Biostratigraphy, Lithostratigraphy, ammonite taxonomy and microfacies analysis of the Middle and Upper Jurassic of norteastern Iran.

Dissertation zur Erlangung des
Naturwissenschaftlichen Doktorgrades
Der Bayerischen Julius-Maximilians-Universität Würzburg

vorgelegt von

Mahmoud Reza Majidifard

aus

Teheran

Würzburg, 2003-10-22

To my wife and my daughter

Abstract

The Middle and Upper Jurassic sedimentary successions of Alborz in northern Iran and Koppeh Dagh in northeastern Iran comprise four formations; Dalichai, Lar (Alborz) and Chaman Bid, Mozduran (Koppeh Dagh)**.** In this thesis, the biostratigraphy, lithostratigraphy, microfacies, depositional environments and palaeobiogeography of these rocks are discussed with special emphasis on the abundant ammonite fauna. They constitute a more or less continuous sequence, being confined by two tectonic events, one at the base, in the uppermost part of the Shemshak Formation (Bajocian), the so-called Mid-Cimmerian Event, the other one at the top (early Cretaceous), the so-called Late-Cimmerian Event. The lowermost unit constitutes the uppermost member of a siliciclastic and partly continental depositional sequence known as Shemshak Formation. It contains a fairly abundant ammonite fauna ranging in age from Aalenian to early Bajocian. The following unit (Dalichai Formation) begins everywhere with a significant marine transgression of late Bajocian age.

The following four sections were measured: The Dalichai section (97 m) with three members; the Golbini-Jorbat composite section (449 m) with three members of the Dalichai Formation (414 m) and two members of the Lar Formation (414 m); the Chaman Bid section (1556 m) with seven members, and the Tooy-Takhtehbashgheh composite section (567 m) with three members of the Dalichai Formation (567 m) and four members of the Mozduran Formation (1092 m).

Altogether, 80 species of ammonites from the Dalichai and Chaman Bid formations belonging to 30 genera and 16 families are described. Among the taxa Phylloceratidae are most abundant, followed by Ataxioceratidae, Perisphinctidae, and Cardioceratidae. Pachyceratidae are the least common family. The ammonite fauna is of low diversity and is concentrated in several levels. Some of the ammonite genera and species are recorded from Iran for the first time. These include *Pachyceras lalandei*, *Cardioceras praecordatum, Microbajocisphinctes* sp., *Geyssantia geyssanti*, *Larcheria schilli, Passendorferia* sp., *Sequeirosia* sp., *Phanerostephanus subsenex, Nothostephanus* sp., *Nannostephanus* cf. *subcomutus, Parawedekindia callomoni*, *Physodoceras* sp., *Extrenodites* sp.. Biostratigraphically, thirty ammonite zones have been recognized for the Middle and Upper Jurassic successions at the four studied sections.

Based on ammonites, the Dalichai Formation ranges from the Upper Bajocian to Callovian (Dalichai section) and from the Upper Bajocian to Lower Tithonian (Golbini-Jorbat section), the Chaman Bid Formation ranges from the ?Bathonian to Lower Tithonian (Chaman Bid section) and from the Upper Bajocian to Middle Kimmeridgian (Tooy-Takhtehbashgheh section), the Lar Formation ranges from the Middle to Upper Tithonian (Golbini-Jorbat section), and the Mozduran Formation from the Upper Kimmeridgian to ?Tithonian.

Forty-four Microfacies types are briefly described. They were grouped into 16 facies associations, which then were interpreted in terms of their palaeoenvironments. They are part of a carbonate system consisting of a platform and adjacent slope to basin. Five major environments are represented: Tidal flat, shelf lagoon, and platform margin barrier as parts of the carbonate platform, and slope to basin representing open marine conditions. The sediments of the Dalichai and Chaman Bid formations are the slope and basinal sediments of the diachronous Lar and Mozduran formations, which formed an extensive carbonate platform in the Middle and Upper Jurassic.

Contents

Chapter 1

Chapter 2

Chapter 3

Chapter 4

Introduction

Jurassic rocks are widely distributed and superbly exposed in the Alborz Mts. (northern Iran) and Koppeh Dagh (northeastern Iran). The Lower Jurassic and large parts of the Middle Jurassic are characterized by a thick siliciclastic succession (Shemshak Formation), whereas the Upper Bajocian to Tithonian rocks are predominantly carbonates, which represent a platform, slope and basin system. Four lithostratigraphic units, the Dalichai and Lar formations in the Alborz and the Chaman Bid and Mozduran formations in the Koppeh Dagh, are the scope of this thesis.
In the last decades, many authors studied the Middle and Upper Jurassic succession of Iran with respect to micro- and macrofossils, among them Erni (1931), Arkell (1956), Assereto (1966), Assereto et al. (1968), Davis et al. (1972), Madani (1977), Stampfli (1978), Afshar Harb (1979, 1994), Seyed- Emami et al. (1985, 1987, 1989, 1991, 1994, 1995, 1996, 1997), Seyed- Emami & Nabavi (1985), (Keshani 1986), Schairer et al. (1992, 1999), Schweitzer & Kirchner (1995,1996) and (Hosseniun 1996).
The aim of the present study is to (1) record and describe the ammonite fauna, (2) discuss the age of the formations based on the ammonites (3) describe and discuss the lithostratigraphic units, (4) describe and interpret the various microfacies types, (5) interpret the depositional environments, (6) discuss the palaeobiogeographic relationship of the ammonite fauna, and (7) elucidate the lateral facies relationships between Alborz and Koppeh Dagh in the Middle and Late Jurassic. For this purpose two sections in the Alborz and two sections in the Koppeh Dagh, each representing a transect, were measured bed-by-bed using a modified Jacob staff (Sdzuy & Monninger 1985). The rocks were described in the field, sampled for microfacies analysis and classified according to depositional texture (Dunham 1962).

Material and methods

Locality of sections: The study area is located in the western Koppeh-Dagh and central and eastern Alborz. Four sections were studied. They are the Dalichai and Golbini-Jorbat sections (Alborz) and the Chaman Bid and Tooy-Takhtehbashgheh sections (western Koppeh-Dagh). The location of these sections is as follows:

Dalichai section: Right bank of Dalichai River, 700 m below Pole e Ferdowsi (bridge) along the Tehran –Firuzkuh road (113 km east of Tehran; Fig. 1.1).

Golbini-Jorbat section: As the calcareous rocks of the Lar Formation at Golbini have been recrystallized and partly dolomitized, a composite section was chosen for recording the Dalichai and Lar formations in this area. Two sections, one at Golbini and one at Jorbat were chosen for this purpose. The distance between the two sections is 38 km They are best accessed as follows:

Golbini section: 16 km N of Jajarm near Golbini farm. To reach the section, follow the Jajarm alumina asphalted road. 13 km from Jajarm take a left turn and continue on a small unpaved road for 3 km (co-ordinates: N 37°05′13′′, E 56°44′41′′; Fig. 1.1).

Jorbat section: 51 km NE of Jajarm. For access to this section, follow the unpaved Jajarm-Sankhast road. The section is reached 9 km after passing through Jorbat village (co-ordinates: N 37°09′00′′, E 56°43′59′′; Fig. 1.1).

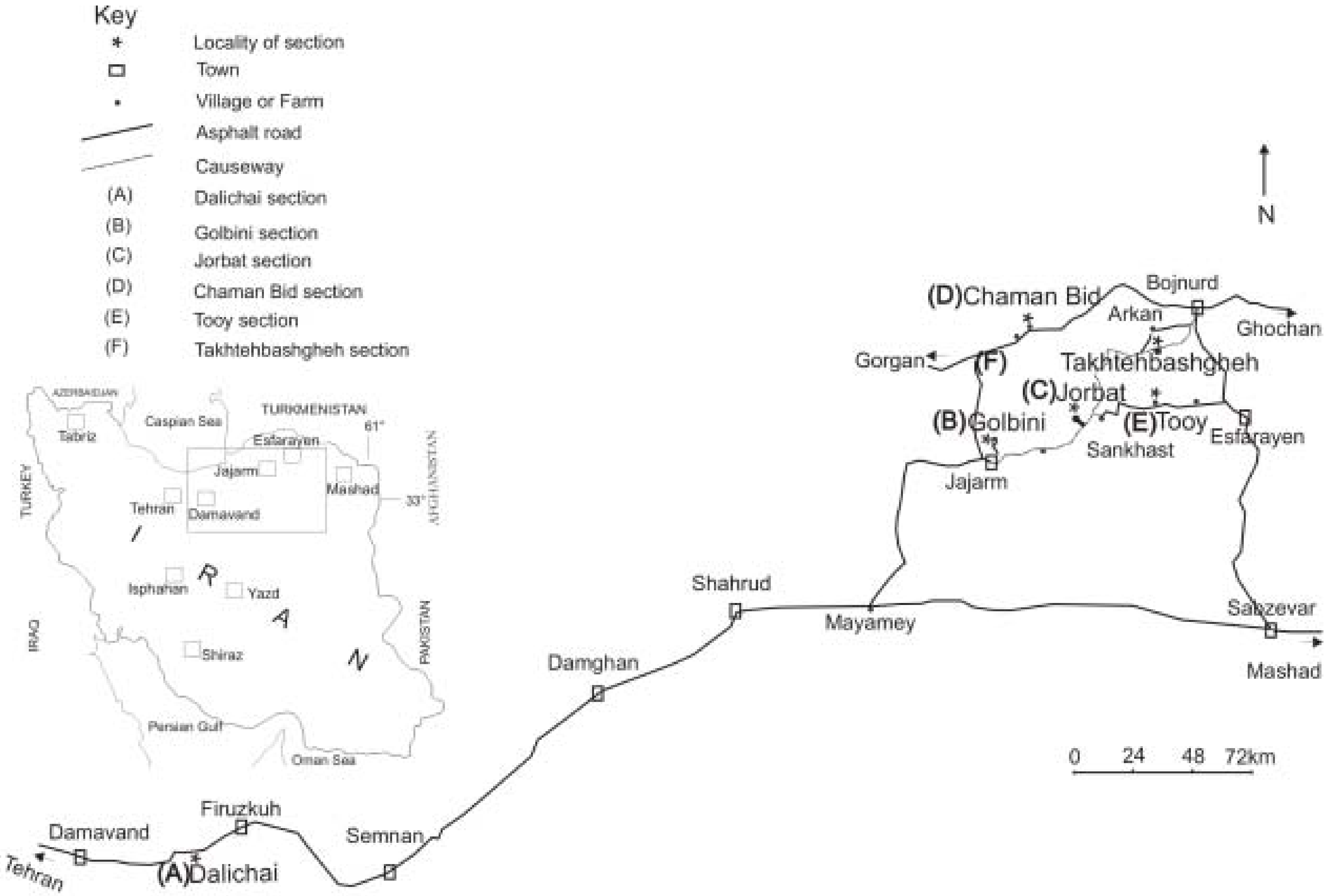


Fig. 1.1. Position of the investigated sections of the Middle and Upper Jurassic rocks of center and eastern Alborz and the western Koppeh Dagh.

Chaman Bid section: The section is located 3.5 km NW of Chaman Bid village in the Kourkhod Mountains. The distance from the section point to the Bojnourd – Gonbad road (60 km W of Bojnourd) is almost 1 km (co-ordinates: N 37°26′00′′, E 56°30′50′′; Fig. 1.1).

Tooy-Takhtehbashgheh section: As the calcareous rocks of the Mozduran Formation in the Tooy area are tectonically disturbed, a composite section was used for studying the Chaman Bid and Mozduran formations. One section (Chaman Bid Formation) is situated at Tooy and one at Takhtehbashgheh (Mozduran Formation); the two localities are 24 km apart. For reaching these sections, the instructions given below should be followed:

Tooy section: 4 km N of Tooy village (49 km W of Esferayen city and 93 km SW of Bojnourd city, respectively). Tooy village is reached by taking a left turn after 9 km along the Esferayen–Bojnourd road and following the Esferayen-Sankhast asphalt road for about 45 km. At Tooy take a small unpaved road, leading north, for about 4 km (co-ordinates: N 37°09′14′′, E 57°09′13′′; Fig. 1.1).

Takhtehbashgheh section: 1 km NE of Takhtehbashegheh farm (Haj Ali Agha kalat), 80 km SW of Bojnourd and 91 km NW of Esferayen. After following the main road Bojnourd-Esferayen for 27 km, take a left turn onto an unpaved road. After 53 km, the Takhtehbashegheh farm is reached (co-ordinates: N 37°19′42′′, E 57°04′13′′; Fig. 1.1).

Microfacies: A total of 524 thin-section have been prepared. The microfacies analysis is based on a component analysis and on textural (including sorting and degree of sphaericity) of the components) and diagenetic features. For limestone classification the scheme of Dunham (1962) was used with the following abbreviations: m, mudstone; w, wackestone; p, packstone; f, floatstone; g, grainstone; r, rudstone. Based on their composition and texture, the thin-sections have been grouped into 44 microfacies types, which characterize five facies belts. Typical components and/or important textural features were used in addition to the terms “with” and “rich in” order to express the relative quantity of other important components.

Ammonites: Since the main part of the thesis deals with ammonites, numerous ammonites were collected from the sections. After identification they were described and used to define the international Standard Zones. Graphs and pie diagrams were constructed to compare the composition of the ammonite fauna at the species and familial level between the sections and the two major regions (Alborz and Koppeh Dagh). The ammonite zonation is based on CARIOU & HANTZPERGUE (1997). As the ammonites are generally well preserved and index species are abundant, the presence of most ammonite zones of the Middle and Upper Jurassic could be demonstrated.

Geological setting

In the following, the geodynamic history and palaeogeographic evolution of northern and central Iran between the Triassic and Late Jurassic is briefly reviewed.
During the Precambrian and Palaeozoic, Iran was situated at the northern margin of Gondwana bordering a great ocean, the so-called Palaeo-Tethys. Towards the end of the Permian and during the Early Triassic, rifting and formation of new oceanic crust (Neotethys) took place at the northern margin of Gondwana. As a result, regions that at present-day constitute central and

parts of northern Iran became separated from this continent and moved towards Laurasia. These separated blocks are called Cimmerian Continent (e.g. SENGÖR 1990). About the beginning of the Late Triassic (Carnian) the closure of the Palaeo-Tethys caused collision of the Cimmerian Continent with the southern margin of Laurasia (Early Cimmerian tectonic event). This collision caused the uplift of northern and central Iran. Evidence and effects of this event can be observed in northern and central regions of Iran in form of laterites, bauxites and Triassic calcareous karst phenomena. From the early Norian onward, widespread transgression of the Shemshak Sea led to deposition of siliciclastic rocks named Shemshak Group (Norian-Middle Bajocian). This cycle ended in the early Bajocian with the onset of the Mid-Cimmerian tectonic event (SEYED-EMAMI & ALAVI-NAINI 1990). The Mid-Cimmerian event (early to late Bajocian) was associated with rifting and magmatic (e.g. DAVOUDZADEH & SCHMIDT 1983-1984)activity, and caused widespread emersion in most of the area. As in the case of the Shemshak Group the following transgression here also was diachronous. This transgression gave rise to an epicontinental sea subdivided into basinal and platform environments in north-central and north-eastern Iran. This condition continued into the Cretaceous when, in the Neocomian, the Late Cimmerian tectonic event terminated the second sedimentary cycle. Therefore, the Jurassic system in Iran consists of two large sedimentary-tectonic cycles. In other words, the lithological changes, biological features and sedimentary environments reflected by Jurassic rocks in Iran indicate that the geographic changes in the Jurassic were closely related to the tectonic events. The rocks of the first sedimentary cycle are mostly siliciclastic in nature indicating fluvial, deltaic, and, at times, shallow marine environments. Upper Triassic and lowermost Jurassic rocks are very similar, so that in most cases the two time intervals cannot be separated.

In total, the Upper Triassic, Lower and lowermost Middle Jurassic rocks formed under more or less homogeneous sedimentary conditions. They comprise a sedimentary cycle confined at the base by the Early Cimmerian and at the top by the Mid Cimmerian tectonic events. The similarity of these sediments and faunas with those of the same age in Afghanistan and Armenia indicates that north and central Iran was situated at the southern margin of Laurasia (SEYED-EMAMI 1990). One important evidence of the Mid-Cimmerian tectonic event in Iran is the presence of melaphyres and alkaline basalts in the Yazd Block below or within Norian-Bajocian rocks, which characterize a tensional phase and intercontinental opening taking place after the mid-Triassic compressional phase (AGHANABATI 1998).

The second sedimentary megacycle consists mostly of marl and limestones and indicates basinal and platform environments (LASEMI 1995). These sediments began to form from the end of the Mid Cimmerian tectonic phase until the Late Jurassic and in some place continued into the "Neocomian" (SEYED-EMAMI 1975; KESHANI 1988). For example, in some areas of the Alborz and Koppeh-Dagh, sedimentation continued from the late Jurassic (Tithonian) to the early Cretaceous (Berriasian). At some localities such as Minodasht, Firouzkouh and Jam the sedimentary basin was not only deep but also pelagic environments prevailed.

The Late Cimmerian tectonic event started in most part of north and central Iran in late Jurassic time and continued into early Cretaceous.

Biostratigraphy and lithostratigraphy

Review of the lithostratigraphy

Alborz Basin

Shemshak Formation

The Shemshak Formation was erected by Assereto in 1966. At the type locality, it consists of 1000 m of sandstone, siltstone, shale and mudstone with intercalations of thin layers of coal. In some regions, marine horizons occur in the upper part of the formation. At the type locality, the rocks have been divided into four units, i.e. from base to top

(1) lower siltstone,

(2) lower carbonaceous series,

(3) upper siltstone,

(4) upper carbonaceous series.

The lower part of the section is faulted and strictly speaking does not quality as type section. The thickness of the formation varies from a few metres to more than 3000 m in the Alborz area. These variations in thickness depend on various tectonic parameters and have no stratigraphic significance (Assereto 1966, Davoudzadeh and Schmidt 1983).

The Shemshak Formation overlies, with an unconformity, rocks of different ages. The upper contact of the formation is again mainly unconformable due to the Mid Cimmerian tectonic event. The rocks of the formation commonly exhibit lateral facies changes. These changes indicate that the sediments were deposited in a tectonically active environment subject in particular to differential block movements (Alavi 1996). Sedimentary environments represented by the Shemshak Formation include lakes, deltas, rivers and shallow shelf (Repin 1987, Vollmer 1987). A comprehensive study of ammonites of this formation has been published by Seyed-Emami & Nabavi (1985) and Seyed- Emami (1987), a monograph of the plant fossils by Schweitzer & Kirchner (1995, 1996).

Dalichai Formation

The type section of this formation consists of 107 m of light-grey to bluish-grey limestone with thin intercalations of marl. According to Steiger (1966), the thickness of the formation is about 50 to 120 m (average: 100 m, reaching more than 300 m in the eastern Alborz). The lower boundary of the Dalichai Formation is an unconformity due to the Mid-Cimmerian tectonic event (the marine transgression of the Dalichai Formation over the Shemshak Formation is diachronous). In many areas the upper boundary of the Dalichai Formation is, however, gradational. In a few areas it is continuous but sharp and followed by the Lar Formation. The sedimentary environments, in which this formation was deposited, are the lower shelf to continental slope. The Dalichai Formation is rich in ammonites, which were studied by Erni (1931), Arkell (1956), Assereto et al. (1968), Seyed- Emami et al. (1985, 1989, 1991, 1994, 1995, 1996, 1997), and Schairer et al. (1992).

Shal Formation

The Shal Formation is restricted to the Talesh Mountains in the north-western Alborz and is Middle to Late Jurassic in age (Davis et al. 1972). At the type section, the thickness is about 61 m. The sediments consist of green, glauconitic and calcareous sandstones grading upward into medium-to thick-bedded glauconitic limestones. The lower part of the formation rests with a sharp boundary on siliciclastic rocks of the Shemshak Formation, whereas at top it grades into yellow marls of the Neocomian Kolur Formation. The Shal Formation contains abundant ammonites, but no detailed studies have been carried out so far. Ammonites of the lower part are thought to be Callovian or even Bathonian in age (Seyed- Emami et al. 2001), whereas those from the top belong to the Tithonian.

