. The Chia Gara Formation is twice as thick as Chia Gara as at Banik, and some of the ammonites are markedly different (Text-fig. 4). For this reason the ammonite faunas of the two sections are discussed separately.

Type section of the Chia Gara Formation and adjacent beds on Chia Gara, near Garagu and Gara

(Text-fig. 3):

<table>
<thead>
<tr>
<th>Bed nos.</th>
</tr>
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<tbody>
<tr>
<td>GARAGU FORMATION (lower part only)</td>
</tr>
</tbody>
</table>

BERRIASIAN

Zone of Fauniriella boissieri

Subzone of Tinosella alpilensis or Berriasella (Berriasella) picteti

142. Yellow crystalline limestone, thickly bedded. Groebericeras rocadii (Pomet) (1). [Groebericeras (?) sp. indet.].

141. Yellow, oolitic, ferruginous limestone.
TEXT-FIG. 3. Map of Wetzel's section on Chia Gara (formerly known as Gebel Gara or Jebel Gara), 10 km south-west of Amadia. The map was drawn from the descriptions in Wetzel's unpublished report of 1 October 1948, and the kilometre grid used by him is shown on the west and south sides, which give the scale of the map. Latitudes and longitudes were inserted on the map from quotations for several of the localities in the Iraq volume of the *Lexique stratigraphique internationale* (Wetzel 1959). There are small discrepancies between Wetzel's kilometre grid references and latitude–longitude references in the *Lexique*, so the localities were placed on the map according to the grid references, and the latitude–longitude scale was added on a best-fit basis. The latitude–longitude scale was obtained from the Cizre sheet of the 1:500,000 geological map of Turkey (Altinini 1963), which covers the south-eastern corner of Turkey, and extends southwards to the area described here.

All the ammonites described by Spath (1950) that were labelled 'Jebel Gara, Amadia', came from bed 91, located immediately north-east of bed 92 shown on the map.

**Bed nos.**

*Turnovella alpilensis* (Mazenot) (1) (Pl. 9, figs 3–4). *Subthaurmannia ('Neocomites') occitanica* (Pictet), 'Lower Valanginian; ammonite derived from the Chia Gara Formation'.

140. Yellow and brown marl, and thin limestone. *No ammonites.*

7.00

**CHIA GARA FORMATION** (total thickness 232.4 m)

139. Hard blue-grey limestone, marly in lower 4 m.

11.70

138. Grey marly limestone.

2.70

Subzone of *Berriasella* (*Mazenoticeras*) *paramouena*

137. Yellow marl with limestone concretions. Many ammonites, bivalves, gastropods, brachiopods and echinoids in the concretions. *Spiticeras* (S.) *spathi* sp. nov. (3) (Pl. 4, figs 1–2, 6–7); *Groebiceras rocardi* (Pomel) (6); *Berriasella* (*Malbosiceras*) *malboi* (Pictet) (7) (Pl. 7, figs 1–4, 7–8);
Bed nos.  

**Dalmasiceras** (Elaenella) prorsiradiatum (8) (Pl. 7, figs 5–6; Pl. 8, figs 1, 3–4 Pl 9, figs 1–2); **Euthymiceras kurdistanense** sp. nov. (1) (Pl. 8, figs 2, 5). [Groebelericeras spp. nov (5 species); Protactanoceras (7) sp. nov. (4 species); new himalaytid].  

136. Thin-bedded grey limestone alternating with yellow marl.  
Groebelericeras rocardi (2) (Pl. 6, figs 1, 3). [Groebelericeras sp. nov. (Craspedites-like)].  

135. Grey and yellow marl.  
134. Grey marly limestone.  
133. Yellow marl.  

127. Limestone. Many molluscs, brachiopods and traces of large ammonites.  

*123–126. Marly limestone in top 6.5 m, hard limestone in bottom 4.1 m.*  
122. Limestone, with marly bands.  
*Spiticeras or Groebelericeras sp. indet. (1).*  
121. Hard limestone. Bivalves.  
120. Marly limestone.  
119. Hard limestone. Oysters at top.  
118. Marly limestone. Oysters at top.  
117. Hard limestone, with marly bands.  
?Berriasella sp. indet. (2); ?Neocosmoceras sp. indet. (1). [?Parodontoceras sp. indet.; ?Berriasella sp.; Acanthodicus sp.].  

105–116. Alternating hard and marly limestones, with some marl and shale.  
Poorly preserved molluscs and occasional traces of ammonites.  

**Zone of Pseudosubplanites euxinus**  

104. Hard limestone with marly bands.  
*Berriasella (Berriasella) jacobi Mazenot (1) (Pl. 4, fig. 5); Berriasella sp. indet. (6). [Parodontoceras callisto (d'Orbigny); Berriasella aff. alpilensis Mazenot; Berriasella aff. carpathica (Pictet). 'Base of the Cretaceous'].*  

**TITHONIAN**  

?Zone of Durangites  

103. Hard limestone.  
102. Hard limestone, with marly bands. Ammonites in lower half.  
*Protactanoceras cf. perornatus* (Retowski) (1) (Pl. 7, fig. 9); indet. berriasellids (7). [Parodontoceras; Berriasella (including B. aff. privasensis); Protactanoceras].  
101. Hard limestone.  
100. Hard limestone, with marly bands.  
*Protanycloceras hondense* (Imlay) (3) (Pl. 2, figs 2, 4, 7); P. cf. kurdistanense Spath (6) (Pl. 2, fig. 1); ?Bianifordiceras sp. indet. (1); ?Berriasella aff. privasensis (d'Orbigny); ?Kossmatia sp.; ?Leptoceras sp.; ?Protactanoceras aff. carpathicus (Behrendsen); ?Parodontoceras spp.; Protactanoceras aff. perornatus (Retowski); Protanycloceras spp.].  

99. Hard limestone, alternating with marly limestone.  

96–98. Soft marly limestone.  
95. Yellow-brown bituminous shale.  
94. Hard limestone. Impressions of ammonites.  
93. Marly limestone with bands of shale. Impressions of ammonites.  

[Base of the section in the Gel-i-Garagu gorge].  

**Zone of Durangites** (lower part) or **Micracanthoceras microcanthus** (upper part)  

92. Dark blue limestone, highly bituminous. Many impressions of ammonites.  
*Substeueroiceras koeneni* (Steuer) (20) (Pl. 1, figs 9–10; Pl. 2, figs 3, 10); *Substeueroiceras sp. indet. (21); Berriasella sp. indet. (1); Protactanoceras cf. andreai* (Kilian) (2); *Haploceras sp. indet. (1). [Grayiceras ('Simbirskites') sp.;
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Bed nos.

Haploceras spp.; Parodontoceras cf. beneckei (Steuer); Spiticeras (Kilianiceras) cf. chomercasee Djanelidze; Substereoceras ?striolatum (Steuer); S. cf. ellipsoidostomum (Steuer); S. aff. lamellicostatum (Burckhardt).

Zones of Micracanthoceras microcanthum to Hybonoticeras hybonotum

91. Coarse, thin-bedded, detrital limestone, alternating with marly shale; many calcareous concretions ('phacoids'), up to 2 m diameter, at top and bottom; all highly bituminous. Abundant ammonites in the concretions, identified and described by Spath (1950): (a) from Microcanthum or ?Bavaricum Zone – Protanciloceras kurdistanense Spath (7); P. aff. gracile (Oppel) (3); Cochloceras tursculatum Spath (9) (Pl. 2, figs 5–6); Oxyloceras lepidum Spath (8); Glochiceras (?) sp. nov. (1); Glochiceras sp. indet. (6); Pseudolissoceras zitteli (Burckhardt) (11); P. advena Spath (5); Phanerocephalus subserenex Spath (34) (Pl. 1, figs 7–8); P. hudsoni Spath (2); P. intermedius Spath (4); P. dalmaisformis Spath (3); Nannostephanus subcornutum Spath (32) (Pl. 1, figs 3–4); Nothostephanus kurdistanensis Spath (42) (Pl. 1, figs 1–2); Proniceras garae Spath (4); Proniceras simile Spath (3); Lamelliptechus sp. indet. (1); (6) from Darwin Zone – Dorsoplanioides (D.) bavaricus Zeiss (1) (Text-fig. 5a–8); (c) from Hybonotum Zone – Hybonoticeras hybonotum (Oppel) (1) (Pl. 1, figs 5–6).

90. Blue-grey limestone, with marly bands.

BARBARIN FORMATION


NAOKELEKAN FORMATION

86. Limestone, alternating with shale. No ammonites.

85. Marly, dolomitic limestone.

Indeterminate perispinichtids (3). [Discosphinctes sp. indet.; ?Planites sp.; ?Nebroditia sp. Lower Kimmeridgian].

84. Obscured.

83. Coarse, detrital limestone, some shale bands; highly bituminous, weathers to large concretions ('phacoids'). The ‘Coal horizon’. Orthosphinctes desmoides (Wegele) (1) (Text-fig. 5a); indeterminate perispinichtid (1). Lower Kimmeridgian.

82. Thin-bedded, dolomitic limestone.

81. Hard dolomitic limestone.

Aulacostephanus cf. volgensis (Vischniakoff) (1) (Text-fig. 5c); indeterminate perispinichtid (2); indeterminate ammonite (1). Lower Kimmeridgian. Base of Naokelekian Formation.

Beds 81–89

Poorly preserved fragments of ammonites found in beds 81, 83 and 85 were identified by Spath with Kimmeridgian genera and species. These beds are in the Naokelekian Formation and Spath’s determinations were quoted by Wettel (1959, p. 213). The ammonite that Spath identified as Aulacostephanus aff. phorcas (Fontannes) was examined by Ziegler (1962, pp. 90, 151), and re-identified by him as A. cf. volgensis (Vischniakoff). It (Text-fig. 5c) is a poorly preserved ammonite, about 50 mm diameter, and it has the characteristic Aulacostephanus features of five bundles from umbilical tubercles and small ventral-lateral tubercles bordering a flat venter. It is more involute and has more ribs than the evolve and more coarsely ribbed and tuberculate species A. phorcas (holotype, Ziegler 1962, pl. 5, fig. 17). This single Aulacostephanus is the most south-easterly record of this Lower Kimmeridgian genus. Spath determined another ammonite from bed 81 as ‘Amoeboceras (Amoebites) sp. indet.’, but it is a very poorly preserved fragment that cannot be safely referred even to a family. The ammonite in bed 83, determined here as Orthosphinctes desmoides (Wegele), was identified by Spath as Ataxioceras inconditus (Fontannes) (quoted in Wettel 1959, p. 213). Revision of the Ataxioceratidae by Atrops (1982) shows that the lectotype of Orthosphinctes inconditus refigured by him (Atrops 1982, p. 104, pl. 10, figs 8–9) has coarser primaries and fewer secondaries than the
bed 83 ammonite (Text-fig. 5a). In its finer ribs and slightly more secondaries, the latter specimen resembles Orthospinctes desmoides (Wegel 1929, p. 64, pl. 6, figs 6–7) more closely. It is especially close to a specimen figured by Atrops (1982, p. 115, pl. 8, fig. 2) as his new species O. perayensis, which may be conspecific with O. desmoides. These specimens come from the Lower Kimmeridgian Platynota and Hypselocyclum Zones of southern France and Germany (Atrops 1982, p. 331). From these ammonites in beds 81 and 83 it seems that the whole of the Naokelekan Formation on Chia Gara is Kimmeridgian in age. The Oxfordian and Callovian ammonites found in the Naokelekan Formation at other localities, which were identified by Spath and listed by Wetzel (1959, p. 212), do not occur in the Chia Gara section. The Barsarin Formation did not yield ammonites anywhere, and is dated as Kimmeridgian by interpolation between the adjacent formations.

Bed 91

Spath (1950) recognized sixteen species in bed 91, including five new genera and twelve new species. In view of the poor quality of the original figures, new photographs are given here of the holotypes of the type species of four of Spath’s new genera—Nothostephanus kurdistanense (Pl. 1, figs 1–2), Phanerostephanus subconex (Pl. 1, figs 7–8), Nannostephanus subcornutus (Pl. 1, figs 3–4) and Cochlocarioceras turriculatum (Pl. 2, figs 5–6). A much better example of Spath’s fifth new genus, Oxytenticeras lepidum, is illustrated in Plate 3, figures 1–2. The ammonites were not subdivided stratigraphically when they were originally collected, and reference of all of them to a single horizon in the Tithonian is difficult because some are traditionally considered to be indicators of entirely different zones. Thus, Pseudoliosoceras zители characterizes the Lower Tithonian Fallauxi and Semiforme Zones (equivalent to the Bavarian Unit in central Europe), while species of Proniceras are not thought to be older than Upper Tithonian. Spath (1950) discussed these dating problems at length, but even so he chose to omit from consideration an example of Hybonoticeras hybonotum (Oppel) in bed 91, whose age implications were too extreme for him to adopt (Spath 1950, p. 96). It occurs with about 60 ammonites from Chia Gara, that included all the normal genera from bed 91—Phanerostephanus, Nothostephanus, Nannostephanus, Pseudoliosoceras, Proniceras, Oxytenticeras, Cochlocarioceras, and Protanycloceras—and there is no reason to exclude it when considering the dating of that bed. It (Pl. 1, figs 5–6) is well preserved in the same black, bituminous limestone as the other ammonites, and consists of septate whorls up to 26 mm diameter, followed by traces of half a whorl of body-chamber ending at about 35 mm diameter. It has weak radial ribs, small umbilical and large ventro-lateral tubercles, and a deep groove in the middle of the venter. It is not physically associated with any other ammonite in the same piece of rock, but as a typical Hybonoticeras hybonotum it shows that the Lower Tithonian Hybonotum Zone must be present in the lower part of bed 91.

Another ammonite that Spath did not consider properly is the specimen that he received after completion of the paper, and which he determined as ‘Virgatosoceras sp. nov. ind. almost certainly entirely new’ (Spath 1950, p. 125). It was also listed by Wetzel (1959, p. 73). Although only a fragment of a large body-chamber from an ammonite of approximately 130 mm diameter (Text-fig. 5a–b), it is solid and well preserved and is readily identifiable as Dorsoplanitoides (D. bavarius) Zeiss (1968, p. 94). With occasional ribs characteristically bifurcating low on the side of the whorl, it is virtually identical with the corresponding part of one of the larger specimens from the Rennertshofen Beds figured by Zeiss (1968, pl. 16, fig. 2). That species accompanies Franconites vininues (Schindl) in the upper part of the Darwini Zone in southern Germany, and the genus Dorsoplanitoides is confined to the Darwini Zone in that area. So the occurrence of D. (D.) bavarius on Jebel Gara must be taken as a definite record of the presence of the Darwini Zone in bed 91.

