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 underlain 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 *Dorsoplanitoides*, 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 *Chigaroceras*, 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., *Dalmasiceras* (*Elenaella*) *prorsiradiatum* sp. nov., *Berriasella* (*Malbosiceras*) *malbosi*, *Thurmanniceras* (*Erdenella*) *isare*, *Tirnovella alpillensis*, 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

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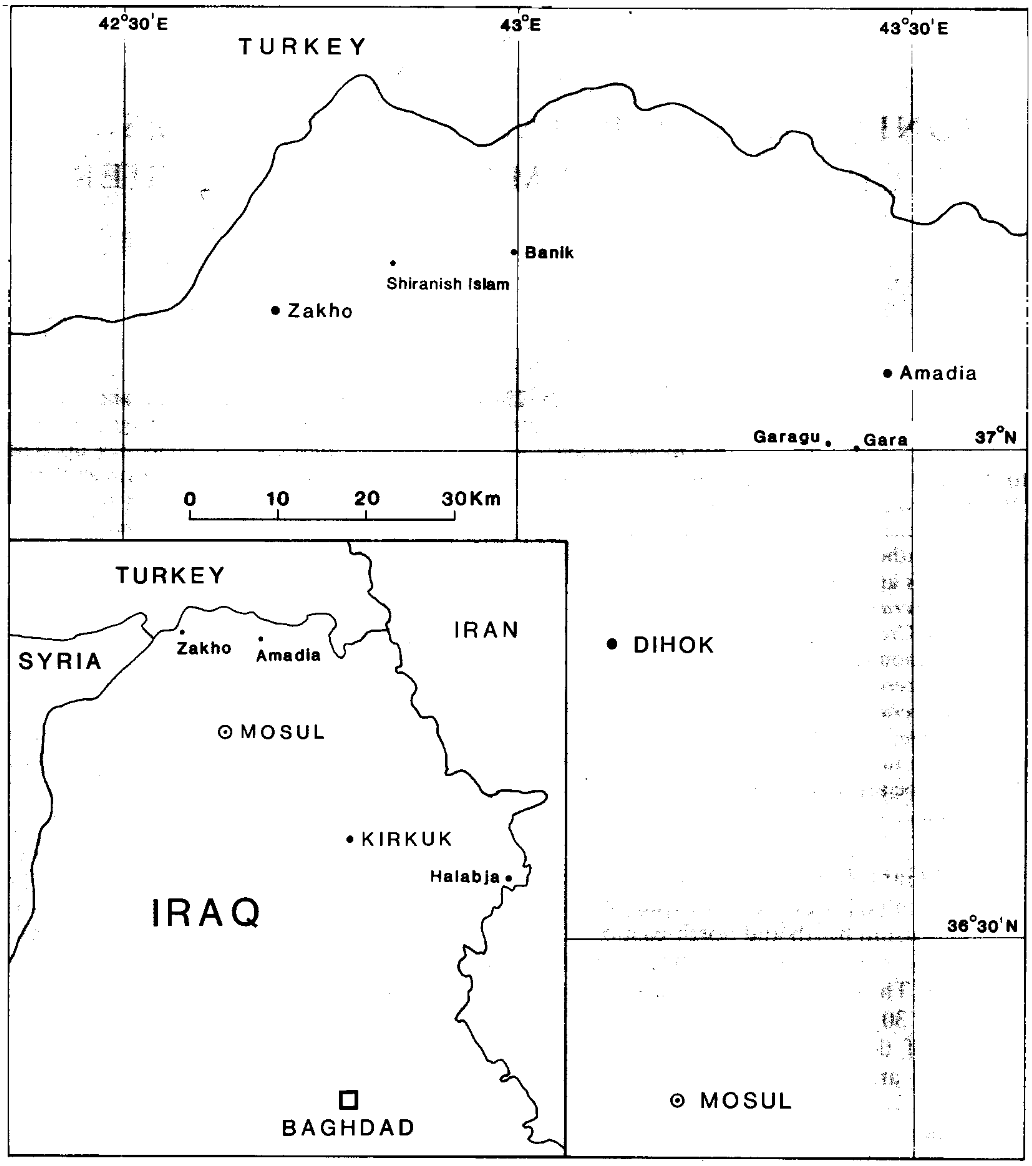


TEXT-FIG. Sketch map of the Kurdistan area of northern Iraq showing the localities from which ammonites were obtained in the Chia Gara Formation.

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 (Test-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

SOUTH AMERICA (after Zeiss)	SOUTH AMERICA (after Jeletzky)		SW EUROPE (SE France, SE Spain)		CENTRAL EUROPE (Bavaria, Carpathians, Crimea)		CAUCASUS MOUNTAINS		MANGYSHLAK PENINSULA (Caspian Sea)	IRAQ Banik	IRAQ Chia Gara
Zones	Zones		Zones	Subzones	Zones	Subzones	Zones	Subzones		Beds	Beds
Neocomites wichmanni	*Neocomites wichmanni*	VALANGINIAN	*Kilianella roubaudiana*	*Tirnovella pertransiens*	*Kilianella roubaudiana*		*Thurmanniceras thurmanni*				
Spiticeras damesi		BERRIASIAN		*Tirnovella alpillensis*	*Fauriella boissieri*			*Fauriella boissieri*			142 141
Argentiniceras noduliferum	*Spiticeras damesi*		*Fauriella boissieri*	*Berriasella picteti*	*Tauricoceras crassicostatum*		*Riasanites riasanensis*	*Riasanites riasanensis*	*Riasanites* (rare)	?56	
— — ? — — —				*Berriasella paramimouna*	*Euthymiceras euthymi*		*Euthymiceras euthymi*	*Euth. euthymi* *Tirn. berriasensis*	*Rias. riasanensis*, *Euth. euthymi*	49-55 46-48	137 136
Substeueroceras koeneni				*Dalmasiceras dalmasi*	*Dalmasiceras dalmasi*			*Dalmasiceras dalmasi*	*Euthymiceras trancaspius*, *Neocosmoceras*		?117
			Tirnovella occitanica	*Berriasella privasensis*	*Spiticeras spitiense*		*Tirnovella occitanica*	*Tirnovella occitanica*			
	Argentiniceras noduliferum			*Tirnovella subalpina*	*Malbosiceras malbosi*						
			Pseudosub. euxinus	*Pseudosubpl. grandis*	*Pseudosubplanites ponticus/euxinus*		*Fauriella latecostata*				
				Berriasella jacobi							104
Corongoceras alternans	*Substeueroceras koeneni*	U TITH	*Durangites*		*Paraulacosphinctes transitorius*		*Paraulacosphinctes transitorius*			23 21	102 100 92
	Corongoceras alternans		*Micracanthoceras microcanthum*								
Windhauseniceras internispinosum	*Windhauseniceras internispinosum*				*Pseudovirg. scruposus*		*Pseudovirgatites scruposus*			16-19	91
Aulacosphinctes proximus	*Aulacosphinctes proximus*	L TITHONIAN	*Micracanthoceras ponti*		*Pseudovirgatites puschi*		*Pseudovirgatites puschi*				
Pseudolissoceras zitteli	*Pseudolissoceras zitteli*		*Semiformiceras fallauxi*		*Pseudoliss. bavaricum*	*Isterites*	*Pseudoliss. bavaricum*	*Isterites*		?16-19	?91
						Lemencia		*Lemencia*			
			Semiformiceras semiforme			*Sublithacoc. Virgatosim.*		*Sublithacoceras*, *Virgatosimoceras*			
Virgatosphinctes mendozanus	*Virgatosphinctes mendozanus*		*Neochetoceras darwini*		*Franconites vimineus* *Dorsoplanit. triplicatus*		*Franconites vimineus* *Dorsoplanitoides triplicatus*				91
			Hybonoticeras hybonotum		*Hybonoticeras hybonotum*		*Hybonoticeras hybonotum*				91

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 (1975*a*, p. 16, 1975*b*, 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 *Paraulacosphinctes 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 occupying 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 (1975*b*, 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-west 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 *Tirnovella alpillenis* as index species for the top subzone (to which it is nearly confined), instead of the much longer-ranging *Berriasella callisto*. The central Europe column is based on the Berriasian zones and subzones in the Crimea according to the latest work of Drushchits (1975, p. 341), Kvantaliani and Lyssenko (1979*a*, 1979*b*), Bogdanova *et al.* (1981), and Bogdanova and Kvantaliani (1983), as interpreted by Jeletzky (1984, p. 240). This area includes significant representatives of the more northern ammonites *Tauricoceras* (which is closely related to *Riasanites*) 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 *Riasanites* 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 *Groebericeras* 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 (1981*a*, 1981*b*), 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 calpionellid zonations (calcareous nannoplankton) of those areas. The main difference between them centres on the rich South American assemblages of *Substeueroceras*, because most of the other Berriasian and Upper Tithonian index ammonites are confined to the South American area. Jeletzky's placing of the *Substeueroceras 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 *Groebericeras* are in the Paramimouna, 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 Chaug 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):

Bed nos.		m
305–313.	Qara Chauq Limestone. Dolomitic limestone. Eocene–Miocene.	109.1
269–304.	Dohuk Formation. Marl, sand, sandstone, conglomerate. Maastrichtian, Palaeocone, Eocene.	364.3
241–268.	Aqra Limestone Formation. Dolomite, limestone, marl. Maastrichtian.	155.3
180–240.	Bekhme Limestone Formation. Limestone. Campanian–Maastrichtian. Disconformity at base. Qamchuqa Limestone Formation. Dolomite, limestone. Barremian-Albian. Sarmord Formation. Marl, limestone. Hauterivian–Barremian.	669.4
140–179.	Garagu Formation. Marl, limestone, sandstone, sand. Barremian–Valanginian.	92.2
90–139.	Chia Gara Formation. Limestone, shale. Tithonian–Berriasian.	232.4
87–89.	Barsarin Formation. Limestone. Kimmeridgian.	23.7
81–86.	Naokelekan Formation. Limestone. Oxfordian–Kimmeridgian.	28.5
65–80.	Sargelu Formation. Limestone, shale. Bajocian–Bathonian. Sehkaniyan Formation. Dolomite, limestone. Lower Jurassic (?Toarcian).	46.0
8–64.	Sarki Formation. Limestone, shale, massive dolomites at top and base. Lower Jurassic.	470.8
1–7.	Baluti Shale Formation. Shale, thin limestones. Rhaetian.	36.2

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):

Bed nos. m

GARAGU FORMATION (lower part only)

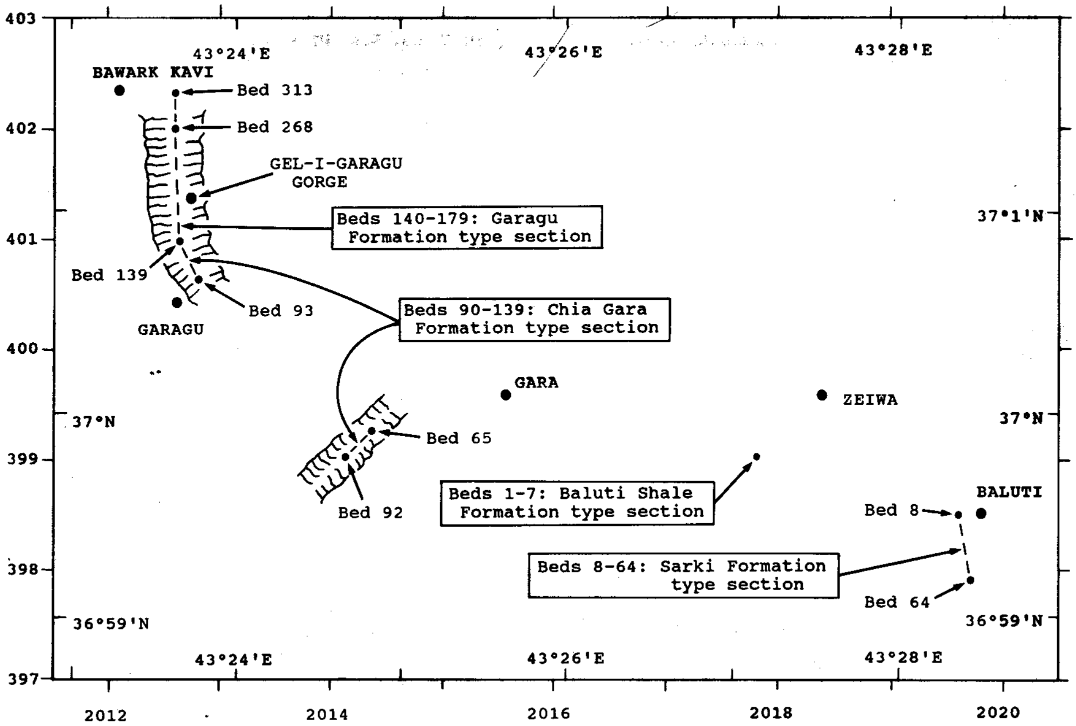
BERRIASIAN

Zone of *Fauriella boissieri*

Subzone of *Tirnovella alpillensis* or *Berriasella* (*Berriasella*) *picteti*

142. Yellow crystalline limestone, thickly bedded. 3.50
Groebericeras rocardi (Pomel) (1). [*Groebericeras* (?) sp. indet.].

141. Yellow, oolitic, ferruginous limestone. 2.50



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 (Altinli 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. | m

Tirnovella alpillensis (Mazenot) (1) (Pl. 9, figs 3–4). [*Subthurmannia* ('*Neocomites*') *occitanica* (Pictet). 'Lower Valanginian; ammonite derived from the Chia Gara Formation'].