Farsian Formation

The Farsian Formation occurs in the northeastern Alborz, close to Azadshahr. For the main part, it consists of red and yellow limestone, silt and marl. Stampfli (1978), who erected the formation, considered the red sediments to be a transitional unit sandwiched between the Shemshak Formation and the Lar Formation. Despite tectonic activity, the boundary between the Farsian and Shemshak formations, is conformable but the upper boundary with the Lar Formation is gradual. The boundary has been drawn where the red limestone of the Farsian Formation changes to the yellowish to cream-coloured Lar Formation. Based on ammonites and foraminifers the age of the formation is late Middle Jurassic. According to Stampfli (1978) the Farsian Formation was deposited in infra-littoral to circa-littoral environments. According to him there is a similarity with respect to stratigraphy and facies between this formation and the Dalichai Formation.

Lar Formation

In 1966 Assereto designated the type section of the Lar Formation northeast of Garmabdar between the Lar and Jajrud river basins. However, so far the type section has neither been measured nor described. According to Assereto (1966) the formation consists in its lower part mainly of thinly bedded white to brown limestone. In the upper part the limestone is mainly massive. This formation also contains chert nodules. Assereto (1966) chose the name "Lar" only for light-coloured and dense limestones and "Abnik" for dark-coloured limestones and dolomites. Allenbach (1966) and Steiger (1966) believed that the dark colour of the limestones and dolomites is mainly due to local changes of facies in the Lar Formation. At the type section, the Lar Formation conformably overlies the Dalichai Formation. Its top is always formed by a weathered surface that is followed by various rocks. It is important to mention that at some places in the Alborz region sedimentation continued into the Lower Cretaceous. Major evidence is the presence of Lower Cretaceous Calpionellidae and algae near the top of the Lar Formation along the Damavand-Firuzkuh road (Seyed-Emami 1975, Keshani 1988). According to Assereto (1966), however, the age of the Lar Formation is Oxfordian to Kimmeridgian. The main sedimentary environments of this formation are shallow marine carbonate platforms.

Koppeh Dagh Basin

Kashafrud Formation

This formation consists of a sequence of dark coloured turbiditic siliciclastics containing turbidites. They mainly comprise shales, siliceous shales and sandstones. This unit is widespread in the south-eastern region of Koppeh Dagh (Madani 1977, Afshar Harb 1994, 1979, Hossinion 1996). In the south-western Koppeh Dagh the Kashafrud Formation is not developed; its time-equivalent rock units are the Bashkalateh and Chaman Bid formations. The lower part of the formation overlies with angular unconformity or locally with a coarse-grained conglomerate the Triassic Aghdarband Group, Upper Permian ophiolites, or the Mashhad Granite of Mid-Cimmerian origin. The upper boundary of the formation is either a disconformity, a tectonic contact, or a conformable contact with the Chaman Bid and Mozduran formations (Hossenion 1996). The Kashafrud Formation represents a turbidite facies forming at the suture of the Iran Plate with the Turan Plate (Seyed-Emami et al.1994).

Bashkalateh Formation

The formation occurs mainly in the western Koppeh Dagh (Afshar Harb 1979, 1994). According to Seyed-Emami et al. (2001) it is a fine-grained lateral equivalent of the Kashafrud Formation.

Chaman Bid Formation

The Chaman Bid Formation consists of grey to bluish, thin- to medium-bedded limestone with intercalations of marly shale and marl (Afshar Harb 1979, 1994). At the type section (north of Chaman Bid village), the formation attains a thickness of 1722 m. The thickness varies and increases from east of Koppeh Dagh towards the west. The Chaman Bid Formation conformably overlies the Bashkalate Formation. Its upper boundary with the Mozduran Formation is sharp. Main sedimentary environments of the formation are basin and continental slope. Afshar Harb (1994) assigned a Late Bajocian to Oxfordian age to the formation, but recent studies (Schairer et al. 1999) show that the formation may continue up to the Tithonian.

Mozduran Formation

At the type section, the Mozduran Formation consists of light-coloured thick-bedded limestones to massive, porous dolomitic limestones and dolomite. According to Afsharharb (1979) the thickness of the formation at the type section is about 420 m, but towards the northeast, at Sirzar village, it reaches 1400 m (Stöcklin 1972). At the type locality, the Mozduran Formation conformably overlies the Kashafrud Formation. According to Afshar Harb (1979) however, the contact is a weathered surface. At some localities of the Koppeh Dagh region, the Mozduran Formation has a conformable contact with the Chaman Bid Formation. The upper boundary of the Mozduran Formation with Shorijeh Formation is erosional. However no detailed information is available to reach any final conclusions (see chapter 3). Nabaviyeh (1995) believed the boundary between the Mozduran Formation and the Shorijeh Formation to be transitional. At many localities, the age of the Mozduran Formation, based on foraminifera, was found to be Oxfordian-Kimmeridgian, at others Neocomian (Afshar Harb 1994). Lasemi (1995) divided the environment of the Mozduran Formation to in four sub-environments, i.e. tidal flat/beach, lagoonal, platform margin, and open marine.

In the following, the lithology of the four measured sections is briefly described and their faunal content, in particular ammonites, is given. The latter are used to biostratigraphically subdivide the successions.

Biostratigraphy and lithostratigraphic descriptions

Dalichai section

At the type locality, the Dalichai Formation is 97 m thick (Pl. 2.1A) and ranges from the Upper Bajocian to the Callovian. It can be subdivided, from bottom to top, into three members (Fig. 2.1).

Shemshak Formation: The Dalichai Formation is underlain by the Shemshak Formation, which consists of alternations of dark-green shales and medium-bedded, dark, fine-grained sandstones containing plant remains. The top of the Shemshak Formation consists of medium-bedded, grey to yellow sandy limestones (grainstone) with bryozoans, bivalves, gastropods, and echinoderm debris. No ammonites have been recovered.

Member 1 (11 m): Dark-brown shales with intercalations of thin-bedded, greenish-grey limestones (wackestone) characterize this member. Limonitic concretions (Pl. 2.1B) occur in layers. The faunal content comprises siliceous sponges, belemnites and ammonites (*Oxycerites* sp., *Cadomites (Polyplectites)* sp., *Parkinsonia radiata,* and *P. depressa*. The last two taxa are indicative of the Upper Bajocian Parkinsoni Zone, *Oxycerites* and *C. (Polyplectites)* of the Bathonian.

Member 2 (19 m): Alternations of medium-bedded, grey limestones (packstone) and greenish-grey pencil shales (Pl. 2.1D) with the ammonite *Hecticoceras* sp. characterise this member. In addition, abundant siliceous sponges, sponge spicules, belemnites and the trace fossil *Zoophycos* occur. *Hecticoceras* is confined to the Callovian.

Member 3 (69 m): Medium-bedded, yellowish-green marly limestones (packstone) alternate with grey to buff limestones (packstone), which at some levels with abundant chert-nodules up to 10 cm thick (Pl. 2.1C). Sedimentary structures consist of parallel lamination and ripple-bedding. The faunal content comprises bryozoans, sponge spicules, bivalves (“filaments”), echinoderm debris, ostracods and benthic foraminifers (*Lenticulina* sp., *Spirillina* sp., and rotaliids).

There is no specific fossil the age of this part. STEIGER (1966) assumed a Late Callovian age, although the ammonite on which the age determination is based came from a different section.

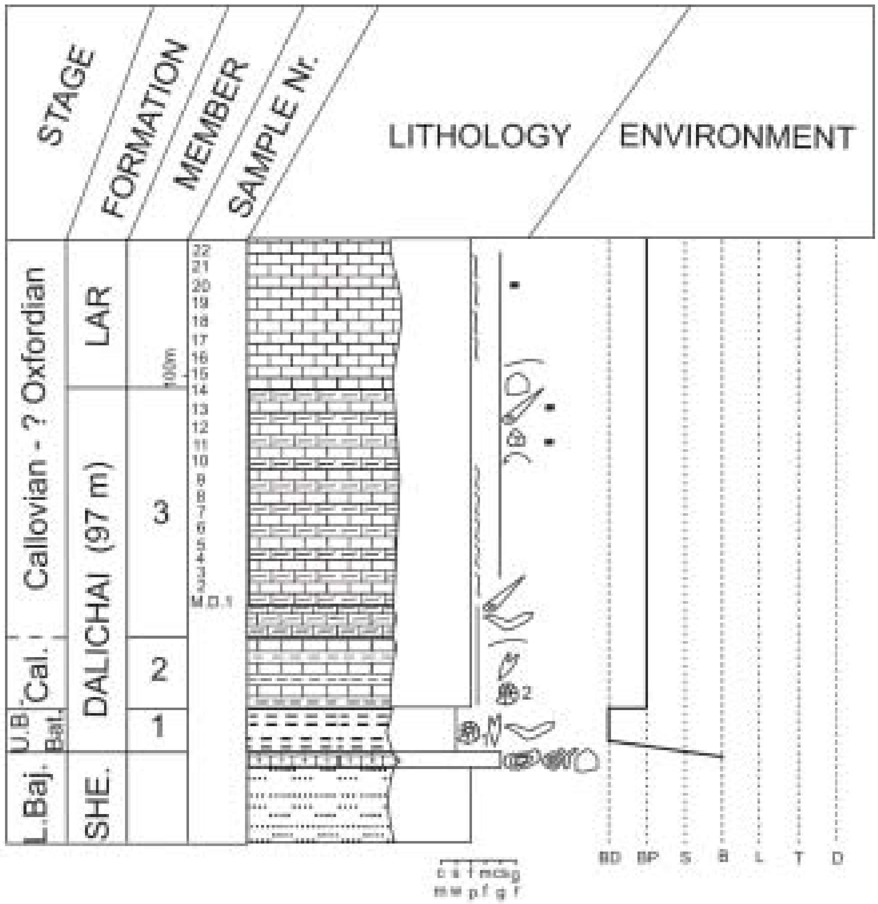


Fig. 2.1. Stratigraphic log of the type section of the Dalichai Formation. For key of symbols see Fig. 2.5.

Lar Formation: The overlying Lar Formation consists of massive to thick-bedded, grey limestones (packstone) with chert-nodules. The upper boundary of the Dalichai Formation is gradational (Pl. 2.1E).

Golbini Jorbat (composite section)

The Dalichai Formation was measured north of Golbini (Pl. 2.1F), with a total thickness of 449 m, ranging from the Upper Bajocian to the Lower Tithonian. It can be subdivided, from bottom to top, into three members (Fig. 2.2)

Shemshak Formation : Alternation of dark-green siltstones and medium-bedded fine-grained sandstone containing plant-debris in the lower part and bivalves (e. g. *Homomya* sp., *Pleuromya* sp., *Plagiostoma* sp.), corals, and gastropods in the upper part. The top of the upper part there is a relict conglomerate which evidence of Mid-Cimmerian tectonic movements in this area. **Dalichai Formation**: The base of the Dalichai Formation consists of medium-bedded, brown weathering sandy limestone (grainstone) with siliceous sponges, bivalves (?*Spondylopecten* sp.), gastropods, belemnites, benthic foraminifers (nodosariids, rotaliids), *Serpula (Cycloserpula)* sp., and ammonites (*Phylloceras* sp., *Strenoceras* sp., *Sphaeroceras tutthum, Garantiana (Orthogarantiana)* cf. *densicostata.* The ammonites indicate the Upper Bajocian Niortense–Garantiana zones. Many of fossils in this member are oxidized and deformed. This formation unconformably underlain by the Shemshak Formation (Pl. 2.1G).

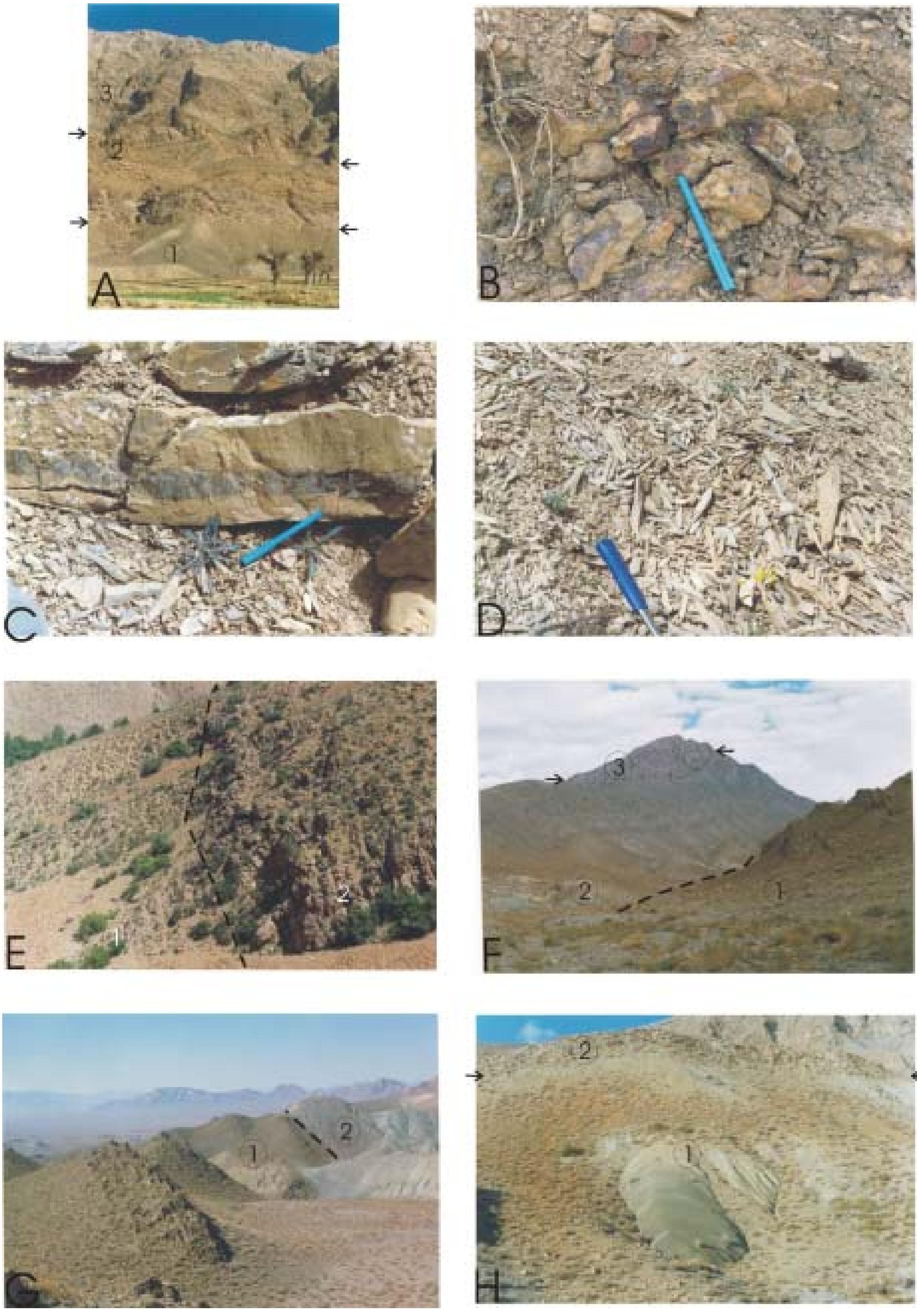
Member 1 (105 m): The member consists of green-grey silty marls (Pl. 2.1H) with small amounts of secondary gypsum. Pink limestones (floatstone) occur 84 m above the base of the member in beds varying from 20 to 60 cm. in thickness. The fossils comprise siliceous sponges, bryozoans, *Terebella lapilloides,* bivalves (?*Anisocardia* sp.), gastropods, (*Obornella* sp.), echinoderm debris, belemnites, microbial crusts, *Tubiphytes,* and ammonites (*Oxycerites yeovilensis*, *Oxycerites* cf. *oxus*, *Bullatimorphites* sp., *Morphoceras multiforme*, *M. macrescens*, *M. egrediens*, and *Ebrayiceras* cf. *sulcatum*). The ammonite fauna indicates the Lower Bathonian Zigzag Zone.

Member 2 (211 m): Alternations of greyish-green marls, well-bedded greyish to yellow marly limestones and limestones (packstone) (Pl. 2.2A) constitute the member. At some levels the marly limestones and limestones contain abundant chert-nodules (Pl. 2.2C) and the trace fossil *Zoophycos* (Pl. 2.2B). This member contains, apart from a few fossils such as bivalves

---

Plate 2.1. Field aspects of the Middle and Upper Jurassic platform to basin sediment of NNE Iran.

Fig. A. Contacts of the Shemshak, Dalichai and Lar formations (arrowed) at the type locality of the Dalichai Formation. 1- Alternation of dark, fine- to medium-bedded siltstones and sandstones (top part of the Shemshak Formation); 2-Alternation of yellowish-green, medium-bedded limestones and shales (Dalichai Formation); 3-Massive to thickly-bedded limestones (Lar Formation).
Fig. B. Limonitic concretions in member 1 of the Dalichai Formation at the type locality.
Fig. C. Chert-bands in limestones of member 3 of the Dalichai Formation at the type locality.
Fig. D. Greenish-grey pencil shales in member 2 of the Dalichai Formation at the type locality.
Fig. E. Gradual contact between the Dalichai Formation (1) and Lar Formation (2) at the type locality.
Fig. F. Dalichai Formation (2) with unconformity contact to the siliciclastics of the underlying Shemshak Formation (1) and gradual contact (arrowed) with the overlying Lar Formation (3) at Golbini.
Fig. G. Contact of the Shemshak Formation (1) and member 1 of the Dalichai Formation (2) at Golbini.
Fig. H. Contact (arrowed) between member 1 (green silty marl (1)) and member 2 (alternation of marl, marly limestones and limestones (2)) of the Dalichai Formation at Golbini.


A
B
C
D
E
F
G
H

(filaments, Protocardia), brachiopods (terebratulids) gastropods, echinoderm debris, belemnites, *Neuropora* sp., ostracods, radiolarians, sponge spicules, benthic foraminifers (*Lenticulina* sp., *Ammobaculites coprolithoformis, Spirillina,* rotaliids, nodosariids, miliolids), a rich ammonite fauna (Table 2.1), indicative of the Upper Bathonian (Retrocostatum Zone), Lower Callovian (Gracilis Zone), Middle Callovian (Anceps and Coronatum zones), Upper Callovian (Lamberti Zone), and Middle Oxfordian (Transversarium Zone).

Table 2.1. Distribution of ammonites in member 2 of the Dalichai Formation at Golbini.

Taxon	**ammonite horizons**							**known range**
	1	2c	3	4	5	6	7	
Phylloceras sp.		*	*	*				U. Bathonian-M. Oxfordian
Calliphylloceras sp.		*	*	*				U. Bathonian-M. Oxfordian
Holcophylloceras cf. *indicum*			*					Callovian
Holcophylloceras sp.			*					Callovian
Ptychophylloceras sp.		*	*	*				U. Bathonian-M. Oxfordian
Sowerbyceras sp.		*	*	*				U. Bathonian-M. Oxfordian
Eochetoceras sp.				*				Lower Oxfordian
Hecticoceras (Putealiceras) metomphalum			*					Anceps Zone
Hecticoceras zieteni			*					Anceps and Coronatum zones
Hecticoceras (Putealiceras) schalchi			*					Anceps Zone
Hecticoceras (Lunuloceras) cf. *lunuloides*			*					Anceps Zone
Hecticoceras (Zietenniceras) evolutum			*					Middle Callovian
Hecticoceras (lunuloceras) aff. *pseudopunctatum*			*					Callovian-L. Oxfordian
Hecticoceras (Brightia) aff. *solinophorum*			*					M. Callovian- L. Oxfordian
Oecotraustes (Paroecotraustes) aff. *serrigerus*		*						Retrocostatum Zone
Taramelliceras cf. *dentostriatum*				*				Transversarium Zone
Taramelliceras (Proscaphites) anar				*				Transversarium Zone
Bullatimorphites (Kheraiceras) sp.		*						Retrocostatum Zone
Pachyceras lalandei			*					Lamberti Zone
Reineckeia (Tyrannites) convex			*					Gracilis Zone

Reineckeia (Tyrannites) sp.	*	Gracilis Zone
Reineckeia (Reineckeia) anceps	*	Anceps Zone
Rehmannia (Loczyceras) segestana	*	Anceps Zone
Rehmannia (Loczyceras) cf. *hungarica*	*	Anceps Zone
Rehmannia (Loczyceras) intermedia	*	Anceps Zone
Rehmannia (Loczyceras) sequanica densicostata	*	Coronatum Zone
Indosphinctes (Elatmites) cf. *revili*	*	Gracilis Zone
Indosphinctes (Elatmites) sp.	*	Middle Callovian
Flabellisphinctes (Flabellia) tsytovitchae	*	Coronatum Zone
Binatisphinctes (Okaites) cf. *mosquensis*	*	Coronatum Zone
Choffatia (Grossouvria) kontkiewiczi	*	Coronatum Zone
Homoeoplanulites (Homoeoplanulites) sp.	*	Callovian

Member 3 (138 m): The member comprises alternations of medium-bedded, grey to pinkish limestones (mudstone to packstone) with cherts, green-grey marls (Pl. 2.2D) and rare limestones (grainstone) with sharp erosional bases in beds varying from 30 to 80 cm in thickness. Sedimentary structures are rare and consist of parallel lamination and ripple bedding. The macro- and microfauna is represented by bivalves (filaments), echinoderm debris, belemnites, ostracods, radiolarians, sponge spicules, benthic foraminifers (*Lenticulina* sp., *Globuligerina* sp., *Ammobaculites* sp., rotaliids, nodosariids and miliolids). In the upper part the member contains microbial crusts, *Terebella, Tubiphytes* and numerous ammonites (Table 2.2).