For the remainder of the bed 91 ammonites, Spath (1950, pp. 125, 131–134) referred several times to the physical association of some of the genera that he had recognized, and stated that as a consequence a single zonal age had to be given to the whole fauna. A survey of all the 216 ammonites in the collection confirms the reality of these associations. One of the most significant is the presence of a typical Nannostephanus subcornutus in the piece of rock that contains the holotype of Proniceras garaeense Spath (1950, pl. 10, fig. 1), and there are several associations of Nannostephanus, Cochlocarioceras and Pseudoliosoceras in the single pieces of rock. A full list of all the physical associations is as follows:

- Pseudoliosoceras sp. + Nannostephanus subcornutus
- Pseudoliosoceras zители + Cochlocarioceras turriculatum
- Nannostephanus sp. + Cochlocarioceras sp. + Pseudoliosoceras spp.
- Protanycloceras aft. gracile + Nannostephanus sp. + Cochlocarioceras sp.
- Proniceras garaeense + Nothostephanus sp.
- Proniceras garaeense + Nannostephanus subcornutus
- Nannostephanus sp. + Nothostephanus sp.
- Nothostephanus sp. + Haploceras sp.
TEXT-FIG. 4. Vertical sections of the Chia Gara Formation in the type section on Chia Gara, and at Banik. In the Chia Gara section all the different systems of bed numbers that have been used are compared: the column labelled A shows the series of letters used by Wetzel (1959, pp. 72-74) when he designated this as type section; B shows the series of letters a-x used by Spath (1950, pp. 96-97) for the Kimmeridgian and Tithonian, followed by the numbers 1-38 used by him (Spath 1952, p. 31) for the Berriasian (bed x = bed 1 of these series); C gives Wetzel's original field numbers that are used in this paper. Note that the Banik section is about half as thick as the Chia Gara section, and that different vertical thickness scales are used.
None of the ammonites in bed 91 shows any signs of derivation from other beds, and it has to be concluded that these species of Pseudolissoceras, Cochliloceras, Protancyloceras, Proniceras, Nothostephanus and Nannostephanus are all of the same date. The only genus missing from this list is Phanerostephanus, but there are so many transitions between it and Nothostephanus and Nannostephanus (many described by Spath) that Phanerostephanus must be added to the list of coeval genera. The conclusion that all these genera are of the same age because they are often associated in pieces of matrix, is supported by the contents of separate collections made by different collectors. Two such collections from Chia Gara, consisting of fifty-three and sixty-four specimens, each contain nine genera from bed 91, while a collection of thirty-six specimens from Shiranish Island lacks only Cochliloceras. Therefore, as emphasized by Spath, it is necessary to find a single zonal age for these ammonites (i.e. excluding the Hybonoticeras hybonotum and Dorosplanitoides bavaricum). The dating evidence from the various groups of ammonites is as follows:

1. Perisphinctidae. The three perisphinctid genera belong to the subfamily Virgotasphinctinae (a Tethyan subfamily of the family Ataxioceratidae, following the classification of Callomon (1981, p. 150)). In fact the holotypes of Nothostephanus and Phanerostephanus (Pl. 1, figs 2, 7) are not markedly different, and as they are microcochle and microconch respectively, they could be united under the generic name Nothostephanus, which has the better preserved holotype. They are probably a development respectively from Virgotasphinctes, showing progressive loss of ribs on the sides of the whorls at larger sizes, while developing prominent umbilical tubercles. Nannostephanus (Pl. 1, fig. 4) is based on small, more coarsely ribbed perisphinctids that develop ventro-lateral tubercles. The largest example is 25 mm diameter, by which size the tubercles have disappeared and more normal, branched perisphinctid ribs remain. Nannostephanus may well be another synonym of Nothostephanus. As probable developments from Virgotasphinctes, these perisphinctids could be any age in the Tithonian above the base. Since Spath's (1950) original description, Phanerostephanus has been found in Turkey and Madagascar. In Turkey, Enay et al. (1971, pp. 406, 419) found examples of Phanerostephanus associated with Hybonoticeras, Aspidoceras, Virgotasphinctes, Pseudinvoluticeras and Aulacosphinctes. The presence of Hybonoticeras led this fauna to be dated as approximately Darwinii Zone, low in the Tithonian, despite the presence of Aulacosphinctes, which is more likely to be Upper Tithonian. In Madagascar, Collignon (1960, pl. 159) figured three fine examples of Phanerostephanus from the Aulacosphinctes hollandii Zone, which represents the whole of the Upper Tithonian. Two of them (Collignon 1960, pl. 159, figs 632, 634) came from the same bed (glastment 238, Antsalova) as four species of Aulacosphinctes (including A. hollandii Ulhig; Collignon 1960, figs 707, 710, 733–734, 739), two species of Hemisimoceras (figs 637, 639), and Spitzceras (Kilianiceras) jacobi Collignon (fig. 662). This is an Upper Tithonian fauna, not older than the Micracanthium Zone, and is a definite identification of the age of Phanerostephanus in Madagascar (P. besairei Collignon is very similar to the Kurdistani species P. hudsoni Spath).

The alleged occurrence of Phanerostephanus in the Lower Tithonian, Hybonotum Zone, at Mombasa, Kenya, described by Verma and Westermann (1984, p. 50) is not acceptable. Their new species P. digoi (Verma and Westermann 1984, p. 53, pl. 9, fig. 1; pl. 10, figs 1–3) is more evolute and lacks the umbilical tubercles of Phanerostephanus, and together with their specimens of Procraspedites (Verma and Westermann 1984, p. 58, pl. 11, figs 1–2) and Gravessia loupektinei Verma and Westermann (1984, p. 59, pl. 11, fig. 3; pl. 12, figs 1–3) at the same horizon, belongs to a species that is probably endemic to East Africa, which would be better placed in the genus Sublithococeras. The ammonites from the Lower Tithonian of south-east France described by

EXPLANATION OF PLATE 1
Figs 1–2. *Nothostephanus kurdistanensis* Spath. BMNH C.40745; holotype; ?adult phragmocone and beginning of body-chamber (figured Spath 1950, pl. 7, fig. 1); from bed 91; Chia Gara, ×1.
Figs 3–4. *Nannostephanus subcornutus* Spath. BMNH C.41066; holotype (figured Spath 1950, pl. 10, fig. 7); from bed 91; Chia Gara, ×2.
Figs 5–6. *Hybonoticeras hybonotum* (Oppel). BMNH C.41290; wholly septate; from bed 91; Chia Gara, ×2.
Figs 7–8. *Phanerostephanus subsenex* spath. BMNH C.41166, holotype, an almost complete adult (?microconch) (figured Spath 1950, pl. 7, fig. 5); from bed 91; Chia Gara, ×1.

Note. On this and following plates the end of the phragmocone is marked by an x. Specimens that are wholly septate and portions of non-septate body-chambers are described as such in the plate explanations, and the absence of such an explanation indicates that the presence and extent of suture-lines cannot be determined.
Donze and Enay (1961, pp. 140–147) as their new species Phanerostephanus grandis (ex. Perisphinctes dacquel Schneid) and P. allobrogicus also lack umbilical tubercles and belong to Sublithococeras.

2. Proniceras. There are well-preserved specimens of two species of Proniceras in bed 91 (Spath 1950, pl. 10, figs 1–6). Proniceras is the oldest genus of the subfamily Spitzicerasinae, and of the family Olcostephanidae, and it appears at the bottom of the Upper Tithonian. The oldest species, P. simplex Djanželidzé (1922b, p. 55), was quickly followed by the more widespread P. pronum (Oppel) (Djanželidzé 1922b, p. 70). They occur in the Upper Tithonian from the base of the Microcanthus Zone, or its equivalents, according to the stratigraphical records of Djanželidzé (1922b, p. 51), Mazenot (1939, p. 25), Enay (1972, p. 375), Le Hégarat (1973, pp. 232, 274–290) and Enay and Geyssant (1975, pp. 42–49). The very similar genus Simospitziceras Oloriz and Tavera (1979a, p. 183) occurs at the base of the Upper Tithonian in south-east Spain, and the stratigraphical records of Oloriz and Tavera (1979b, pp. 502–503, fig. 3) show that the oldest Spitzicerasinae occur at the base of the Microcanthus Zone in that area.

3. Pseudolissoceras. Good dating evidence ought to be obtainable from the two species of Pseudolissoceras in bed 91. One of them, P. zitteli (Burckhardt), is the index of the Zitteli Zone in South America, and is morphologically very close to P. bavaricum Barthel (1962, p. 14), which is characteristic of the Bavarium Zone in southern Europe. However, in reviewing the dating of the Neuburg Formation in south Germany, Jeletzky (1989, pp. 155–158) doubted the usefulness of species of Pseudolissoceras as zone indicators in the Lower Tithonian. Jeletzky used evidence from two sources: first, the Kurdistan bed 91 fauna described here, which he said had to be 'Late Tithonian' because of the presence of Proniceras, and secondly, Memmi's (1967, pp. 258;
Memmi and Salaj 1975, pp. 61–64, tables 1–4) records of *Pseudolissoceras zitteli* in the Upper Tithonian at several localities in Tunisia. There can be no doubt about the Upper Tithonian age of the Tunisian strata, but the record relies on identifications of unfigured specimens. This is the only other record of *Pseudolissoceras* in the Upper Tithonian, and it must be viewed cautiously until verifiable specimens are figured.

4. Other genera. *Protanclycoceras* is not useful for dating bed 91: the genus also occurs in bed 100 on Chia Gara, and elsewhere it extends into the Berriasian. Lower occurrences go down at least as far as the Darwini Zone in the Lower Tithonian (Jeletzky 1989, p. 157, fig. 2; Enay and Geyssant 1975, p. 42, fig. 2). So the presence of the endemic species *P. kurdistanense* Spath, and specimens determined by Spath as *P. aff. gracile* (Oppel), do not help in dating the bed 91 ammonites. Similarly *Oxylenticeras* and *Cochlionioceras* are endemic Kurdistan genera. *Oxylenticeras* is a genus of the subfamily Strebitidae which ranges from Kimmeridgian to Hauterivian. *Cochlionioceras* is an allegedly helically-coiled genus of the Bochaniitidae, based on small, fragmentary material. The holotype (Pl. 2, figs 5–6) consists of two small fragments on the same piece of rock, said by Spath to be parts of the same specimen, but the fragments are well separated and their original continuity is doubtful. All the fragments are less than half a whorl long, and the only evidence for helical coiling is the oblique ribbing on the venter. The morphological basis and the systematic position of *Cochlionioceras* are unsatisfactory.

From the evidence outlined above, it seems that despite the work of the last forty years, it is still as difficult to date the bed 91 ammonites as it was when Spath discussed their age in 1950. There can be no doubt that both Hybonotum and Darwini Zones occur in the lower part of the 10 m thickness of that bed, but it still appears to be necessary to give a single date to the remaining ammonites because of their physical associations. The view can be taken that the presence of *Pronicerias* is crucial in determining that age as Microcanthus Zone, Upper Tithonian, following the records of Djanfelidzé (1922b), the opinions of Jeletzky (1989, p. 155), and Olorz and Taveras' (1979a, 1979b) investigations of the date of the earliest Spitzeriania in Spain. However, if the latter subfamily, and *Pronicerias* in particular, had its origin in Kimmeridgian Idoceratinae, then Spitzeriania should occur in the Lower Tithonian somewhere in the world. If this is in Kurdistan, then the date of the main part of the bed 91 ammonites could be Lower Tithonian, and Bavariaicum Zone would now be the best estimate of that date, from the presence of *Pseudolissoceras*, which is well dated elsewhere. It would clearly be advantageous if further collecting in bed 91 could find some stratigraphical separation between different groups of ammonites within its thickness of 10 m.

**Bed 92**

The ammonite fauna of this bed is dominated by crushed impressions of *Substeueroeras*. About half of them are identified here as *S. koeneni* (Steuer) (see below p. 56, Pl. 1, figs 9–10; Pl. 2, figs 3, 10), and the remainder are either *S. cf. koeneni* or *Substeueroeras* sp. indet. Spath identified them as three species of *Substeueroeras*, one species of the very similar genus *Paradoctioceras*, and *‘Grayiceras’ (‘Simbrakites’) sp.*. However, all have the characters of *S. koeneni* (Steuer) and its synonyms, as displayed by the broader interpretation of that species adopted by Verme and Westermann (1973, p. 240). Other specimens amongst the bed 92 ammonites are two examples of crushed inner whorls of *Protacanthoceras cf. andraei* (Kilian), and two poorly preserved specimens of *Haploceras* and *Berriasella*. There are no ammonites in the collection to which Spath would have given the determination *Spiterias* (Kilianiceras) *chomaracense* Djanfelidzé as quoted by Wetzl (1959, p. 73) from bed 92. This is a distinctive evolute and strongly tuberculate spiceratid, and the origin of Spath's identification is unknown. *Substeueroeras* occurs uncommonly in the Durangites Zone in south-east France and other localities in Europe, and commonly in the Koeneni Zone in South America. *Protacanthocids* occurs in the Upper Tithonian, and does not extend into the Berriasian. From these distributions and from the date of bed 100 above, bed 92 may be correlated with the middle of the Transitorius Zone in central Europe and the Caucasus Mountains. In terms of the succession in south-east France it is either low in the Durangites Zone or high in the Microcanthus Zone.

**Bed 100**

Nine specimens of *Protanclycoceras* were found in this bed. Six of them are parts of small whorls that have fine ribbing similar to that of *P. kurdistanense* in bed 91, but they have much more closely coiled whorls than the widely open spiral of *P. kurdistanense* (Spath 1950, pl. 9, fig. 5), as can be seen on the specimen figured in Plate 2, figure 1, and the ribbing is generally straighter than in Spath's species. For these reasons, and because of the indifferent preservation, they are identified as *Protanclycoceras cf. kurdistanense* Spath. The other three
specimens have similarly coiled whorls, but the rate of whorl expansion is smaller, the ribs are straight and more widely spaced, and they have small ventro-lateral tubercles. These, and two better preserved specimens from a nearby locality, are described below (p. 617, Pl. 2, figs 2, 4, 7) as Protanclyoceras hondense (Inlay), a species from the Viñales Limestone of Cuba, where it is of low Upper Tithonian age. There are parts of three large flattened ammonites in bed 100 that are probably Bianfordiniceras, and five other Berriasellids which were identified as Parodontoceras and ?Kosmatia by Spath, but they are very poorly preserved, and are not identifiable. The example of Protanclyoceras aff. perornatus (Retowski) included in the bed 100 fauna by Wetzel (1959, p. 73) comes in reality from bed 102. The presence of Protanclyoceras and ?Bianfordiniceras fits in with an Upper Tithonian date for bed 100, but neither genus allows the date to be determined more accurately.

Bed 102
Ammonites consist of only the flattened inner whorls of Protacanthodiscus cf. perornatus (Retowski) already mentioned, which is described on page 640, and seven unidentified berriasellids. The latter were identified by Spath as Parodontoceras and Protacanthodiscus, but they are very poor and fragmentary. The Protacanthodiscus is Upper Tithonian, and probably excludes the possibility that bed 102 could be Berriasian.

Bed 104
Of seven specimens of Berriasella collected, only one is specifically determinable. That is the complete microconch with a well-preserved lappet, described below (p. 631, Pl. 4, fig. 5) as B. (B.) jacobi Mazenot. It is an indicator of the Euxinus Zone and of the base of the Berriasian, which starts, therefore, at the base of bed 104 on Chia Gara. Spath reached the same conclusion by determining this specimen as the zone fossil Berriasella callisto (d'Orbigny), complete with mouth-border and lappet, marking the lowest Berriasian. But B. callisto is now interpreted as an ammonite in the Picteti and Alpilensis Subzones at the tope of the Berriasian by Le Hegarat (1973, p. 53) and Hoedemaeker (1982). The other two species of Berriasella in Spath's list were his identifications of the other six ammonites from this bed; they are very poorly preserved and are not specifically identifiable.

Beds 117, 122 and 132
All contain poorly preserved ammonites that are not definitely identifiable. Spath made determinations mainly at genus level, which can hardly be confirmed from the poor state of preservation. The specimen in bed 132 that he determined as Neocomites praenoeomansi Burckhardt (1912, p. 193, pl. 45, figs 16–18, 20–23) is a badly worn ammonite 27 mm diameter which could be a Neocomites or Berriasella. The presence of a ?Neocosmomoceras sp. indet. in bed 117, which is possibly similar to the inner whorls of N. flabelliforme figured by Le Hegarat (1973, p. 136, pl. 44, fig. 2), suggests that bed 117 is probably of Privasensis to Paramiminoua Subzones age. Bed 122 and 132 cannot be dated from the ammonites.

Beds 136 and 137
Bed 137 is the source of one of the four well-preserved ammonite faunas in Kurdistan (the others are Chia Gara bed 91 and Banik Beds 23 and 46–56). It contains six specimens of Groebericeras rocardi, but the genus and species first appears in the Chia Gara section as two examples in bed 136 (p. 626, Pl. 6, figs 1, 3). These are the only ammonites in bed 136 and enable it to be given the same date as bed 137. As mentioned elsewhere (p. 626) G. rocardi ranges from Paramiminoua to Alpilensis Subzones age in south-east Spain. Other ammonites in bed 137 are a new species of Dalmasiceras (Elenaella) (p. 636), which could be of Paramiminoua Subzone age, a new large species of Spiticeras (Spiticeras) (p. 623), which does not help in accurately dating, and seven examples of Berriasella (Malbosiceras) malboisi (p. 632). The latter occurs in the Dalmas, Paramiminoua and Picteti Subzones, but is commonest in the Paramiminoua Subzone. Finally, bed 137 yielded a single well-preserved ammonite that is made the holotype of a new species of Euthymiceras (p. 641) (Spath identified it as a 'new himalaylid'). That genus is characteristic of a Zone just above the middle of the Berriasian in the Crimea, the Caucasus Mountains and the Mangyshlak Peninsula, which is correlated with the Paramiminoua Subzone. The average of the age ranges of all these ammonites in bed 137 is Paramiminoua Subzone, which is the date that can be confidently given to that bed.
Beds 141 and 142

Single ammonites are known from both beds: *Tornovella alpilensis* occurs in bed 141 (p. 648), and the highest *Groebertceras radiati* in bed 142. *T. alpilensis* is the index ammonite for the Alpilensis Subzone, but it first occurs in the top part of the Picteti Subzone according to the stratigraphical records of Hoedemaeker (1982, pl. 4). The highest occurrences of *Groebertceras* are in the Alpilensis Subzone. Although Alpilensis Subzone is the most likely age for beds 141 and 142, it is possible that they are of top Picteti Subzone age.