140. Yellow and brown marl, and thin limestone. 7.00
No ammonites.

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*) *paramimouna*

137. Yellow marl with limestone concretions. Many ammonites, bivalves, gastropods, brachiopods and echinoids in the concretions. 0.80
Spiticeras (*S.*) *spathi* sp. nov. (3) (Pl. 4, figs 1–2, 6–7); *Groebericeras rocardi* (Pomel) (6); *Berriasella* (*Malbosiceras*) *malbosi* (Pictet) (7) (Pl. 7, figs 1–4, 7–8);

Bed nos.		m
	Dalmasiceras (*Elenaella*) *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). [*Groebericeras* spp, nov (5 species); *Protacanthodiscus* (?) ssp. nov. (4 species); new himalayitid].	
136.	Thin-bedded grey limestone alternating with yellow marl. *Groebericeras rocardi* (2) (Pl. 6, figs 1, 3). [*Groebericeras* sp. nov. (*Craspedites*-like)].	3.50
135.	Grey and yellow marl.	2.30
134.	Grey marly limestone.	5.00
133.	Yellow marl.	0.50
132.	Hard brown limestone. Many molluscs and brachiopods. Indeterminate berriasellids (2). [*Acanthodiscus* sp.; ?*Dalmasiceras* sp.; *Berriasella* sp.; *Neocomites praeneocomiensis* Burckhardt].	4.00
128–131.	Hard limestone, marly in basal 3 m. No ammonites.	12.60
127.	Limestone. Many molluscs, brachiopods and traces of large ammonites.	2.60
123–126.	Marly limestone in top 6·5 m, hard limestone in bottom 4·1 m.	10.60
122.	Limestone, with marly bands. *Spiticeras* or *Groebericeras* sp. indet. (1).	4.00
121.	Hard limestone. Bivalves.	4.00
120.	Marly limestone.	4.90
119.	Hard limestone. Oysters at top.	3.50
118.	Marly limestone. Oysters at top.	5.60
117.	Hard limestone, with marly bands. ?*Berriasella* sp. indet. (2); ?*Neocosmoceras* sp. indet. (1). [?*Parodontoceras* sp. indet.; ?*Berriasella* sp.; *Acanthodiscus* spp.].	4.00
105–116.	Alternating hard and marly limestones, with some marl and shale. Poorly preserved molluscs and occasional traces of ammonites.	39.20
	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. *alpillensis* Mazenot; *Berriasella* aff. *carpathica* (Pictet). 'Base of the Cretaceous'].	4.80
	TITHONIAN	
	?Zone of *Durangites*	
103.	Hard limestone.	4.90
102.	Hard limestone, with marly bands. Ammonites in lower half. *Protacanthodiscus* cf. *perornatus* (Retowski) (1) (Pl. 7, fig. 9); indet. berriasellids (7). [*Parodontoceras*; *Berriasella* (including *B.* aff. *privasensis*); *Protacanthodiscus*].	12.00
101.	Hard limestone.	5.50
100.	Hard limestone, with marly bands. *Protancyloceras hondense* (Imlay) (3) (Pl. 2, figs 2, 4, 7); *P.* cf. *kurdistanense* Spath (6) (Pl. 2, fig. 1); ?*Blanfordiceras* sp. indet. (3), indet. berriasellids (5). [*Ancyloceras* sp.; *Berriasella* aff. *privasensis* (d'Orbigny); ?*Kossmatia* sp.; '*Leptoceras*' spp.; *Parodontoceras* aff. *calistoides* (Behrendsen); *Parodontoceras* spp.; *Protacanthodiscus* aff. *perornatus* (Retowski); *Protancyloceras* spp.].	4.00
99.	Hard limestone, alternating with marly limestone.	4.00
96–98.	Soft marly limestone.	21.20
95.	Yellow-brown bituminous shale.	7.50
94.	Hard limestone. Impressions of ammonites.	0.50
93.	Marly limestone with bands of shale. Impressions of ammonites. [Base of the section in the Gel-i-Garagu gorge].	11.00
	Zone of *Durangites* (lower part) or *Micracanthoceras microcanthum* (upper part)	
92.	Dark blue limestone, highly bituminous. Many impressions of ammonites. *Substeueroceras koeneni* (Steuer) (20) (Pl. 1, figs 9–10; Pl. 2, figs 3, 10); *Substeueroceras* sp. indet. (21); *Berriasella* sp. indet. (1); *Protacanthodiscus* cf. *andraei* (Kilian) (2); *Haploceras* sp. indet. (1). [*Grayiceras* ('*Simbirskites*') sp.;	14.50

Bed nos. m

Haploceras spp.; *Parodontoceras* cf. *beneckei* (Steuer); *Spiticeras* (*Kilianiceras*) cf. *chomeracense* Djanélidzé; *Substeuroceras* ?*striolatum* (Steuer); *S.* cf. *ellipsostomum* (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. 10.00

Abundant ammonites in the concretions, identified and described by Spath (1950): (*a*) from Microcanthum or ?Bavaricum Zone – *Protancyloceras kurdistanense* Spath (7); *P.* aff. *gracile* (Oppel) (3); *Cochlocrioceras turriculatum* Spath (9) (Pl. 2, figs 5–6); *Oxylenticeras lepidum* Spath (8); *Glochiceras* (?) sp. nov. (1); *Glochiceras* sp. indet. (6); *Pseudolissoceras zitteli* (Burckhardt) (11); *P. advena* Spath (5); *Phanerostephanus subsenex* Spath (34) (Pl. 1, figs 7–8); *P. hudsoni* Spath (2); *P. intermedius* Spath (4); *P. dalmasiformis* Spath (3); *Nannostephanus subcornutum* Spath (32) (Pl. 1, figs 3–4); *Nothostephanus kurdistanensis* Spath (42) (Pl. 1, figs 1–2); *Proniceras garaense* Spath (4); *Proniceras simile* Spath (3), *Lamellaptychus* sp. indet. (1); (*b*) from Darwini Zone – *Dorsoplanitoides* (*D.*) *bavaricus* Zeiss (1) (Text-fig. 5A–B); (*c*) from Hybonotum Zone – *Hybonoticeras hybonotum* (Oppel) (1) (Pl. 1, figs 5–6).

90. Blue-grey limestone, with marly bands. 11.00

BARSARIN FORMATION

87–89. Blue and grey limestones, laminated and brecciated in parts. No ammonites. ?Kimmeridgian. 23.70

NAOKELEKAN FORMATION

86. Limestone, alternating with shale. No ammonites. 4.50

85. Marly, dolomitic limestone. 2.50

Indeterminate perisphinctids (3). [*Discosphinctes* sp. indet.; ?*Planites* sp.; ?*Nebrodites* sp. Lower Kimmeridgian].

84. Obscured. 3.50

83. Coarse, detrital limestone, some shale bands; highly bituminous, weathers to large concretions ('phacoids'). The 'Coal horizon'. 10.00

Orthosphinctes desmoides (Wegele) (1) (Text-fig. 5D); indeterminate perisphinctid (1). Lower Kimmeridgian.

82. Thin-bedded, dolomitic limestone. 3.50

81. Hard dolomitic limestone. 4.50

Aulacostephanus cf. *volgensis* (Vischniakoff) (1) (Text-fig. 5C); indeterminate perisphinctids (2); indeterminate ammonite (1). Lower Kimmeridgian. Base of Naokelekan Formation.

Beds 81–89

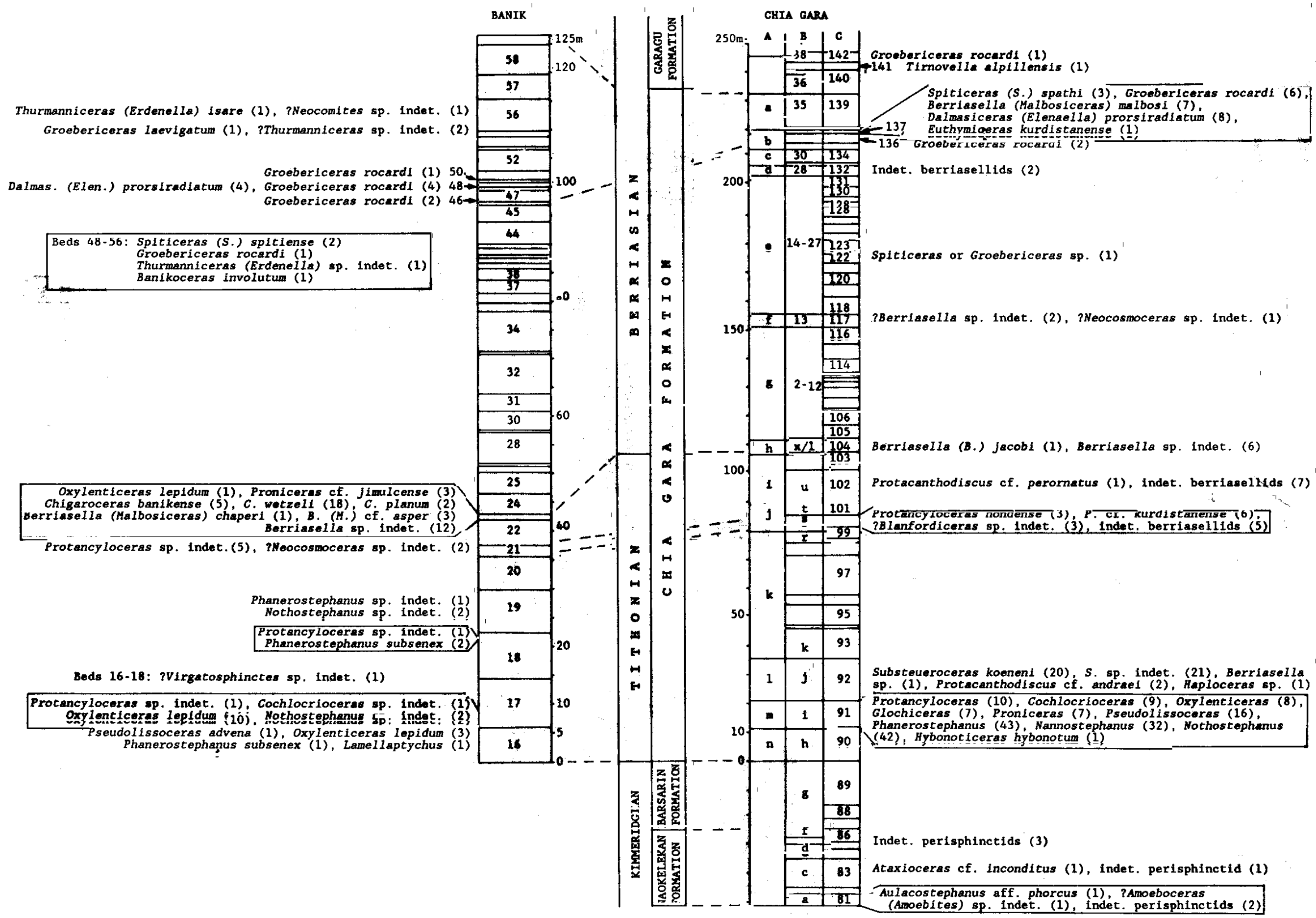
Poorly preserved fragments of ammonites found in beds 81, 83 and 85 were identified by Spath with Kimmeridgian genera and species. These beds are in the Naokelekan Formation and Spath's determinations were quoted by Wetzel (1959, p. 213). The ammonite that Spath identified as *Aulacostephanus* aff. *phorcus* (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, but it has the characteristic *Aulacostephanus* features of fibs bundled from umbilical tubercles and small ventro-lateral tubercles bordering a flat venter. It is more involute and has more ribs than the evolute and more coarsely ribbed and tuberculate species *A. phorcus* (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 small 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 Wetzel 1959, p. 213). Revision of the Ataxioceratinae 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. 5D). In its finer ribs and slightly more secondaries, the latter specimen resembles *Orthosphinctes desmoides* (Wegele 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 subsenex* (Pl. 1, figs 7–8), *Nannostephanus subcornutus* (Pl. 1, figs 3–4) and *Cochlocrioceras turriculatum* (Pl. 2, figs 5–6). A much better example of Spath's fifth new genus, *Oxylenticeras 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, *Pseudolissoceras zitteli* characterizes the Lower Tithonian Fallauxi and Semiforme Zones (equivalent to the Bavaricum Zone 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*, *Pseudolissoceras*, *Proniceras*, *Oxylenticeras*, *Cochlocrioceras*, and *Protancyloceras* – 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 '*Virgatosimoceras* 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.*) *bavaricus* 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 vimineus* (Schneid) 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.*) *bavaricus* 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 garaense* Spath (1950, pl. 10, fig. 1), and there are several associations of *Nannostephanus*, *Cochlocrioceras* and *Pseudolissoceras* in the single pieces of rock. A full list of all the physical associations is as follows:

Pseudolissoceras ssp. + *Nannostephanus subcornutus*
Pseudolissoceras zitteli + *Cochlocrioceras turriculatum*
Nannostephanus sp. + *Cochlocrioceras* sp. + *Psdeudolissoceras* spp.
Protancyloceras aff. *gracile* + *Nannostephanus* sp. + *Cochlocrioceras* sp.
Proniceras garaense + *Nothostephanus* sp.
Proniceras garaense + *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*, *Cochlocrioceras*, *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 Islam lacks only *Cochlocrioceras*. Therefore, as emphasized by Spath, it is necessary to find a single zonal age for these ammonites (i.e. excluding the *Hybonoticeras hybonotum* and *Dorsoplanitoides bavaricum*). The dating evidence from the various groups of ammonites is as follows:

1. Perisphinctidae. The three perisphinctid genera belong to the subfamily Virgatosphinctinae (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 mắcroconch and microconch respectively, they could be united under the generic name *Nothostephanus*, which has the better preserved holotype. They are probably a development from *Virgatosphinctes*, 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 persphinctid ribs remain. *Nannostephanus* may well be another synonym of *Nothostephanus*. As probable developments from *Virgatosphinctes*, 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*, *Virgatosphinctes*, *Pseudinvoluticeras* and *Aulacosphinctes*. The presence of *Hybonoticeras* led this fauna to be dated as approximately Darwini 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 hollandi* Zone, which represents the whole of the Upper Tithonian. Two of them (Collignon 1960, pl. 159, figs 632, 634) came from the same bed (gisement 238, Antsalova) as four species of *Aulacosphinctes* (including *A. hollandi* Uhlig; Collignon 1960, figs 707, 710, 733–734, 739), two species of *Hemisimoceras* (figs 637, 639), and *Spiticeras* (*Kilianiceras*) *jacobi* Collignon (fig. 662). This is an Upper Tithonian fauna, not older than the Microcanthum Zone, and is a definite identification of the age of *Phanerostephanus* in Madagascar (*P. besairei* Collignon is very similar to the Kurdistan species *P. hudsoni* Spath).