Table 2.2. Distribution of ammonites in member 3 of the Dalichai Formation at Golbini.

Taxon	**ammonite horizons**							**known range**
	1	2	3	4	5	6	7	
Phylloceras sp.					*	*		U. Oxfordian-Kimmeridgian
Sowerbyceras sp.					*	*		U. Oxfordian-Kimmeridgian
Ochetoceras marantianum					*			Bimammatum Zone
Ochetoceras semifalcatum					*			Bimammatum Zone

Perisphinctes (Dichotomosphinctes) buckmani	*	U. Oxfordian
Dichotomosphinctes sp.	*	U. Oxfordian
Perisphinctes (Dichotomoceras) bifurcatus	*	Bifurcatus Zone
Orthosphinctes (Ardescia) schaireri	*	Platynota Zone
Orthosphinctes (Ardescia) proinconditus	*	Platynota Zone
Orthosphinctes (Ardescia) cf. *thieuloyi*	*	Platynota Zone
Orthosphinctes (Orthosphinctes) sp.	*	Platynota Zone
Orthosphinctes (Ardescia) sp.	*	Platynota Zone
Orthosphinctes sp.	*	Platynota Zone
Sequeirosia (Gemmellarites) sp.	*	Kimmeridgian
Subdiscosphinctes sp.	*	Bimammatum Zone
Richterella richteri	*	Richteri Zone
Euaspidoceras hypselum	*	Bimammatum Zone

The ammonites indicate the Upper Oxfordian Bifurcatus and Bimammatum zones, the Kimmeridgian Platynota Zone, and the Tithonian Richteri Zone.

Lar Formation : At Golbini, the Lar Formation is represented by thick-bedded, cliff-forming, grey dolomitic limestones to limestones that, when weathered, are cream-coloured to yellowish. *Tubiphytes* and microbial crusts are common. The formation was measured at Jorbat where it reaches a thickness of 414 m (Pl. 2.2E).

Member 1 (102 m): Alternations of cliff-forming, grey to pink dolomitic limestones

---

Plate 2.2. Field aspects of the Middle and Upper Jurassic platform to basin sediments of NNE Iran.

Fig. A. Member 2 of the Dalichai Formation at Golbini; alternations of marls, marly limestones, and limestones.
Fig. B. *Zoophycos* in member 2 of the Dalichai Formation at Golbini.
Fig. C. Bedding plane with chert-nodules in member 2 of the Dalichai Formation at Golbini.
Fig. D. Member 3 of the Dalichai Formation at Golbini; alternations of limestones and marls.
Fig. E. Lar Formation (2) conformably overlying the Dalichai Formation (1) at Jorbat.
Fig. F. Massive to thickly-bedded limestones of the Lar Formation at Jorbat.
Fig. G. Massive limestones of the Lar Formation at Jorbat.
Fig. H. Shurijeh Formation equivalent (2) between the Lar Formation (1) and Cretaceous rocks (3) at Jorbat.


A
B
C
D
E
1
2
F
G
H
1
2
3

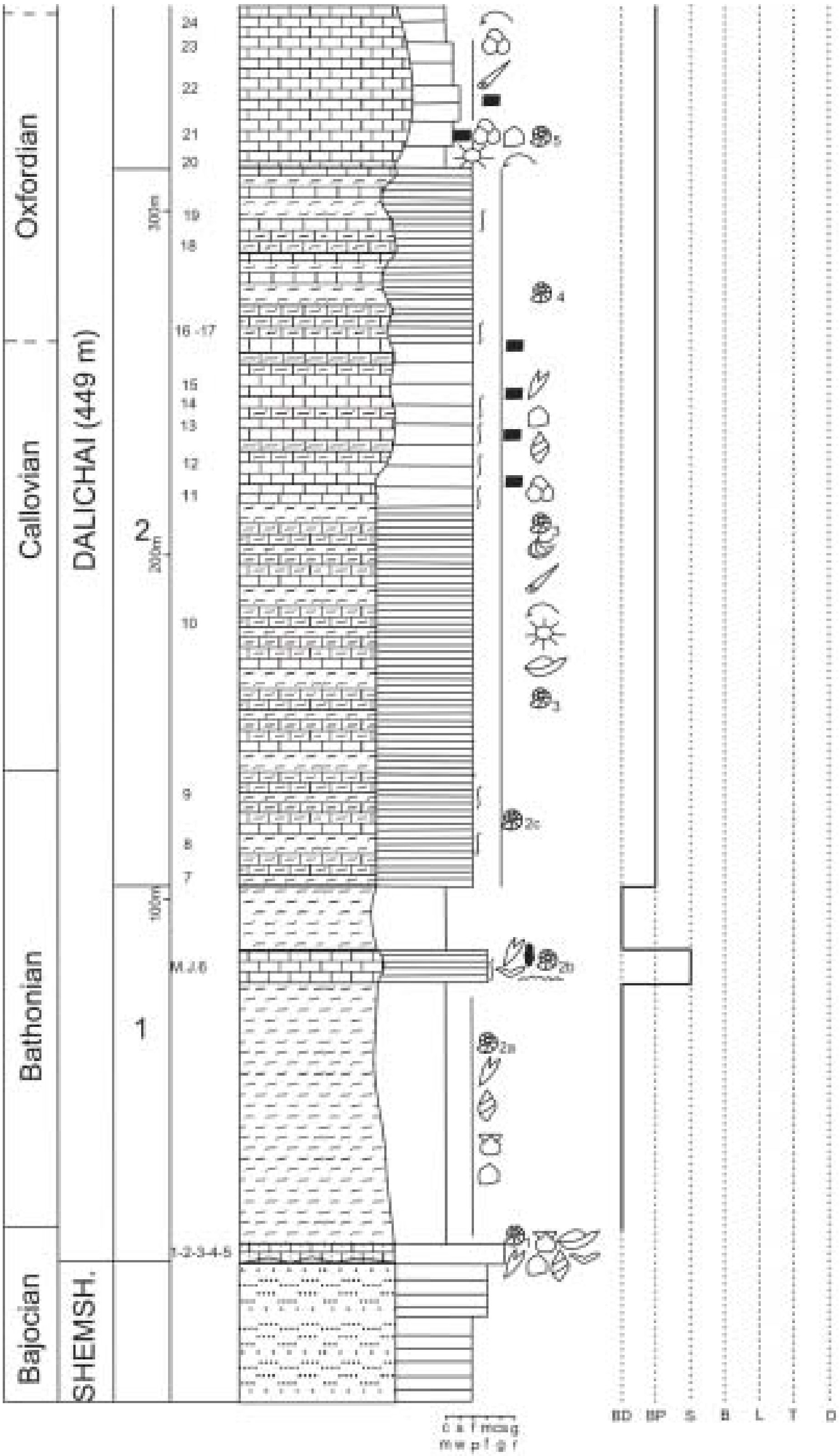
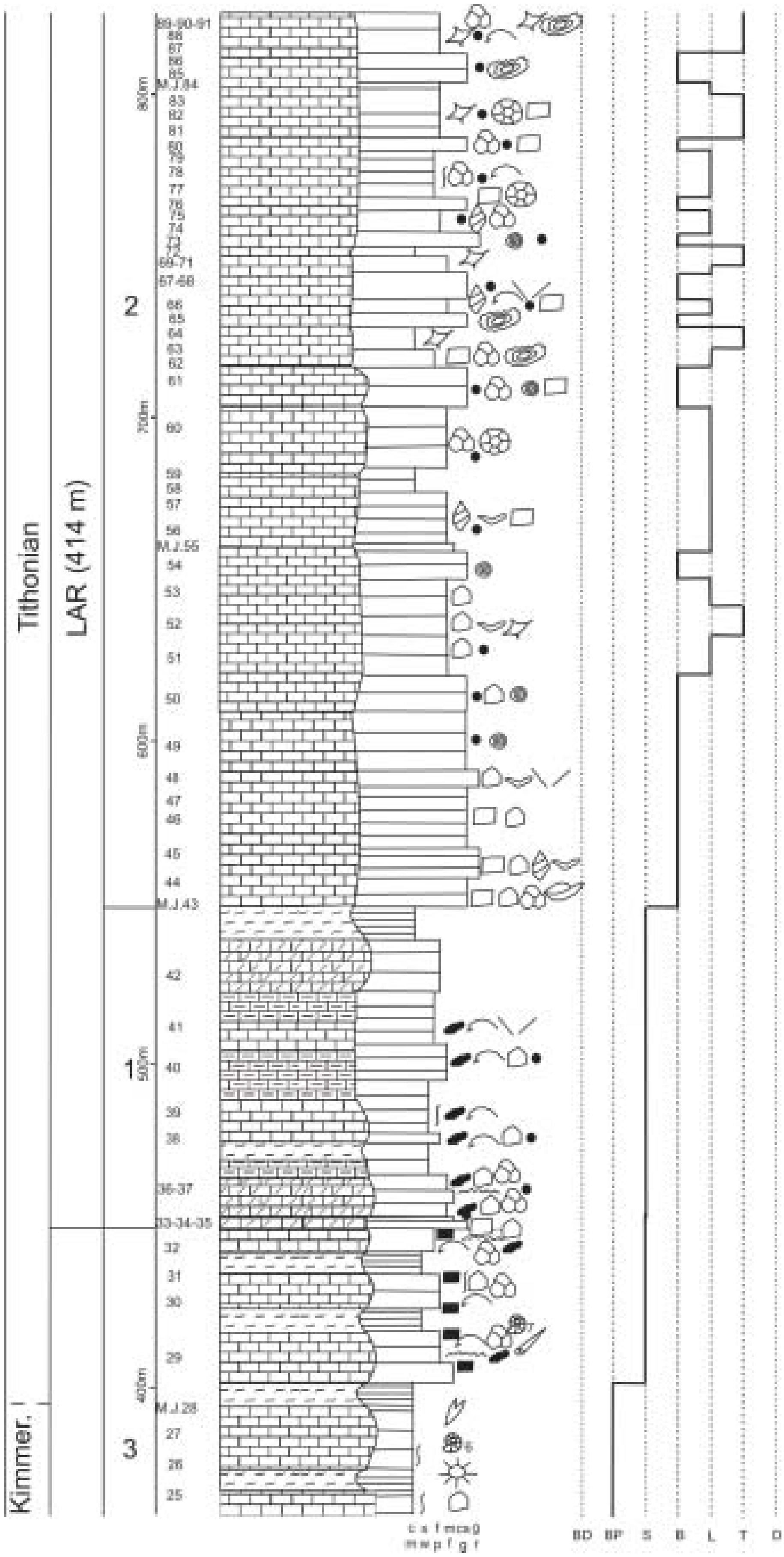


Fig. 2.2. Stratigraphic log of the Dalichai and Lar formations and their members in the Golbini-Jorbat section. For key of symbols see Fig. 2.5.


Tithonian
Kimmer.
LAR (414 m)
2
1
3
800m
700m
600m
500m
400m
89-90-91
M.J.84
69-71
67-68
M.J.55
M.J.43
36-37
33-34-35
M.J.28
BD
BP
S
B
L
T
D

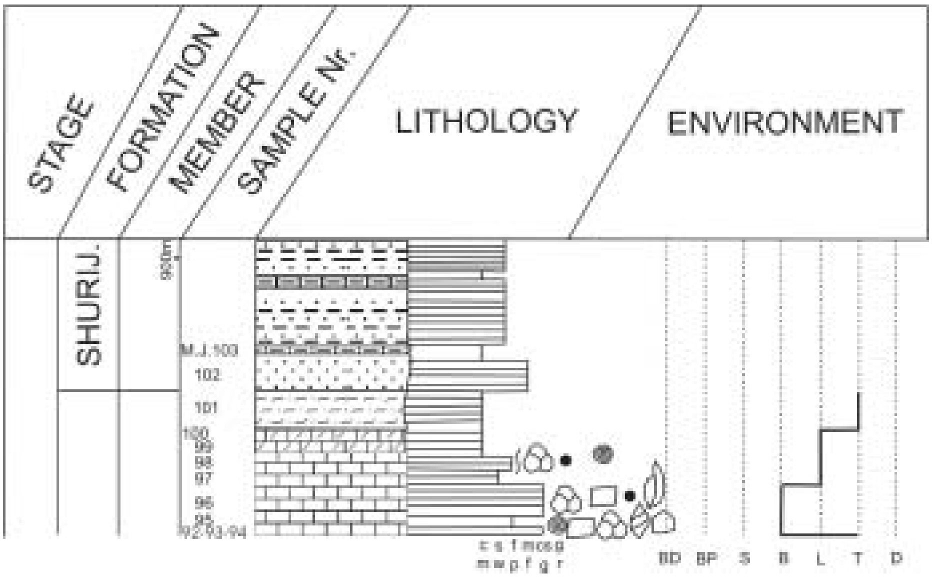


Fig. 2.2 (cont.)

packstone) and thin- to medium-bedded, greenish-grey argillaceous limestones with intercalations of green marls. The fauna comprises sponges (hexactinellids), echinoderm debris, ostracods, benthic foraminifers (*Ammobaculites coprolithiformis,* rotaliids). In addition microbialites with abundant *Tubiphytes* occur.

Member 2 (319 m): Thick to massive, grey to pink, peloidal and oolitic limestones (mudstone to grainstone; Pl. 2.2F). In the upper part fenesteral fabrics occur abundantly. The member contains sponges, corals, brachiopods, terebratulids, gastropods, echinoderm debris, *Cayeuxia* sp., ostracods, and benthic foraminifers *(Nautiloculina* sp., *Ammobaculites coprolithiformis,* nodosariids, miliolids). Because of the lack of Lower Cretaceous index fossils, and the find of the Lower Tithonian ammonite *Richterella* sp. in member 3 of the Dalichai Formation, that member and member 1 probably indicate Tithonian.

Top: Alternations of red shales and medium-bedded, red to green, medium-grained sandstones of the Shorijeh Formation (Pl. 2.2H) conformably overlie the Lar Formation.

Chaman Bid section

In contrast to the 1722 m measured by Afshar Harb (1994) 1556 m were measured here (Fig. 2.3). The Chaman Bid Formation mostly consists of alternations of grey limestone, grey marly limestone (mudstone to packstone) with pyrite, shale, argillaceous shale, and a few levels of sandstones. According to the ammonite fauna, the Chaman Bid Formation ranges from the ?Bathonian to the Tithonian. At the type locality (Fig. 2.3), the formation has been subdivided, from base to top, into seven members.

Bashkalateh Formation: This formation is characterised by thinly bedded siltstone and dark grey silt with intercalations of medium-bedded, dark-grey sandstones interpreted as turbidites. Fossils include the trace fossils *Paleodictyon*, reworked plant remains (Pl. 2.3C), and in the upper part small pyritized ammonites and belemnites (*Cadomites* sp.) the latter indicating a Late Bajocian age. The transition to the overlying Chaman Bid Formation is gradual (Pl. 2.3B).

Member 1 (30 m): Alternations of grey shales and thin-bedded, sandy limestones (grainstone) with bryozoans, sponge spicules, bivalves (filaments), echinoderm debris, belemnites and radiolarians.

Member 2 (408 m): This member has been subdivided into three submembers. The lower and upper parts are similar and consist of alternations of medium-bedded, grey limestones (wackestone to packstone), argillaceous limestone (wackestone) and rare grainstones beds with sharp bases in beds varying from 10 to 80 cm in thickness (Pl. 2.3D). The fauna includes bryozoans, bivalves (filaments), gastropods, echinoderm debris, belemnites, ammonites, benthic foraminifers (nodosariids, miliolids), sponge spicules, ostracods, and radiolarians. The middle part consists of medium- to thick-bedded, light-grey limestones (wackestone) and rare argillaceous shales with bivalves (filaments), echinoderm debris, belemnites, ammonites, benthic foraminifers (*Spirillina,* miliolids), sponge spicules, and ostracods. In the middle part pyrite and chert nodules occur at some levels. Trace fossils include *Zoophycos* and rare *Thalassinoides*. The member contains the following ammonites:

Hecticoceras sp., *Reineckeia* sp., *and Rehmannia* sp., which indicate a Callovian age.

All ammonites have been obtained from the upper part of the member. For the lower part, which lacks index ammonites, a ?Bathonian age is inferred based on its stratigraphic position, as Upper Bajocian ammonites have been recorded from the top of the Bashkalateh Formation.

Member 3 (33 m): Alternations of thin- to thick-bedded, greenish-grey, well sorted, fine-grained sandstones and silty marl with intercalations of greenish-grey silt (Pl. 2.3F). The sandstone beds are usually 0.1-2.5 m thick, and are parallel-laminated, exhibit low-angle, large-scale trough cross-bedding, or small-scale ripple-bedding and oscillation ripple surfaces. Commonly, these sandstone-silty marl alternations form small-scale thickening-upward cycles. Convolute bedding, flute casts, load casts (Pl. 2.3G), and reworked sandstone clasts occur. Trace fossils include *Thalassinoides, Planolites*, and *Gyrochorte*.

Member 4 (357 m): The member consists of alternations of dark-grey limestones (wackestone) with pyrite, argillaceous shales, and greyish-green marls (Pl. 2.3H) with intercalations of limestones (grainstone) with sharp erosional bases. Bed thicknesses vary from 10 to 100 cm (Pl. 2.4A). Flute casts occur on some lower surfaces of the limestone beds, which contain abundant ooids and peloids.

Apart from corals, bryozoans, echinoderm debris, belemnites, benthic foraminifers (*Ammobaculites coprolithiformis, Spirillina*, miliolids), sponge spicules, *Saccocoma*, radiolarians, and ostracods, the member contains a rich ammonite fauna, indicative of the Oxfordian-Lower Tithonian. Based on these ammonites, three assemblage zones can be distinguished:

Biozone A (Oxfordian) comprises the ammonites *Taramelliceras* cf. *costatum* (Bimammatum

---

Plate 2.3. Field aspects of the Middle and Upper Jurassic platform to basin sediment of NNE Iran.

Fig. A. Massive to thickly-bedded limestones of the Mozduran Formation (2) conformably but sharply overlying alternations of limestones, argillaceous limestones and argillaceous shales of the Chaman Bid Formation (1) at the type locality of the latter formation.
Fig. B. Chaman Bid Formation (2) with transitional contact to siliciclastics of the Bashkalateh Formation (1) at the type locality of the Chaman Bid Formation.
Fig. C. Reworked plant remains in sandstones within the top part of the Bashkalateh Formation at the type locality of the Chaman Bid Formation.
Fig. D. Member 2 (alternating grey limestones and argillaceous shales) of the Chaman Bid Formation at the type locality.
Fig. E. Contact (arrowed) between the lower deltaic siliciclastics (member 3; (1)) and platform slope facies (member 4; (2)) of the Chaman Bid Formation at the type locality.
Fig. F. Thin- to thick-bedded, greenish-grey sandstones and siltstones (lower deltaic siliciclastics, member 3) Chaman Bid Formation at the type locality.
Fig. G. Flute casts and load casts within sandstone unit of member 3 of the Chaman Bid Formation at the type locality.
Fig. H. Member 4 (alternating limestones, argillaceous shales, and marls) of the Chaman Bid Formation at the type locality.