In Kurdistan, the type sections of the Chia Gara and Garagou Formations are part of the same continuous sequence of beds 600 m north of Garagou (Text-fig. 3). In defining the Garagou Formation, Wetzel placed the base at the bottom of bed 140 for lithological reasons, and his Valanginian age for the whole of the formation was based on the age assessment of the Foraminifera that are present. Spath's identification of the single *Tornovella alpilensis* in bed 141 as 'Subthermannia ('Neocomites') occitanica (Pictet)', which he said was definitely of Berrisanian age, created difficulties for Wetzel (1959, pp. 75, 106), and he had to postulate that such an ammonite in Valanginian rocks must have been derived from a nearby, eroded source of the Berrisanian Chia Gara Formation. There are several misconceptions here: first, *Tornovella occitanica* occurs lower in the Berrisanian, mainly in the Privasensis Subzone, and differs from *T. alpilensis* in having reduced ribbing; secondly, the ammonite in question has a ferruginous, oolithic matrix like that of the Garagou Formation and unlike that of the Chia Gara Formation, and it shows no signs of derivation; and thirdly, the base of the Garagou Formation does not have to be Valanginian in age. In fact there are no ammonites in the present collection that enable the age of the higher parts of the Garagou Formation to be determined. That it is top Berrisanian in age at its base is clearly demonstrated by both the ammonites in beds 141 and 142.

THE SECTION AT BANIK

Wetzel measured the whole section from the 'Fars formation' to the bottom of the Jurassic that is exposed north of Banik village, 27.5 km east-north-east of Zakho (Text-fig. 1). In his unpublished report dated May 1952 he stated that the 'section runs for 3-5 km north-south from the Jurassic outcrops that are exposed in the wadi at 1 km north of Banik village, to the axis of the Fars syncline on the Batufa road.' The following summary is taken from that report:

<table>
<thead>
<tr>
<th>Bed nos.</th>
<th>Succession 1-5 km north of Banik:</th>
</tr>
</thead>
<tbody>
<tr>
<td>141-156.</td>
<td>Pila Spi Limestone Formation. Massive crystalline limestone; bed 145 (46.8 m thick) forms a massive cliff 64-110.8 m above the base. Eocene. 152.7</td>
</tr>
<tr>
<td>137-140.</td>
<td>Dohuk Formation. Conglomerates, sandstones, marls. Palaeocene, Eocene. 467.0</td>
</tr>
<tr>
<td>105-116.</td>
<td>Shiranish Formation. Marl, limestone. Maastrichtian. 258.3</td>
</tr>
<tr>
<td>86-104.</td>
<td>Bekhme Limestone Formation. Hard limestone; disconformity at base. Campanian. 83.3</td>
</tr>
<tr>
<td>77-85.</td>
<td>Qamchuqa Limestone Formation. Limestone. Disconformity at base.</td>
</tr>
<tr>
<td>76-77.</td>
<td>Barremian-Albian.</td>
</tr>
<tr>
<td>59-76.</td>
<td>Garagou Formation. Sandstone, marl, limestone. Valanginian. 19.8</td>
</tr>
<tr>
<td>16-59.</td>
<td>Chia Gara Formation. Limestone. Shale. Tithonian-Berrisanian. 126.6</td>
</tr>
<tr>
<td>5-8.</td>
<td>Naokelkan Formation. Limestone, shale. ?Oxfordian-Kimmeridgian. 10.7</td>
</tr>
<tr>
<td>2-4.</td>
<td>Sargelu Formation. Thin-bedded dolomite, shale. Bajocian-Bathonian. 94.0</td>
</tr>
<tr>
<td>1.</td>
<td>Sehkanjaniy Formation. Dolomite, limestone. Lower Jurassic (?Toarcian). 130.0</td>
</tr>
</tbody>
</table>

The following succession of the Chia Gara Formation and the underlying beds about 1 km north of Banik (see Text-figs 1, 4), gives the bed numbers, thicknesses and lithology from Wetzel's unpublished report. The figures in brackets after each ammonite determination are numbers of specimens.

<table>
<thead>
<tr>
<th>Bed nos.</th>
<th>CHIA GARA FORMATION (total thickness 126.6 m)</th>
</tr>
</thead>
<tbody>
<tr>
<td>58.</td>
<td>Grey marly limestone. 1.70</td>
</tr>
<tr>
<td>57.</td>
<td>Hard dolomitic limestone. Small oysters. 5.20</td>
</tr>
<tr>
<td>56.</td>
<td>Hard limestone. Small oysters. 4.30</td>
</tr>
</tbody>
</table>
Zone of Fauriella boissieri
Subzones of Tirnovella alpilensis, Berriasella (B.) picteti, or B. (Malbosiceras) paramimouna

56. Marly limestone, alternating with yellow marl. Many molluscs. *Thurmanniceras (Erdennella) isare* (Pomel) (1) (Pl. 12, figs 5, 7); *?Neocomites* sp. indet. (1).

Subzone of Berriasella (Malbosiceras) paramimouna

55. Grey concretionary limestone. Many molluscs. *Groebnericeras laevigatum* sp. nov. (1) (Pl. 6, figs 5–6); *?Thurmanniceras* sp. indet. (2).

54. Yellow marl. 1.70
53. Limestone. Bivalves and gastropods. 0.50
52. Shale; central 0·2 m bed of limestone with many oysters. 3.80
51. Marl. 1.40

49. Shale. 1.00
48. Yellow-brown limestone. Many ammonites, other molluscs and brachiopods. *Groebnericeras rocardi* (4) (Pl. 4, figs 3–4); *Dalmasiceras* (*Elenella*) *prorsiradiatum* sp. nov. (4).

[From scree of beds 48–56; *Spiticeras* (S.) *spitiense* (Blanford) (2) (Pl. 5, figs 1, 4); *Groebnericeras rocardi* (1) (Pl. 6, figs 2, 4); *Thurmanniceras (Erdennella)* sp. indet. (1); *Banikoceras* *involutum* gen. et sp. nov. (1) (Pl. 12, figs 1–4)].

47. Shale. 2.00

46. Hard limestone. Many molluscs. 0.50

*Groebnericeras rocardi* (2) (Pl. 5, figs 5–6).

24–45. Alternating blue–grey limestones, marls and yellow-brown shales. Many molluscs (especially oysters) and brachiopods, but no ammonites. 53.90

TITHONIAN

Zone of Durangites

23. Thin-bedded marly limestone; bituminous. Many molluscs. *Oxylenticeras lepidum* Spath (1) (Pl. 2, figs 11–12); *Proniceras* cf. *jimulense* Imlay (3) (Pl. 5, figs 2–3); *Berriasella* (Malbosiceras) *chaperi* (Piceti) (1) (Pl. 9, figs 6–7); B. (M.) *cf. aspers* Mazenot (3) (Pl. 9, figs 5, 8); *Berriasella* sp. indet. (12);

*Chiragoceras* *bankense* gen. et sp. nov. (5) (Pl. 10, figs 1–3, 6); Pl. 12, figs 6, 8; C. *wetzei* sp. nov. (18) (Pl. 10, figs 4–5; Pl. 11, figs 1, 3–5); *C. planum* sp. nov. (2) (Pl. 11, figs 2, 6).

47. Shale. 4.50

22. Black, marly, bituminous limestone. *Protanychiceras* sp. indet. (5); *?Neocomoceras* sp. indet. (2); indeterminate Berriasellids (8).

20. Black shale. 5.60

Zone of Microcanthoceras microcanthum


18. Dolomite, with thin beds of shale, and small ‘phacoid’ concretions. From 2 m below top: *Protanychiceras* sp. indet. (1); *Phanerostephanus* *subsenex* Spath (2).

17. Alternating beds of dolomite and shale; large ‘phacoid’ concretions of bituminous dolomites up to 0·5 m thick in lower part. From near the base: *Protanychiceras* sp. indet. (1); *Cochlococioceras* sp. indet. (1); *Oxylenticeras lepidum* Spath (10) (Pl. 2, figs 8–9; Pl. 3, figs 1–2); *Notostephanus* sp. indet. (2); *Lamelliptychus* (1).

16. Shale, with dolomite ‘phacoid’ concretions; all highly bituminous; abundant small ammonites. 6.00
HOWARTH: TITHONIAN-BERRIASSIAN AMMONITES

Bed nos. m

_Pseudolissoceras advena_ Spath (1); _Oxylenticeras lepidum_ (3); _Phanerostephanus subrenex_ (1); _Lamellaptychus_ (1)

[From scree of beds 16–18: _Pseudolissoceras advena_ (1); _Oxylenticeras lepidum_ (2); _Virgatosphinctes_ sp. indet. (1); _Phanerostephanus_ sp. indet. (3); _Nannostephanus_ sp. indet. (4); _Protanycloceras_ sp. indet. (1)].

**BARSARIN FORMATION**


**NAOKELEKAN FORMATION**

47.30

8. Limestone.

7. Shale.

6. Dolomite.

5. Limestone, highly bituminous: the ‘Coal horizon’

**Indeterminate perisphechinaeids (2); Kimmeridgian or Oxfordian.**

**Beds 16–19**

The fauna of ammonites that occurs in the 10 m of bed 91 on Chia Gara is spread through the greater thickness of 301 m of beds 16–19 at Banik. With a few exceptions the ammonites are crushed and poorly preserved compared with those of Chia Gara, but they yield some further information on the association of different genera. _Oxylenticeras lepidum_ occurs in bed 16 and the base of bed 17 in the lower half of this group of beds, where it accompanies _Nothostephanus_, _Cochlocricoceras_ and _Protanycloceras_ in bed 17, and _Phanerostephanus_ and _Pseudolissoceras advena_ in bed 16. This shows that _Oxylenticeras_ occurs with, and is the same age as, the other genera, an association which cannot be proved on Chia Gara. By far the best of the ammonites in these beds at Banik are the two superb examples of _O. lepidum_ Spath from the base of bed 17 that are figured in Plate 2, figures 8–9 and Plate 3, figures 1–2, and they enable Spath’s genus to be described properly for the first time (see p. 618). The only other well-preserved ammonite in these beds is an uncrushed example of _P. advena_ from the scree of beds 16–18, which is similar to the holotype (Spath 1950, pl. 6, fig. 9) from Chia Gara bed 91. _Phanerostephanus_ occurs in beds 16, 18 and 19, and _Nothostephanus_ in beds 17 and 19, which demonstrates that the Kurdistan perisphechinaeids range throughout the full thickness at Banik. _Nannostephanus_ was obtained from the scree of beds 16–18. Evolute species of _Proniceras_ like those in Chia Gara bed 91, have not been found in these Banik beds. Nevertheless, a clear correlation has to be made between Banik beds 16–19 and Chia Gara bed 91 because of the large number of ammonites in common, so the date of Banik beds 16–19 is the same as that Chia Gara bed 91, i.e. the lower part of the Microcanthus Zone, Upper Tithonian, or possibly the Bavaricum Zone, Lower Tithonian.

**Bed 21**

All the ammonites are fragmentary and poorly preserved. The presence of five specimens of _Protanycloceras_, and two small tuberculate ammonites that could be _Neocosmosceras_, suggests that the age is Upper Tithonian rather than Berriasian. No age information can be deduced from the eight indeterminate _Berriasellidae_ in the bed. Bed 21 is probably similar in age to bed 100 on Chia Gara, i.e. Upper Tithonian, Durangites Zone or upper Microcanthus Zone.

**Bed 23**

The well-preserved ammonite fauna of bed 23 is dominated by the new genus of _Berriasellidae_ described below as _Chigaroceras_ (p. 641). There are twenty-five examples of this strongly ribbed, tuberculate genus, distributed amongst three new species. The alternative course of allocating them all to a single species and uniting such markedly different specimens in as Plate 10, figures 1–2, and Plate 11, figures 2, 6, is not adopted here because continuous variation between these end morphologies cannot be proved in the present collection. It is not possible to put an accurate date to _Chigaroceras_ if the genus is considered in isolation, but fortunately several accompanying ammonites allow a good age determination to be made. Foremost amongst these are four specimens of _Berriasella_ (Malabsoceras); one of them is _B. (M.) chaperi_ (Pictet) (p. 634, Pl. 9, figs 6–7), while the other three are less complete examples of _B. (M.) asper_ Mazenot (p. 635, Pl. 9, figs 5, 8). Both species occur only in the top of the Upper Tithonian, in the Durangites Zone or its equivalent. There are also 12 fragments of _berriasellidae_ that are not generically determinable. Three crushed specimens of _Proniceras_ occur in bed 23:
these are not small evolute forms like those described by Spath from Chia Gara bed 91, but are larger, more involute, compressed, and less strongly ornamented, and they are identified as *P. cf. jimulense* Imlay (Pl. 5, figs 2–3). They indicate an Upper Tithonian date. Finally, a single small, well-preserved example of *Oxylenticeras lepidum* was found in bed 23 (Pl. 2, figs 11–12). It is exactly like some of the smaller specimens in beds 16 and 17 at Banik, and although *Oxylenticeras* has not been found outside Kurdistan and is not datable independently, it supports the conclusion from the other ammonites that bed 23 is not greatly different in age from beds 16–18. All the evidence points to the date of bed 23 being Durangites Zone, Upper Tithonian, or its equivalent. This is the top division of the Tithonian, and it is the age of the new genus *Chigaroceras*. None of the ammonites in bed 23 gives any indication of a Berriasian age.

**Beds 46–56**

After an interval of nearly 54 m of beds 24–45 in which no ammonites were found, well-preserved ammonites return in beds 46–56. Although only small numbers were collected, the dominant genus is *Groeblicheria*; two *G. rocardi* were found in bed 46, four in bed 48, one in bed 50 and one came from the screens of beds 48–56. Slightly higher up a single large *Groeblicheria* from bed 55 is made the type of a new large species, *G. iwanigaturn*, which has smooth whorls of near-circular whorl section (p. 630, Pl. 6, figs 5–6). Four examples of *Dalmaticeras (Elenaella) prosriradiatum* sp. nov. (p. 636) were found in bed 48. There is a clear correlation between Banik beds 46–56 and Chia Gara beds 136–142 which also contain the same species of *Dalmaticeras* and *Groeblicheria*. The Chia Gara beds are mainly of Paramimouma Subzone age, but there is some evidence for Alpillensis or Picteti Subzones in the Upper part. The only evidence for such higher subzones at Banik is in the poorly preserved ammonite identified as *Neoconites* sp. indet. in bed 56, which might be from the Alpillensis Subzone, and the single example of *Thurmanniceras (Erdelenella) issari* also in bed 56 (Pl. 12, figs 5, 7), which is of Paramimouma or Picteti Subzone age. The other ammonites at Banik are from the Paramimouma Subzone or are less definitely datable. There are two poorly preserved *Thurmanniceras* sp. indet. in bed 55. One of them is a very large, 260 mm diameter, wholly septate specimen with massive whorls on which little ornament can be seen due to the rough preservation. Other ammonites obtained loose from screens of beds 48–56 include a large fragment of *Thurmanniceras (Erdelenella)* sp. indet., two examples of *Spiticeras spitienese* (Blanford) (Pl. 5, figs 1, 4), and finally, the superb ammonite figured in Plate 12, figures 1–4, which is so different in morphology from anything described before that it has been given the new name *Banikoceras involutum* gen. et sp. nov.