The alleged occurrence of *Phanerostephanus* in the Lower Tithonian, Hybonotum Zone, at Mombasa, Keyna, 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 *Gravesia loupekinei* 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 *Sublithacoceras*. The ammonites from the Lower Tithonian of south-east France described by

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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.

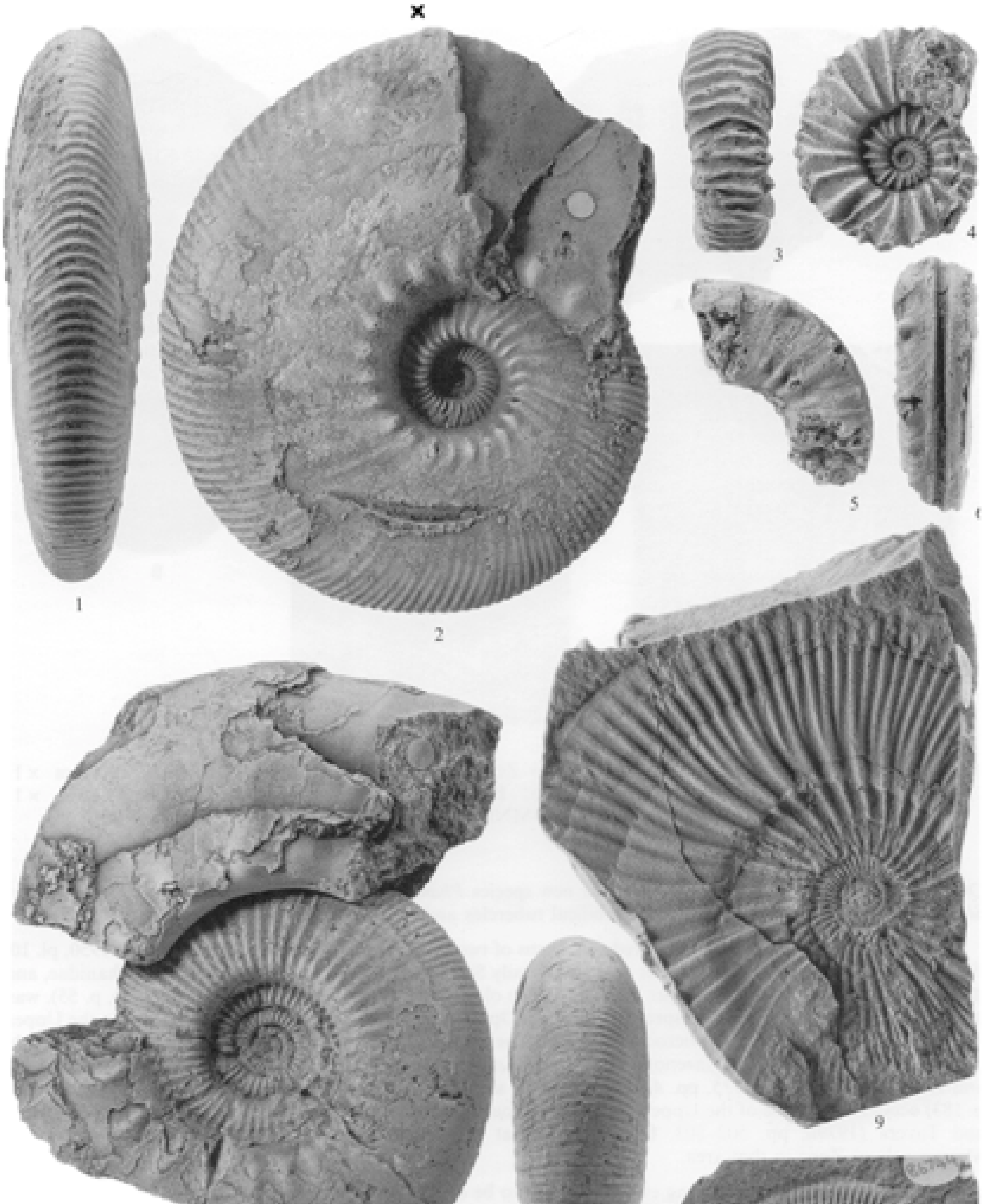
Figs 3–4. *Nannostephanus subcornutus* Spath. BMNH C.41066; holotype (figured Spath 1950, pl. 10, fig. 7); from bed 91; Chia Gara, ×2.

Figs 5–6. *Hybonoticeras hybonotum* (Oppel). BMNH C.41290; wholly septate; from bed 91; Chia Gara, ×2.

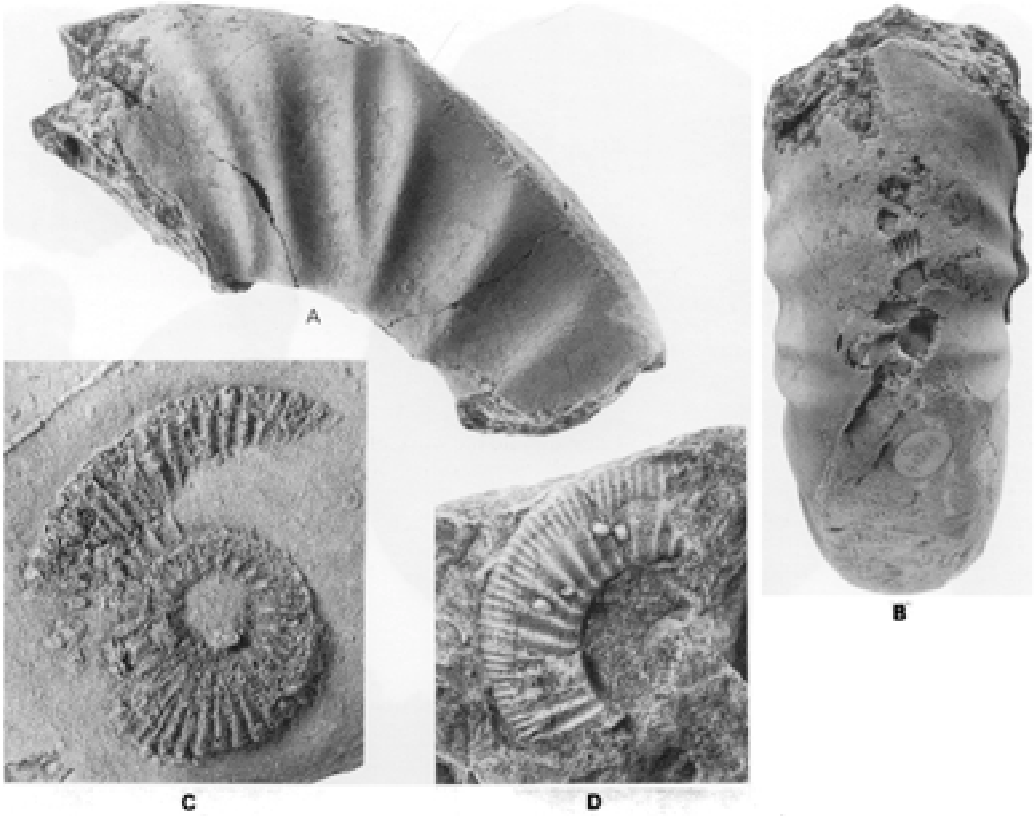
Figs 7–8. *Phanerostephanus subsenex* spath. BMNH C.41166, holotype, an almost complete adult (?microconch) (figured Spath 1950, pl. 7, fig. 5); from bed 91; Chia Gara, ×1.

Figs 9–10. *Substeueroceras koeneni* (Steuer). 9, BMNH C.86750. 10, BMNH C.86744. Both from bed 92; 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.



HOWARTH, Upper Tithonian ammonites



TEXT-FIG. 5. A, B, *Dorsoplanitoides (D.) bavaricus* Zeiss; BMNH C.41284; from bed 91; Chia Gara ×1. C, *Aulacostephanus* cf. *volgensis* (Vischniakoff); BMNH C.41292; from bed 81; Chia Gara, ×1. D, *Orthosphinctes desmoides* (Wegele); BMNH C.41291; from bed 83; Chia Gara, ×1·5.

Donze and Enay (1961, pp. 140–147) as their new species *Phanerostephanus grandis* (ex. *Perisphinctes dacquei* Schneid) and *P. allobrogicus* also lack umbilical tubercles and belong to *Sublithacoceras*.

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 Spiticeratinae, and of the family Olcostephanidae, and it appears at the bottom of the Upper Tithonian. The oldest species, *P. simplex* Djanélidzé (1922*b*, p. 55), was quickly followed by the more widespread *P. pronum* (Oppel) (Djanélidzé 1922*b*, p. 70). They occur in the Upper Tithonian from the base of the Microcanthum Zone, or its equivalents, according to the stratigraphical records of Djanélidzé (1922*b*, 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 *Simospiticeras* Oloriz and Tavera (1979*a*, p. 183) occurs at the base of the Upper Tithonian in south-east Spain, and the stratigraphical records of Oloriz and Tavera (1979*b*, pp. 502–503, fig. 3) show that the oldest Spiticeratinae occur at the base of the Microcanthum 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 Bavaricum 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, p. 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. Protancyloceras* 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 *Cochlocrioceras* are endemic Kurdistan genera. *Oxylenticeras* is a genus of the subfamily Streblitinae which ranges from Kimmeridgian to Hauterivian. *Cochlocrioceras* is an allegedly helically-coiled genus of the Bochianitidae, 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 *Cochlocrioceras* 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 *Proniceras* is crucial in determining that age as Microcanthum Zone, Upper Tithonian, following the records of Djanélidzé (1922*b*), the opinions of Jeletzky (1989, p. 155), and Oloriz and Tavera's (1979*a*, 1979*b*) investigations of the date of the earliest Spiticeratinae in Spain. However, if the latter subfamily, and *Proniceras* in particular, had its origin in Kimmeridgian Idoceratinae, then Spiticeratinae 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 Bavaricum 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 *Substeueroceras*. 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 *Substeueroceras* sp. indet. Spath identified them as three species of *Substeueroceras*, one species of the very similar genus *Parodontoceras*, and '*Grayiceras* ("*Simbirskites*") sp.'. However, all have the characters of *S. koeneni* (Steuer) and its synonyms, as displayed by the broader interpretation of that species adopted by Verma 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 *Spiticeras* cf. (*Kilianiceras*) *chomeracense* Djanélidzé as quoted by Wetzel (1959, p. 73) from bed 92. This is a distinctive evolute and strongly tuberculate spiticeratid, and the origin of Spath's identification is unknown. *Substeueroceras* occurs uncommonly in the Durangites Zone in south-east France and other localities in Europe, and commonly in the Koeneni Zone in South America. *Protacanthodiscus* 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 Microcanthum Zone.

Bed 100

Nine specimens of *Protancyloceras* 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 *Protancyloceras* 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 *Protancyloceras hondense* (Imlay), 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 *Blanfordiceras*, and five other Berriasellids which were identified as *Parodontoceras* and ?*Kossmatia* by Spath, but they are very poorly preserved, and are not identifiable. The example of *Protacanthoceras* aff. *perornatus* (Retowski) included in the bed 100 fauna by Wetzel (1959, p. 73) comes in reality from bed 102. The presence of *Protancyloceras* and ?*Blanfordiceras* 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 unidentifiable berriasellids. The latter were identified by Spath as *Parodontoceras* and *Protacanthoceras*, but they are very poor and fragmentary. The *Protacanthoceras* 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 Alpillensis Subzones at the tope of the Berriasian by Le Hégarat (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 praeneocomiensis* 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 ?*Neocosmoceras* sp. indet. in bed 117, which is possibly similar to the inner whorls of *N. flabelliforme* figured by Le Hégarat (1973, p. 136, pl. 44, fig. 2), suggests that bed 117 is probably of Privasensis to Paramimouna 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 ammonites 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 Paramimouna to Alpillensis Subzones age in south-east Spain. Other ammonites in bed 137 are a new species of *Dalmasiceras* (*Elenaella*) (p. 636), which could be of Paramimouna Subzone age, a new large species of *Spiticeras* (*Spiticeras*) (p. 623), which does not help in accurately dating, and seven examples of *Berriasella* (*Malbosiceras*) *malbosi* (p. 632). The latter occurs in the Dalmasi, Paramimouna and Picteti Subzones, but is commonest in the Paramimouna 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 himalayitid'). 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 Paramimouna Subzone. The average of the age ranges of all these ammonites in bed 137 is Paramimouna Subzone, which is the date that can be confidently given to that bed.