2
1
A
2
1
B
1 cm
C
D
2
1
E
F
G
H

and planula zones), Dichotomoceras sp., Glochiceras sp., and Subdiscosphinctes sp..

Biozone B: This biozone is represented by abundant ammonites, which occur in the upper part of the member and which are similar to the ammonites described by SPATH (1970) from northern Iraq. According to SPATH (1970), these ammonites indicate the upper part of the Lower Tithonian and the lower part of the Upper Tithonian. However, at top of this member *Richterella richteri* is common, which indicates Lower Tithonian (CECCA 1986). Therefore, the age of this assemblage is older than that of *Richterella.* The assemblage comprises the following taxa:

Pseudolissoceras zitteli, Glochiceras sp*., Oxylenticeras* cf*. lepidum, Phanerostephanus subsenex, Nothostephanus* sp*., Phanerostephanus* sp*.,* and *Nannostephanus* cf*. subcornutus.*

Biozone C: This biozone is indicative of the Lower Tithonian Fallauxi Zone and is characterised by abundant *Richterella richteri* and *Richterella* sp.. *Sublithacoceras* sp. is rare.

Member 5 (78 m): Alternations of thin- to thick-bedded, greenish-grey, well sorted, fine-grained sandstones and silty marl with intercalations of greenish-grey silt. The sandstone beds are usually 10-150 cm thick (Pl. 2.4C) and are parallel-laminated, exhibit large-scale, low-angle trough cross-bedding or small-scale ripple bedding, hummocky cross-stratification, or oscillation ripple surfaces. Commonly, the sandstone-silty marl alternations form small-scale thickening-upward cycles. Flute casts, load casts and reworked sandstone clasts occur. Trace fossils include *Gyrochorte.*

Member 6 (42 m): The member consists of alternations of greenish-grey marls, thin-bedded, grey limestones (wackestone) and argillaceous shales (Pl. 2.4D) with radiolarians and *Spirillina.*

Member 7 (658 m): Well-bedded, light-grey limestones (mudstone; distal basin facies; Pl. 2.4E) alternate with argillaceous shales that contain microbialites (Pl. 2.4F) in the upper part with *Terebella, Tubiphytes,* and *Ammobaculites coprolithoformis.* Rarely, grey marl is intercalated. This member has a uniform facies. Fossils comprise echinoderm debris, *Spirillina*, sponge spicules, radiolarians and the trace fossils *Taenidium serpentinum*. In the upper part two microbialitic limestone beds occur that contain *Tubiphytes* and sponges debris. Based on its stratigraphic position, a Tithonian-?Neocomian age of the member is assumed, although no index fossils were recorded.

Mozduran Formation: Massive, light-grey limestones (wackestone to grainstone), which overlie the Chaman Bid Formation with conformable but sharp contact (Pl. 2.4 G).

Tooy Takhtehbashgheh (composite section)

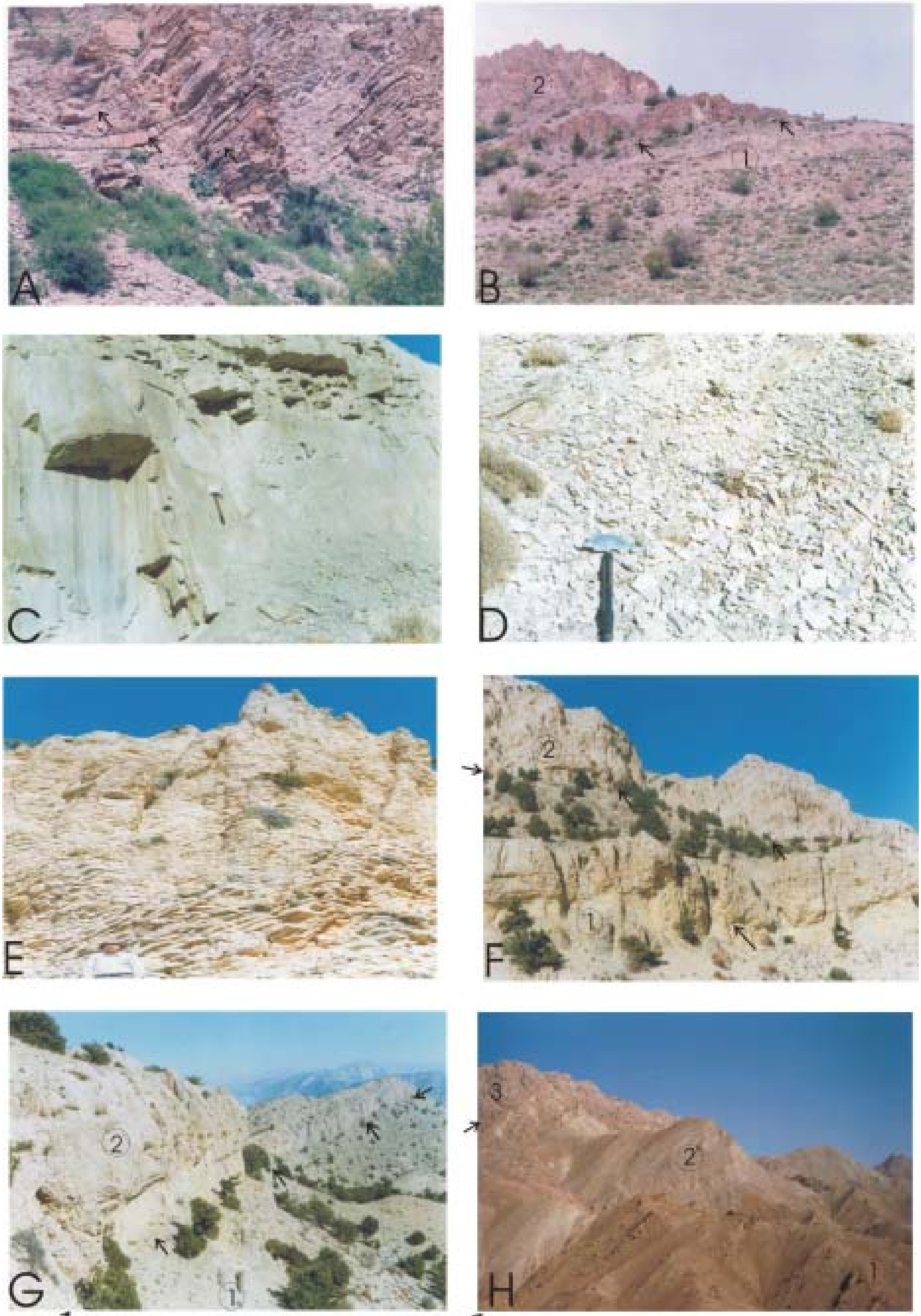
The Chaman Bid Formation was measured north of Tooy. At that locality the formation is 567 m thick and has been subdivided into three members (Fig. 2.4). The ammonite fauna of the section indicate Upper Bajocian to Kimmeridgian.

Shemshak Formation: Alternations of dark-red to red siltstones and medium- to thick-bedded dark-grey sandstones. The contact to member 1 of the Chaman Bid Formation is angular unconformity (Pl. 2.4H, Text Fig. 2.1A). The base of the Chaman Bid Formation consists of brown weathering sandy limestones (grainstone), which laterally changes into a micro-conglomerate (Text Fig. 2.1B). The thickness of the the limestone varies from 2 to 8 m. The fauna consists of siliceous sponges, bryozoans, terebratulids, bivalves (inoceramids, *Protocardia* sp., *Bositra* sp., *Eopecten* sp., *Chlamys* sp., *Plagiostoma* sp.), gastropods (*Obornella* sp.), irregular echinoids (tests and spines), belemnites, benthic foraminifers (*Nautiloculina* sp., *Trocholina* sp., miliolids, nodosariids), and the ammonites *Holcophylloceras* sp., *Spiroceras orbignyi* (Garantiana Zone), *Spiroceras annulatum* (Niortense and Garantiana zones), *Sphaeroceras tuttum* (Garantiana and Parkinsoni zones), *Garantiana (Pseudogarantiana) dichotoma* (Garantiana Zone), and *Parkinsonia parkinsoni* (Parkinsoni Zone),

---

Plate 2.4. Field aspects of the Middle and Upper Jurassic platform to basin sediments of NNE Iran.

Fig. A. Member 4 of the Chaman Bid Formation: medium- to thick-bedded allodapic limestones (arrowed) are intercalated between medium- to thick-bedded platform-slope sediments at the type locality.
Fig. B. Contact (arrowed) between the deltaic siliciclastics (1; member 5) and distal basin sediment (2; member 6) of the Chaman Bid Formation at the type locality.
Fig. C. Alternations of thin to thick-bedded, greenish-grey sandstones and siltstones (deltaic siliciclastics; member 5) of the Chaman Bid Formation at the type locality.
Fig. D. Greenish-grey argillaceous shales (member 6) the Chaman Bid Formation at the type locality.
Fig. E. Well-bedded, light-grey distal basin limestones (member 7) of the Chaman Bid Formation at the type locality.
Fig. F. Contact (short arrows) between the Mozduran Formation (2) and the Chaman Bid Formation (1). Position of microbialitic limestones is shown by long arrow. Type locality of the Chaman Bid Formation.
Fig. G. Massive to thickly-bedded limestones of the Mozduran Formation (2) conformably but sharply (arrowed) overlie the Chaman Bid Formation (1) at the type locality.
Fig. H. Contacts between Shemshak (1), Chaman Bid (2) and Mozduran (3) formations at Tooy.


A
B
2
1
C
D
E
F
2
1
G
2
1
H
3
2
1

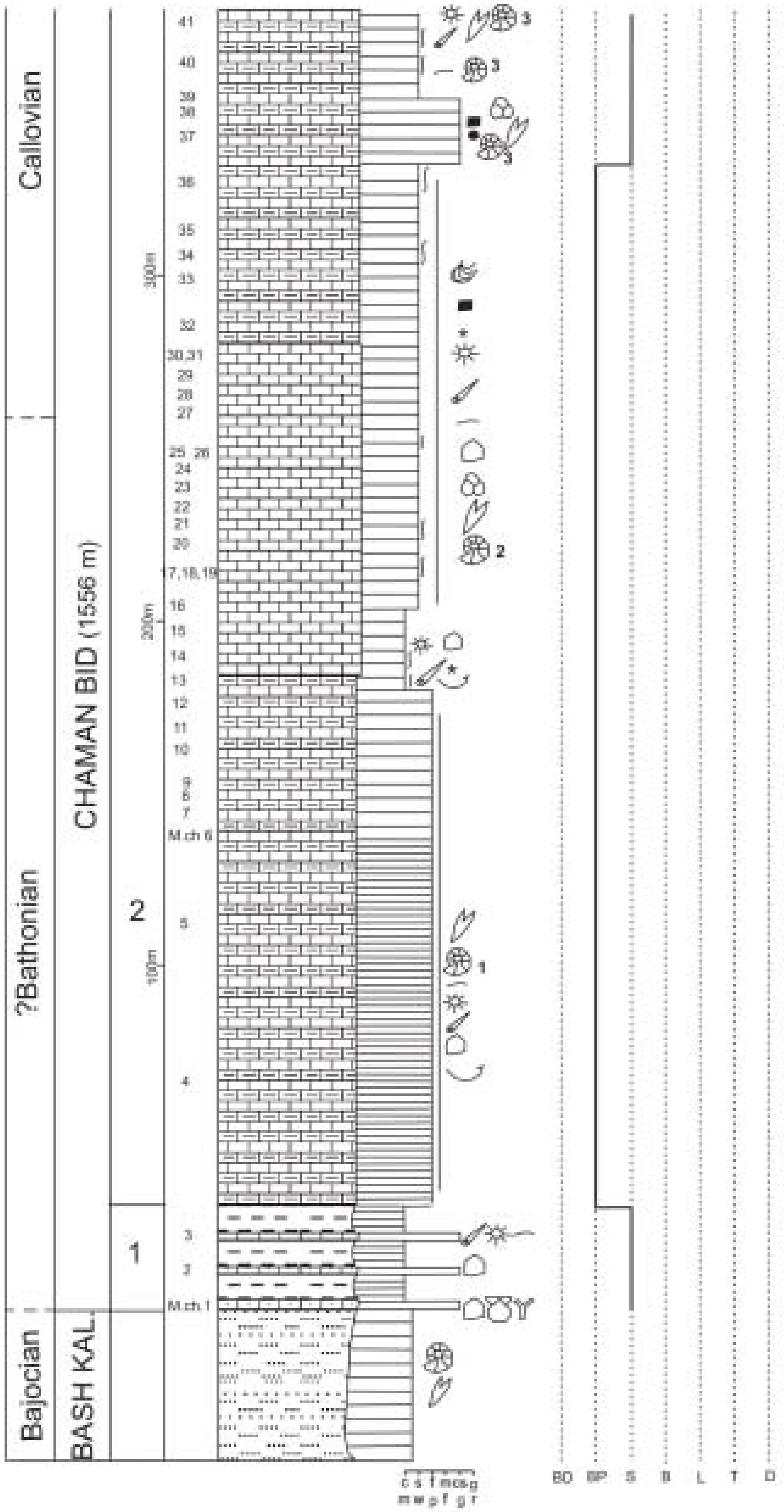
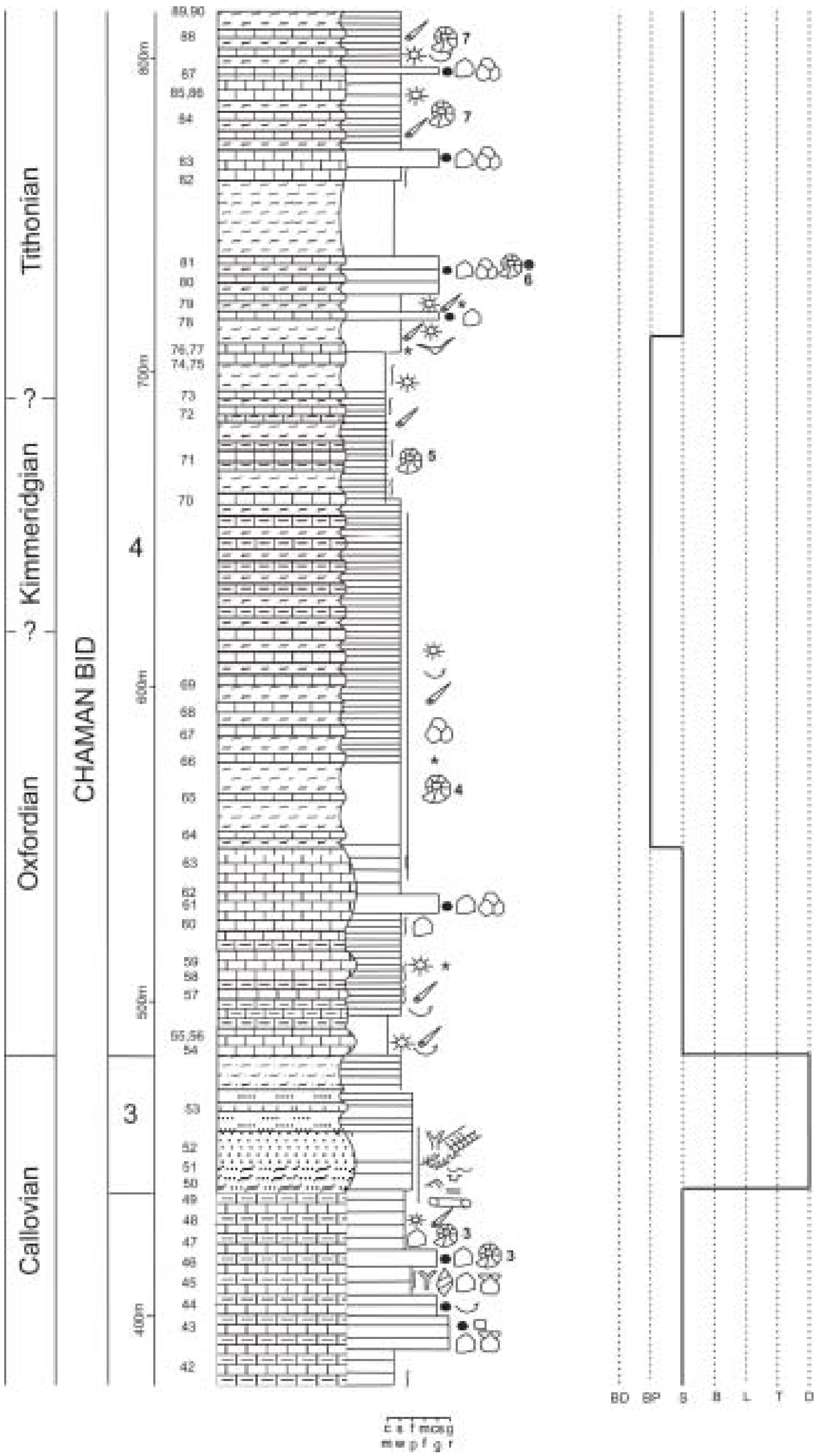
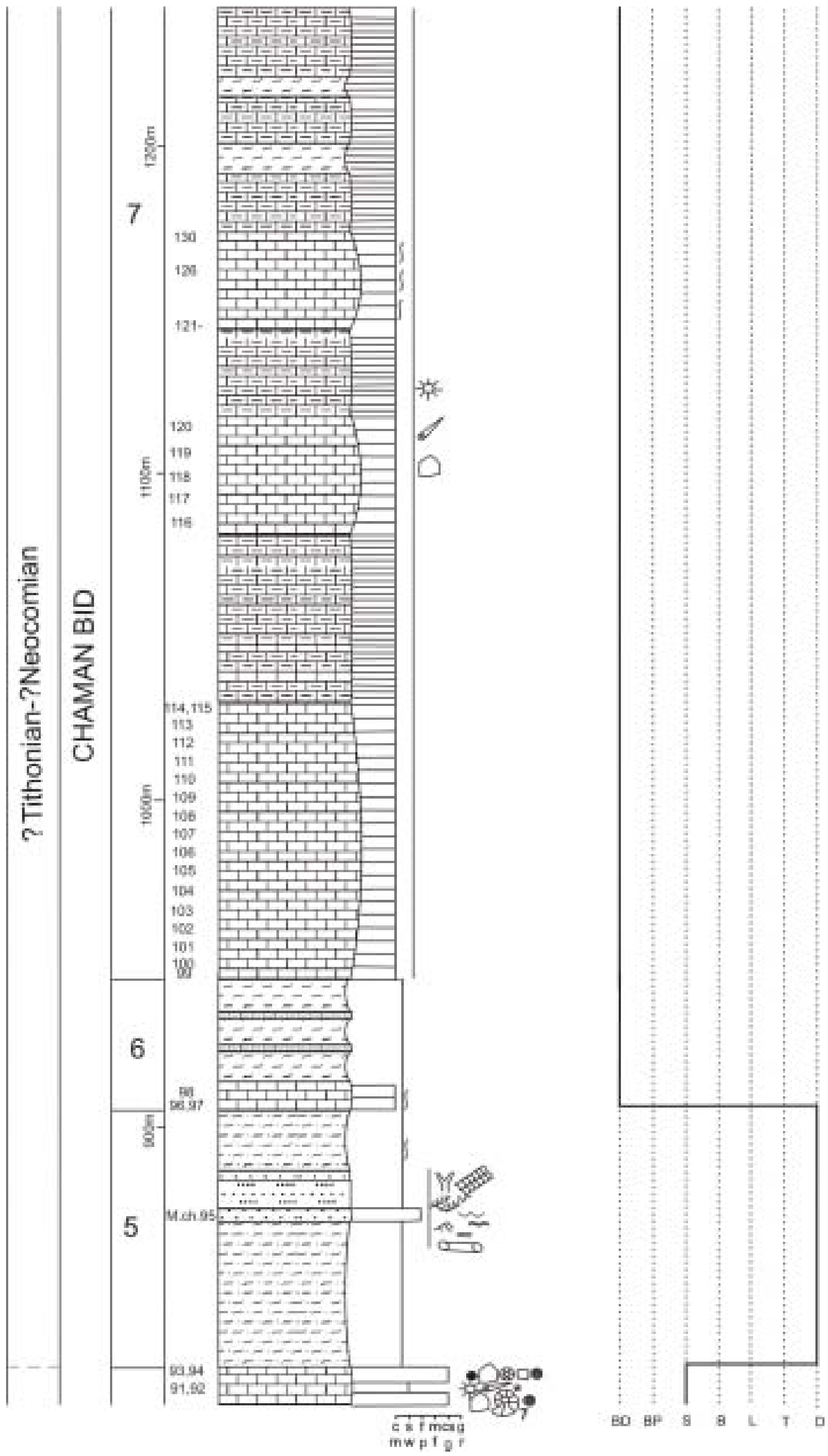
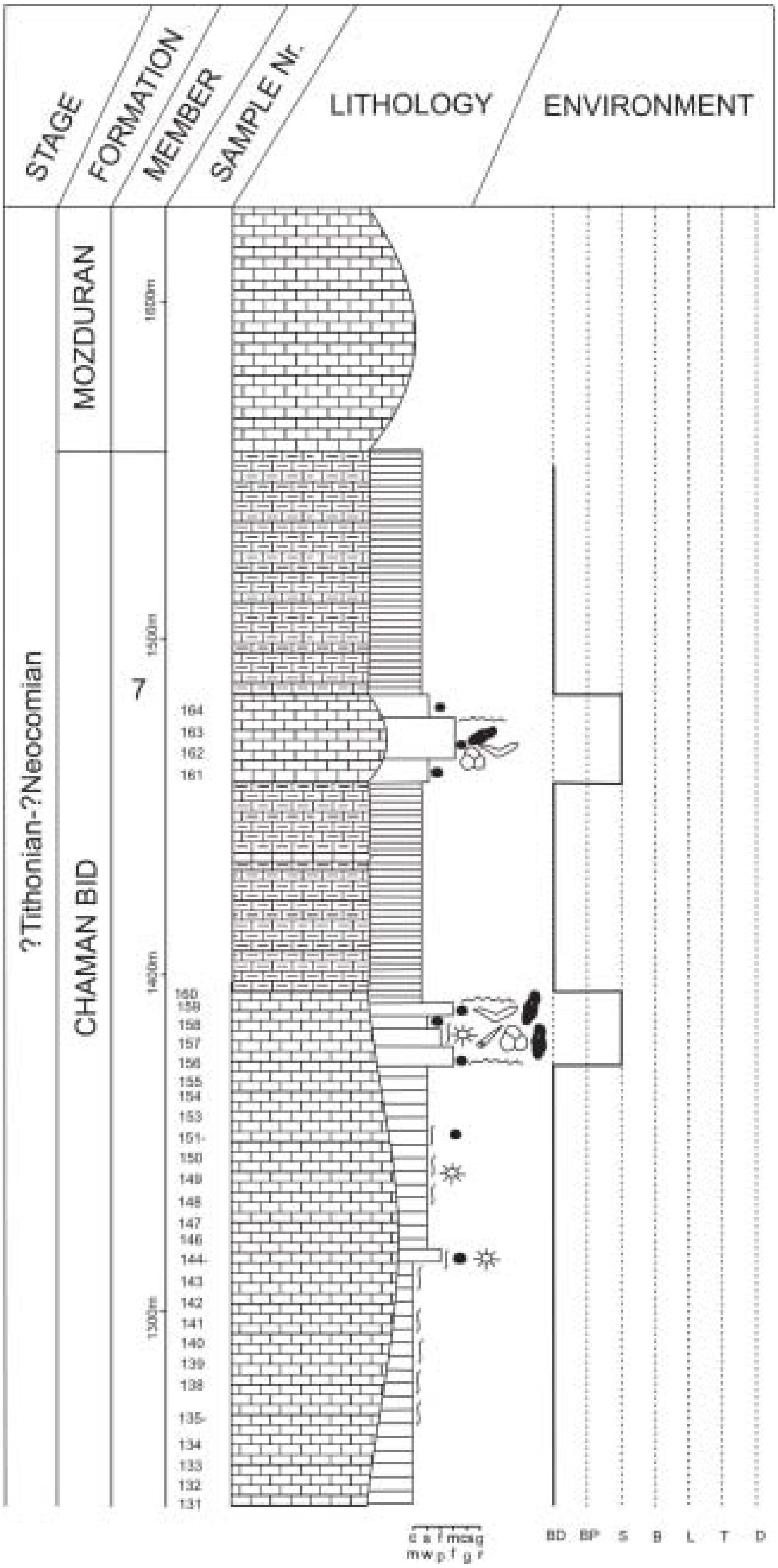