**CORRELATION AND CONCLUSIONS**

The zonal positions of those beds on Chia Gara and at Banik that contain datable ammonites are shown in the right-hand columns to Text-figure 2. Vertical sections of the Tithonian and Berriasian rocks on Chia Gara and Banik and a more detailed correlation between them are given in Text-figure 4. The most important features of the ammonites at these localities are:

1. The oldest well-preserved ammonites are those in Chia Gara bed 91 and Banik beds 16–19. Apart from single specimens of *Hybonoticeras hybonotum* and *Dorsoplanitoides (D.) bavaricus* in bed 91 which indicate that the Hybonotum and Darwini Zones occur low in that bed, the main genera are of basal Upper Tithonian, Microcanthus Zone, or Lower Tithonian, Bavricum Zone age. They are *Pseudolissoceras* and the endemic Kurdistan genera *Nothostephanus* (including *Phanerostephanus* and *Namnostephanus*), *Oxylenticeras* and the poorly known *Cochlocriceras*. *Oxylenticeras* extends to the top of the Tithonian in Banik bed 23, but the other Kurdistan genera are confined to lower horizons.

2. Less well-preserved ammonites in Chia Gara bed 92 include many examples of *Substeuroceras*, which is the most abundant occurrence of the genus outside the Americas. *Protyxoceratites*, including the Cuban genus *P. hondense* Imlay, occurs in Chia Gara bed 100 and Banik beds 18 and 21.

3. Well-preserved ammonites in Banik bed 23 include many examples of the new Berriasellid genus *Chigaroceras*, and several accompanying ammonites that enable the bed to be dated as Durangites Zone. This is the top of the Tithonian and none of these ammonites was found in the Chia Gara section.
4. On Chia Gara, a single *Berriasella (Berriasella) jacobi* in bed 104 almost certainly indicates the Euxinus Zone, and allows the base of the Berriasian to be placed at the bottom of that bed. The base of the Cretaceous cannot be identified at Banik, but it must be closely above the top of bed 23.

5. After an interval on Chia Gara in which there are only a few poorly preserved ammonites, and an unfossiliferous interval at Banik, well-preserved ammonites re-appear in Chia Gara beds 136–142 and Banik beds 46–56. *Groebeliceras rocardi* occurs at both localities and the new species *G. laevigatum* was found at Banik; this is the largest collection of the genus outside Argentina. Other ammonites allow a Paramimouma Subzone date to be given to most of these beds. They include a fine example of a new species of *Euthymiceras* and new species of *Spiticeras* and *Dalmasiceras (Elenaelea)* on Chia Gara, and the enigmatical new genus *Banikoceras* at Banik. Higher up, there is some evidence for subzones up to the Alpillensis Subzone at both localities, but the top of the Berriasian is probably within the overlying Garagu Formation.

It is remarkable that the new genus *Chigarcoceras* is so well developed at Banik, yet was not found on Chia Gara. This genus, together with the new species of *Euthymiceras* and *Banikoceras*, each known only from single examples, the good collections of *Groebeliceras*, and the endemic Tithonian ammonites at both localities, must make the Chia Gara Formation of northern Iraq one of the best areas of the world for further exploration and potential discoveries on the systematics and biostratigraphy of Tithonian and Berriasian ammonites. It is hoped that the locality details shown in Text-figure 3 will allow this important area to be investigated further at a future date.

**SYSTEMATIC PALAEONTOLOGY**

Ammonite whorl measurements are given in the order: diameter (D), whorl height (Wh), whorl breadth (Wb), umbilical width (U); figures in brackets are proportions of the diameter.

- **Superfamily ANCYLOCERATAEAE Gill, 1871**
  - **Family BOCHIANITIDAE Spath, 1922**
  - **Subfamily PROTANCYLOCERATINAE Breistroffer, 1947**
  - **Genus PROTANCYLOCERAS Spath, 1924**

*Type species.* *Ammonites guembeli* Oppel, 1868, by original designation.

*Protancyloceras hondense* (Imlay, 1942)

Plate 2, figs 2, 4, 7

1942 *Leptoceras? hondense* Imlay, p. 1456, pl. 10, figs 5-9, 11–12.

*Material.* Three specimens, BMNH C.86794–86796, from bed 100, Chia Gara; two specimens, BMNH C.87067–87068, labelled Zeiwa, are from the same locality and horizon.
Type species. *O. lepidum* Spath, 1950, by original designation.

*Oxylenticeras lepidum* Spath, 1950

1950 *Oxylenticeras lepidum* Spath, p. 99, pl. 6, figs 1–5.

**Holotype.** BM C.41118, from bed 91, Chia Gara, figured by Spath (1950, pl. 6, fig. 1).

**Material.** Thirty-five specimens: BMNH C.86858–86860 from bed 16, BMNH C.86861–86870 from the base of bed 17, BMNH C.86871–86872 from beds 16–18, and BMNH C.86929 from bed 23, at Banik; BMNH C.87045–87063 from a locality on Jebel Gara.

Description. Attains at least 170 mm diameter. Oxycone whorl shape: umbilicus small, becoming closed at larger sizes; very acute, lanceolate, knife-edge venter. Whorl section compressed, whorl sides rounded, whorl breadth greatest on the dorsal half of the whorl. Ornament consists of sigmoidal growth-line striae; at sizes of more than 30 mm diameter the striae curve strongly backwards on approaching the keel; at all sizes the striae are grouped into very low undulations or ribs, especially on the outer half of the whorl. Surface-line highly complex, and has strongly indented and undercut saddles.

**Measurements.**

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Remarks. This monospecific genus is unique to the Tithonian of northern Iraq. Spath (1950, p. 99) based his description on nine specimens from bed 91 of the Chia Gara Formation on Chia Gara, and nine more from the same horizon at Shranish Islam, 14 km north-east of Zakho. All are small and poorly preserved; they consist of solid phragmocoanes and any part of the body-chamber that is preserved is crushed flat. The holotype is much the largest phragmcone amongst them and attains 58 mm diameter. Its shell surface was damaged so much by Spath in his (unsuccessful) attempt to obtain a suture-line, that no surface features of the shell remain. Little can be seen on Spath’s original figures, and even less on the reproduction of the figure of the holotype in the Treatise (Arkell 1957, p. L283, fig. 336–3). It is fortunate, therefore, that knowledge of the genus can be rescued with the much better material amongst the sixteen new specimens from Banik, and the nineteen new specimens from a locality on Chia Gara. In fact it has been possible to obtain details of most of a suture-line (Text-fig. 6b) from one of the latter specimens. It proves to be highly

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**EXPLANATION OF PLATE 2**

Fig. 1. *Protancylloceras cf. kurdistanense* Spath. BMNH C.86798; from bed 100; Chia Gara, ×1.

Figs 2, 4, 7. *Protancylloceras hondense* (Imlay). 2, BMNH C.86795. 4, BMNH C.87068. 7, BMNH C.87067. All from bed 100; Chia Gara, ×1.

Figs 3, 10. *Substeueroceras knoeneni* (Steuer). 3, C.86773. 10, BMNH C.86749; part of a large venter. Both from bed 92; Chia Gara, ×1.

Figs 5–6. *Cochlloceras turricatatum* Spath. BMNH C.41157 (figured Spath 1950, pl. 8, fig. 8); from bed 91; Chia Gara, ×1.

Figs 8–9, 11–12. *Oxylenticeras lepidum* Spath. 8–9, BMNH C.86866; wholly septate; from the base of bed 17; Banik, ×1. 11–12, BMNH C.86929; wholly septate; from bed 23; Banik, ×1-5.
HOWARTH, Upper Tithonian ammonites
complex and indented, and confirms Spath’s (1950, p. 99) belief that *Oxylenticeras* should be referred to the subfamily Strebloplaninae, and that it is not an extreme oxycone development of the Garniericeratinae, which would have simplified suture-lines. The material from the base of bed 17 also includes the two ammonites figured in Plate 2, figures 8–9 and Plate 3, figures 1–2. The larger of these (C.86861) is a superbly preserved specimen, having an uncrushed phragmocone ending at 101 mm diameter, followed by portions of the shell of the crushed body-chamber which suggest that the latter was half a whorl in length when complete. The diameter at the final mouth-border would have been about 170 mm, and the umbilicus appears to have been closed at these larger sizes. The growth lines are clearly apparent on the intact surface of the shell. They are gently sigmoidal in shape on most of the side of the whorl, but at these large sizes they curve strongly backwards on approaching the knife-edge venter. The second figured specimen (C.86866) is an uncrushed phragmocone ending at 67 mm diameter. Both specimens have low undulations on the outer half of the whorl. All the other specimens are smaller, most being phragmocones of less than 30 mm diameter without body-chambers; at these sizes the umbilicus is up to 10–11 per cent of the diameter, and the vague ribbing is radial in direction on the outer half of the whorl. One such specimen (Pl. 2, figs 11–12) with an umbilical width of 11 per cent is the single example found in bed 23 at Banik, and is important for the dating of that bed. It has slightly thicker whorls than most specimens from Banik beds 16–18 and Chia Gara bed 91, but the range of variation does include similar specimens, such as the Shiranish Islam example figured by Spath (1950, p. 99, pl. 6, fig. 5) which he called ‘a more inflated variety’.

Family *Olcostephanidae* Pavlov, 1892
Subfamily *Spiticeraeinae* Spath, 1924
Genus *Spiticeras* Uhlig, 1903
Subgenus *Spiticeras* Uhlig, 1903

*Type species.* *Ammonites spitiensis* Blanford, 1863.

*Spiticeras* (*Spiticeras*) *spitiense* (Blanford, 1863)
Plate 5, figs 1, 4

1863 *Ammonites spitiensis* Blanford, p. 131, pl. 2, fig. 4.
1903 *Holocostephanus* (*Spiticeras*) *spitiense* (Blanford); Uhlig, p. 89, pl. 8, figs 1–3.
?1922b *Spiticeras* cf. *spitiense* (Blanford); Djanelidé, p. 130, pl. 11, figs 1–2.


*Description.* The smaller specimen, C. 86952 (Pl. 5, figs 1, 4), consists of septate whorls of 90 mm diameter; the whorl sides converge to a broadly rounded venter, and three or four gently curved ribs issue from each of the radially elongated umbilical tubercles; there are about four constrictions per whorl, similar in shape to the ribs. C.86951 is a larger, but less well-preserved, specimen, which is also wholly septate up to its maximum size of 140 mm diameter; it has more rounded whorls, which become more compressed near the aperture, where the umbilical tubercles are larger and more widely spaced.

*Remarks.* Blanford’s holotype was from Spiti and was refigured by Uhlig (1903, pl. 8, fig. 3). Both

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**EXPLANATION OF PLATE 3**

Figs 1–2. *Oxylenticeras lepidum* Spath. BMNH C.86861; (?adult) phragmocone with parts of the body-chamber attached; from the base of bed 17; Banik.
All × 1.
HOWARTH, *Oxylenticeras, Spiticeras*
Kurdistan specimens are similar to a larger Spiti example that was also figured by Uhlig (1903, pl. 8, fig. 1). The specimens from south-east France figured by Djanéldzé (1922b) were said to differ only in having 4–6 ribs per umbilical tubercle instead of 4 as in the Spiti examples. The zonal age of this species within the Berriasian has not been ascertained elsewhere, but in Kurdistan it occurs in the Boissieri Zone, Upper Berriasian.

Spiticeras (Spiticeras) bulliforme (Uhlig, 1903).

Plate 3, figs 3–4

1903 Holostephanus (Spiticeras) bulliformis Uhlig, p. 114, pl. 13, fig. 2.
1922b Spiticeras bulliforme (Uhlig); Djanéldzé, p. 127, pl. 14, figs 2–3.

Material. One specimen, BMNH C.40741, from Chia Gara.

Description. The single example is 110 mm diameter and is wholly septate. The whorls are moderately evolute and depressed; the whorl section is evenly rounded, including the umbilical walls, the umbilical edge and the broad venter, and the greatest whorl breadth is at the position of the prominent lateral tubercles. Small umbilical tubercles low on the rounded umbilical slope are connected by thin ribs to larger lateral tubercles. Ribs issue from the lateral tubercles in bundles of 3 or 4, there are also a few intercalated ribs, and all of them pass radially over the venter without interruption. There are 17 lateral tubercles on the last whorl at 103 mm
HOWARTH: TITHONIAN-BERRIASIAN AMMONITES

623
diameter, and on that whorl 10 of the lateral tubercles correspond to 47 ribs over the venter. Whorl dimensions:
at 100 mm diameter: 38·2, 51·4, 37·6; at 80 mm diameter: 28·0 (0·35), 43·0 (0·54), 31·6 (0·40).

Remarks. Spiticeras bulliforme has much more depressed whorls than any other species of Spiticeras. In
the Kurdistian specimen the whorl breadth greatly exceeds the whorl height at all sizes up to
100 mm diameter: the whorl height/breadth ratio is 0·74 at 100 mm diameter, and 0·65 at 80 mm
diameter. It is a close match for Uhlig’s (1903, pl. 13, fig. 2) holotype, which is comparable in size.
The only difference between them is the single curved constriction on the outer whorl of the Spiti
specimen. Djanéldzé (1922b, p. 127) described three specimens from the Berriasian of south-east
France, of which the largest was 49 mm diameter and they all have similarly depressed whorl
sections; his two figured specimens also have oblique constrictions on their outer whorls. The
horizon within the Berriasian is not known for the French or Spiti specimens, so it is unfortunate
that the Kurdistian ammonite is one of the few well-preserved ammonites from the Chia Gara area
for which no stratigraphical horizon was recorded.

Spiticeras (Spiticeras) spathi sp. nov.

Plate 4, figs 1–2, 6, 7; Text-fig. 6A

Holotype. BMNH C.86848, from bed 137, Chia Gara.

Paratypes. Two specimens, BMNH C.86846-86847, from the same horizon and locality.

Description. All three specimens are wholly septate; the holotype would have been at least 185 mm diameter
at the end of the phragmocone, and C.86846 and C.86847 are 150 mm and 88 mm diameter respectively at their
apertures. The whorls are massive and relatively involute; the whorl section is nearly triangular, with the
greatest whorl breadth near the umbilical edge, and the near-flat whorl sides converge to a narrowly rounded
venter. There are 12–15 large umbilical tubercles per whorl at 80–140 mm diameter. Radial ribs arise in bundles
of 3 or 4 from the umbilical tubercles, and curve only slightly forwards on the side of the whorl; ribs cross the
venter diminished in strength, but without a mid-ventral interruption. The suture-line (Text-fig. 6A) is well
indentated and has bifid first and second lateral saddles and a trifid lateral lobe.

Measurements.

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Remarks. Distinctive features of this new species are the high degree of involution, the massive
whorls and the triangular whorl section. The holotype would have been at least 250 mm diameter
when complete, and it is more involute than any other species of Spiticeras that reaches such a large
size. The closest species in morphology is S. mosvari (Uhlig 1903, p. 110, pl 17, fig. 1) from the
Lochamhier Limestone, Nepal, which reaches 154 mm diameter, at which size the umbilical width is
41 per cent of the diameter compared with 32 per cent in S. spathi at the same size. The umbilical
tubercles and radial ribs remain undiminished at least to the end of the phragmocone in S. spathi,
and the semi-triangular whorl section is more marked in earlier growth stages than is usual in
Spiticeras.

Genus Proniceras Burckhardt, 1919

Type species. Ammonites promus Oppel, in Zittel 1868, subsequently designated by Roman 1938.

Proniceras cf. jimulcense Imlay, 1939

Plate 5, figs 2–3

1939 Proniceras jimulcense Imlay, p. 55, pl. 18, figs 1–3.

Material. Three specimens, BMNH C.86895–86897, from bed 23, Banik.
Remarks. These three crushed specimens have whorl heights of 40–50 mm diameter and are parts of ammonites of about 100 mm diameter. One of them (C.86897) is still septate at 90 mm diameter. The whorls are relatively involute, though it is difficult to judge whorl proportions accurately in flattened specimens. Reduced ribs in the inner half of the whorl become much stronger, curved, prorsiradiate and may bifurcate on the outer half of the whorl. There are 4–6 deep constrictions per whorl similar in shape to the ribs, but usually more prorsiradiate than those ribs immediately behind. Low tubercles occur at the umbilical edge.