Beds 141 and 142

Single ammonites are known from both beds: *Tirnovella alpillensis* occurs in bed 141 (p. 648), and the highest *Groebericeras rocardi* in bed 142. *T. alpillensis* is the index ammonite for the Alpillensis Subzone, but it first occurs in the top part of the Picteti Subzone according to the stratigraphical records of Hoedemaeker (1982, encl. 4). The highest occurrences of *Groebericeras* are in the Alpillensis Subzone. Although Alpillensis 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 Garagu Formations are part of the same continuous sequence of beds 600 m north of Garagu (Text-fig. 3). In defining the Garagu 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 *Tirnovella alpillensis* in bed 141 as '*Subthurmannia* ("*Neocomites*") *occitanica* (Pictet)', which he said was definitely of Berriasian 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 Berriasian Chia Gara Formation. There are several misconceptions here: first, *Tirnovella occitanica* occurs lower in the Berriasian, mainly in the Privasensis Subzone, and differs from *T. alpillensis* in having reduced ribbing; secondly, the ammonite in question has a ferruginous, oolitic matrix like that of the Garagu Formation and unlike that of the Chia Gara Formation, and it shows no signs of derivation; and thirdly, the base of the Garagu 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 Garagu Formation to be determined. That it is top Berriasian 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:

Succession 1–5 km north of Banik:

Bed nos.		m
	'Fars formation'; Miocene; Basal contact obscured	
141–156.	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
137–140.	Dohuk Formation. Conglomerates, sandstones, marls. Palaeocene, Eocene.	467.0
117–136.	Tanjero Clastic Formation. Sand, sandstone. Maastrichtian.	594.1
105–116.	Shiranish Formation. Marl, limestone. Maastrichtian.	258.3
86–104.	Bekhme Limestone Formation. Hard limestone; disconformity at base. Campanian.	83.3
77–85.	Qamchuqa Limestone Formation. Limestone. Disconformity at base. Barremian–Albian.	46.2
60–76.	Garagu Formation. Sandstone, marl, limestone. Valanginian.	19.8
16–59.	Chia Gara Formation. Limestone, Shale. Tithonian–Berriasian.	126.6
9–15.	Barsarin Formation. Dolomitic limestone. ?Kimmeridgian.	47.3
5–8.	Naokelekan Formation. Limestone, shale. ?Oxfordian–Kimmeridgian.	10.7
2–4.	Sargelu Formation. Thin-bedded dolomite, shale. Bajocian–Bathonian.	94.0
1.	Sehkaniyan Formation. Dolomite, limestone. Lower Jurassic (?Toarcian).	130.0

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.

Bed nos.		m
	CHIA GARA FORMATION (total thickness 126·6 m)	
	BERRIASIAN	
59.	Grey marly limestone.	1.70
58.	Hard dolomitic limestone. Small oysters.	5.20
57.	Hard limestone. Small oysters.	4.30

Bed nos.		m
	Zone of *Fauriella boissieri* Subzones of *Tirnovella alpillensis*, *Berriasella (B.) picteti*, or *B. (Malbosiceras) paramimouna*	
56.	Marly limestone, alternating with yellow marl. Many molluscs. *Thurmanniceras (Erdenella) isare* (Pomel) (1) (Pl. 12, figs 5, 7); ?*Neocomites* sp. indet. (1).	5.60
	Subzone of *Berriasella (Malbosiceras) paramimouna*	
55.	Grey concretionary limestone. Many molluscs. *Groebericeras laevigatum* sp. nov. (1) (Pl. 6, figs 5–6); ?*Thurmanniceras* sp. indet. (2).	1.00
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
50.	Limestone. Molluscs, ammonites at top. *Groebericeras rocardi* (Pomel) (1).	0.40
49.	Shale.	1.00
48.	Yellow-brown limestone. Many ammonites, other molluscs and brachiopods. *Groebericeras rocardi* (4) (Pl. 4, figs 3–4); *Dalmasiceras (Elenaella) prorsiradiatum* sp. nov. (4). [From scree of beds 48–56; *Spiticeras (S.) spitiense* (Blanford) (2) (Pl. 5, figs 1, 4); *Groebericeras rocardi* (1) (Pl. 6, figs 2, 4); *Thurmanniceras (Erdenella)* sp. indet. (1); *Banikoceras involutum* gen. et sp. nov. (1) (Pl. 12, figs 1–4)].	0.60
47.	Shale.	2.00
46.	Hard limestone. Many molluscs. *Groebericeras rocardi* (2) (Pl. 5, figs 5–6).	0.50
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. *jimulcense* Imlay (3) (Pl. 5, figs 2–3); *Berriasella (Malbosiceras) chaperi* (Pictet) (1) (Pl. 9, figs 6–7); *B. (M.)* cf. *asper* Mazenot (3) (Pl. 9, figs 5, 8); *Berriasella* spp. indet. (12); *Chigaroceras banikense* gen. et sp. nov. (5) (Pl. 10, figs 1–3, 6; Pl. 12, figs 6, 8); *C. wetzeli* sp. nov. (18) (Pl. 10, figs 4–5; Pl. 11, figs 1, 3–5); *C. planum* sp. nov. (2) (Pl. 11, figs 2, 6).	0.80
22.	Shale.	4.50
21.	Black, marly, bituminous limestone. *Protancyloceras* sp. indet. (5); ?*Neocosmoceras* sp. indet. (2); indeterminate Berriasellids (8).	2.00
20.	Black shale.	5.60
	Zone of *Micracanthoceras microcanthum*	
19.	Black shale with bands of dolomite. *Phanerostephanus* sp. indet. (1); *Nothostephanus* sp. indet. (2).	7.60
18.	Dolomite, with thin beds of shale, and small 'phacoid' concretions. From 2 m below top: *Protancyloceras* sp. indet. (1); *Phanerostephanus subsenex* Spath (2).	8.00
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: *Protancyloceras* sp. indet. (1); *Cochlocrioceras* sp. indet. (1); *Oxylenticeras lepidum* Spath (10) (Pl. 2, figs 8–9; Pl. 3, figs 1–2); *Nothostephanus* sp. indet. (2); *Lamellaptychus* (1).	8.50
16.	Shale, with dolomite 'phacoid' concretions; all highly bituminous; abundant small ammonites.	6.00

Bed nos.		m
	Pseudolissoceras advena Spath (1); *Oxylenticeras lepidum* (3); *Phanerostephanus subsenex* (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); *Protancyloceras* sp. indet. (1)].	
	BARSARIN FORMATION	
9–15.	Hard dolomite. No ammonites.	47.30
	NAOKELEKAN FORMATION	
8.	Limestone.	1.90
7.	Shale.	3.30
6.	Dolomite.	1.50
5.	Limestone, highly bituminous: the 'Coal horizon'	4.00
··	Indeterminate perisphinctids (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 30·1 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*, *Cochlocrioceras* and *Protancyloceras* 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 perisphinctids 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 Microcanthum 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 *Neocosmoceras*, suggests that the age is Upper Tithonian rather than Berriasian. No age information can be deduced from the eight indeterminate Berriasellids in the bed. Bed 21 is probably similar in age to bed 100 on Chia Gara, i.e. Upper Tithonian, Durangites Zone or upper Microcanthum 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* (*Malbosiceras*); 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.*) cf. *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 berriasellids 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. *jimulcense* 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 *Groebericeras*; 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 *Groebericeras* from bed 55 is made the type of a new large species, *G. laevigatum*, which has smooth whorls of near-circular whorl section (p. 630, Pl. 6, figs 5–6). Four examples of *Dalmasiceras* (*Elenaella*) *prorsiradiatum* 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 *Dalmasiceras* and *Groebericeras*. The Chia Gara beds are mainly of Paramimouna 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 ?*Neocomites* sp. indet. in bed 56, which might be from the Alpillensis Subzone, and the single example of *Thurmanniceras* (*Erdenella*) *isare* also in bed 56 (Pl. 12, figs 5, 7), which is of Paramimouna or Picteti Subzone age. The other ammonites at Banik are from the Paramimouna 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 screes of bed 48–56 include a large fragment of *Thurmanniceras* (*Erdenella*) sp. indet., two examples of *Spiticeras spitiense* (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 two 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 *Dorsoplanitoids* (*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, Microcanthum Zone, or Lower Tithonian, Bavaricum Zone age. They are *Pseudolissoceras* and the endemic Kurdistan genera *Nothostephanus* (including *Phanerostephanus* and *Nannostephanus*), *Oxylenticeras* and the poorly known *Cochlocrioceras*. *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 *Substeueroceras*, which is the most abundant occurrence of the genus outside the Americas. *Protancyloceras*, 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. *Groebericeras 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 Paramimouna 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* (*Elenaella*) 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 *Chigaroceras* 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 *Groebericeras*, and the endemic Tithonian ammonites at both localites, 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.

Family OPPELIIDAE Douvillé, 1890
Subfamily STREBLITINAE Spath, 1925
Genus OXYLENTICERAS Spath, 1950

Type species. O. lepidum Spath, 1950, by original designation.

Oxylenticeras lepidum Spath, 1950

Plate 2, figs 8–9, 11–12; Plate 3, figs 1–2; Text-fig. 6B

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. Sature-line highly complex, and has strongly indented and undercut saddles.

Measurements.	D	Wh	Wb	U	Wh/Wb
BMNH C.86861	96·1 (1·00)	60·1 (0·63)	20·6 (0·21)	0·0	2·92
C.86866	63·7 (1·00)	40·2 (0·63)	16·6 (0·26)	0·0	2·42
C.86867	52·2 (1·00)	31·3 (0·60)	13·8 (0·26)	0·0	2·27
C.86929	23·5 (1·00)	13·6 (0·58)	6·4 (0·27)	2·5 (0·11)	2·13

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 Shiranish Islam, 14 km north-east of Zakho. All are small and poorly preserved; they consist of solid phragmocones and any part of the body-chamber that is preserved is crushed flat. The holotype is much the largest phragmocone 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. *Protancyloceras* cf. *kurdistanense* Spath. BMNH C.86798; from bed 100; Chia Gara, ×1.

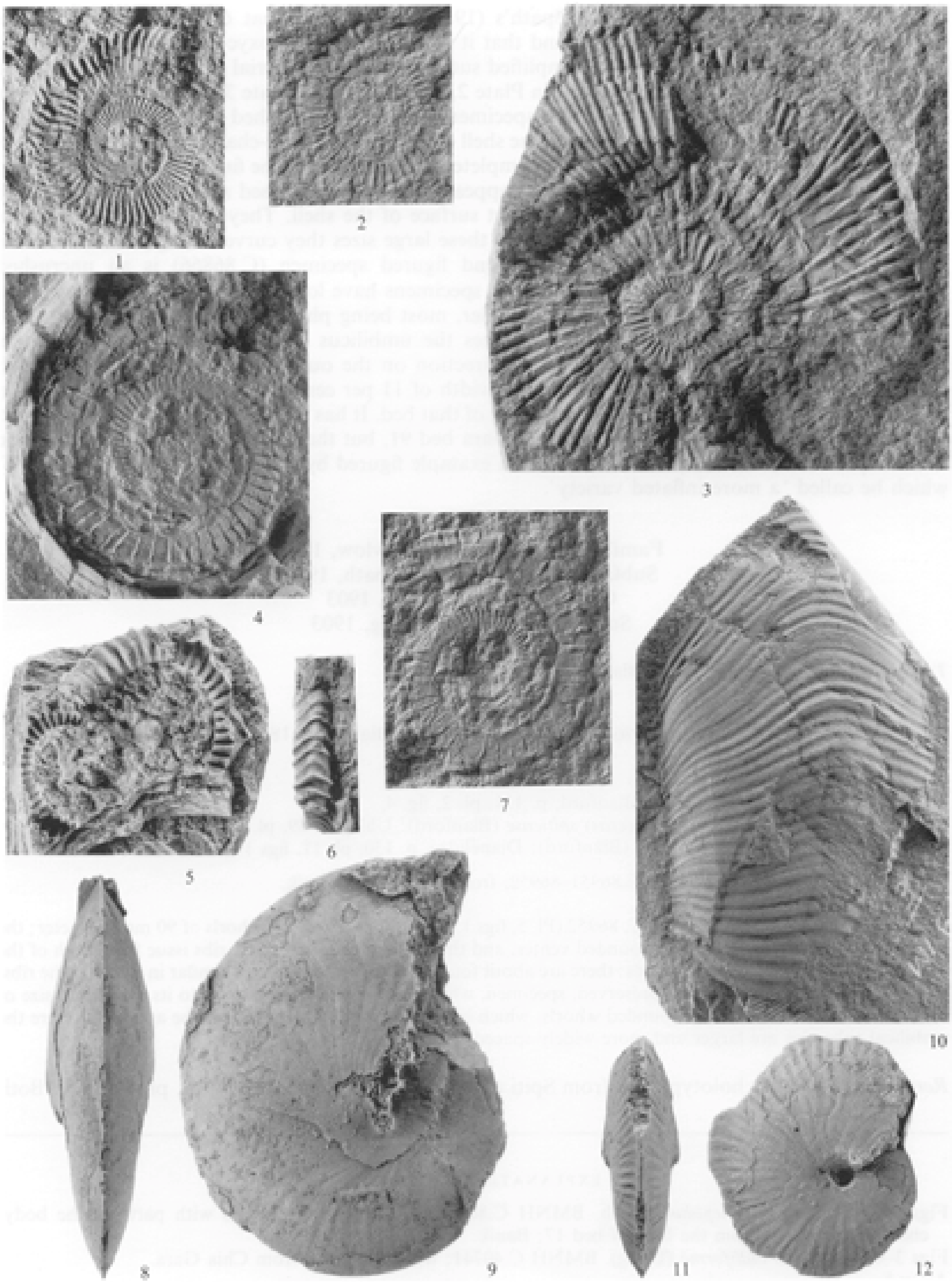
Figs 2, 4, 7. *Protancyloceras hondense* (Imlay). 2, BMNH C.86795. 4, BMNH C.87068. 7, BMNH C.87067. All from bed 100; Chia Gara, ×1.

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

Figs 5–6. *Cochlocrioceras turriculatum* 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.

PLATE 2



HOWARTH, Upper Tithonian ammonites

complex and indented, and confirms Spath's (1950, p. 99) belief that *Oxylenticeras* should be referred to the subfamily Streblitinae, 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 Pavlow, 1892
Subfamily SPITICERATINAE 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 *Holcostephanus* (*Spiticeras*) *spitiense* (Blanford): Uhlig, p. 89, pl. 8, figs 1–3.
?1922*b* *Spiticeras* cf. *spitiense* (Blanford); Djanélidzé, p. 130, pl. 11, figs 1–2.

Material. Two specimens, BMNH C.86951–86952, from beds 48–56, Banik.