Fig. 2.3. Stratigraphic log of the type section of the Chaman Bid Formation N of Chaman Bid village. For key of symbols see Fig. 2.5.


Tithonian
Kimmeridgian
Oxfordian
Callovian
CHAMAN BID
4
3
400m
500m
600m
700m
800m
BD
BP
S
B
L
T
D


?Tithonian-?Neocomian
CHAMAN BID
7
6
5
1200m
1100m
1050m
900m
130
126
121
120
119
118
117
116
114,115
113
112
111
110
109
108
107
106
105
104
103
102
101
100
99
98
96,97
M.ch.95
93,94
91,92
c s f m c s g
m w p f g r
BD BP S B L T D


STAGE
FORMATION
MEMBER
SAMPLE Nr.
LITHOLOGY
ENVIRONMENT
?Tithonian-?Neocomian
MOZDURAN
CHAMAN BID
7
1600m
1500m
1400m
1300m
164
163
162
161
160
159
158
157
156
155
154
153
151-
150
149
148
147
146
144-
143
142
141
140
139
138
135-
134
133
132
131
c s f mcsg
m w p f g r
BD BP S B L T D

Microbajocisphinctes sp., and Microbajocisphinctes cf. pseudointerruptus.
The ammonite fauna indicates Upper Bajocian.

Member 1 (73 m): The member consists of green silty marls with belemnites and ammonites (Text Fig. 2.1C). A 0.2 to 1 m thick pink limestone bed (wackestone) occurs 72 m above the base of the member. It contains sponges, brachiopods, gastropods, echinoid spines, belemnites, benthic foraminifers (*Nautiloculina* sp., *Lenticulina* sp., nodosariids), ostracods and the ammonites *Bullatimorphites (Kheraiceras) bullatus* (Lower to ?Middle Bathonian), *Cadomites (Polyplectites) dorni* (Lower Bathonian), *Homoeoplanulites (Homoeoplanulites)* cf. *bugesiacus* (Discus Zone), *Homoeoplanulites (Parachoffatia) arkelli* (Discus Zone), and *Homoeoplanulites* sp..
The ammonite fauna indicates the Lower Bathonian Discus Zone.

Member 2 (299 m): The member is characterized by alternations of well-bedded greyish-green marls, greyish to yellow marly limestones (mudstone to packstone) and medium-bedded, grey limestones (mudstone to packstone) with chert nodules at some levels. Trace fossils include *Zoophycos* and *Thalassinoides*. The faunal content comprises bivalves (filaments, inoceramids, *Entolium* sp.), brachiopods (terebratulids, , rhynchonellids), gastropods (*Obornella* sp.), *Plagioecia* sp., belemnites, nautiloids, ostracods, sponge spicules, radiolarians, echinoderm debris, benthic foraminifers (*Globuligerina* sp., *Lenticulina* sp., *Ammobaculites coprolithiformis, Spirillina,* nodosariids, rotaliids, ophtalmiids, miliolids, textulariids), Laevaptychus, and abundant and diverse ammonites (Table 2.3).

Table 2.3. Distribution of ammonites in member 2 of the Chaman Bid Formation at Tooy.

taxon	**ammonite horizons**									**known range**
	1	2	3	4	5	6	7	8	9	
Phylloceras sp.			*	*		*	*	*		Callovian-Oxfordian
Calliphylloceras sp.			*		*	*	*			Callovian-Oxfordian
Ptychophylloceras sp.			*		*			*		Callovian-Oxfordian

Lissoceratoides sp.	*	Oxfordian
Taramelliceras (Richeiceras) cf. *dentostriatum*	*	Transversarium Zone
Taramelliceras (Richeiceras) sp.	*	Bifurcatus-Bimammatum zones
Bullatimorphites (Sphaeroptychius) sp.	*	Lower Callovian
Bullatimorphites (Bomburites) cf. *microstoma*	*	Macrocephalus Zone
Macrocephalites (M.) jacquoti	*	Macrocephalus Zone
Macrocephalites (Kamptokephalites) cf. *kamptus*	*	Lower Callovian
Macrocephalites cf. *subtrapezinus*	*	Lower Callovian
Macrocephalites (Dlikephalites) cf. *perseverans*	*	Lower Callovian
Cardioceras (Scarburgiceras) praecordatum	*	Minax-Paturattensis zones
Reineckeia (Reineckeia) anceps	*	Anceps Zone
Reineckeia aff. *polycosta*	*	Anceps Zone
Reineckeia (Reineckeia) aff. *nodosa*	*	Athleta Zone
Choffatia (Choffatia) sakuntala	*	Patina Zone
Loboplanulites cf. *collociaris*	*	Lower Callovian
Grossouvria (Alligaticeras) sp.	*	Middle Callovian
Grossouvria sp.	*	Middle Callovian
cf. *Hubertoceras* sp.	*	Callovian
Perisphinctes (Dichotomoceras) bifurcatus	*	Bifurcatus Zone
Perisphinctes (Dichotomoceras) microplicatilis	*	Upper Oxfordian
Dichotomosphinctes sp.	* *	Lower-Middle Oxfordian
Passendorferia (Enayites) sp.	*	Upper Oxfordian
Geyssantia geyssanti	*	Bimammatum Zone
Geyssantia sp.	*	Upper Oxfordian
Subdiscosphinctes sp.	*	Bimammatum Zone
Idoceras (Subnebrodites) schroederi	*	Planula Zone
Larcheria schilli	*	Transversarium Zone
Extranodites sp.	*	Middle Oxfordian
Epipeltoceras cf. *berrense*	*	Middle Oxfordian
Paraspidoceras sp.		Oxfordian
Parawedekindia callomoni	*	U. Callovian to L. Oxfordian

Parawedekindia stephanovi	*	Oxfordian

The ammonites indicate the Callovian (Macrocephalus, Patina, Anceps and Athleta zones) and Oxfordian (Cordatum, Bifurcatus, Planula and Transversarium zones).

Member 3 (189 m): The member consists of green silty marl, alternating thin- to thick-bedded greenish-grey, well sorted, fine-grained sandstones and siltstone, alternating medium-bedded, cream-coloured to yellow limestones (wackestone) and marls, alternating thin- to thick-bedded greenish-grey, well sorted, fine-grained sandstones and siltstones and alternations of medium-bedded, cream-coloured to yellow limestones (wackestone) and marls. The sandstone beds occur between 0-26 and 98-138 m above the base of the member. They are usually 5-130 cm thick and exhibit low-angle, large-scale trough cross-bedding. Commonly, the sandstone, siltstone and silty marl are arranged to form small-scale thickening-upward cycles. The sandstone beds are bioturbated; trace fossils include *Zoophycos* and *Rhizocorallium.* Limestone (wackestone) in the lower part contains bivalves, belemnites and the ammonites *Taramelliceras* cf. *kiderleni, Sutneria eumela, Sutneria lorioli* (Eudoxus Zone), and *Physodoceras* sp. which indicate the Kimmeridgian Eudoxus Zone. In the upper part of the member only bivalve fragments and belemnites occur.

Mozduran Formation: The Chaman Bid Formation is overlain by thick-bedded, cliff-forming, grey limestones (mudstone to grainstone) and buff dolomitic limestones of the Mozduran Formation. The contact is conformable but sharp (Text Fig. 2.1D).
The Mozduran Formation was measured with a total thickness of 1092 m north of Takhtehbashgheh.

Member 1 (269 m): Massive, grey limestones (mudstone to grainstone). In the lower part some of the beds change to buff dolomitic limestones. Commonly, microbial limestones with *Tubiphytes* occur in the lower part. In the upper part, birds-eyes, peloidal and oncoidal limestones occur.
The faunal content of the member includes sponges, corals, bryozoans, brachiopod debris, bivalves, gastropods, echinoderm debris, echinoid spines, ostracods, benthic foraminifers (*Ammobaculites coprolithiformis, Lenticulina* sp., *Bullopora, Nautiloculina oolithica, Trocholina pala, Pseudocyclammina manci* and ?Paleodictyoconida, nodosariids, textulariids, miliolids),

algae (*Salpingoporella annulata*, *Cayeuxia* sp., *Clypeina jurassica, Acicularia* sp.), *Favreina prasensis, Favreina severina, Terebella lapilloides,* and worm tubes occur. The benthic foraminifers and algae indicate a Late Jurassic age.

Member 2 (75 m): Unfossiliferous green marl.

Member 3 (490 m): The member consists of massive, light-grey limestones (wackestone to grainstone) with intercalations of thin-bedded, grey limestones (mudstone to wackestone). In the lower part abundant peloids and ooids, in some beds also birds-eyes, occur. Fossils include sponges, corals, bryozoans, bivalves, gastropods, echinoderm debris, echinoid spines, algae (*Clypeina jurassica, Cayeuxia* sp.), stromatoporiids, ostracods, *Favreina severina, Favreina prasensis,* worm tubes, *Salpingoporella annulata,* benthic foraminifers (*Natiliculina oolithica, Bullopora, Trocholina pala, Trocholina alpina, Pseudocyclammina manic*, ?Paleodictyoconida, *Ammobaculites coprolithiformis,* nodosariids, *Lenticulina* sp., miliolids and textulariids).

Member 4 (253 m): Alternations of green to yellow marls, marlstone and medium-bedded, grey limestones (mudstone), in the upper part rarely grey limestones (grainstone). Fossils comprise in the lower part gastropods, echinoderm debris, echinoid spines, benthic foraminifers (*Trocholina* sp., textulariids, miliolids), and ostracods. In the upper part corals, bryozoans, gastropods,

---

Text Fig. 2.1. Field aspects of the Middle and Upper Jurassic platform to basin sediments of NNE Iran.

Fig. A. Member 1 of the Chaman Bid Formation (2) intercalated between the Shemshak Formation (1) .The Chaman Bid Formation overlies the Shemshak Formation with angular unconformity at Tooy.
Fig. B. Microconglomerate, base of the Chaman Bid Formation at Tooy.
Fig. C. Contact (arrowed) between member 1 (green silty marl; (1)) and member 2 (alternating marls and limestones; (2)) of the Chaman Bid formation at Tooy.
Fig. D. Massive to thickly-bedded limestones of the Mozduran Formation (2) overlie with conformable but sharp contact (arrowed) marls and limestones of the Chaman Bid Formation (1) at Tooy.
Fig. E. Contacts between Mozduran (1), Shurijeh (carbonates (2), and siliciclastics (3) and Tirgan (4) formations at Takhtehbashgheh. The Shurijeh Formation overlies the Mozduran Formation with a gradual contact and is followed, also with gradual contact, by the massive to thick-bedded *Orbitolina* limestones of the Tirgan Formation (Lower Cretaceous).