These ammonites are larger, more involute and higher-whorled than the Proniceras in Chia Gara bed 91 described by Spath (1950, p. 117, pl. 10, figs 1–6). The Upper Tithonian specimen from Chomérac (Ardèche), south-east France figured as P. multicosatum (Djanélidzé 1922b, p. 63, pl. 1, fig. 11) is nearly as involute, but it has straighter, denser ribs, and all the Berriasian species of Spicieras that are similarly involute (e.g. S. multiforme Djanélidzé 1922b, p. 143) have much stronger umbilical tubercles. The closest resemblance is with P. jimulense Imlay (1939, pl. 55, figs 1–3) which comes from the Substeuero keras koeneni Zone at the top of the Upper Tithonian in central Mexico. Imlay's holotype has compressed, high whorls like the Banik specimens, but it is somewhat less involute.

**Genus Groebericeras** Leanza, 1945

*Type species.* *G. bifrons* Leanza 1945, p. 82, by original designation [= Ammonites rocardi Pomel, 1889].

*Diagnosis.* Moderately involute, becoming more involute at larger sizes, with compressed to rounded whorls, and a whorl section broadest near the umbilical edge, tapering to a narrow rounded venter. Ribs are single with intercalated secondaries, fading first on the inner half of the whorl, often fading completely at larger sizes. Occasional narrow constrictions occur similar in shape to the ribs. Small umbilical, lateral and ventral-edge tubercles may be present on inner whorls up to 15 mm diameter, but all tubercles disappear by 25 mm diameter.

Remarks. Groebericeras is essentially a smooth Spicieras. Any tubercles that are present on small inner whorls quickly disappear, and the ribbing progressively weakens at sizes greater than 50 mm diameter, leaving a smooth shell in many specimens. Examples larger than 300 mm diameter are known, but dimorphism is not yet proved. Groebericeras is a rare genus. About forty-four specimens are known world-wide, and the eighteen Kurdistamian specimens described here are the largest number from one area. The remainder are: the unique holotype of *Ammonites rocardi* Pomel (1889) from Algeria; twelve specimens of *G. bifrons* Leanza (1945) from Mendoza, Argentina, which are considered here to be conspecific with *A. rocardi*; ten examples from south-east Spain identified by Hoedemaeker (1982); a poor fragment from the west coast of Vancouver Island figured by Jeletzky (1965, p. 33, pl. 11, fig. 7), which is only doubtfully referred to *Groebericeras*; and a single unfigured specimen from the Spiti Shales at Muktinath, Nepal, said to be a *Groebericeras* by Helmstaedt (1969, p. 75). This leaves the very large ammonite from California described by Imlay and Jones (1970, p. B35, pl. 5; pl. 6, figs 1–2, 5–6, 8–11; pl. 15) as their new species *Groebericeras? baileyi*, which is not accepted as a *Groebericeras*. It is more than 550 mm diameter, and has flat, compressed whorls, and straight radial ribs that issue from umbilical tubercles. The ribs are present up to the largest size preserved, though the tubercles diminish in size. It is Tithonian in age, and

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**EXPLANATION OF PLATE 4**

Figs 1–2, 6–7. *Spicieras* (*Spicieras*) *spathi* sp. nov. 1–2, BMNH C.86847; paratype, x = 1. 6–7, BMNH C.86848; holotype, x = 0.8. Both wholly septate and from bed 137; Chia Gara.

Figs 3–4. *Groebericeras rocardi* (Pomel). BMNH C.86938; last part of the phragmocone and beginning of the body-chamber; from bed 48; Banik, x = 1.

Fig. 5. *Berrissella* (*Berrissella*) *jacobii* Mazenot. BMNH C.86812; complete adult, with a long lateral lappet; from bed 104; Chia Gara, x = 1.
HOWARTH, *Spiticeras, Groebericerat, Berriasella*
appears to be virgatosphinctinid, possibly a *Nothostephanus* or a *Phanerostephanus*, both of which have similar ornament (and are possibly congeneric).

The considerable amount of variation in whorl thickness and strength of ribbing is well seen in the seventeen Kurdistan specimens that are referred to *G. rocardi*. One of them shows the ornament of the innermost whorls of *Grobericeras* for the first time, where there are tubercles on the ventral ends of ribs which border a narrow smooth venter. The unique holotype of *G. laevigatum* sp. nov. is markedly different in having much thicker, rounded whors, and is entirely devoid of ornament from at least 40 mm diameter.

The most accurate age determination of *Grobericeras* is from their occurrence in south-east Spain in the Paramimouana, Picteti and the base of the Alpiffens Subzones at the top of the Berriasian (Hoedemaeker 1982, encl. 4). The age of *G. rocardi* at Lamoricière, Algeria, is not known accurately from Pomele’s (1889) original work, but in revising the fauna from that locality, Benest et al. (1977, pp. 119–202) found that the beds that yielded ammonites were all in the Paramimouana and Picteti Subzones (though they did not find any new examples of *G. rocardi*). In Argentina *Grobericeras* occurs in the *Argentiniceras noduliferum* Zone, which is the lower half of the Berriasian. It is not clear whether the latter occurrence is really different in age from the European occurrences, due to uncertainties in the correlation of the South American and European Berriasian.


*Grobericeras rocardi* (Pomel, 1889)

Plate 4, figs 3–4; Plate 5, figs 5–6; Plate 6, figs 1–4; Text-figs 6a–e, 7

- 1889 *Ammonites rocardi* Pomel, p. 65, pl. 8, figs 3–5.
- 1945 *Grobericeras bifrons* Leanza, p. 82, pl. 17, figs 2, 5; pl. 18, pl. 19, figs 1–2, 7.
- 1982 *Spiticeras* (Pomel) *Grobericeras* rocardi (Pomel); Hoedemaeker, p. 35.
- 1982 *Spiticeras* (Pomel) *Grobericeras* aff. bifrons (Leanza); Hoedemaeker, pp. 39, 41, p. 4, fig. 3.

**Holotype.** The single specimen described by Pomel from the Berriasian, 2 km east of Lamoricière, Algeria, is the holotype. All Pomel’s ammonites were lost by the 1930s when Mazenot (1939, pp. 8, 118 etc.) attempted to find them through Professor Savornin at Algiers University.

**Material.** Seventeen specimens from the Chia Gara Formation: BMNH C.86823–86824, from bed 136, Chia Gara; BMNH C.86834–86839, from bed 137, Chia Gara; BMNH C.86853, from bed 142, Chia Gara; BMNH C.86935–86936, from bed 46, Banik; BMNH C.86937–86940, from bed 48, Banik; BMNH C.86945, bed 50, Banik BMNH C.86955, beds 48–56, Banik.

**Measurements.**

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**Explanation of Plate 5**

Figs 1, 4. *Spiticeras* (*Spiticeras*) *spitiense* (Blanford), BMNH C.86852; wholly septate; loose in scribes from beds 48–56; Banik, × 1.


Figs 5–6. *Grobericeras rocardi* (Pomel). BMNH C.86936; the phragmocone and part of the body-chamber; from bed 46; Banik, × 0.75.
HOWARTH, *Spiticeras, Proniceras, Groeberticeras*
Description. Although the seventeen Kurdistan specimens are largely uncushed, many are fragmentary, and there are no complete specimens with mouth-borders. The largest whorls preserved have a diameter of approximately 150 mm, but septa are present on whorls up to 120 mm diameter, indicating that some specimens reached sizes of at least 200 mm diameter. One specimen (C.86939) has parts of the inner whorls, including the venter, exposed down to 10 mm diameter. Most specimens are moderately involute, with inner whorls between one half and two-thirds covered by the next outer whorl, but the umbilical diameter is variable, ranging from 24 mm to 33 mm at 100 mm diameter (Text-fig. 7). The whorl breadth is greatest near the rounded umbilical edge and the sides of the whorl converge towards a smoothly rounded venter. The whorl shape is considerably variable: at a whorl height of 40 mm, the whorl breadth varies from 23 to 37 mm. Small inner whorls are ornamented with ribs that curve strongly forwards, and end at prominent tubercles bordering a narrow venter; ribs from opposite sides alternate across the venter. There are also narrow constrictions following the line of the ribs, and very small umbilical and lateral tubercles. This ornament is present up to 15 mm diameter. All the tubercles have disappeared by 25 mm diameter, and the strongly curved ribs and constrictions on the side of the whorl now meet from opposite sides and cross the venter as forwardly pointing chevrons. The ribs disappear, or are further reduced, on the side of the whorl by 50 mm diameter. Larger whorls are smooth, except for ribs on the ventral half of the whorls in some specimens. The suture-line (Text-fig. 60–4) has broad first and second lateral saddles, which are finally divided in some, separated by a narrow deeply trifid first lateral lobe.

Remarks. The holotype is lost, and no further specimens were found by Benest et al. (1977) during specimen that he figured, and closely resembles Pome's holotype of G. rocardi. The whorl species which can be interpreted satisfactorily from Pome's (1889) description and figure of his only specimen. That holotype was preserved up to about 90 mm diameter and was septate up to 70 mm diameter; the whorl section is compressed and the venter smoothly rounded; small umbilical tubercles fade at about 20 mm diameter, and ribbing near the ventro-lateral edge at 45–70 mm diameter is the only ornament shown on the outer whorl, except for two gently curving constrictions. The same characters are found in G. bifrons Leanza (1945, p. 82), which was proposed for twelve specimens from Mendoza, Argentina, of which five were figured. One of them (Leanza 1945, pl. 19, figs 1–2) is here designated lectotype of G. bifrons. It is the only complete medium-sized specimen that he figured, and closely resembles Pome's holotype of G. rocardi. The whorl dimensions of the two specimens are very similar (Text-fig. 6), and the whorl shape and ornament are alike, so there can be little doubt that G. bifrons is a synonym of Ammonites rocardi. A much larger specimen figured by Leanza (1945, pl. 18) is more than 300 mm diameter, and has widely umbilicate, evolute whorls, which retain weak ventro-lateral ribs up to the end. Though large, it is fragmentary and damaged, and is not suitable to be the lectotype.

All the Kurdistan specimens come from beds 136–142 on Chia Gara, or beds 46–56 at Banik. They show considerable variation in thickness, from compressed specimens like C.86823 (Pl. 6, figs 1, 3), to much thicker specimens like C.86936 (Pl. 5, figs 5–6). Most are smooth at diameters of more than 70 mm, but some retain weak ribs near the ventro-lateral edge. There are many gradations between them in whorl shape and ornament. The smallest inner whorls in the collection are seen in C.86938 (Pl. 4, figs 3–4), which have curved ribs ending in ventral edge tubercles, and similar-shaped constrictions; on the outer whorl of this specimen the tubercles have disappeared, and only the ribs and constrictions remain at 45 mm diameter. It is possible that this specimen might be a microconch.

C.86937 (Pl. 6, figs 2, 4) is a medium-sized (80 mm diameter) specimen, with weak ribs on the outer

EXPLANATION OF PLATE 6

Figs 1–4. Groebicheri arocardi (Pome). 1, 3, BMNH C.86823; the phragmocone and half a whorl of body-chamber; from bed 136; Chia Gara. 2, 4, BMNH C.86937; (suture-lines not visible); from bed 48; Banik. All × 1.1.

Figs 5–6. Groebicheri arocardi sp. nov. BMNH C.86946; ?adult phragmocone and part of the body-chamber near the aperture; from bed 55; Banik. × 0.75.
HOWARTH, Groebericeras
TEXT-FIG. 7. Whorl proportions of *Grobebericeras*. The three groups of points are the whorl height, whorl breadth and umbilical width plotted against the diameter, for the Algerian holotype and nine Kurdistan specimens of *G. rocardi*, and the lectotype and three paralectotypes of the synonym *G. 'bifrons'* from Argentina. The holotype of the new thick-whorled species *G. laevigatum* is included for comparison.

half of the whorl, which greatly resembles the lectotype of *G. bifrons* Leanza in whorl proportions and ornament.

In addition to the single specimen from Algeria, Leanza's twelve Argentinian specimens, and the seventeen Kurdistan specimens, the only other known examples of *G. rocardi* are three specimens from the Paraminouna Subzone in south-east Spain identified as *G. rocardi* by Hoedemaeker (1982, p. 35), and another seven specimens from the Picteti and Alpillensis Subzones that were identified as *G. aff. bifrons* (Hoedemaeker 1982, p. 49, pl 4, fig. 3). The latter figured specimen is 30 mm diameter and has curved ribs and constrictions like C.86938 figured in Plate 4, figures 3–4.

*Grobebericeras laevigatum* sp. nov.

Plate 6, figs 5–6; Text-fig. 7

*Holotype.* BMNH C.86946, from bed 55, Chia Garà Formation, Banik.

*Description.* The holotype consists of most of the whorls of a complete phragmocone up to what is probably the final septum before the body-chamber at 133 mm diameter. A fragment of the (?adult) body-chamber fits on to the phragmocone just over half a whorl later, and the ammonite is 195 mm diameter at its broken aperture. It is close to the final mouth-border, which would have occurred at 200–205 mm diameter, if the body-chamber was about 0.75 whorls long. The specimen is extensively damaged and parts of the whorls are missing, but it is not crushed and so retains its original whorl proportions. The phragmocone has depressed
whorls, in which the whorl breadth is larger than the whorl height, and the whorl section is smoothly rounded except for slight narrowing (angling) of the venter. On the fragment of the body-chamber the whorl section has become more triangular, and is higher than broad; the greatest whorl breadth is near the rounded umbilical edge and the whorl sides converge towards a broadly rounded venter. No ribs or tubercles are present on any of the whorls, which are smooth down to the smallest size visible at about 40 mm diameter.

**Measurements.**

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**Remarks.** This large ammonite is referred to _Groebiceras_ rather than to _Spiticeras_ because it has no ribs or tubercles. It fact it is entirely smooth from the smallest visible diameter at 40 mm, and amongst species of _Groebiceras_ it is unique in having depressed, rounded whorls. The whorl breadth is significantly larger than in _G. rocardi_ at comparable diameters (Text-fig. 7), and the whorl section is rounded unlike the compressed, semi-triangular whorl section of that species. Although examples of the latter species are known that are smooth at sizes larger than 70 mm (e.g. Pl. 5, figs 5–6; Pl. 6, figs 1, 3), ribs are always present at smaller sizes at least near the ventro-lateral edge. The only example of _Groebiceras_ that is larger than C.86946 is the largest Argentinian specimen figured by Leanza (1945, pl 18), which reaches about 300 mm diameter at the end of its fragmentary outer whorl. All other specimens of _Groebiceras_ are less than 160 mm diameter.

Family **Neoconomitidae** Salfeld, 1921
Subfamily **Berriasellinae** Spath, 1922
Genus **Berriasella** Uhlig, 1905

**Type species.** _Ammonites privasensis_ Pictet, 1867, by subsequent designation by Roman (1938, p. 324).

Subgenus **Berriasella** Uhlig, 1905

**Synonym.** _Hegaratella_ Nikolov and Sapunov, 1977 (type species, _Berriasella paramacilenta_ Mazenot, 1939).

**Berriasella** (_Berriasella_) _jacobi_ Mazenot, 1939

Plate 4, fig. 5

1890 _Hoplitites callisto_ (d’Orbigny); Toucas, p. 600, pl 17, fig. 3.
1890 _Hoplitites carpaticus_ Zittel; Toucas, pl. 602, pl. 17, figs 10–11.
1939 _Berriasella jacobi_ Mazenot, p. 54, pl. 4, figs 1–4.
1968 _Berriasella jacobi_ Mazenot; Le Hégarat and Remane, p. 25, pl. 5, figs 1–2.
1973 _Berriasella (Berriasella) jacobi_ Mazenot; Le Hégarat, p. 56, pl. 6, figs 9–12; pl. 38, figs 3, 6–7.
1982 _Berriasella (Berriasella) jacobi_ Mazenot; Nikolov, p. 51, pl. 8, figs 4–8.
1982 _Berriasella (Hegaratella) jacobi_ Mazenot; Hoedemaeker, p. 14, pl. 1, fig. 7.