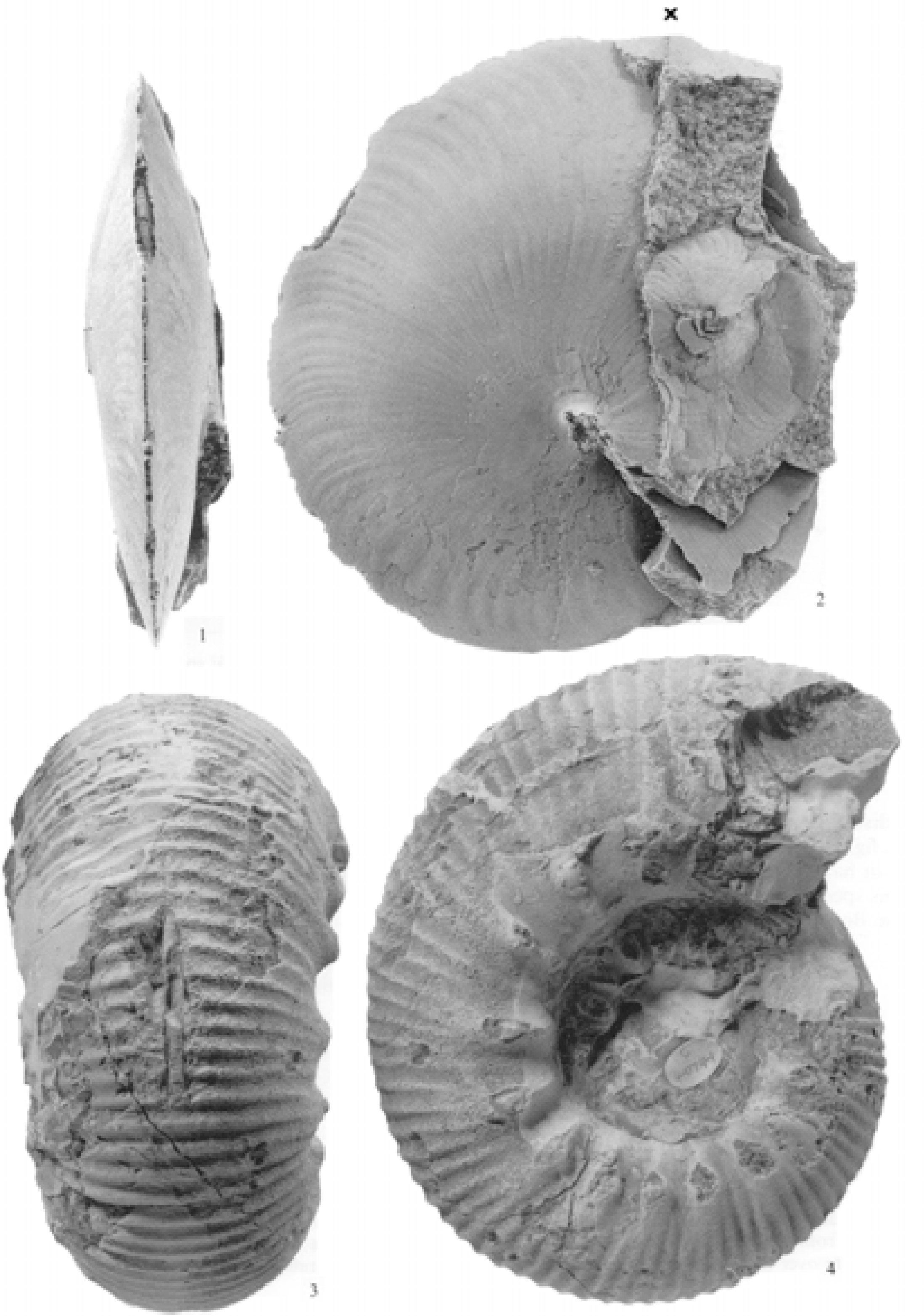
Description. The smaller specimen, C. 86952 (Pl. 5, figs 1, 4), consists of septate whorls of 90 mm diameter; the whorl sides converge to a broadly rounded venter, and three or four gently curved ribs issue from each of the radially elongated umbilical tubercles; there are about four constrictions per 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

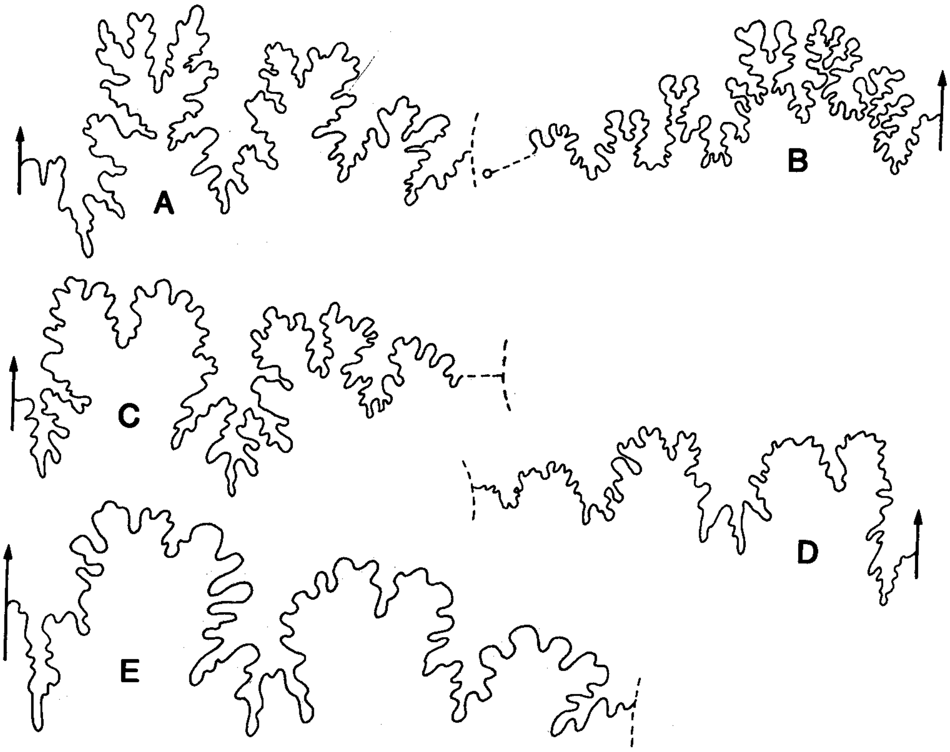
EXPLANATION OF PLATE 3

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.
Figs 3–4. *Spiticeras bulliforme* (Uhlig). BMNH C.40741; wholly septate; from Chia Gara.
All ×1.

PLATE 3



HOWARTH, *Oxylenticeras*, *Spiticeras*



TEXT-FIG. 6. Suture-lines of Kurdistan ammonites. A, *Spiticeras* (*Spiticeras*) *spathi* sp. nov., at 31 mm whorl height; BMNH C.86847; from bed 137; Chia Gara. B, *Oxylenticeras lepidum* Spath, at 22 mm whorl height; BMNH C.87051; from Chia Gara. C, *Euthymiceras kurdistanense* sp. nov., at 23 mm whorl height; BMNH C.86825; from bed 137; Chia Gara. D–E, *Groebericeras rocardi* (Pomel); D, at 32 mm whorl height; BMNH C.86823; from bed 136; Chia Gara; E, at 44 mm whorl height; BMNH C.86936; from bed 46; Banik. A, C–E, ×2·3; B, ×3·4.

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 Djanélidzé (1922*b*) 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 *Holcostephanus* (*Spiticeras*) *bulliformis* Uhlig, p. 114, pl. 13, fig. 2.
1922*b* *Spiticeras bulliforme* (Uhlig); Djanélidzé, 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 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, 37·0; 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 Kurdistan 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. Djanélidzé (1922*b*, 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 Kurdistan 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 indented and has bifid first and second lateral saddles and a trifid lateral lobe.

Measurements.	D	Wh	Wb	U
BMNH C.86846	147·0 (1·00)	58·6 (0·40)	53·0 (0·36)	47·3 (0·32)
C.86847	79·0 (1·00)	34·7 (0·44)	29·2 (0·37)	19·8 (0·25)
C.86848	90·0 (1·00)	41·5 (0·46)	38·5 (0·43)	25·3 (0·28)

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. mojsvari* (Uhlig 1903, p. 110, pl 17, fig. 1) from the Lochambiel 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 pronus 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. multicostatum* (Djanélidzé 1922*b*, p. 63, pl. 1, fig. 11) is nearly as involute, but it has straighter, denser ribs, and all the Berriasian species of *Spiticeras* that are similarly involute (e.g. *S. multiforme* Djanélidzé 1922*b*, p. 143) have much stronger umbilical tubercles. The closest resemblance is with *P. jimulcense* Imlay (1939, pl, 55, figs 1–3) which comes from the *Substeueroceras 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 evolute 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 *Spiticeras*. 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 Kurdistan 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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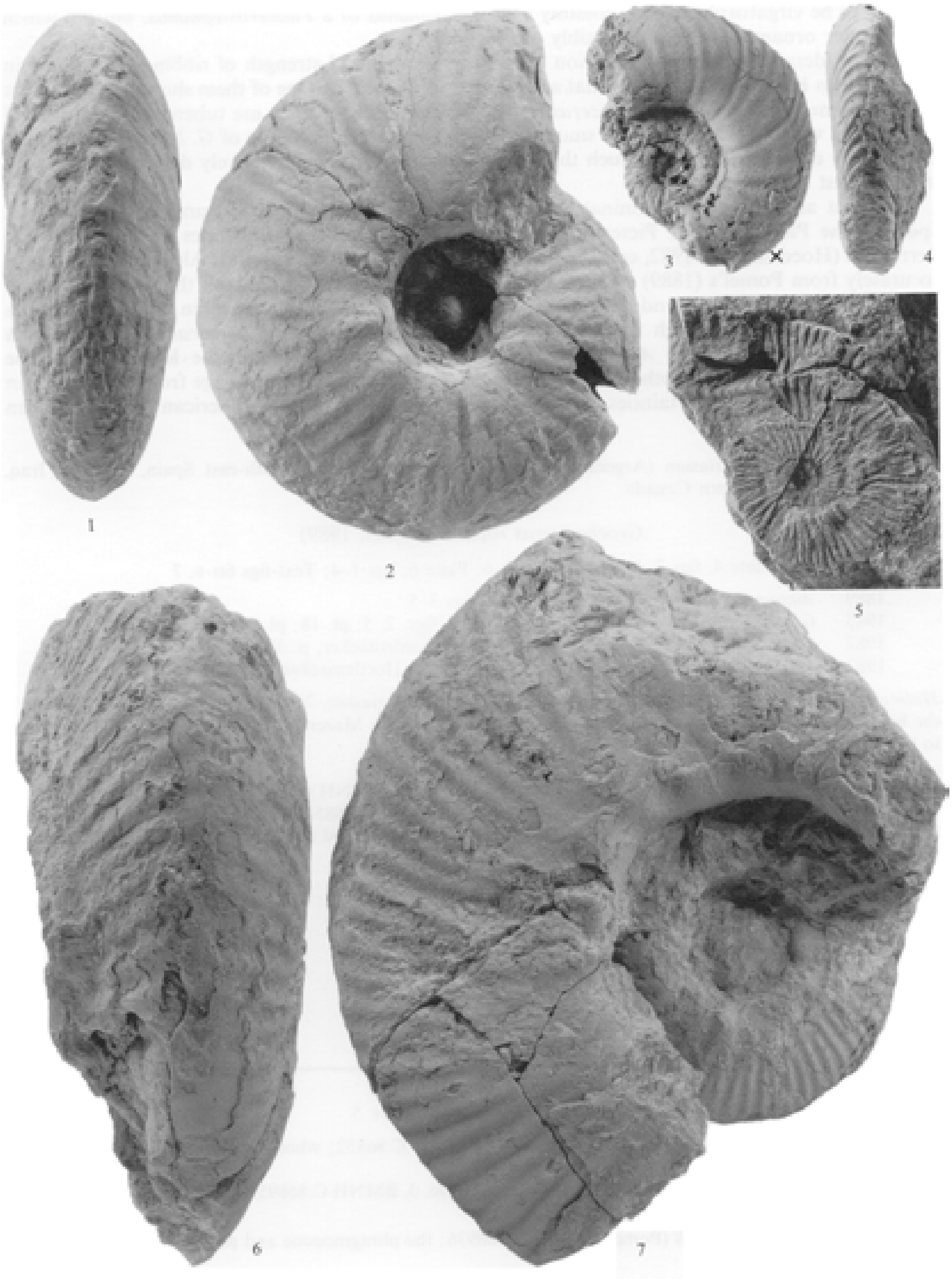
EXPLANATION OF PLATE 4

Figs 1–2, 6–7. *Spiticeras* (*Spiticeras*) *spathi* sp. nov. 1–2, BMNH C.86847; paratype, × 1. 6–7, BMNH C.86848; holotype, × 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, × 1.

Fig. 5. *Berriasella* (*Berriasella*) *jacobi* Mazenot. BMNH C.86812; complete adult, with a long lateral lappet; from bed 104; Chia Gara, × 1.

PLATE 4



HOWARTH, *Spiticeras*, *Groebericeras*, *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 *Groebericeras* 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 whorls, and is entirely devoid of ornament from at least 40 mm diameter.

The most accurate age determination of *Groebericeras* is from their occurrence in south-east Spain in the Paramimouna, Picteti and the base of the Alpillensis Subzones at the top of the Berriasian (Hoedemaeker 1982, encl. 4). The age of *G. rocardi* at Lamoricière, Algeria, is not known accurately from Pomel'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 Paramimouna and Picteti Subzones (though they did not find any new examples of *G. rocardi*). In Argentina *Groebericeras* 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.

Distribution. ?Lower Berriasian (Argentina), Upper Berriasian. Algeria, south-east Spain, northern Iraq, ?Nepal, Argentina, ?western Canada.