A
1
2
B
C
1
2
D
1
2
E
1
2
3
4
F

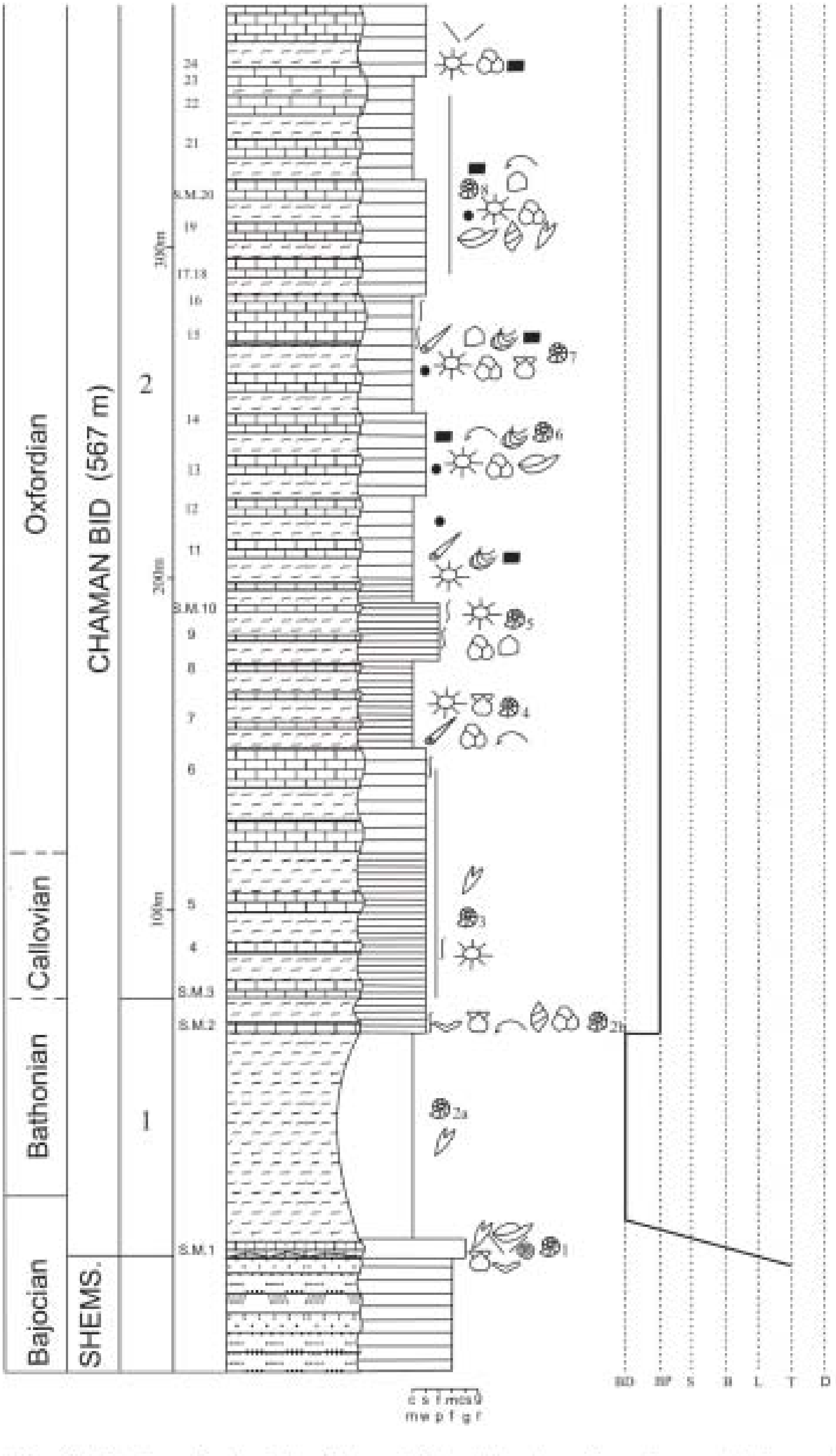
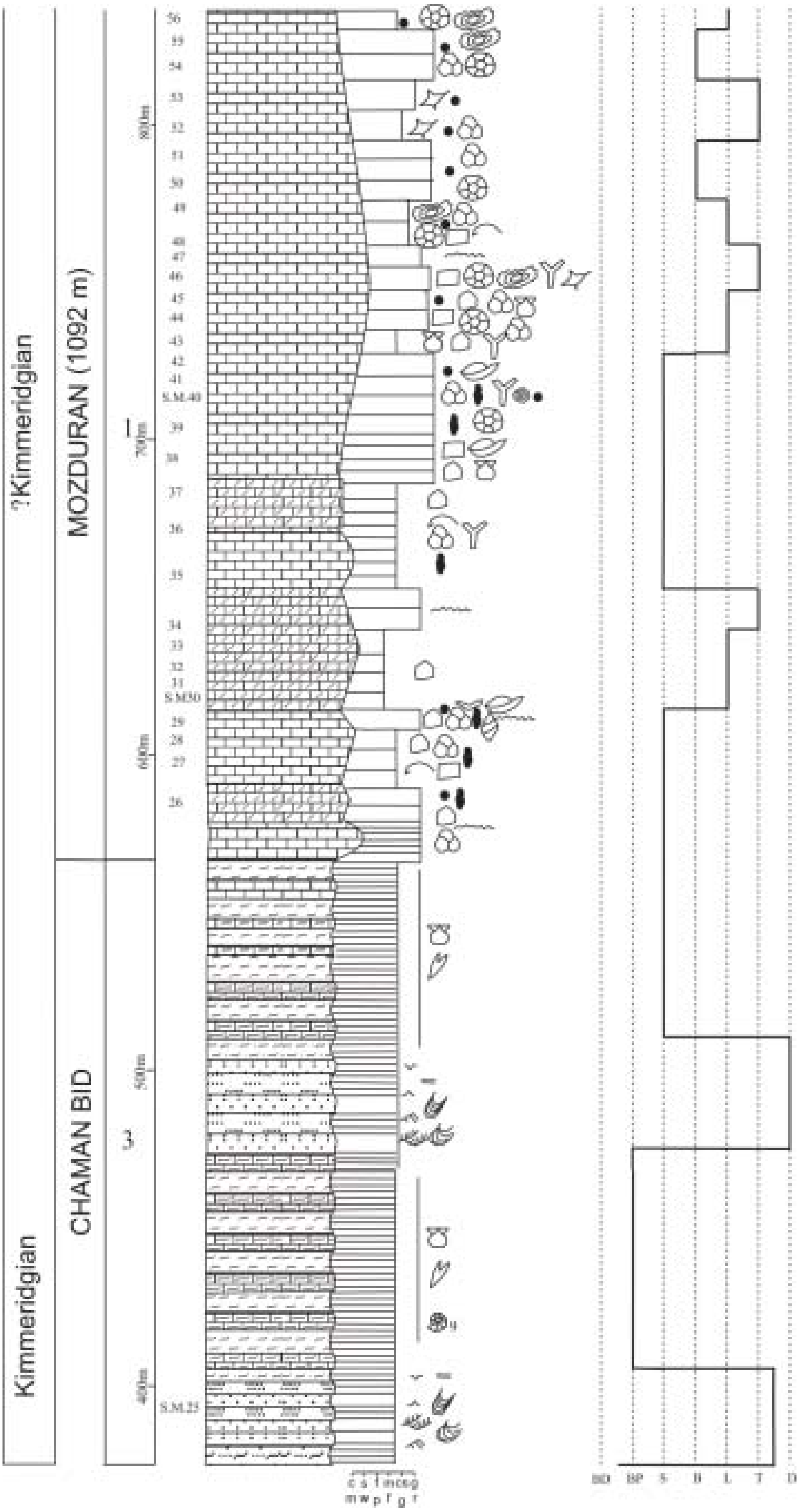
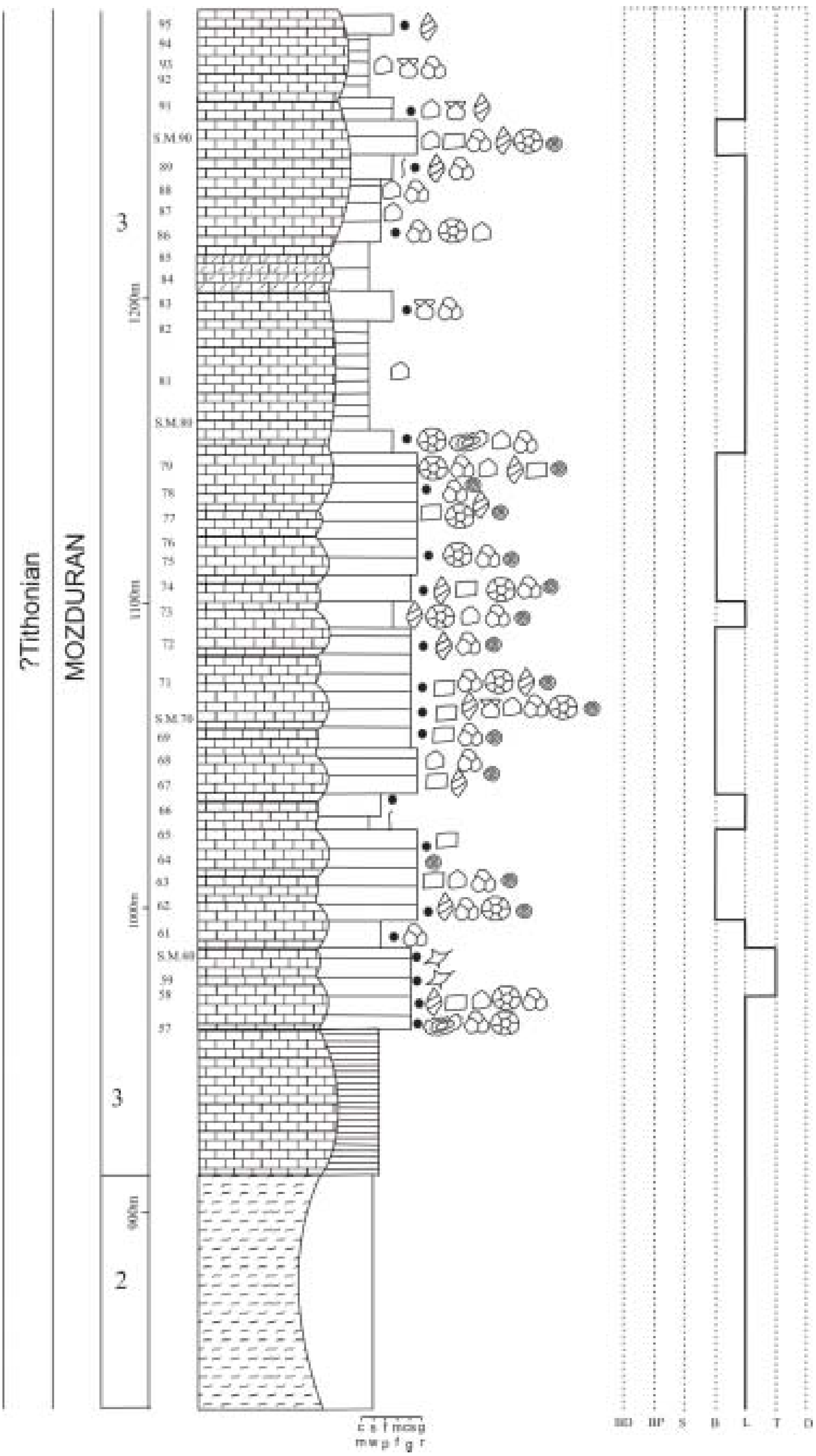
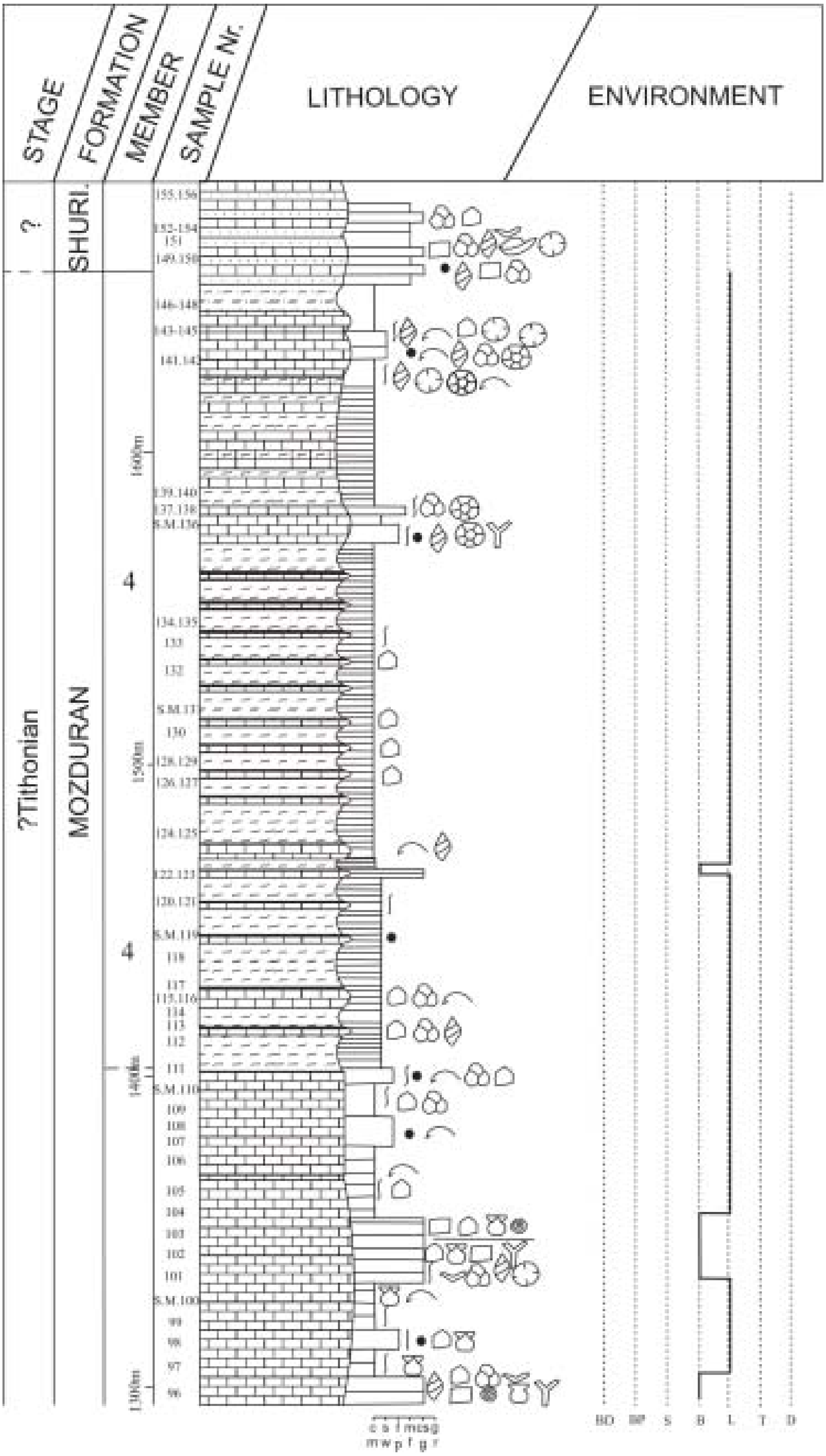


Fig. 2.4. Stratigraphic log of the Chaman Bid and Mozduran formations and their members in the Tooy-Takhtehbashgheh section. For key of symbols see Fig. 2.5.


Kimmeridgian
?Kimmeridgian
CHAMAN BID
MOZDURAN (1092 m)
400m
500m
600m
700m
800m
S.M.25
S.M30
S.M.40
BD BP S B L T D


?Tithonian
MOZDURAN


STAGE
FORMATION
MEMBER
SAMPLE Nr.
LITHOLOGY
ENVIRONMENT
?
SHURI.
?Tithonian
MOZDURAN
4
4
1600m
1500m
1400m
1300m
c s f m c s g
m w p f g r
BD BP S B L T D

echinoderm debris, echinoid spines, benthic foraminifers (*Trocholina* sp., *Nautiloculina oolithica, Pseudocyclammina* sp., *Salpingoporella* sp., *Lenticulina* sp., miliolids), algae (*Acicularia* sp.) and ostracods occur. The stratigraphic position, benthic foraminifers and algae of members 1-4 indicate a Late Jurassic age. As Member 4 of the underlying Chaman Bid Formation is Kimmeridgian in age, the members most likely correspond to the Kimmeridgian-?Tithonian.

Shourijeh Formation: Alternations of grey to buff limestones (packstone to grainstone) and medium-bedded, pink medium-grained sandstones in the lower part, and of medium, red to brown medium-grained sandstones and green to yellow silty marls in the upper part. The Shurijeh Formation overlies the Mozduran Formation with a transitional contact (Text Fig. 2.1E).

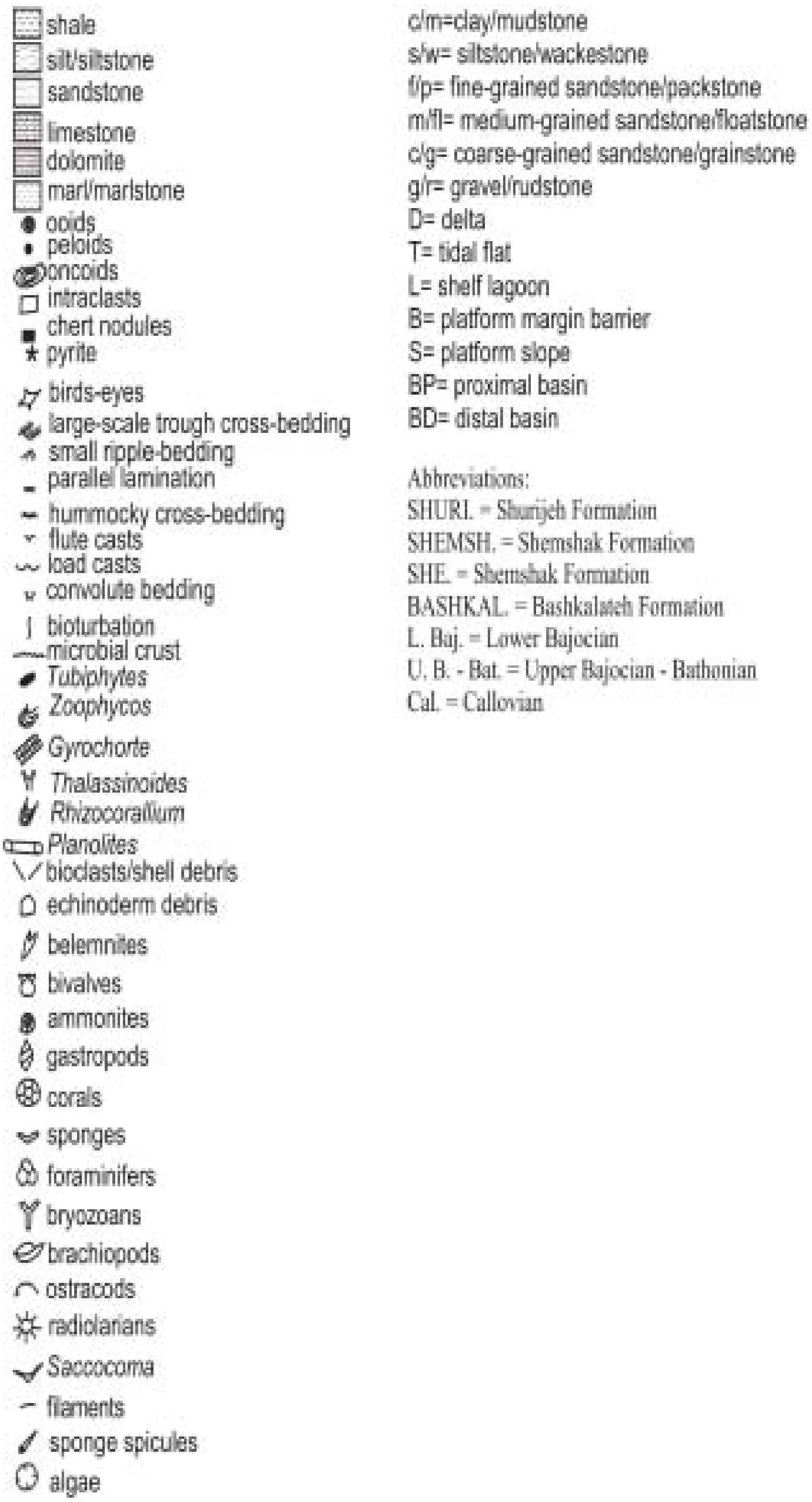


Fig. 2.5. Legend and abbreviations for sections (Figs. 2.1-2.4).

Lithostratigraphic correlation

Disscussion:

As is shown in the lithostratigraphic correlation chart (Table 2.4), the Mid-Cimmerian Event (Upper Bajocian) is well-documented in the, Golbini and Tooy sections. This event was followed by transgressive deposits of the Upper Bajocian. However, in the Chaman Bid section, Upper Bajocian ammonites were found in the upper part of Bashkalateh Formation. The existence of these ammonites suggests that the Mid- Cimmerian Event occurred before deposition of Bashkalateh sediments. As the base of the Bashkalateh Formation is not exposed, nothing is known about the features left by the tectonic event at the section. In the Mashad area again the Mid-Cimmerian Event is well-indicated (i.e. the southern part of the Koppeh Dagh), the basal Kashafrud Formation, which is the lateral equivalent of the Bashkalateh Formation, unconformably overlies older rocks. At the contact a basal conglomerate can be seen at the Golbanu mine and an angular unconformity at Tapeh Nader (NE Mashad) and along the road to the Aghdarband mine at Ghaleh-Sangi (Seyed-Emami et al.1994, Hossenion 1996).

From a lithostratigraphic point, the grey siltstone of the lower part of the Dalichai Formation at the type locality and at Golbini can be considered as distal tongue of the Bashekalateh Formation. Altogether, the Bashekalateh and Kashafrud formations most likely represent the eastern continuation of the Dalichai and Chaman Bid formations. However, this claim requires additional research, which is beyond the scope of the present study.

The main diagnostic feature of the Chaman Bid Formation at the type section and at Tooy is the existence of sandstone units (members 3 and 5 at Chaman Bid and member 3 at Tooy). In the Dalichai Formation, in contrast, such siliciclastic intercalations are absent.

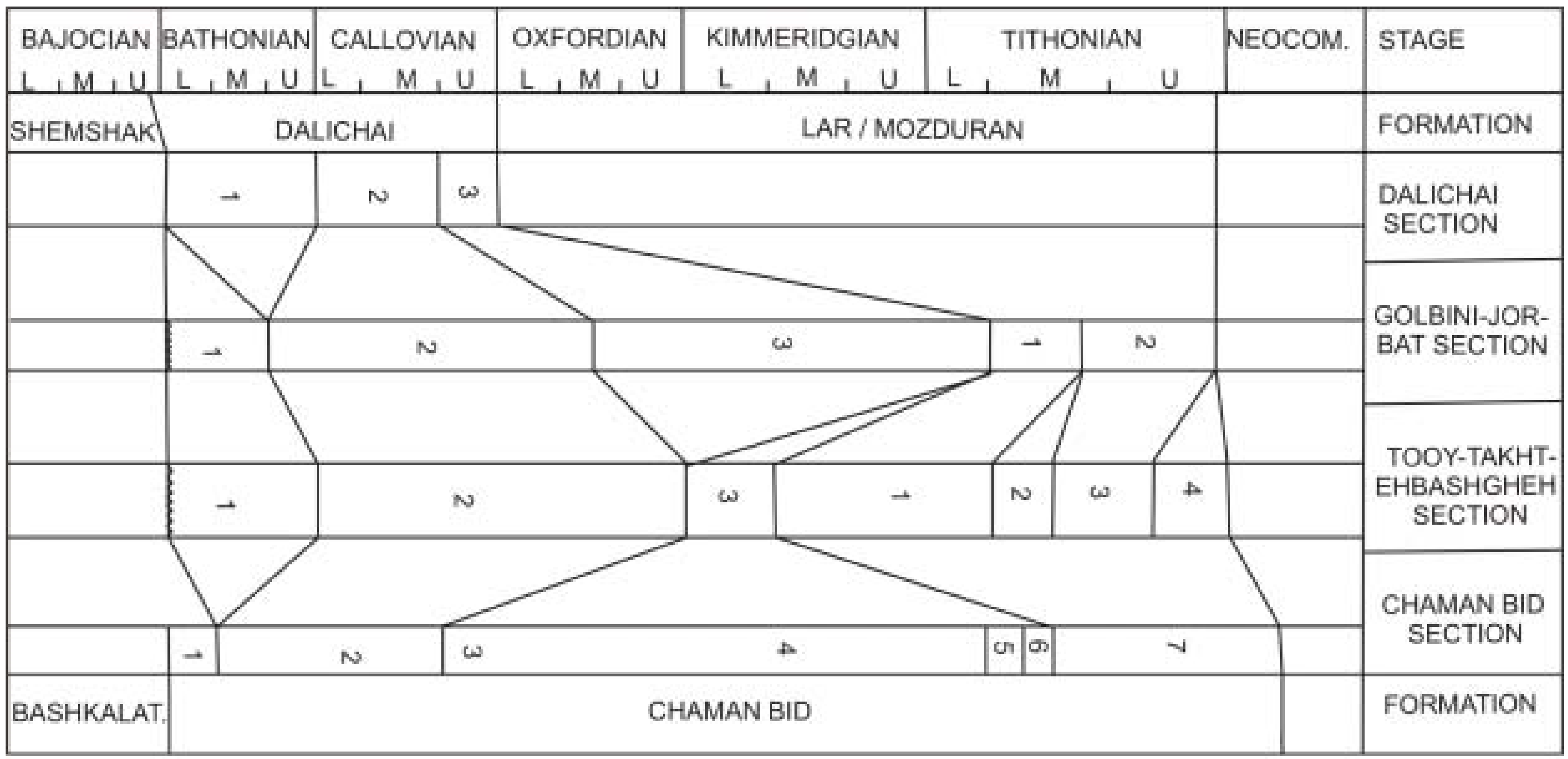


Table 2.4. Lithostratigraphic correlation of the Middle and Upper Jurassic rocks of central and eastern Alborzand the western Koppeh Dagh. BASHKALT. = Bashkalateh Formation; NEOCOM. = Neocomian.