**Material.** BMNH C.86812, from bed 104, Chia Gara.

**Remarks.** This crushed ammonite is a complete microconch, approximately 42 mm diameter at its mouth border which has a long slender lappet. It is moderately involute and finely ribbed, and is very similar to Mazenot’s (1939, pl. 4, fig. 1) holotype and to the specimens figured by Le Hégarat and Remane (1968) and Le Hégarat (1973). It is more involute and more finely ribbed than _Berriasella_ (_B._) _privasensis_ (Pictet) (lectotype figured by Mazenot 1939, pl. 45, pl. 2, fig. 3) which occurs about two zones higher in the Berriasian. _B. (B.) jacobi_ occurs mainly in the Jacobi and Grandis Subzones in south-east France (Le Hégarat 1973, p. 51) and south-east Spain (Hoedemaeker 1982, enl. 5), which are now amalgamated into the Euxinus Zone marking the base of the Berriasian. The Kurdistan specimen is important in fixing the Euxinus Zone, and therefore the base of the Berriasian as used here, at bed 104 of the Chia Gara Formation on Chia Gara.
Subgenus Malbosiceras Grigorieva, 1935

Type species. Ammonites malbosi Pictet, 1867, by original designation.


Remarks. Malbosiceras is a subgeneric name for bituberculate Berriasellidae. The type species and B. paramimouna (Mazenot, 1939) first occur in the lower part of the Dalmasi Subzone, then become more numerous in the overlying Paramimouna Subzone. The highest species are in the Picteti Subzone, and Malbosiceras does not survive into the Lower Valanginian. Eight species in the Dalmasi to Picteti Subzones were described by Le Hégarat (1973, pp. 83–96) and Nikolov (1982, pp. 126–146), and stratigraphical data on their occurrence in south-east Spain was given by Hoedemaeker (1982, pp. 17, 32; encl. 2). An older series of bituberculate Berriasellidae belongs to the group of Ammonites chaperi Pictet. They occur in the Durangites and Euxinus Zones and five species were described by Le Hégarat (1973, pp. 82–88) and Nikolov (1982, pp. 126–132), both of whom referred them to Malbosiceras. However, A. chaperi was made the type species of Chapericeras Hoedemaeker, 1981, but Hoedemaeker’s (1982, pp. 67–68) later view was that Chapericeras and its group of species were better included in the subgenus Berriasella (Hegaratella) Nikolov and Sapunov, 1977. The type species of Hegaratella is Berriasella paramacilentia Mazenot (1939, p. 127, pl. 20, figs 1–4; pl. 21, fig. 1), which has dense ribs and is not tuberculate, and is so similar to the lectotype (Mazenot 1939, pl. 2, fig. 3) of B. privasensis, the type species of Berriasella (Berriasella), that there is no justification for separating Hegaratella from the nominal subgenus. Ammonites chaperi is properly bituberculate, and is retained here in the subgenus Malbosiceras, of which Chapericeras is a synonym.

Berriasella (Malbosiceras) malbosi (Pictet, 1867)

Plate 7, figs 1–4, 7–8

1867 Ammonites malbosi Pictet, p. 77, pl. 14, fig. 1.
1889 Ammonites malbosi Pictet; Pomel, p. 57, pl. 5, figs 1–3.
1914 Acanthodiscus eucyrtus (Say); Kiiian and Reboul, p. 5, pl. 1, fig. 3; pl. 2, figs 2–3.
1935 Malbosiceras malbosi (Pictet); Grigorieva, p. 110, pl. 5, figs 1a–c.
1939 Berriasella malbosi (Pictet); Mazenot, p. 98, pl. 13, fig. 8 (lectotype refigured); pl. 14, fig. 1.
1939 Berriasella sp. indet.; Mazenot, p. 95, pl. 12, fig. 3.
1951 Berriasella malbosi (Pictet); Arnold-Saget, p. 52, pl. 5, fig. 7.
1960 Protacanthodiscus malbosi (Pictet); Nikolov, p. 174, pl. 14, fig. 4; pl. 15, fig. 1.
1960 Malbosiceras malbosi (Pictet); Drushchits and Koudriavtsev, p. 273, pl. 23, fig. 1.
1967 Malbosiceras malbosi (Pictet); Dimitrova, p. 108, pl. 50, fig. 6; pl. 52, fig. 1.
1973 Malbosiceras malbosi (Pictet); Le Hégarat, p. 87, pl. 9, fig. 5; pl. 10, figs 1–5.
1976 Malbosiceras malbosi (Pictet); Khimshiashvili, p. 95, pl. 8, fig. 1.
1982 Malbosiceras malbosi (Pictet); Nikolov, p. 134, pl. 45, fig. 2; pl. 46, figs 1–2.

EXPLANATION OF PLATE 7

Figs 1–4, 7–8. Berriasella (Malbosiceras) malbosi (Pictet). 1–2, BMNH C.86842; adult phragmocone and beginning of body-chamber. 3, 8, BMNH C.86841; wholly septate. 4, 7, BMNH C.86840; fragment of a body-chamber. All from bed 137; Chia Gara.
Figs 5–6. Dalmasiceras (Eleniaella) prorsiradiatum sp. nov. BMNH C.86827; paratype; from bed 137; Chia Gara; although this ammonite appears to be a possible microconch, the presence or absence of suture-lines cannot be determined due to defective preservation, and the apparent 'uncoiling' of the umbilical seam at the aperture is due to crushing of the umbilical wall towards the venter.
Fig. 9. Protacanthodiscus cf. perornatus (Retowski). BMNH C.86804; from bed 102; Chia Gara.
All ×1.
HOWARTH, Berriasella, Dalmasiceras, Protocanthodiscus
Lectotype. The specimen figured by Pictet (1867, pl. 14, fig. 1) was designated lectotype and refigured by Mazenot (1939, p. 98, pl. 13, fig. 8); it is from the Upper Berriasian at Berrias, south-east France.

Material. Seven specimens, BMNH C.86840–86843, BMNH C.80849–80851, from bed 137, Chia Gara.

Description. C.86842 (Pl. 7, figs 1–2) has its last suture-line at 92 mm diameter, then a quarter of a whorl of body-chamber ending at 110 mm diameter. The other six specimens are more fragmentary, the largest consisting of part of a body-chamber that has a maximum whorl height of 50 mm. The inner whorls are moderately involute, compressed, and have a narrow, flat venter and fine ribs that divide or are intercalated near the venter. Between 50 and 70 mm diameter the ribs increase in strength, and small umbilical tubercles, large lateral tubercles and large ventro-lateral tubercles appear. The umbilical and lateral tubercles are equal in number and are connected by single ribs, but only about half the ribs bifurcate at the lateral tubercles, so that the ratio of ventro-lateral to lateral tubercles is about 1:5:1. The whorl section becomes broader and trapezoidal, with a flat venter, and the greatest whorl breadth is at the lateral tubercles.

Measurements.

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Remarks. This is a distinctive species characterized by flat, fine-ribbed inner whorls, and coarse-ribbed, tuberculate and angular whorls from the middle stage of growth. The considerable amount of variation is illustrated by the three specimens figured by Mazenot (1939, pl. 12, fig. 3; pl. 13, fig. 8 (lectotype); pl. 14, fig. 1), which show differences in size and density of ribs and tubercles. The Kurdistan specimens show similar variation in tubercle size, and especially in the size at which strength of ribs and tubercles suddenly increases. This happens at 70 mm diameter in C.86842 and at 50 mm in C.86841 (Pl. 7, figs 3, 8). In one of the examples figured by Mazenot (1939, pl. 13, fig. 8) the onset of tubercles is delayed until about 90 mm diameter.

Other species of Berriasella (Malbosiceras) differ in ornament and whorl shape. In B. (M.) paramimouna (Mazenot 1939, p. 92, pl. 11, fig. 1; pl. 12, fig. 2) umbilical and lateral tubercles are well developed, but the ventro-lateral tubercles are small, the ribs remain fine and dense throughout, and the whorls are compressed. B. (M.) pousyanei (Pomel 1889, p. 59, pl. 3, figs 4–8; Mazenot, p. 94, pl. 11, fig. 3) has large tubercles, widely spaced ribs and is more evolute. B. (M.) rouillevii (Matheron 1880, p. 25, pl. B2, fig. 2; Mazenot 1939, p. 100, pl. 14, fig. 4) become coarsely ribbed on its large body-chambers. Four other species from the Upper Berriasian were described by Nikolov (1982, pp. 134–144); they are mainly fine-ribbed, and differ from B. (M.) paramimouna only in details.

Occurrence. Upper Berriasian; Occitanica Zone, Dalmasi Subzone to Boissieri Zone, Picteti Subzone. Southeast France, Spain, Algeria, Tunisia, Bulgaria, Iraq, Crimea, Caucasus.

Berriasella (Malbosiceras) chaperi (Pictet, 1868)

Plate 9, figs 6–7

1868 Ammonites chaperi Pictet, p. 242, pl. 37, figs 1–2.
1889 Hoplitites chaperi (Pictet); Kilian, p. 666, pl. 30, fig. 5.
1939 Berriasella chaperi (Pictet); Mazenot, p. 80, pl. 8, figs 5–7 (lectotype refigured), 8–9; pl. 9, fig. 1.
1939 Berriasella sp. indet., Mazenot, p. 95, pl. 10, fig. 5; pl. 11, fig. 5.
1973 Malbosiceras chaperi (Pictet); Le Hégarat, p. 86, pl. 9, figs 6–7.
1977 Malbosiceras chaperi (Pictet); Sapunov, p. 6, fig. 2.
1979 Malbosiceras chaperi (Pictet); Sapunov, p. 184, pl. 57, figs 2–5.
1982 Malbosiceras chaperi (Pictet); Nikolov, p. 128, pl. 42, figs 5–6; pl. 43, figs 1–2.

Material. One specimen, BMNH C.86894, from bed 23, Banik.
Remarks. This ammonite consists of most of two whorls that are septate up to 107 mm diameter, followed by a quarter of a whorl of body-chamber up to the aperture at 130 mm diameter. The whorls are evolute and the whorl section is quadrate, with vertical umbilical walls and flat venter. Widely spaced primary ribs start from small umbilical tubercles and divide into two or three secondaries at medium-sized lateral tubercles. More secondary ribs are intercalated, and they all swing forwards to pass over the venter without interruption at the diameters (70–130 mm) at which the venter is exposed. The inner whorl closely resembles Pictet’s lectotype (Mazenot 1939, pl. 12, fig. 5). Mazenot (1939, p. 84), Le Hégarat (1973, pp. 83, 86), Nikolov (1982, p. 130) and Hoedemaeker (1982, p. 12) all agree that Berriasella (Malbosiceras) chaperi occurs in the top zone or subzone of the Upper Tithonian, and does not extend into the Berriasian, when that stage is defined, as here, as starting with the Euxinis Zone.

Berriasella (Malbosiceras) cf. asper Mazenot, 1939

Plate 9, figs 5, 8

1939 Berriasella aspera Mazenot, p. 84, pl. 9, figs 2–3.

1973 Malbosiceras asper (Mazenot); Le Hégarat, p. 84, pl. 9, fig. 1; pl. 40, fig. 9.

1982 Malbosiceras asper (Mazenot); Nikolov, p. 126, pl. 42, figs 3–4.

Material. Three specimens, BMNH C.86904–86906, from bed 23, Banik.

Remarks. The figured specimen (Pl. 9, figs 5, 8) is a short portion of a septate whorl, which has a whorl height of 47 mm at the larger end. Moderately dense, slightly sigmoidal ribs arise mostly in pairs from small umbilical tubercles, then bifurcate at small mid-lateral tubercles, and pass radially over the narrow venter with no interruption. The other specimens (C.86904–86905) are smaller and less well preserved. All three differ from the single example of B. (M.) chaperi (C.8694) in the same bed at Banik in having slightly denser ribbing. But the resemblance is close, and they are only compared with Mazenot’s species asper because of their fragmentary nature and lateral crushing. B. (M.) asper was found to accompany B. (M.) chaperi in the top of the Upper Tithonian by both Le Hégarat (1973, p. 84) and Nikolov (1982, p. 128).

Genus Dalmasiceras Djanéldzé, 1922

Type species. Ammonites dalmasi Pictet, 1867, subsequently designated by Roman (1938, p. 337).

Remarks. Dalmasiceras is characterized by the possession of small, radially elongated, umbilical tubercles, from which ribs issue in bundles. In the typical group of species of the nominal subgenus, the whorls are moderately involute, the ribs fade on the sides of the whorl at an early stage, and the umbilical tubercles are the most prominent feature at larger sizes. Species that are more evolute and have ribs that remain to larger sizes are grouped in the subgenus D. (Elenaela) Nikolov, 1966. The type species of Elenaela is Berriasella cularensis Mazenot (1939, p. 75, pl. 8, figs 1–2) in which the onset of umbilical tubercles and bundled ribs is delayed until a much later growth stage than in Dalmasiceras s.s. Subalpinites Mazenot, 1939 (type species, S. fauriensis Mazenot, 1939, p. 224, pl. 36, figs 1–2) has been used as another subgenus of Dalmasiceras by Hoedemaeker (1982), in which the ribs and bundled tubercles are stronger and a mid-lateral tubercle is developed. Dalmasiceras ranges from the Upper Tithonian up to almost the top of the Berriasian according to the range charts of Le Hégarat (1973, pp. 207, 222, 274), and Hoedemaeker (1982) showed that in south-east Spain the highest species occur in the Paramimouna Subzone, Boissieri Zone.
Type species. *Berriasella cularensis* Mazenot, 1939, by original designation.

*Dalmasiceras (Elenaella) prorsiradiatum* sp. nov.
Plate 7, figs 5-6; Plate 8, figs 1, 3-4; Plate 9, figs 1-2

*Holotype*. BMNH C.86845, from bed 137, Chia Gara.

*Paratypes*. Seven specimens, BMNH C.86827–86833, from the same horizon and locality as the holotype.

*Other material*. Four specimens, BMNH C.86941–86944, from bed 48, Banik

*Diagnosis*. A species of *Dalmasiceras (Elenaella)* that has moderately evolve whorls, and is characterized by ribs that are slightly prorsiradiate near the umbilical edge, then curve strongly forwards and pass over the venter as forwardly pointing chevrons. Ribs remain strong until late growth stages, and tend to fade on the side of the whorl only at diameters larger than about 75 mm.

*Measurements*. D Wh Wb U Wh/Wb

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*Description*. The collection consists of three fairly complete specimens of 108, 105 and 52 mm maximum diameters, and nine smaller specimens or fragments, the largest having a whorl height of 52 mm. The holotype is wholly septate at its maximum diameter of 108 mm, and C.86831 has part of a whorl of about 140 mm diameter. Specimens probably reached sizes larger than 185 mm diameter when complete. Whorls are moderately involute, the cross-section is elliptical and compressed, and both umbilical edge and venter are smoothly rounded. Radially elongated umbilical tubercles are present on whorls up to at least 80 mm diameter. Ribs issue from them in bundles of two or three, and are straight and slightly prorsiradiate on the inner half of the whorl, then curve strongly forwards on the outer half. Ribs from opposite sides meet on the venter to form forwardly pointing chevrons. The ribs hardly diminish in strength on crossing the venter, which has neither sulcus nor smooth band, but the ribs gradually fade on the inner half of the whorl side above 75 mm diameter. There are no lateral tubercles.

*Remarks*. The strongly prorsiradiate ribbing on the outer half of the whorl is a constant feature in all twelve Kurdistan specimens and distinguished them from all the species of *Dalmasiceras, Elenaella* and *Subalpinites* described by Djanelidzé (1922a), Mazenot (1939), Le Hégarat (1973) and Nikolov (1982). One of the most similar specimens was that figured by Mazenot (1939, pl. 38, fig. 1), which Nikolov (1982, p. 100, pl. 25, figs 3–4) included in his new species *Dalmasiceras (D.) mazenoti*. The latter is more involute, however, and the ribs are not so strongly curved as in *D. (Elenaella) prorsiradiatum*. All the other species have straighter, more rectiradiate ribs, and different combinations of degree of involution and loss of ribbing. The Kurdistan species is referred to *Elenaella* rather than to the nominate subgenus because of its relatively wide umbilicus, and its retention of ribs on the side of the whorl to larger sizes. No lateral tubercles are developed at any growth stage, which prevents reference to the subgenus *Subalpinites*.