Groebericeras rocardi (Pomel, 1989)

Plate 4, figs 3–4; Plate 5, figs 5–6; Plate 6, figs 1–4; Text-figs 6D–E, 7

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

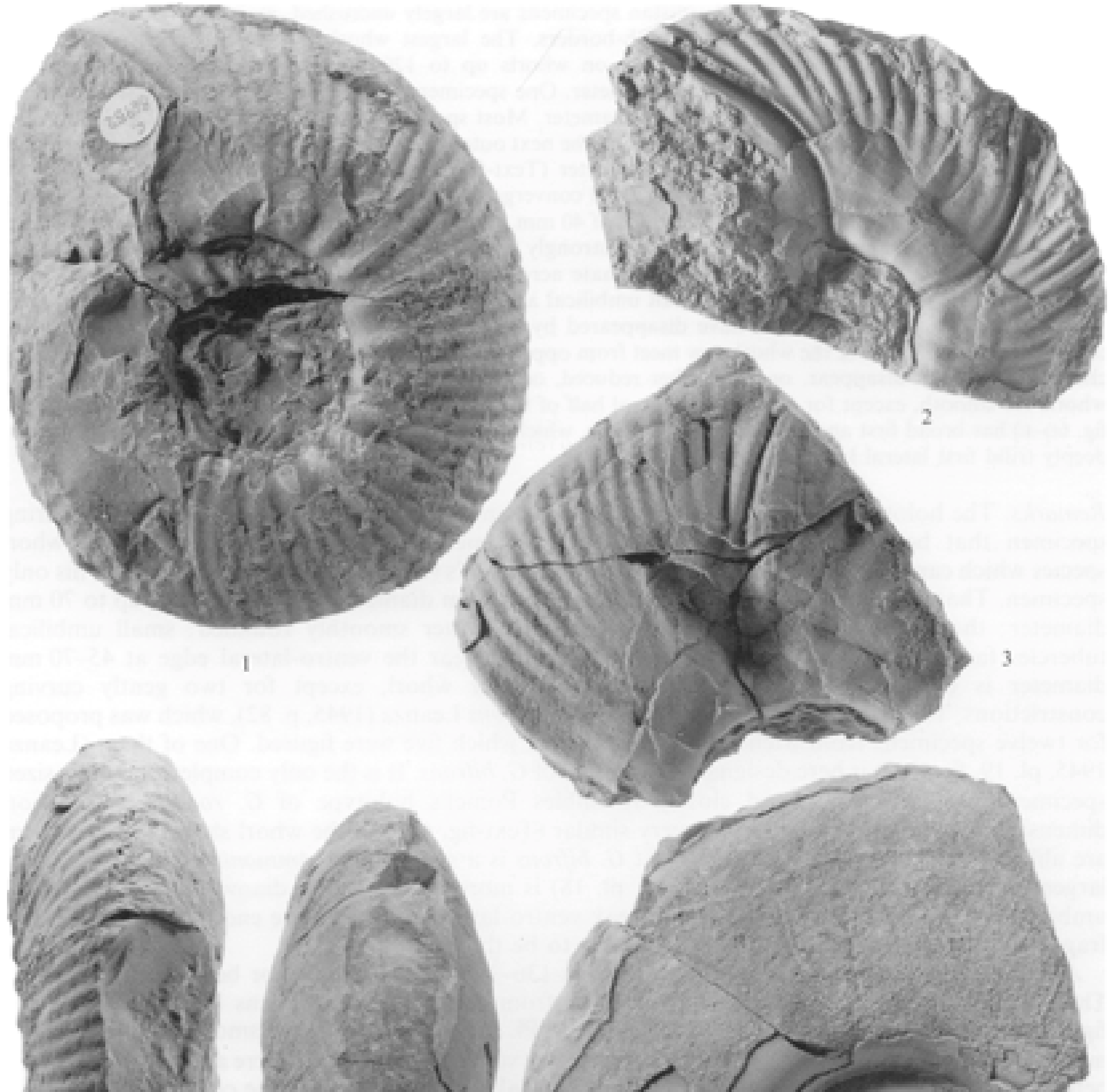
Measurements.	D	Wh	Wb	U	Wh/Wb
BMNH C.86823	94·3 (1·00)	43·2 (0·46)	25·0 (0·27)	22·1 (0·23)	1·73
C.86836	91·7 (1·00)	43·4 (0·47)	28·3 (0·31)	25·4 (0·28)	1·53
C.86936	126·5 (1·00)	52·6 (0·42)	43·0 (0·34)	38·9 (0·31)	1·22
C.86937	67·5 (1·00)	27·9 (0·41)	17·7 (0·26)	19·7 (0·29)	1·58
C.86945	116·0 (1·00)	50·0 (0·43)	35·3 (0·30)	29·6 (0·26)	1·42

EXPLANATION OF PLATE 5

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

Figs 2–3. *Proniceras* cf. *jimulcense* Imlay. 2, BMNH C.86896. 3, BMNH C.86895. Both are fragments of body-chambers; from bed 23; Banik, ×1.

Figs 5–6. *Groebericeras rocardi* (Pomel). BMNH C.86936; the phragmocone and part of the body-chamber; from bed 46; Banik, ×0·75.



HOWARTH, *Spiticeras, Proniceras, Groebericeras*

Description. Although the seventeen Kurdistan specimens are largely uncrushed, 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 ventor 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. 6D–E) has broad first and second lateral saddles, which are finally divided in some, separated by a narrow deeply trifid first lateral lobe.

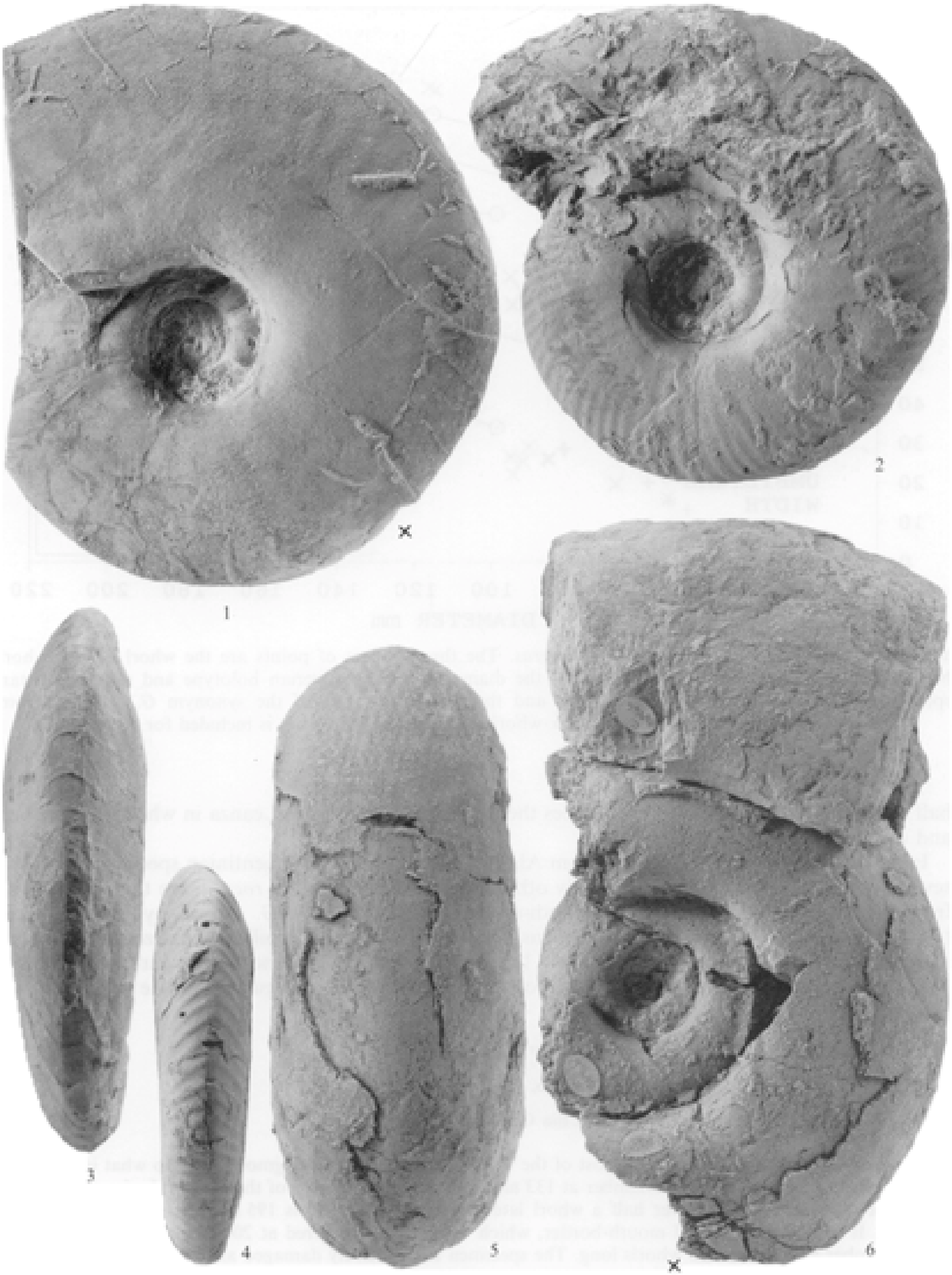
Remarks. The holotype is lost, and no further specimens were found by Benest *et al.* (1977) during specimen that he figured, and closely resembles Pomel's holotype of *G. rocardi*. The whorl species which can be interpreted satisfactorily from Pomel's (1889) description and figure of his only specimen. 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 Pomel'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

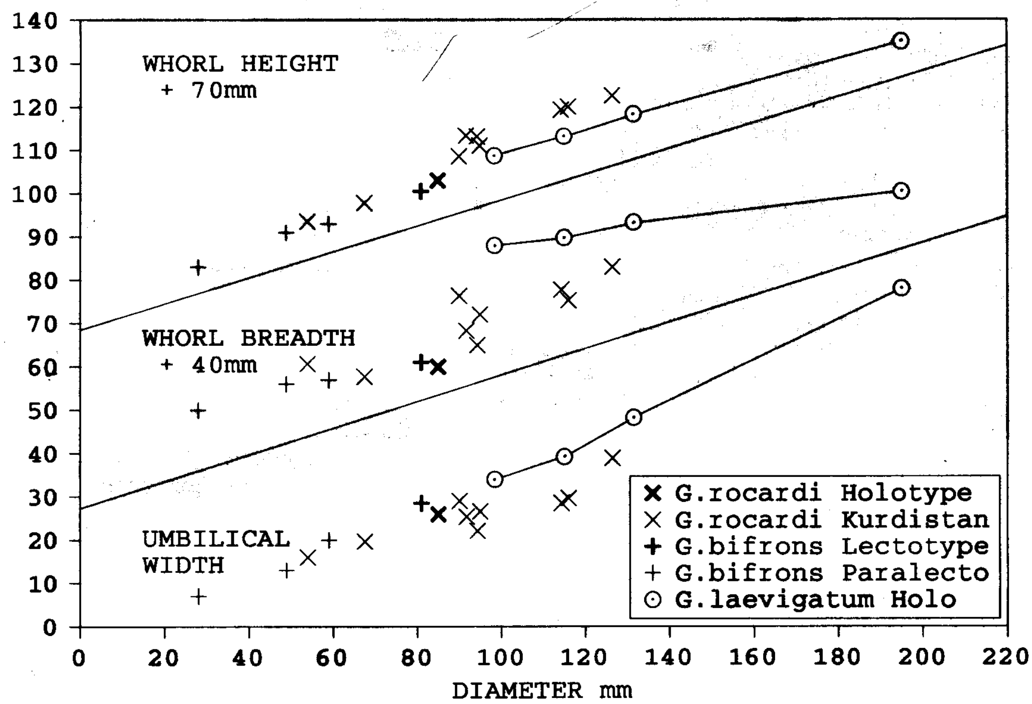
EXPLANATION OF PLATE 6

Figs 1–4. *Groebericeras rocardi* (Pomel). 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.

Figs 5–6. *Groebericeras laevigatum* 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 porportions of *Groebericeras*. 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 Paramimouna 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.

Groebericeras laevigatum sp. nov.

Plate 6, figs 5–6; Text-fig. 7

Holotype. BMNH C.86946, from bed 55, Chia Gara 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.	D	Wh	Wb	U	Wh/Wb
BMNH C.86946	195·0 (1·00)	65·5 (0·34)	60·5 (0·31)	77·5 (0·40)	1·08
C.86946	131·0 (1·00)	48·3 (0·37)	53·3 (0·41)	48·0 (0·37)	0·91
C.86946	98·5 (1·00)	38·7 (0·39)	48·0 (0·49)	34·0 (0·35)	0·81

Remarks. This large ammonite is referred to *Groebericeras* rather than to *Spiticeras* because it has no ribs or tubercles. It fact it is entirely smooth from the smallest size visible at 40 mm diameter, and amongst species of *Groebericeras* 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 *Groebericeras* 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 *Groebericeras* are less than 160 mm diameter.

Family NEOCOMITIDAE 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 *Hoplites callisto* (d'Orbigny); Toucas, p. 600, pl 17, fig. 3.
1890 *Hoplites carpathicus* 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, p. 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, encl. 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.

Synonym. Chapericeras Hoedemaeker, 1981 (type species, *Ammonites chaperi* Pictet, 1868, 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 paramacilenta* 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* (Sayn); Kilian and Reboul, p. 5, pl. 1, fig. 3; pl. 2, figs 2–3.
1935 *Malbosiceras malbosi* (Pictet); Grigorieva, p. 110, pl. 5, fig. 1*a–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); Arnould-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 Koudriavtzev, p. 278, 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* (*Elenaella*) *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. *peronatus* (Retowski). BMNH C.86804; from bed 102; Chia Gara.

All $\times 1$.