Plate 2.5. Middle and Upper Jurassic Foraminifera from NNE Iran.

Fig. A. Nodosariid foraminifer (**N**); top part of Shemshak Formation, section 2, M-J-4, x50.
Fig. B. Nodosariid foraminifer; lower Mozduran Formation, section 3, M-S-40, x50.
Fig. C. Nodosariid foraminifer (**N**); top part of Shemshak Formation, section 2, M-J-1, x125.
Fig. D. Rotaliid foraminifer (**R**); top part of Shemshak Formation, section 2, M-J-3, x50.
Fig. E. ?*Lenticulina* sp.; lower Mozduran Formation, section 3, M-S-36, x125.
Fig. F. *Lenticulina* sp.; middle Dalichai Formation, section 2, M-J-15, x125.
Fig. G. Unidentified foraminifer; middle Lar Formation, section 2, M-J-52, x50.
Fig. H. Miliolid foraminifer; middle Chaman Bid Formation, section 3, M-S-15, x125.

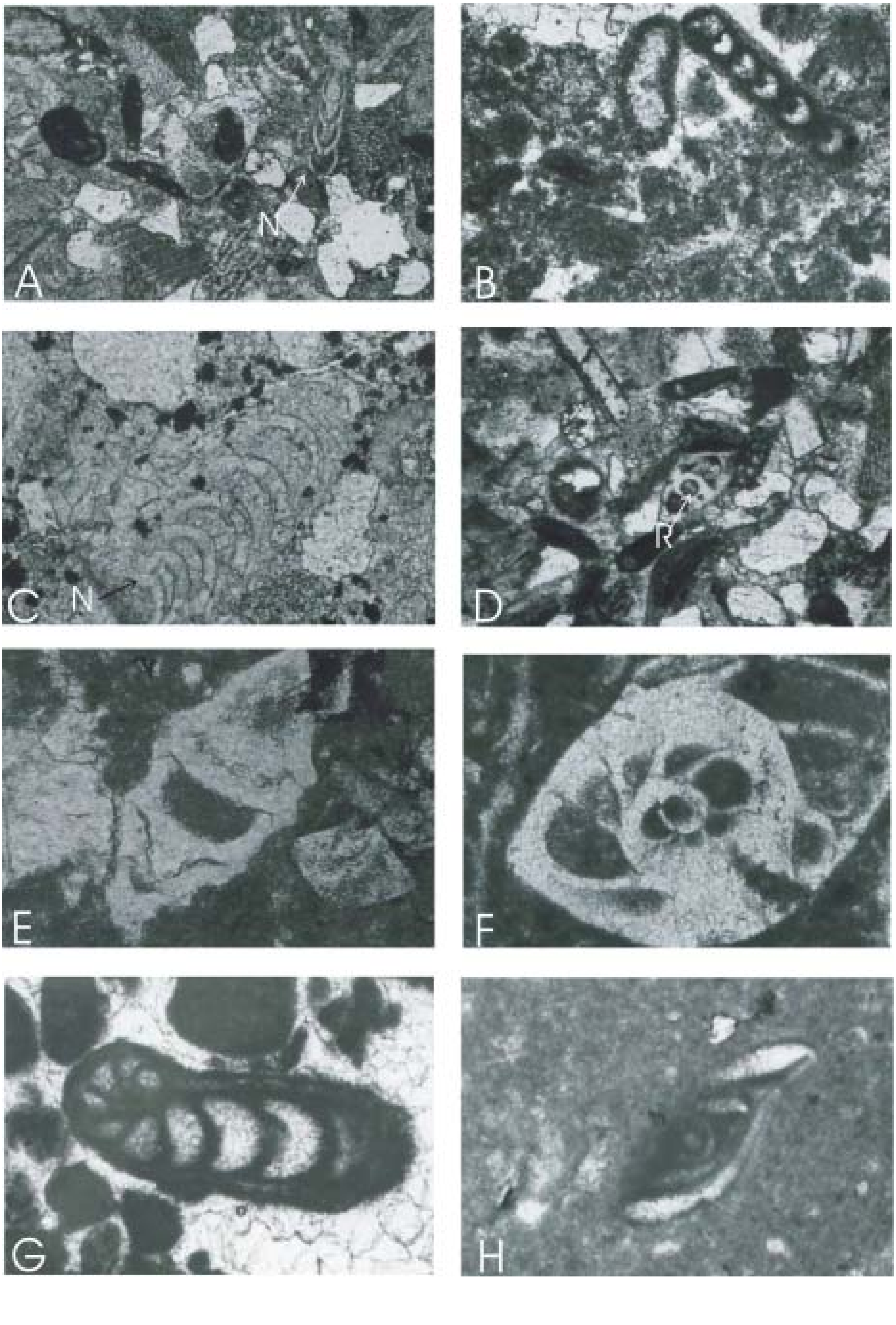

A
N
B
C
N
D
R
E
F
G
H

Plate 2.6. Middle and Upper Jurassic Foraminifera from NNE Iran.

Fig. A. *Nautiloculina oolithica* MOHLER; middle Mozduran Formation, section 3, M-S-63, x125.
Fig. B. *Nautiloculina oolithica* MOHLER as nuclei of ooids; upper Mozduran Formation, section 3, M-S-149, x50.
Fig. C. *Nautiloculina* sp.; middle Mozduran Formation, section 3, M-S-58, x125.
Fig. D. *Pseudocyclammina maynci* HOTTINGER; middle Mozduran Formation, section 3, M-S-62, x50.
Fig. E. *Pseudocyclammina maynci* HOTTINGER; lower Mozduran Formation, section 3, M-S-43, x50.
Fig. F. *Pseudocyclammina maynci* HOTTINGER; middle Mozduran Formation, section 3, M-S-63, x50.
Fig. G. *Pseudocyclammina maynci* HOTTINGER; lower Mozduran Formation, section 3, M-S-44, x50.
Fig. H. *Trocholina* sp.; lower Mozduran Formation, section 3, M-S-44, x50.

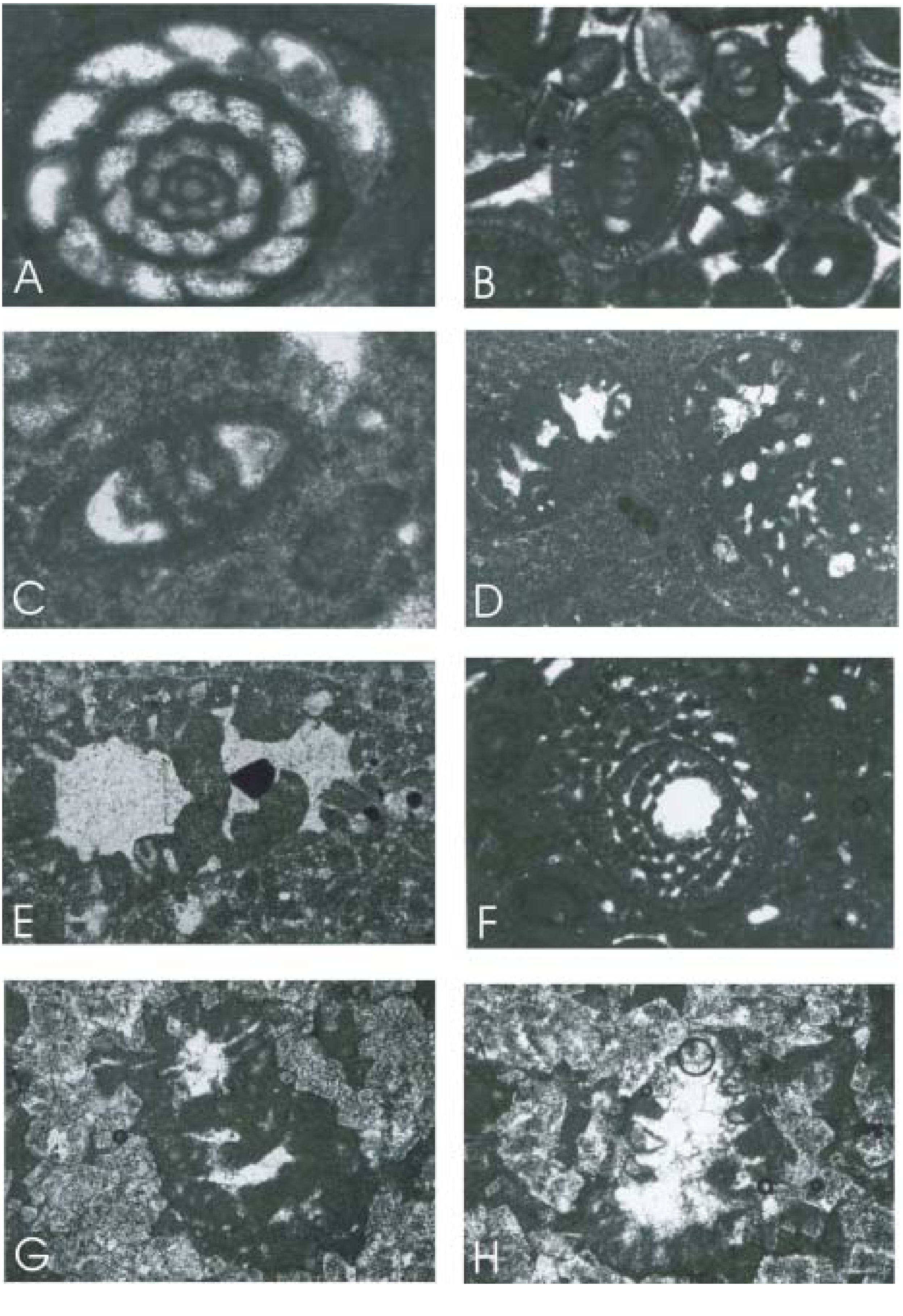

A
B
C
D
E
F
G
H

Plate 2.7. Middle and Upper Jurassic Foraminifera and Microproblematica from NNE Iran.

Fig. A. *Trocholina* sp.; middle Mozduran Formation, section 3, M-S-63, x125.
Fig. B. *Trocholina alpina* LEUPOLD; upper Mozduran Formation, section 3, M-S-79, x50.
Fig. C. *Trocholina alpina*; LEUPOLD middle Mozduran Formation, section 3, M-S-68, x12.5.
Fig. D. *Trocholina* sp.; upper Mozduran Formation, section 3, M-S-113, x125.
Fig. E. *Globuligerina* sp.; lower Chaman Bid Formation, section 3, M-S-8, x50.
Fig. F. *Ammobaculites coprolithiformis* SCHWAGER; lower Mozduran Formation, section 3, M-S-43, x50.
Fig. G. ?Paleodictyoconid foraminifer; lower Mozduran Formation, section 3, M-S-29, x50.
Fig. H. Unidentified foraminifer; middle Mozduran Formation, section 3, M-S-63, x12.5.
Fig. I. Microproblematicum A; lower Dalichai Formation, section 2, M-J-7, x125.
Fig. K. Microproblematicum B; lower Dalichai Formation, section 2, M-J-7, x125.

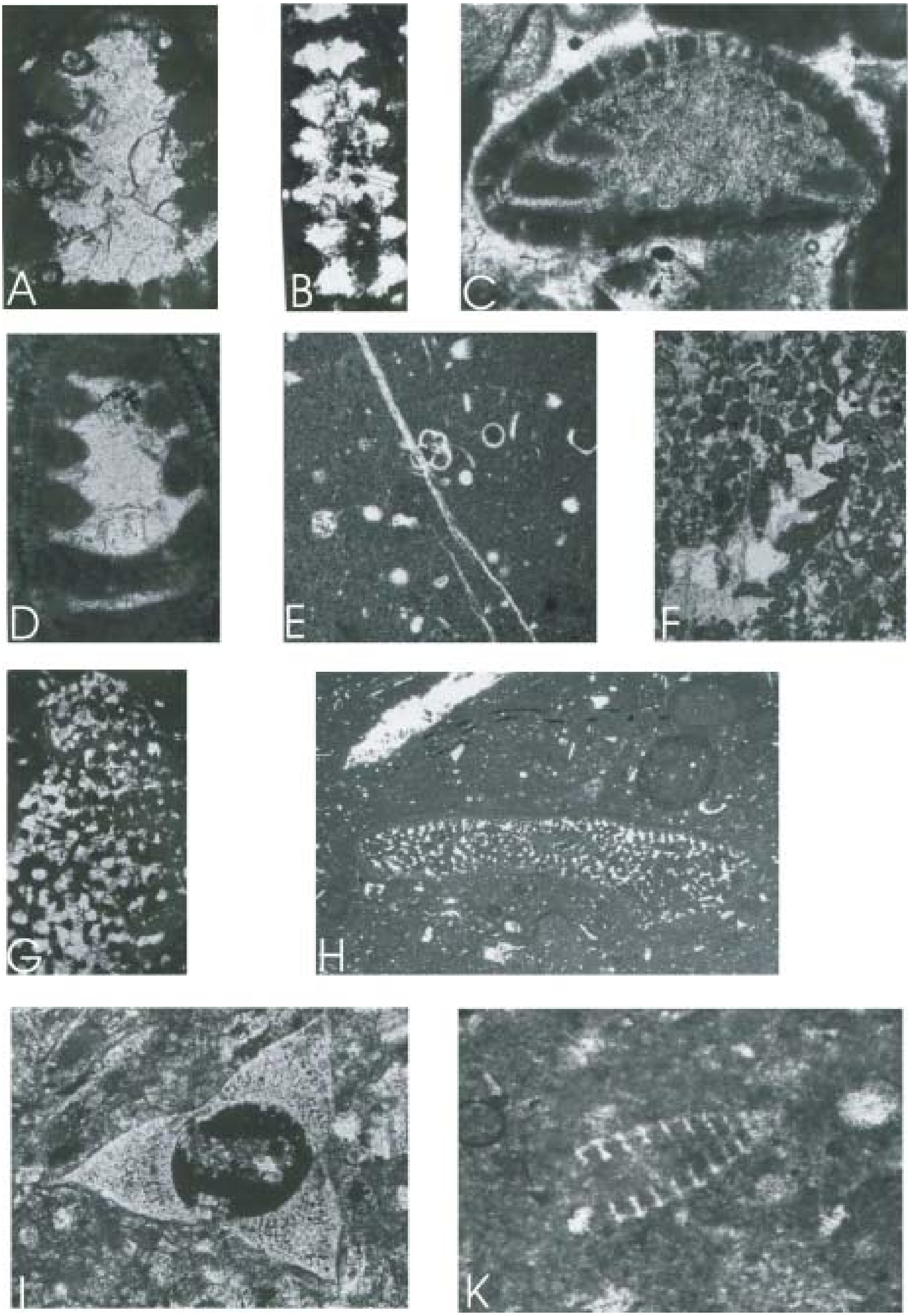

A
B
C
D
E
F
G
H
I
K

Plate 2.8. Middle and Upper Jurassic algae and microfossils from NNE Iran.

Fig. A. *Clypina jurassica* FAVRE; upper Mozduran Formation, section 3, M-S-79, x125.
Fig. B. *Clypina jurassica* FAVRE; upper Mozduran Formation, section 3, M-S-113, x125.
Fig. C. *Clypina jurassica* FAVRE; upper Mozduran Formation, section 3, M-S-142, x70.
Fig. D. *Rivularia (=Cayeuxia) piae* RECH-FROLLO; middle Mozduran Formation, section 3, M-S-46, x50.
Fig. E. *Lithocodium* sp.; lower Mozduran Formation, section 3, M-S-38, x50.
Fig. F. *Favreina prasensis* PAREJAS; middle Mozduran Formation, section 3, M-S-61, x50.
Fig. G. *Favreina severina* PAREJAS ; middle Mozduran Formation, section 3, M-S-61, x50.
Fig. H. *Saccocoma* sp.; middle Chaman Bid Formation, section 4, M-CH-77, x50.