**EXPLANATION OF PLATE 8**

Figs 1, 3-4. *Dalmasiceras (Elenaella) prorsiradiatum* sp. nov. 1, BMNH C.86830; paratype. 3–4, BMNH C.86845; holotype; wholly septate. Both from bed 137; Chia Gara.

Figs 2, 5. *Euthyniceras kurdistanensis* sp. nov. BMNH C.86825; holotype; phragmocone and most of the (adult) body-chamber; from bed 137; Chia Gara.

All ×1.
Type species. Odontoceras koeneni Steuer, 1897, by original designation.

Remarks. The presence of Substeuerceras in Kurdistan is of considerable significance in view of Jeletzky's (1984, p. 179) assertion that the genus does not occur in the European Tethyan belt. Jeletzky's reasoning cannot be accepted: he stated that all the alleged European records of Substeuerceras have ventral furrows, and are therefore different from the Argentinian type species which is always unfurrowed. This is not so: ventral furrows are present on the smaller whorls of the type species (e.g. Steuer 1897, pl. 17, figs 4–5), and the types of Neocomites beneckei Jacob from south-east France figured by Mazenot (1939, p. 208, pl. 32, figs 8–14) are virtually identical with that South American species. Very similar specimens of Substeuerceras beneckei also occur in the Upper Tithonian of Bulgaria (Nicolov 1982, p. 208, pl. 72, figs 4–9), Hungary (Fülöp 1976, p. 78, pl. 35, fig. 1), the Crimea (Drushchits and Kudryavtseva 1960, p. 282, pl. 26, fig. 1) and Tunisia (Arnould-Saget 1951, p. 73, pl. 7, figs 6–7, 9). From these examples there can be little doubt that Substeuerceras is present, albeit rarely, in European Tethys. This conclusion was also arrived at by Hoedemaeker (1982, p. 68), and is to be preferred to Le Hégaret's (1973, p. 172) reference of Neocomites beneckei to Pseudargentiniceras, which differs in developing umbilical tubercles. Substeuerceras occurs commonly in the Upper Tithonian of Argentina and Mexico, and many specimens were figured by Steuer (1897), Burckhardt (1912), Imlay (1939) and Leaniz (1945). Verma and Westermann (1973) adopted a more practical and broader view of the genus and its species, and they even proposed that Paradonomoceras Spath (1923, p. 305; type species, Hoplitites callistoides Behrendsen, 1891) should be a synonym. As so used, Substeuerceras consists of a group of species that are moderately involute to fairly evolute, with flat whorl sides, a tabulate venter, and moderate to dense gently flexuous ribs which divide at differing heights, and are interrupted by a ventral furrow at small sizes but cross straight over the venter at larger sizes.

The Kurdistan collection of Substeuerceras consists of about forty specimens from bed 92 on Chia Gara. Unfortunately all are crushed, and many are only short positions of single whorls. They range in size from inner whorls of 30 mm diameter, up to parts of specimens of 150–200 mm diameter. All are finely ribbed and non-tuberculate, and the ribs divide into two or three secondaries at varying heights on the side of the whorl. From the state of preservation it is not certain that they all belong to one species, but about half of them are identified as Substeuerceras koeneni (Steuer).

One of the better preserved small specimens (Pl. 1, fig. 10) is fairly involute and is very similar to an ammonite from the Spiti Shales figured as *Simbirskites n. sp. ind.* by Uhlig (1910, p. 275, pl. 81, fig. 2). This is the origin of Spath's manuscript identification 'Grayiceras' ('*Simbirskites* sp.', Uhlig, pl. 81, fig. 2) for the Kurdistan specimen. It is also like one of the smaller paratypes of Substeuerceras koeneni (Steuer 1897, pl. 17, fig. 4) and a Mexican specimen figured by Imlay (1939, p. 50, pl. 15, fig. 9) as Substeuerceras cf. subfuscium (Steuer). The Kurdistan specimen of Plate 1, figure 9 is equally involute, but shows more widely spaced primary ribs at its larger size, and there are others that have gently flexuous ribbing like that of Substeuerceras lamellicostatum (Burckhardt

**EXPLANATION OF PLATE 9**

Figs 1–2. *Dalmasiceras (Elenaella) prorsiradiatum* sp. nov. BMNH C.86831; paratype; wholly septate; from bed 137; Chia Gara.
Figs 3–4. *Tumulovella alpilleri* (Mazenot). BMNH C.83428; wholly septate; from bed 141; Chia Gara.
Figs 5, 8. *Berriasella (Malhosiceras) cf. asper* Mazenot. BMNH C.86906; wholly septate; from bed 23; Banik.
Figs 6–7. *Berriasella (Malhosiceras) chaperi* (Piceti). BMNH C.86894; phragmocone and part of the body-chamber; from bed 23; Banik.

All × 1.
HOWARTH, Dalmaeceras, Tinovella, Berriasella
1912, p. 167, pl. 40, figs 1–4, 6; 1921, pl. 19, figs 9–10; pl. 20, figs 4–9). Most of these Mexican specimens were included in *Substeueroceras koeneni* by Verma and Westermann (1973, p. 240). Slightly more evolute specimens are represented by Plate 2, figure 3. One of the three crushed examples in the collection of broad flat venters is figured on Plate 2, figure 10; it is about 30 mm across the unfurrowed venter, and must have been from a specimen of 150–180 mm diameter. It is very similar to the ventral view of one of Steuer's (1897, pl. 18, fig. 2) larger examples of *S. koeneni*.

**Genus Protacanthodiscus** Spath, 1923

*Type species:* *Hoplitès andreæi* Kilian, 1889, by original designation.

*Protacanthodiscus* cf. *perornatus* (Retowski, 1893)

Plate 7, fig. 9

1893 *Hoplitès perornatus* Retowski, p. 270, pl. 12, fig. 5.

**Material.** One specimen, BMNH C.86804, from bed 102, Chia Gara.

**Remarks.** This small crushed ammonite consists of only inner whorls of 30 mm diameter, but it has the distinctive morphology of *Protacanthodiscus*, and it resembles the smaller part of the outer whorl of Retowski's holotype of *P. perornatus*. Primary ribs connect the umbilical tubercles to the lateral tubercles, which are low on the side of the whorl, then the ribs bifurcate and swing forwards to join the tubercles at the edge of the venter. *P. perornatus* is more finely ribbed than *P. andreæi* (Kilian ; holotype figured by Mazenot 1939, p. 96, pl. 12, fig. 1), the type species of *Protacanthodiscus*. This is an uncommon genus, of which the distribution is not well documented, partly due to the removal to *Malbosticeras*, *Mazenoticeras* and *Neocosmoceras* of many species that were formerly placed in *Protacanthodiscus*. In southern Europe it occurs in the Microcanthus and Durangites Zones according to the distribution recorded by Enay and Geyssant (1975, p. 45), Hoedemaeker (1982, pp. 12, 17) and Nikolov (1982, p. 22), and it had become extinct before the Euxinus Zone.

**Genus Euthymiceras** Grigorieva, 1935

*Type species.* *Ammonites euthymi* Picket, 1867, by original designation.

**Remarks.** A neotype for *E. euthymi* was proposed by Le Hégarat (1965, p. 125, pl. 1, fig. 1), to replace the lost holotype on which Pictet (1867, p. 76, pl. 13, fig. 3) had based his stylized drawing. That neotype has compressed, quadrate whors (whorl height/breadth = 1:71 at 77 mm diameter), and umbilical, lateral and ventral-edge tubercles of approximately equal size; 10 umbilical and 10 lateral tubercles correspond to 22 ventral-edge tubercles; weak to moderate ribs join the tubercles and cross the venter with some weakening along the mid-ventral line. It came from the Paramimouna Subzone in south-east France, and there are rare occurrences of the species in Bulgaria (Nikolov 1982, p. 166), Crimea, Caucasus (Khimshiashvili 1976, p. 108, pl. 20, fig. 1) and Mangyshlak (Luppov et al. 1975, p. 130). Another four species of *Euthymiceras* were described by Bogoslovsky (1897, pp. 94–103, pl. 6, figs 1–4) from the Ryazan horizon on the Russian Plain, south-east of Moscow. These are *E. micheicium* and *E. transfigurabile* which are evolute and have few ribs, and *E. hospes* and *E. inexploratum* which are more involute and have more ribs. Sazonova (1975, pp. 89–99) showed that *Euthymiceras* occurs in the mid to upper part of the Berriasian in that area, and the genus was given a similar position in the more complex correlation charts of Jeletzky (1964, pp. 232–237, figs 10–11). *Euthymiceras* occurs at the same horizon in the Caucasus (Khimshiashvili 1976, pp. 106–110, pl. 16, fig. 4; pl. 20, fig. 1), from where Grigorieva (1935, p. 109, pl. 4, fig. 2) described the new species *E. salenskii*, and also in the Mangyshlak Peninsula where
another species, *E. transiaspium* (Luppov et al. 1949), occurs. In Crimea *E. euthymi* and *E. transfigurabile* occur with *Dalmasiceras dalmasi* in beds that are correlated with the Paramimouna and Dalmasi Subzones (Drushchits and Kudryavtzeva 1960, p. 280, pl. 33, figs 3–4; pl. 34, figs 2–3; Drushchits 1975).

**Distribution.** Berriasian, Dalmasi and Paramimouna Subzones. South-east France, central Russian Plain, Crimea, Caucasus, Mangyshlak Peninsula, northern Iraq.

**Euthymiceras kurdistanense** sp. nov.

Plate 8, figs 2, 5; Text-fig. 6c

**Holotype.** BMNH C.86825, from bed 137, Chia Gara.

**Description.** The single example is well preserved, and neither crushed nor distorted; it is septate up to 60 mm diameter, and has exactly half a whorl of body-chamber up to the broken aperture at 88 mm diameter. The whorls are moderately involute; the whorl section is quadrate or trapezoidal, with the greatest whorl breadth at the umbilical edge and near-flat whorl sides that converge to a broad flat venter. The umbilical wall is sloping. The primary ribs are almost straight, and are single or divide into two or three secondaries at the poorly developed lateral tubercle; more often, secondary ribs are intercalated at the same position; ribs pass straight across the venter, only slightly diminished in strength at the mid-ventral line. There are 14 primary ribs at 88 mm diameter, and 14 primaries and about 35 secondaries at 74 mm diameter. Moderately large umbilical and ventro-lateral tubercles occur on each rib; the lateral tubercles are smaller and are dorsal of the mid-lateral line. The suture-line is shown in Text-fig. 6c.

**Measurements.**

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**Remarks.** This well-preserved ammonite has the distinctive combination of widely spaced ribs, umbilical, lateral and ventro-lateral tubercles, and a ‘swollen’ whorl section which makes it readily comparable with the central Russian species figured by Bogoslovsky (1897, pl. 6). It differs from any previously described species of *Euthymiceras*, however, by its depressed, trapezoidal whorl section. *E. hospes* (Bogoslovsky 1897, p. 97, pl. 6, fig. 2) is the species to which it has most resemblance, because it is similarly involute and has a comparable rib-density, but *E. hospes* has larger lateral tubercles and the whorls are parallel-sided, not trapezoidal, and are more compressed (the whorl height/breadth ratio is about 1:3 at 80 mm diameter). Spath (1952, p. 31) identified this new ammonite as 'a new himalayitid', and suggested that it was comparable with *Acanthodiscus euthymiformis* (Burckhardt) from the base of the Berriasian succession at San Pedro del Gallo, Mexico. Burckhardt's (1912, p. 187, pl. 44, figs 8, 12–13, 16) specimen is more involute, and has stronger ribs than the Kurdistan specimen. It might be a late species of *Protacanthodiscus*.

**Genus chigaroceras gen. nov.**

**Etymology.** From Chia Gara, northern Iraq.

**Type species.** Chigaroceras banikense sp. nov.

**Diagnosis.** Involute, compressed, rounded venter without a groove, angled or well-defined umbilical edge, undercut umbilical walls. Weak to strong primary ribs divide mid-laterally into two or three secondaries and pass over the venter without interruption. Small umbilical and medium to large mid-lateral tubercles occur on most ribs.
**Measurements.**

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**C. banikense**

**C. wetzeli**

**C. planum**

**Remarks.** Twenty-five ammonites collected from bed 23 at Banik have a combination of characters that are not found in any previously described genus of Berriasellidae. The involute whorls, undercut umbilical walls, the tendency towards massive whorls and large ribs and tubercles, and ribbing that is not interrupted on the venter, is a unique combination of morphological features. Similar involute, compressed whorls and umbilical and mid-lateral tubercles are found in several species of *Dalmasiceras* that occur in the top of the Upper Tithonian in Europe (e.g. some of those figured by Djanelić 1922a, pls 12–14; Mazenot 1939, pls 26–28; Le Hégarat 1973, pp. 206–221; Nikolov 1982, pp. 95–103). That genus is characterized by reduced ribbing in the middle of the side of the whorl, and interrupted ribs on the venter. Nevertheless, the morphological change from a large involute *Dalmasiceras* such as *D. biplanum* Mazenot (1939, p. 170, pl. 26, fig. 8) from the Upper Tithonian of south-east France, to the examples of *Chigoroceras* figured in Plate 11, would involve an increase in involucre of the whorls, an increase in the strength of the ribs and tubercles, and continuity of the ribs across the venter. Such changes are feasible, and point to *Dalmasiceras* as a possible ancestor for *Chigoroceras*.

*Chigoroceras* is more involute than most Berriasellidae, and it is tempting to postulate an alternative relationship with the Boreal genera *Tollia*, *Praetollia*, or especially *Hectoroceras*. The latter genus is known from Greenland, eastern England and several areas of western and central Russia, at a horizon which is probably equivalent to about the middle of the Berriasian. Spath made a similar suggestion when he gave the manuscript determination 'Hectoroceras? sp. nov.' to a poorly preserved external mould (now BMNH C.83419) from the Chia Gara Formation in the Bekhme Gorge, Rawandiz, north-east Iraq. This was the origin of the determination 'Hectoroceras?' quoted by Hudson (1954, p. 48) when he described a new stromatoporoid from the same beds, but that ammonite is poor, and is a genetically indeterminate berriasid. In reality all the figured specimens of Boreal *Hectoroceras* (Spath 1947, pl. 1–3; Shulgina 1972, pp. 149, 184, pl. 4, fig. 2; pl. 24, fig. 3; pl. 25, fig. 1; Klimova 1972, p. 214, pl. 40, figs 1–4; Casey 1973, p. 244, pl. 7) differ from *Chigoroceras* in having a rounded umbilical edge, sloping umbilical walls and a funnel-shaped umbilicus. They also have no umbilical or lateral tubercles, and the suture-line (Spath 1947, pl. 21, fig. 5) is simpler and has many more auxiliary saddles than the complex and highly divided suture-line of *Chigoroceras*. In any case *Chigoroceras* has been shown to be topmost Tithonian in age from the associated ammonites in Banik bed 23, and this is considerably older than the mid-Berriasian *Hectoroceras*. For these reasons it is held that the affinities of *Chigoroceras* are with the Berriasellidae and especially *Dalmasiceras*, rather than the Boreal Craspeditidae.

**Distribution.** Durangites Zone, Upper Tithonian, Banik bed 23, northern Iraq.
HOWARTH: TITHONIAN–BERRIASIAN AMMONITES

Chigacroceras banikense sp. nov.
Plate 10, figs 1–3, 6; Plate 12, figs 6, 8
Holotype. BMNH C.86930 (Pl. 10, figs 1–2).
Paratypes. BMNH C.86931, C.86934.
Other material. BMNH C.86932–86933 are two fragments.
Locality and horizon. All are from bed 23, Banik.

Diagnosis. Like C. wetzeli, but larger, more evolute, has thicker whorls, and ribs become larger and widely spaced at sizes of more than 70 mm diameter. Umbilical and mid-lateral tubercles also become large.