PLATE 7

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.	D	Wh	Wb	U
BMNH C.86841	69·8 (1·00)	27·1 (0·39)	19·6 (0·28)	22·5 (0·32)
C.86842	109·0 (1·00)	39·0 (0·36)	28·3 (0·26)	40·5 (0·37)
C.86842	59·3 (1·00)	26·1 (0·44)	16·1 (0·27)	—

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.*) *pouyannei* (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.*) *rouvillei* (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. South-east 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 *Hoplites 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, pl. 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 Euxinus 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.86894) 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 Djanélidzé, 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.* (*Elenaella* Nikolov, 1966). The type species of *Elenaella* 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.

Subgenus ELENAELLA Nikolov, 1966

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 evolute 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
BMNH C.86845	105·0 (1·00)	38·8 (0·37)	25·4 (0·24)	36·7 (0·35)	1·53
C.86827	47·0 (1·00)	19·4 (0·41)	11·2 (0·24)	14·2 (0·30)	1·73

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.

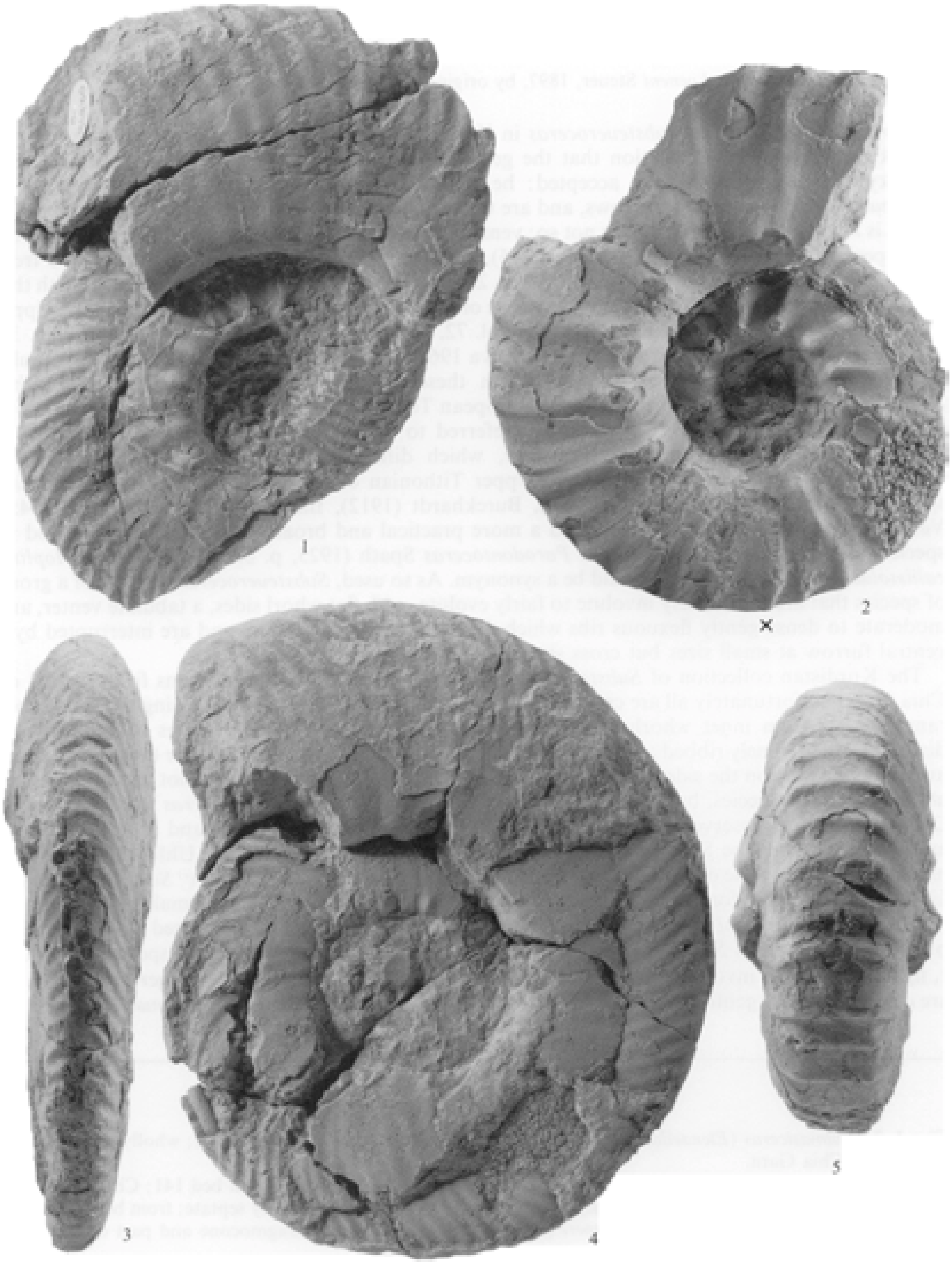
Remarks. The strongly prorsiradiate ribbing on the outer half of the whorl is a constant feature in all twelve Kurdistan specimens and distinguished them from all the species of *Dalmasiceras*, *Elenaella* and *Subalpinites* described by Djanélidzé (1922*a*), Mazenot (1939), Le Hégarat (1973) and Nikolov (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. *Euthymiceras kurdistanense* sp. nov. BMNH C.86825; holotype; phragmocone and most of the (?adult) body-chamber; from bed 137; Chia Gara.

All ×1.



HOWARTH, *Dalmasiceras*, *Euthymiceras*

Genus SUBSTEUEROCERAS Spath, 1923

Plate 1, figs 9–10; Plate 2, figs 3, 10

Type species. Odontoceras koeneni Steuer, 1897, by original designation.

Remarks. The presence of *Substeueroceras* 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 *Substeueroceras* 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 *Substeueroceras beneckei* also occur in the Upper Tithonian of Bulgaria (Nikolov 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 *Substeueroceras* 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 Hégarat's (1973, p. 172) reference of *Neocomites beneckei* to *Pseudargentiniceras*, which differs in developing umbilical tubercles. *Substeueroceras* occurs commonly in the Upper Tithonian of Argentina and Mexico, and many specimens were figured by Steuer (1897), Burckhardt (1912), Imlay (1939) and Leanza (1945). Verma and Westermann (1973) adopted a more practical and broader view of the genus and its species, and they even proposed that *Parodontoceras* Spath (1923, p. 305; type species, *Hoplites callistoides* Behrendsen, 1891) should be a synonym. As so used, *Substeueroceras* 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 *Substeueroceras* 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 *Substeueroceras 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 *Substeueroceras koeneni* (Steuer 1897, pl. 17, fig. 4) and a Mexican specimen figured by Imlay (1939, p. 50, pl. 15, fig. 9) as *Substeueroceras* cf. *subfasciatum* (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 *Substeueroceras lamellicostatum* (Burckhardt

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EXPLANATION OF PLATE 9

Figs 1–2. *Dalmasiceras* (*Elenaella*) *prorsiradiatum* sp. nov. BMNH C.86831; paratype; wholly septate; from bed 137; Chia Gara.

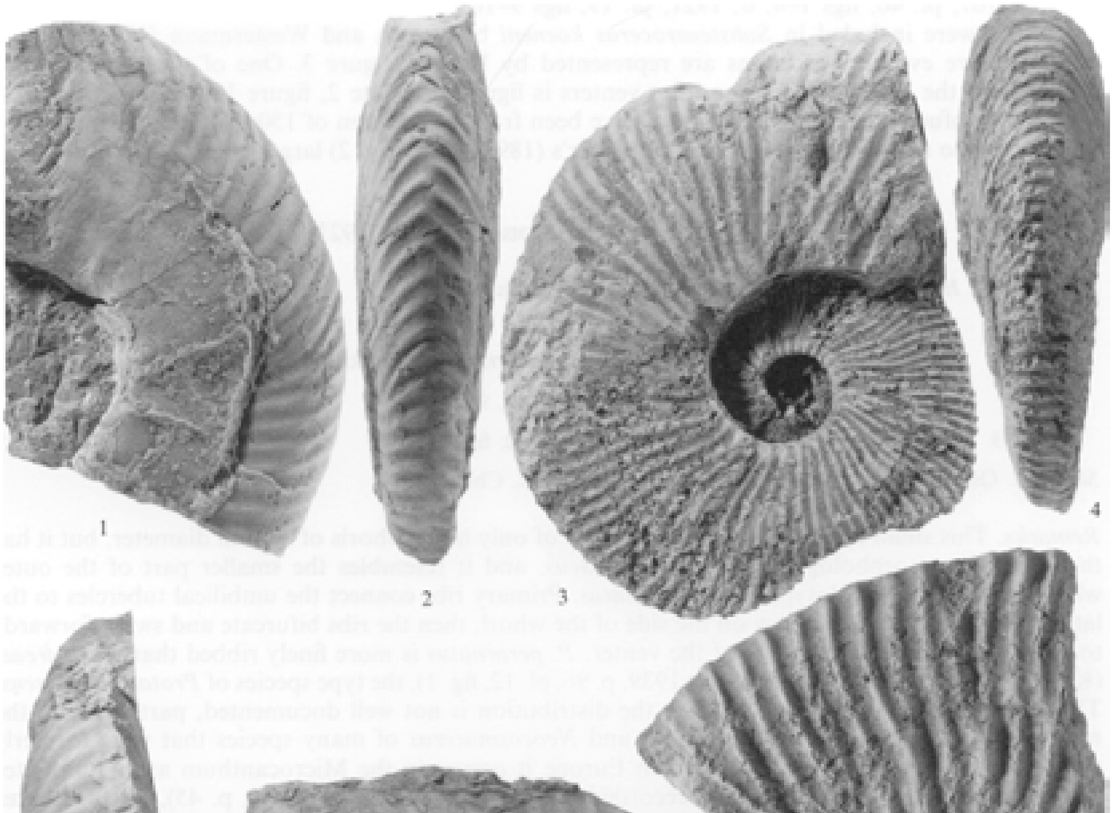
Figs 3–4. *Tirnovella alpillensis* (Mazenot). BMNH C.83428; wholly septate; from bed 141; Chia Gara.

Figs 5, 8. *Berriasella* (*Malbosiceras*) cf. *asper* Mazenot. BMNH C.86906; wholly septate; from bed 23; Banik.

Figs 6–7. *Berriasella* (*Malbosiceras*) *chaperi* (Pictet). BMNH C.86894; phragmocone and part of the body-chamber; from bed 23; Banik.

All ×1.

PLATE 9



HOWARTH, *Dalmasiceras*, *Tirnovella*, *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 in 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. Hoplites andreaei Kilian, 1889, by original designation.

Protacanthodiscus cf. *perornatus* (Retowski, 1893)

Plate 7, fig. 9

1893 *Hoplites 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. andreaei* (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 *Malbosiceras, Mazenoticeras* and *Neocosmoceras* of many species that were formerly placed in *Protacanthodiscus.* In southern Europe it occurs in the Microcanthum 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 Pictet, 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 whorls (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. micheicum* 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 (1984, pp. 232–237, figs 10–11). *Euthymiceras* occurs at the same horizon in the Caucasus (Khimshishvili 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. transcaspium* (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 Kudryavtseva 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-figure 6c.

Measurements.	D	Wh	Wb	U	Wh/Wb
BMNH C.86825	85·5 (1·00)	32·0 (0·37)	33·0 (0·39)	30·2 (0·35)	0·97
C.86825	57·4 (1·00)	22·7 (0·40)	21·9 (0·38)	18·9 (0·33)	1·04
C.86825	45·0 (1·00)	18·4 (0·41)	19·8 (0·44)	14·5 (0·32)	0·93

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 Bogoslowsky (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.

		D	Wh	Wb	U
C. banikense	BMNH C.86930	126·6	60·0 (0·47)		28·5 (0·23)
	C.86930	101·5	48·4 (0·48)	34·3 (0·34)	22·0 (0·22)
	C.86934	180·0	80·2 (0·45)		44·9 (0·25)
	C.86934	136·0	61·0 (0·45)		35·4 (0·26)
C. wetzeli	BMNH C.86909	84·3	42·5 (0·50)	—	16·4 (0·19)
	C.86909	63·5	32·1 (0·51)	19·0 (0·30)	11·8 (0·19)
	C.86910	92·7	46·6 (0·50)		17·9 (0·19)
	C.86910	70·8	35·1 (0·50)	22·9 (0·32)	14·4 (0·20)
	C.86911	105·5	52·8 (0·50)		20·7 (0·20)
	C.86913	103·0	51·3 (0·50)	25·8 (0·25)	15·5 (0·15)
C. planum	BMNH C.86927	79·0	44·5 (0·56)		9·6 (0·12)
	C.86927	56·2	29·9 (0·53)		7·2 (0·13)

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 Djanélidzé 1922*a*, 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 *Chigaroceras* figured in Plate 11, would involve an increase in involution 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 *Chigaroceras*.

Chigaroceras 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 generically indeterminate berriasellid. In reality all the figured specimens of Boreal *Hectoroceras* (Spath 1947, pl. 1–3; Shul'gina 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 *Chigaroceras* 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 *Chigaroceras*. In any case *Chigaroceras* 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 *Chigaroceras* are with the Beriasellidae and especially *Dalmasiceras*, rather than the Boreal Craspeditidae.

Distribution. Durangites Zone, Upper Tithonian, Banik bed 23, northern Iraq.

Chigaroceras 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 *Chigaroceras*. 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 *Chigaroceras* from Banik.

Chigaroceras 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

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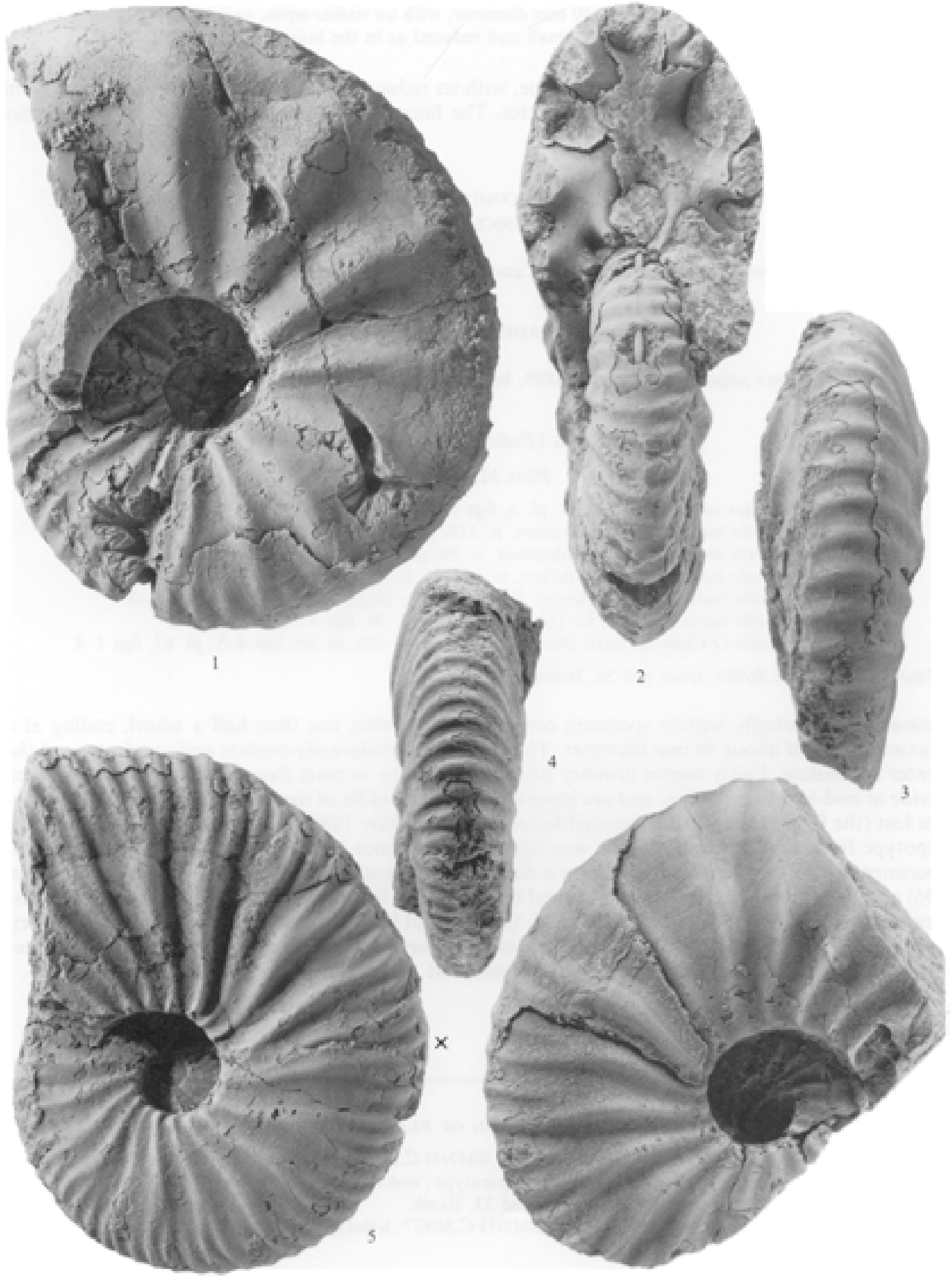
EXPLANATION OF PLATE 10

Figs 1–3, 6. *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 andraei* (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.

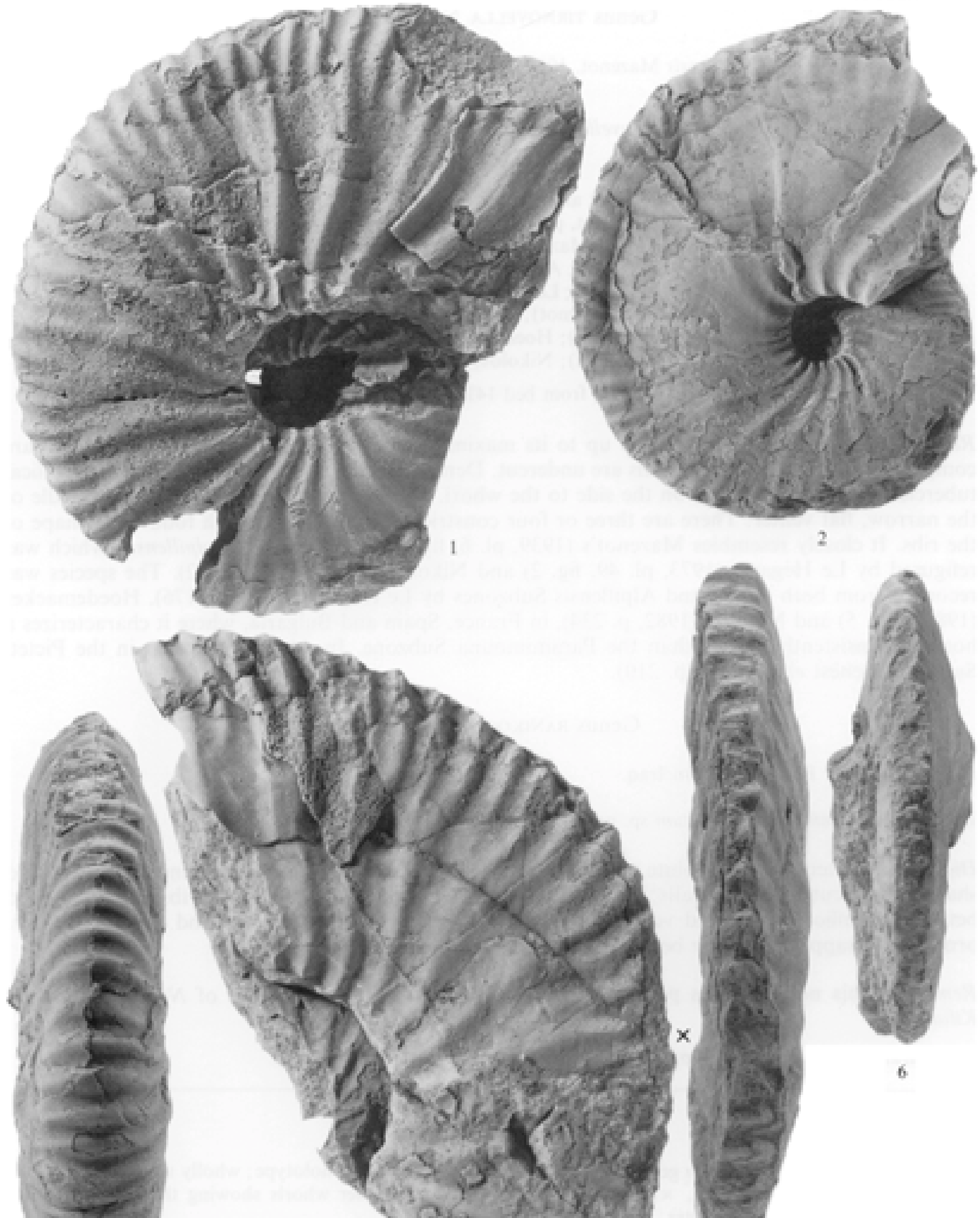
Remarks. This wholly septate specimen consists of somewhat less than half a whorl, ending at a maximum size of about 56 mm diameter. The whorls are moderately evolute and quadrate, and the venter is tabulate. Fairly coarse primary ribs arise singly or in pairs from umbilical tubercles, then divide at 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 Lamoricière, 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 Lamoricière, but it was not *in situ*. All the other ammonites came from the Paramimouna and Picteti Subzones at that locality.

EXPLANATION OF PLATE 11

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.



HOWARTH, *Chigaroceras*

Genus TIRNOVELLA Nikolov, 1966

Type species. Berriasella alpillensis Mazenot, 1939, by original designation.

Tirnovella alpillensis (Mazenot, 1939)

Plate 9, figs 3–4

1907 *Thurmannia thurmanni* Pictet and Campiche; Sayn, p. 40, pl. 5, fig. 5.
1939 *Berriasella alpillensis* Mazenot, p. 73, pl. 6, fig. 22.
?1939 *Berriasella boissieri* (Pictet); Mazenot, p. 106, pl. 16, fig. 2.
1951 *Berriasella alpillensis* Mazenot; Arnould-Saget, p. 48, pl. 5, fig. 2.
1973 *Tirnovella alpillensis* (Mazenot); Le Hégarat, p. 178, pl. 27, figs 1, 3; pl. 28, fig. 5; pl. 49, figs 1–3.
1977 *Tirnovella* aff. *alpillensis* (Mazenot); Benest, Donze and Le Hégarat, p. 210, pl. 5, fig. 4.
.1982 *Tirnovella alpillensis* (Mazenot); Hoedemaeker, pp. 50, 69, pl. 5, fig. 1.
1982 *Tirnovella alpillensis* (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. alpillensis*, which was refigured by Le Hégarat (1973, pl. 49, fig. 2) and Nikolov (1982, pl. 84, fig. 2). The species was recorded from both Picteti and Alpillensis 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 (Benest *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.

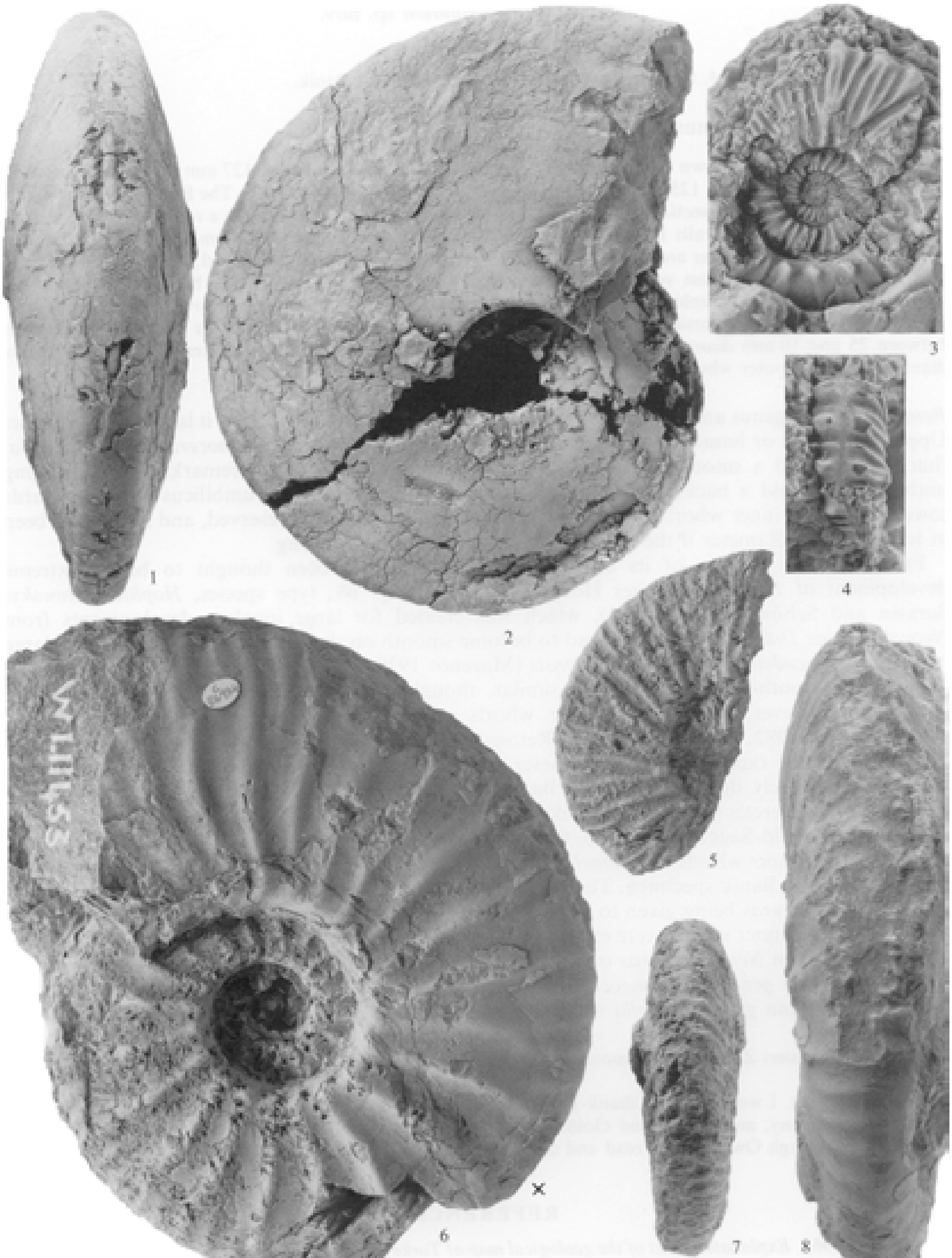
EXPLANATION OF PLATE 12

Figs 1–4. *Banikoceras involutum* gen. et sp. nov. 1–2, BMNH C.86954; holotype; wholly septate; loose from screes of beds 48–54; Banik, ×0·8. 3–4, same specimen, the inner whorls showing the strong ribs and tubercles up to 25 mm diameter, ×2·4.

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

Figs 6, 8. *Chigaroceras banikense* gen. et sp. nov. BMNH C.86934; paratype; phragmocone and half a whorl of adult body-chamber; from bed 23; Banik, ×0·6.

PLATE 12



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: 64·0 (0·51), 40·8 (0·33), 21·4 (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, prorsiradiate constrictions occur on the inner whorls. This ornament disappears between 25 and 50 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, *Hoplites retowskyi* Sarasin and Schöndelmayer, 1901), which was created for large involute developments from *Neocomites* (or *Dalmasiceras*), that tend to become smooth on the body-chamber. In fact the large holotype of *Pseudoneocomites suprajurensis* (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.*

Distribution. Boissieri Zone, ?Paramimouna Subzone, Berriasian. Banik, northern Iraq.

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