Description. The holotype is a well-preserved, uncrushed specimen, septate up to 105 mm diameter, and has about 70° of body-chamber ending at the broken aperture at 126 mm diameter. It may be adult. The paratype, C.86934 (Pl. 12, figs 6, 8), is a larger, somewhat crushed specimen, only preserved well on one side. It is septate up to 134 mm diameter, then has half a whorl of body-chamber ending at an incomplete aperture at 191 mm diameter; it is probably adult and nearly complete. The other paratype, C.86931 Pl. 10. figs 3, 6, consists of well-preserved, uncrushed, septate whorls ending at about 95 mm diameter, whereas C.86932–86933 are non-septate fragments of ventral parts of whorls from specimens of 140–150 mm diameter. The whorls are moderately involute, the whorl section is elliptical, with a smoothly rounded venter, rounded umbilical edge, and vertical to slightly undercut umbilical walls. At sizes up to about 70 mm diameter, moderately strong radial ribs bend slightly backwards and bifurcate at mid-lateral tubercles, or secondary ribs are intercalated on the outer half of the whorl instead of the bifurcation. The ribs swing slightly forward and pass over the venter without interruption. From about 70 mm diameter the ribs become very strong and more widely spaced, especially on the holotype where they form large folds on the side of the whorl. There are small umbilical tubercles and larger mid-lateral tubercles on each primary rib, but no ventro-lateral tubercles. The mid-lateral tubercles increase in size as the ribs become larger.

Remarks. C. banikense is the largest and most strongly ornamented species of Chigacroceras. The ribs are more widely spaced than in C. wetzeli, and fragments of large whorls are distinctive because of their widely spaced secondary ribs on the venter. The holotype (Pl. 10, figs 1–2) is a moderately sized ammonite with this distinctive morphology, whereas C.86934 (Pl. 12, figs 6, 8), though considerably larger, is covered in matrix and crushed on the unfigured side. In fact the holotype is the only entirely uncrushed ammonite amongst the twenty-five specimens of Chigacroceras from Banik.

Chigacroceras wetzeli sp. nov.
Plate 10, figs 4–5; Plate 11, figs 1, 3–5
Holotype. BMNH C.86909 (Pl. 10, figs 4–5).
Paratypes. BMNH C.86910–86916.
Other material. BMNH C.86917–86926 are ten fragments.
Locality and horizon. All are from bed 23, Banik.

Diagnosis. Up to 180 mm diameter when complete. Involute, compressed, flat whorl sides, rounded venter, angled umbilical edge and undercut umbilical walls. Ribs moderately strong, slightly sinuous, dividing into two or three secondaries at a mid-lateral tubercle, and cross the venter without interruption. Small umbilical and blunt mid-lateral tubercles.

Description. The holotype and seven paratypes consist of six specimens and two large body-chamber fragments.
The holotype has suffered less crushing than the others and in fact is undistorted except for the last quarter whorl; it is septate up to 68 mm diameter, then has a quarter of a whorl of body-chamber ending at 88 mm diameter. The paratypes are septate up to diameters varying between 56 mm and 100 mm; they range up to about 140 mm in maximum size, and all are more crushed or less complete than the holotype. The longest body-chamber is about 0.6 whorls long in C. 86912; it is the only one with a mouth-border that is probably complete at 89 mm diameter, but it has no adult features. The whorls are involute, compressed, with near-flat whorl sides, a rounded venter, an angled umbilical edge and vertical or undercut umbilical walls. The ribs are of medium strength at all sizes, only slightly sinuous, and divide into two or three secondaries at the mid-lateral tubercle; they are angled forward at the ventro-lateral edge and pass over the venter without interruption. There are small tubercles at the umbilical edge and larger blunt mid-lateral tubercles, but no ventro-lateral tubercles. Amongst the ten fragments that are not designated as paratypes, one specimen, C. 86819, is a short part of a large body-chamber, with a whorl height of 72 mm at its larger end. Its umbilicus appears to be relatively wider than at smaller sizes in other specimens, but the ribbing is similar to that of the holotype. It would have been at least 180 mm diameter when complete, and it shows that the ornament remains unchanged up to this large size, which is probably part of an adult body-chamber. There are no lappets on any of the specimens.

Remarks. This is the commonest species of Chigaroceras at Banik, and one in which the ornament remains unchanged up to the largest size preserved of about 180 mm diameter. The holotype (Pl. 10, figs 4–5) is the best preserved specimen, the paratype of Plate 11, figures 1, 3, is larger, while the body-chamber fragment of Plate 11, figures 4–5 shows the ornament up to about 135 mm diameter. In C. banikense the ribs become larger and widely spaced and the whorls become thicker. C. planum is more involute, more compressed, tends to become smooth on the side of the whorl, and has finer secondary ribs at the edge of the narrower venter.

Chigaroceras planum sp. nov.

Plate 11, figs 2, 6

Holotype. BMNH C. 86927.

Paratype. BMNH C. 86928.

Locality and horizon. Both are from bed 23, Banik.

Diagnosis. Like C. wetzeli, but more involute, more compressed, more narrowly rounded venter, and ribs much reduced on the sides of the whorl.

Description. The holotype is well preserved, though somewhat crushed, and is septate up to 70 mm diameter, then has a quarter of a whorl of body-chamber ending at about 85 mm diameter. It is very involute, with a small umbilicus, flat whorl sides that converge to a narrowly rounded venter, an angled umbilical edge and a sharply undercut umbilical wall. The ribs are much reduced on the whole of the last whorl from 36–85 mm diameter; they almost disappear on the outer half of the whorl, but the secondary ribs are more prominent near the ventro-lateral edge and pass over the venter with no interruption. The ribs are raised into slight, thin tubercles at the umbilical edge, but there are only rudimentary traces of lateral tubercles. The paratype

EXPLANATION OF PLATE 10

Figs 1–3. Chigaroceras banikense gen. et sp. nov. 1–2, BMNH C. 86930; holotype; ?adult phragmocone and a small part of the beginning of the body-chamber near the umbilicus. 3, 6, BMNH C. 86931; paratype; wholly septate. Both from bed 23, Banik.

Figs 4–5. Chigaroceras wetzeli gen. et sp. nov. BMNH C. 86909; holotype; phragmocone and the beginning of the body-chamber; from bed 23; Banik.

All ×1.
HOWARTH, *Chigaroceras*
consists of about one-third of a whorl at 50 mm diameter, with no visible septa, so it is probably an immature body-chamber. The ribs and tubercles are small and reduced as in the holotype.

Remarks. The compressed involute holotype, with its reduced ribbing, is sufficiently different from *C. wetzeli* to be separated as a distinct species. The finer ribs on a more narrowly rounded venter are also distinctive.

**Subfamily NEOCOMITINAE** Salfeld, 1921

**Genus THURMANNICERAS** Cossmann, 1901

**Type species.** *Ammonites thurmanni* Pictet and Campiche, 1860, by original designation.

**Subgenus ERDENELLA** Nikolov, 1979

**Type species.** *Hoplites paquieri* Simionescu, 1899, by original designation.

*Thurmanniceras* (*Erdenella*) *isare* (Pomel, 1889)

Plate 12, figs 5, 7

1889 *Ammonites isaris* Pomel, p. 49, pl. 5, figs 4–6; pl. 14, fig. 1.

1939 *Berriasella isaris* (Pomel); Mazenot, p. 118, pl. 18, figs 2–3.

?1939 *Berriasella andraeai* (Kilian); Mazenot, p. 96, pl. 12, fig. 4.

1960 *Berriasella isaris* (Pomel); Nikolov, p. 165, pl. 6, figs 2–4; pl. 11, fig. 1.

1977 *Jabronella isaris* (Pomel); Benest, Donze and Le Hégarat, p. 211, pl. 5, figs 2–3.

1973 *Jabronella isaris* (Pomel); Le Hégarat, p. 194, pl. 30, figs 3–7; pl. 50, fig. 2.

1982 *Jabronella* (*Erdenella*) *isaris* (Pomel); Nikolov, p. 186, pl. 66, figs 4–5; pl. 67, figs 1–4.

**Material.** BMNH C.86949, from bed 56, Banik.

Remarks. This wholly septate specimen consists of somewhat less than half a whorl, ending at a maximum size of about 56 mm diameter. The whorls are moderately evolute and quadrate, and the venter is tabulate. Fairly coarse primary ribs arise singly or in pairs from umbilical tubercles, then divide at mid-lateral tubercles, and are interrupted in the middle of the venter. Pomel’s two syntypes are lost (the figured one was designated lectotype by Nikolov 1982, p. 186) but an almost identical topotype from Lamorticère, Algeria, was figured by Mazenot (1939, pl. 18, fig. 3). The Kurdistan specimen is also very similar and allows a definite identification to be made. Le Hégarat (1973, p. 196) and Hoedemaeker (1982, encl. 4) found this species in the Paramimouna Subzone in south-east France and south-east Spain. Benest *et al.* (1977, p. 211) found one new specimen during their reinvestigation of Pomel’s ammonites at Lamorticère, but it was not *in situ*. All the other ammonites came from the Paramimouna and Piceti Subzones at that locality.

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**EXPLANATION OF PLATE II**

Figs 1, 3–5. *Chigaroceras wetzeli* gen. et sp. nov. 1, 3, BMNH C.86910; paratype; phragmocone and beginning of ?adult body-chamber. 4–5, BMNH C.86915; paratype; end of the phragmocone and about a quarter of a whorl of ?adult body-chamber. Both from bed 23, Banik.

Figs 2, 6. *Chigaroceras planum* gen. et sp. nov. BMNH C.86927; holotype; phragmocone and beginning of the body-chamber; from bed 23; Banik.

All ×1.
Type species. *Berriasella alpillensis* Mazenot, 1939, by original designation.

*Tirnovella alpillensis* (Mazenot, 1939)

Plate 9, figs 3–4

1907 *Thurnmannia thorunnni* Pictet and Campiche; Sayn, p. 40, pl. 5, fig. 5.
1939 *Berriasella alpilensis* Mazenot, p. 73, pl. 6, fig. 22.
1939 *Berriasella boissieri* (Pictet); Mazenot, p. 106, pl. 16, fig. 2.
1951 *Berriasella alpilensis* Mazenot; Arnoiu-Saget, p. 48, pl. 5, fig. 2.
1973 *Tirnovella alpilensis* (Mazenot); Le Hégarat, p. 178, pl. 27, figs 1, 3; pl. 28, fig. 5; pl. 49, figs 1–3.
1977 *Tirnovella aff. alpilensis* (Mazenot); Benest, Donze and Le Hégarat, p. 210, pl. 5, fig. 4.
1982 *Tirnovella alpilensis* (Mazenot); Hoedemaeker, pp. 50, 69, pl. 5, fig. 1.
1982 *Tirnovella alpilensis* (Mazenot); Nikolov, p. 233, pl. 84, fig. 2; pl. 85, figs 1–3.

**Material.** One specimen, BMNH C.83428, from bed 141, Chia Gara.

**Remarks.** This ammonite is septate up to its maximum size of 82 mm diameter. The whorls are compressed and the umbilical walls are undercut. Dense ribs that arise from rudimentary umbilical tubercles are gently flexuous on the side to the whorl, and are partly interrupted in the middle of the narrow, flat venter. There are three or four constrictions per whorl which follow the shape of the ribs. It closely resembles Mazenot's (1939, pl. 6, fig. 22) holotype of *T. alpilensis*, which was refuged by Le Hégarat (1973, pl. 49, fig. 2) and Nikolov (1982, pl. 84, fig. 2). The species was recorded from both Picteti and Alpilensis Subzones by Le Hégarat (1973, p. 176), Hoedemaeker (1982, encl. 5) and Nikolov (1982, p. 234), in France, Spain and Bulgaria, where it characterizes a horizon consistently higher than the Paramimouna Subzone. In Algeria it occurs in the Picteti Subzone (Bennet et al. 1977, p. 210).

**Genus Banikoceras gen. nov.**

**Etymology.** After Banik, northern Iraq.

**Type species.** *Banikoceras involutum* sp. nov.

**Diagnosis.** Outer whorl involute, smooth, with triangular whorl section, rounded venter, and sharply undercut umbilical walls; inner whorls like *Neocosmoceras*, with strong ribs that are looped between umbilico-lateral and ventro-lateral tubercles, strong constrictions, and grooved venter; ornament disappears rapidly between 25 and 50 mm diameter.

**Remarks.** This new genus is probably an involute, compressed derivative of *Neocosmoceras* or *Kilianella*.

**Age.** Paramimouna Subzone, Upper Berriasian.

**Explanations of Plate 12**

Figs 1–4. *Banikoceras involutum* gen. et sp. nov. 1–2, BMNH C.86954; holotype; wholly septate; loose from screen of beds 48–54; Banik, ×0.8. 3–4, same specimen, the inner whorls showing the strong ribs and tubercles up to 20 mm diameter, ×2.4.

Figs 5, 7. *Thurnmanniceras (Erdenella) iare* (Pomel). BMNH C.86949; wholly septate; from bed 56; Banik, ×1.

Figs 6, 8. *Chigaroceras banikense* gen. et sp. nov. BMNH C.86934; paratype; pachycone and half a whorl of adult body-chamber; from bed 23; Banik, ×0.6.
HOWARTH, Banikoceras, Thurmanniceras, Chigaroceras
Banikoceras involutum sp. nov.

Plate 12, figs 1-4

Holotype. BMNH C.86954, the only specimen, from beds 48-56 at Banik.

Diagnosis. As for the genus.

Description. The single known specimen is still septate at its maximum size of 127 mm diameter. The whorl dimensions at that size are: 125 mm diameter: 640 (0.51), 408 (0.33), 214 (0.17). The final whorl is involute, and has a triangular whorl section, whorl sides that are almost flat and converge to a rounded venter, a small umbilicus, and umbilical walls that slope strongly backwards and undercut the umbilical edge. The inner whorls up to 25 mm diameter are more evolute, and the whorl section is more rounded; strong ribs divide into two or three at tubercles just ventral of the umbilical edge, then most are looped to larger ventro-lateral tubercles, but a few single, unlooped ribs occur; the venter is smooth and forms a groove between the ventro-lateral tubercles; deep, prossiradial constrictions occur on the inner whorls. This ornament disappears between 25 and 30 mm diameter, leaving only very reduced ribs near the ventro-lateral edge up to 75 mm diameter, and the outer whorl is entirely smooth.

Remarks. A new genus and species is created for this single specimen because it is unlikely any other Upper Berriasian or basal Valanginian ammonite. Basically it is a Neocosmoceras (or a Kilianella) that has acquired a smooth, compressed, involute outer whorl, and a remarkable overhanging umbilical edge and a backwardly sloping umbilical wall, so that the umbilicus widens inwards towards the next inner whorl. It is septate up to the maximum size preserved, and must have been at least 190 mm diameter if the body-chamber was half a whorl long.

From the morphology of its outer whorl it might have been thought to be an extreme development of Pseudoneocomites Hoedemaeker (1982, p. 68; type species, Hoplitites retowskiyi Sarasin and Schöndelmayer, 1901), which was created for large involute developments from Neocomites (or Dalmatacereus), that tend to become smooth on the body-chamber. In fact the large holotype of Pseudoneocomites suprajarensis (Mazenot 1939, p. 211, pl. 33, fig. 5) from the Upper Tithonian of south-east France has a similar, though less extreme, outer whorl to the Banik specimen. However, the smallest inner whorls of Pseudoneocomites that have been figured (Hoedemaeker 1982, p. 31, pl. 2, fig. 7; Retowski 1893, p. 265, pl. 11, figs 7-9; Sayn 1907, pl. 3, fig. 14) are in the range 15–50 mm diameter and are involute, compressed and finely ribbed like Neocomites, entirely different from the Banik specimen. The ribs looped between umbilical and ventro-lateral tubercles in the latter are like those of the small pyritized Neocosmoceras from Tunisia figured by Arnould-Saget (1951, pl. 6, figs 3–16), though the ventro-lateral tubercles are larger in that genus. The inner whorls of Kilianella figured by Sayn (1907, pl. 6) also have strong ribs and constrictions like the Banik specimen. These inner whorls are distinctive, and prevent a determination such as Groebericeras being given to the specimen (this was the manuscript identification made by Spath before the inner whorls were exposed). In conclusion it seems likely that as a smooth involute development from Neocosmoceras or Kilianella in the Upper Berriasian, Banikoceras parallels the Upper Tithonian genus Pseudoneocomites which is a smooth involute Neocomites, and also the Lower Hauterivian genus Saynella which is a smooth involute development from Leopoldia.


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