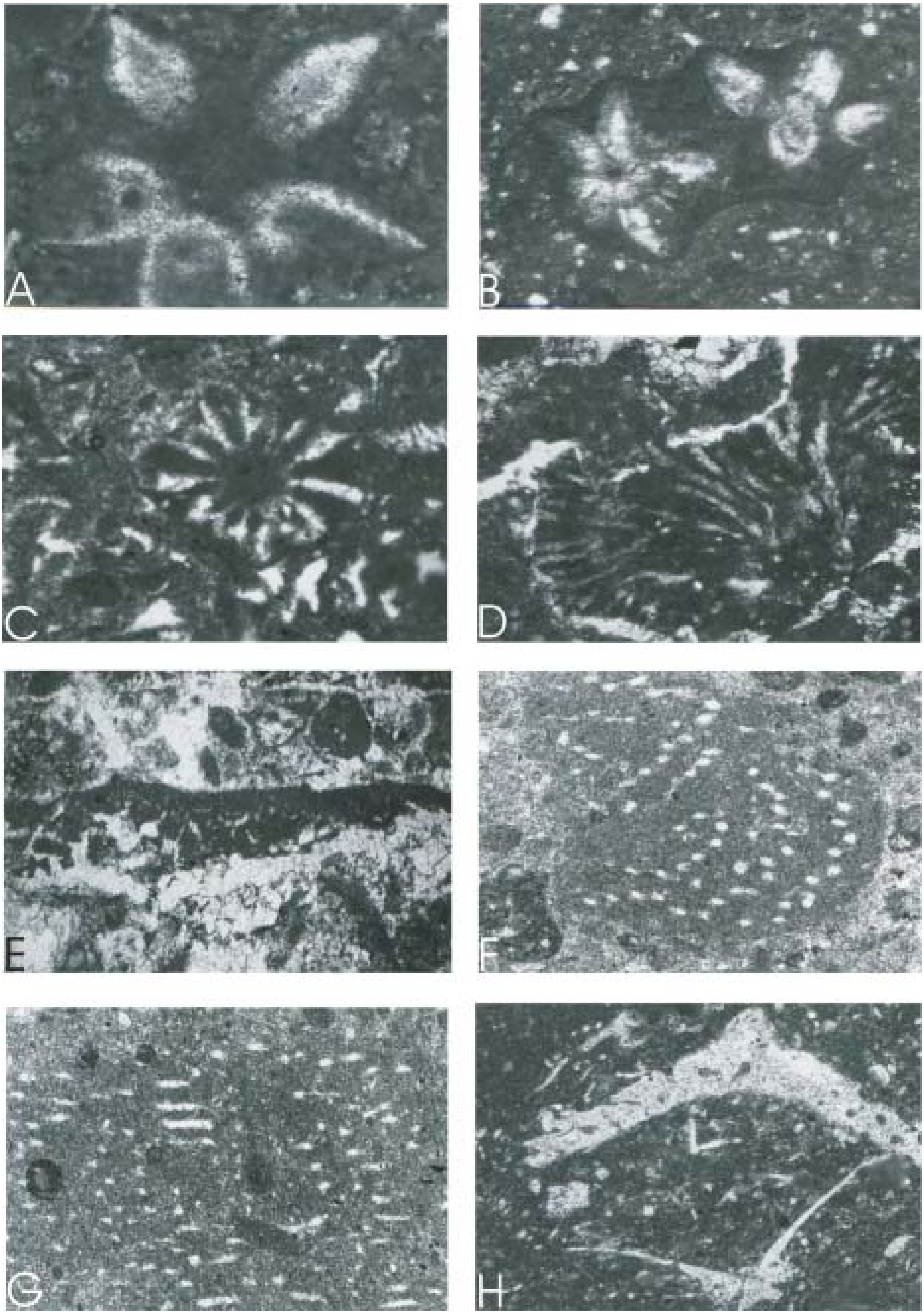
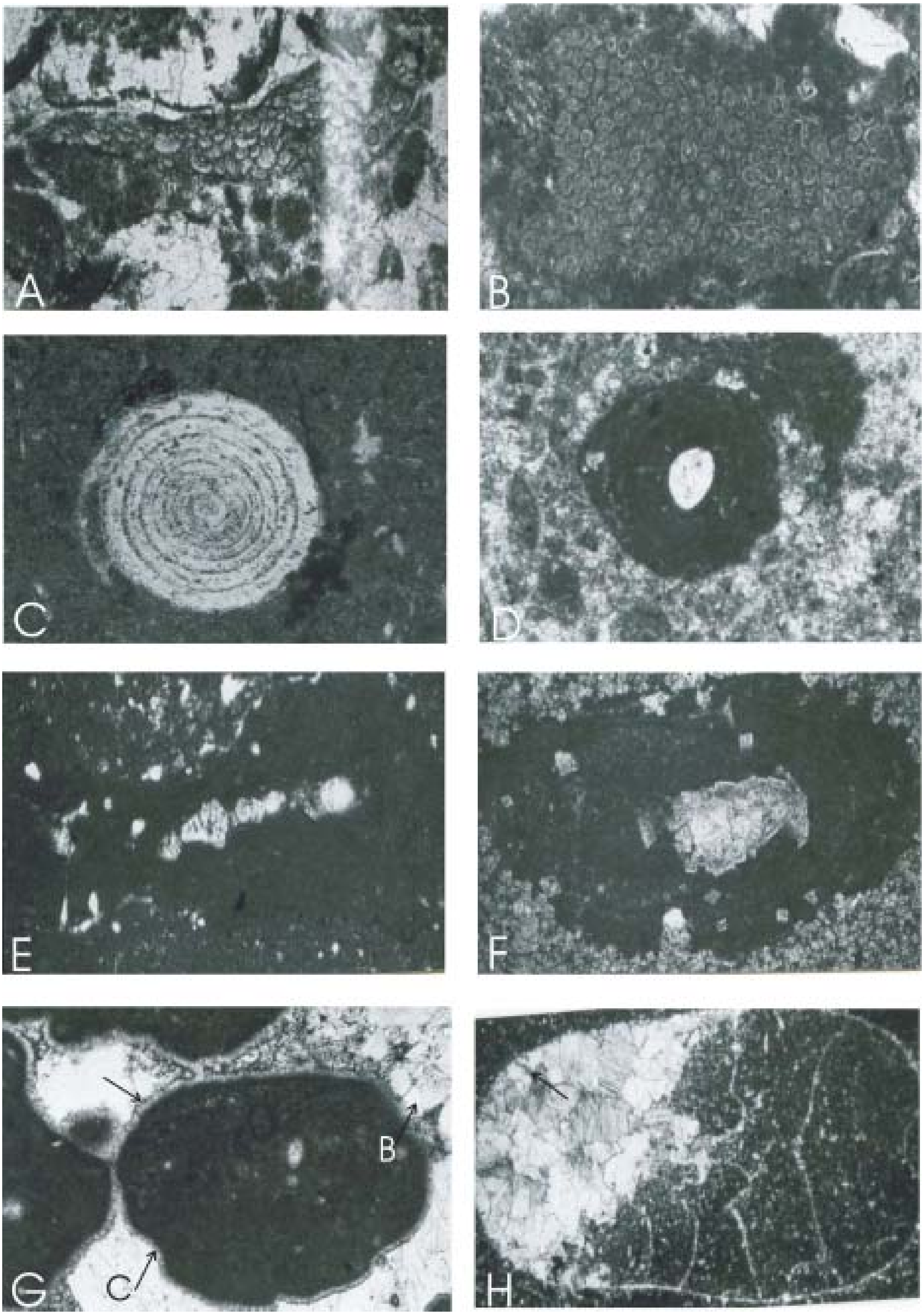

A
B
C
D
E
F
G
H

Plate 2.9. Middle and Upper Jurassic microfossils, Microproblematica, and microfacies from NNE Iran.

Fig. A. Microproblematicum C; middle Mozduran Formation, section 3, M-S-68, x125.
Fig. B. Microproblematicum D; upper Mozduran Formation, section 3, M-S-152, x125.
Fig. C. *Spirillina* sp.; lower Chaman Bid Formation, section 3, M-S-8, x125.
Fig. D. *Tubiphytes* sp.; lower Mozduran Formation, section 3, M-S- 41, x50.
Fig. E. *Tubiphytes* sp.; basal part of Mozduran Formation, section 3, M-S-26, x50.
Fig. F. *Tubiphytes* sp.; basal part of Mozduran Formation, section 3, M-S-27, x50.
Fig. G. Intra-grainstone with isopachous rim cement (**C**) followed by blocky sparite (**B**); basal part of Lar Formation, section 2, M-J-33, x50.
Fig. H. Geopetal fill in ammonite; middle Dalichai Formation, section 2, M-J-12, x12.5.


A
B
C
D
E
F
G
B
C
H

Microfacies analysis

Abbreviations:

section 1	Dalichai section
section 2	Golbini-Jorbat section
section 3	Tooy-Takhtehbashgheh section
section 4	Chaman Bid section

Most beds of the Dalichai, Lar, Chaman Bid, and Mozdouran formations are carbonates. Their microfacies was studied based on 524 thin-sections. The classification scheme used is that of DUNHAM (1962). 44 different microfacies types were recognized and are briefly described in the following. They were grouped into 16 facies associations, which then were interpreted in terms of their palaeoenvironments. They are parts of a carbonate system consisting of a platform and the adjacent slope to basinal sediments. Five major sedimentary environments are represented: (1) Tidal flat, (2) shelf lagoon, and (3) platform margin barrier as part of the carbonate platform, (4) slope and (5) basin, the latter two representing open marine conditions.

The facies analysis is primarily based on the study of rock specimens in the field and of thin-sections. It has been supplemented by observations, in the field, of features such as bedding, sedimentary structures and fossil content.

Tidal flat

Seven microfacies types are regardly a having formed in tidal areas. They are:

fenestral mudstone	fenestral pel-onco-packstone
fenestral pel-wackestone	fenestral onco-grainstone
fenestral pel-packstone	stromatolite boundstone
intra pel-packstone/grainstone	

These facies have a micritic or sparitic matrix. Skeletal grains are benthic foraminifers and algal remains. Non-skeletal grains are mainly peloids, oncoids, and rarely also ooids and intraclasts. Fenestral keystone vugs occur in this facies.

Fenestral mudstone: Fenestral mudstone is common in the upper part of the Lar Formation and in the lower part of the Mozduran Formation. Generally, they form packages 1-2 m thick, intercalated between peloidal wackestone to packstone and bio-wackestone to packstone. Components are nearly totally absent. The homogeneous micrite exhibits a distinct fenestral fabric. The rock is finely laminated. The horizontally arranged sparitic vugs are spaced at a distance of 100-200 µm.

Fenestral pel-wackestone/packstone: This microfacies is similar to the fenestral mudstone except that it contains peloid of. variable packing densities. The peloids are fairly uniform in size and most likely of faecal origin. The horizontally arranged sparitic vugs are spaced 150-250 µm apart (Pl. 3.1A-B).

Intra-pel-packstone/grainstone: Most of the grains are peloids and intraclasts, which vary in shape and size (Pl. 3.1C) The intraclasts consist of angular lumps of fine-grained sediment. They are pieces of partly lithified carbonate mud which were eroded and locally reworked soon after deposition.

Stromatolite boundstone: The wavy to flat-laminated stromatolite boundstones (Pl. 3.1F) occur near the base of the Mozduran Formation.

Fenestral onco-grainstone: This microfacies occurs in the middle part of the Lar Formation in distinct, laterally persisting beds. The well sorted, spherical oncoids reach diameters of up to 3 mm but are usually between 2 and 2.5 mm in size. The nuclei are algal fragments (Pl. 3.1E), the cortex is indistinctly laminated. In contrast to ooids, there is no tendency to increased sphericity during growth. The horizontally arranged sparitic vugs are spaced 150-250 µm apart. The matrix between the oncoids is sparitic.

Interpretation: Fenestral mudstone/wackestone/packstone are interpreted to have been deposited in the intertidal zone, the fenestral onco-grainstone in the lower intertidal. The wavy to laminated stromatolite boundstones formed by trapping and binding of fine-grained carbonate sediment particles by cyanobacteria. Due to the aridity of the supratidal zone and the presence of qrazing metazoans in the lower intertidal and subtidal environments, the stromatolites were restricted to the upper intertidal zone. The fenestral pel-to onco-grainstones were deposited in the high-energy lower intertidal zone. The lower intertidal origin is supported by the lack of micrite, presence of features indicating sub-aerial exposure (fenestral fabrics), and the vertical association with lagoonal and proximal tidal flat facies. The tidal flat facies of the Lar and Mozduran formations is similar to the extensive intertidal-supratidal facies of the Persian Gulf (SHINN 1983a, 1986, LASEMI 1995).

Shelf Lagoon

Eight microfacies types represent sub-environments of the different shelf lagoon facies.

bio-pel-mudstone	bio-pel-packstone to grainstone
onco-pel-wackestone	silty bio-pel-wackestone
bio-pel-packstone	silty intra-pel-packstone
bio-pel-intra-packstone to grainstone	

The sediments of the shelf lagoon are composed mainly of peloids, oncoids, few intraclasts and ooids and skeletal grains. The bioclasts are of brachiopod, gastropod, bivalve, benthic foraminifer, ostracod, calcareous green algae and to a lesser extent echinoderm, bryozoan and coral origin. Oncoids reach sizes of 2 to 3 mm and have nuclei of fossil fragments or quartz grains. There are thin beds of coralgal framestone which laterally develop into patch reefs.

Plate 3.1. Microfacies (Tidal flat and Shelf lagoon) of the Upper Jurassic Lar and Mozduran formations, NNE Iran.

A-F: Tidal flat facies.

Fig. A. Fenestral wackestone with keystone vugs; lower Mozduran Formation, section 3, M-S-52, x1.

Fig. B. Fenestral packstone with keystone vugs; upper Lar Formation, section 2, M-J-72, x1.

Fig. C. Intra-pel-packstone/grainstone with fenestral fabric, keystone vugs; intraclasts (**I**), and ooids (**O**); lower Lar Formation, section 2, M-J-52, x12.5.

Fig. D. Pel-onco-packstone with fenestral fabric and keystone vugs and oncoids (**O**); upper Lar Formation , section 2, M-J-91, x1.

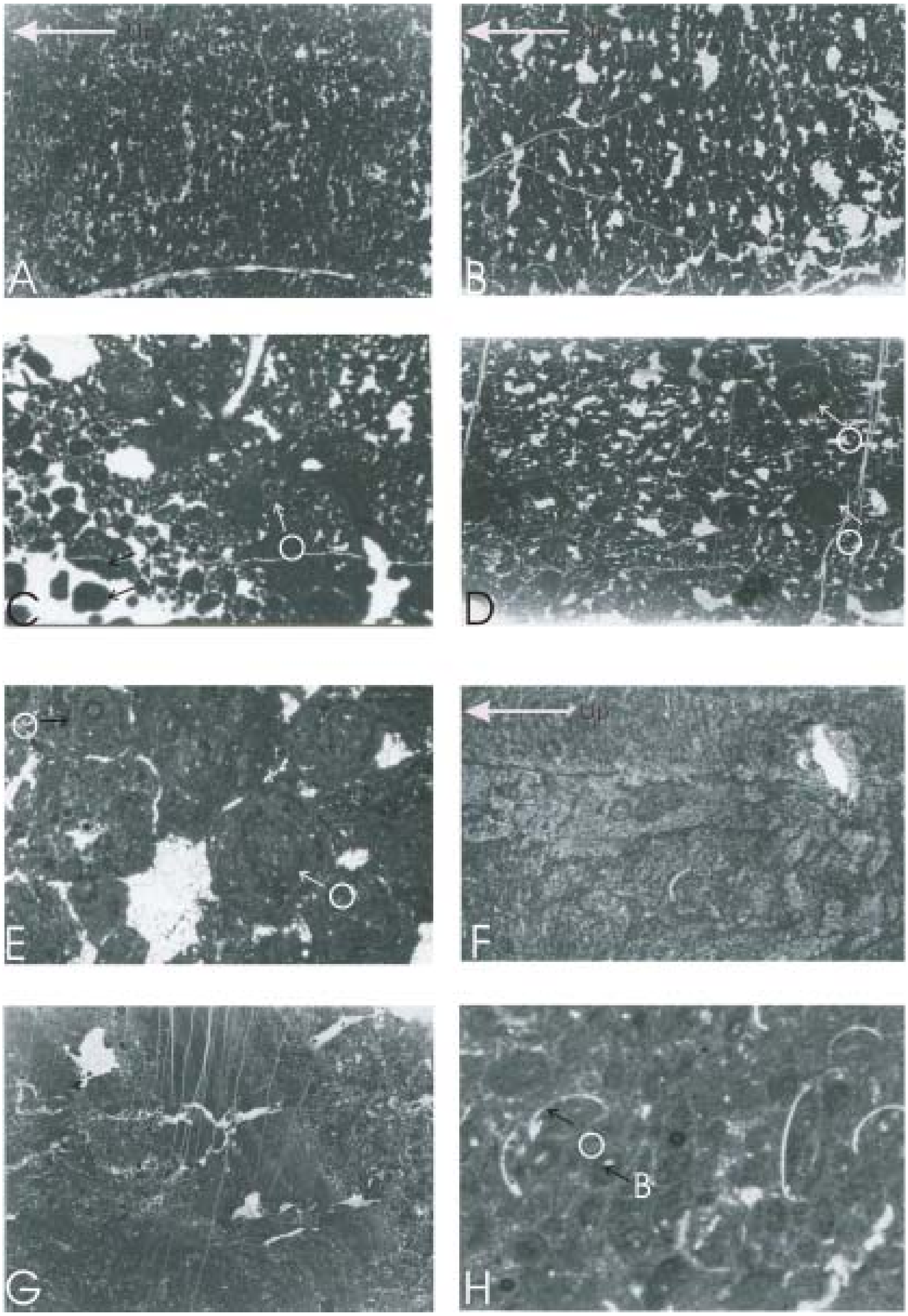
Fig. E. Fenestral onco-grainstone; oncoid (**O**); middle Mozduran Formation, section 3, M-S-59, x12.5.

Fig. F. Stromatolite boundstone; lower Mozduran Formation, section 3, M-S-34, x1.

Shelf lagoon facies

Fig. G. Pel-packstone/grainstone with peloidal stromatolite; basal part of Lar Formation, section 2, M-J-35, x1.

Fig. H. Bio-pel-packstone with ostracods (**O**)and bahamite peloids (**B**); upper Mozduran Formation, section 3, M-S-108, x50.


up
A
up
B
O
C
O
O
D
O
O
E
up
F
G
O
B
H

Bio-pel-mudstone: Grey, thinly-bedded to massive units, which occur in the Lar and Mozduran formations. Variable amounts of bioclasts (echinoderm, ostracod, and bivalve debris), rare foraminifers (*Lenticulina* sp., *Nautiloculina* sp.) and peloids occur in the bioturbated sediment. This facies, which was deposited in low-energy inner platform (lagoonal) settings, constitutes only small parts of the Mozduran and Lar formations.

Onco-pel-wackestone: The bioturbated light-grey wackestones with minor amounts of bioclasts (echinoderm, coral, ostracod, bryozoan, and algal debris), rare foraminifers (textulariids) occur in medium to thick beds in the Lar and Mozduran formations. Some of the peloids exhibit a faint internal structure and are perhaps heavily micritized bioclasts. Oncoids are about 2 to 30 mm in diameter. Their centres were at some stage hollow and were filled during diagenesis with cement.

Silty bio-pel-wackestone: This facies is common in the upper part of the Mozduran and less so in the Lar Formation. Generally, it forms packages 20-30 cm in thickness. Components are variable amounts of bioclasts of ostracod, echinoderm, and algal origin, rare foraminifera (*Lenticulina* sp., textulariids) and peloids (Pl. 3.2C).

Bio-pel-packstone: Apart from the densely packed peloids microbioclasts of ostracod, echinoderm, gastropod, bivalve, coral, sponge, and bryozoan origin, and foraminifers (*Nautiloculina* sp., *Pseudocyclammina* sp., *Trocholina* sp., textulariids) occur. The sediment is bioturbated. This facies constitutes the middle parts of the Lar and Mozduran formations occurring in medium- to thick-bedded units. Bahamite grains of bioclast origin (seen at their centres) are common (Pl. 3.1H). They are fine-grained subrounded to angular micritic particles of a variety of shapes and sizes and often occur together with bioclasts or cortoids, which are micritized to various degrees. Subrounded micritic particles generally are without internal structures (Pl. 3.2B).

Silty intra-pel-packstone: This facies occurs sporadically in the Lar and Mozduran formations, commonly in well-bedded units with less than 20% microbioclasts of echinoderm and ostracod origin and foraminifers (*Ammobaculites* sp., *Pseudocyclammina* sp., textulariids, miliolids). The peloids are of variable shape and size but generally subrounded. The intraclasts are relatively small angular lumps of fine-grained sediments and bioclasts, especially echinoderm debris (Pl. 3.2A).

Bio-pel-packstone to grainstone: Grey, often thick-bedded to massive limestone in the lower part of the Lar and Mozduran formations. The densely packed pack- to grainstones contain, apart from peloids, less than 20% microbioclasts (algal, brachiopod, echinoderm, coral, and gastropod debris) and foraminifers (*Nautiloculina* sp., *Pseudocyclammina* sp., *Ammobaculites* sp., textulariids, miliolids). The peloids are often of the bahamite type, subrounded to angular micritic particles of variable shape and size that often co-occur with bioclasts or cortoids, micritized to various degrees. The sub-rounded micritic particles generally lack internal structures. They were deposited in a protected inner platform setting subject to episodic weak currents or wave action. In some of the thin-sections peloid stromatolites occur (e.g. Pl. 3.1G).

Bio-pel-intra-packstone to -grainstone: This facies occurs as thick-bedded to massive units at various levels in the Lar and Mozduran formations. Bioclasts consist of less than 20% microbioclasts (echinoderm, bivalve, brachiopod, and chaetetid sponge debris) and foraminifers (*Ammobaculites* sp., *Pseudocyclammina* sp., miliolids). The intraclasts vary in shape and size, are poorly sorted and contain angular bioclasts, especially echinoderm debris and green algae (Pl. 3.2D). Other components of the sediment include bahamite peloids and micritized bioclasts. The bahamite peloids vary in shape and size and are poorly sorted. Both micrite and sparite matrix occur, which suggest a shallow-water environment subject to fluctuating conditions. A protected inner platform (close to the platform margin) is envisaged.

Interpretation: Sediments of the lagoonal facies were deposited in an extensive, semi-restricted to restricted shelf lagoon landward of the shelf margin shoal/barrier facies. The restricted condition is suggested by the lack of normal-marine biota and abundant skeletal components of restricted biota. There is no evidence of subaerial exposure. The bio-pel-intra-packstone/grainstone and silty intra-pel-packstone suggests elevated energy conditions in a shallow subtidal setting (landward or seaward side of the lagoon). The bioturbated and pelleted mudstone/wackstone indicate a protected inner shelf.

Platform margin barrier

The platform margin facies are characterized by:

bio-intra-oo-grainstone	pisoid-grainstone
bio-oo-packstone/grainstone	bio-pel-oo-grainstone
bio-pel-oo-packstone	bio-intra-grainstone
bio-oo-grainstone	bio-intra-packstone/grainstone
oo-intra-grainstone	bio-intra-pel-packstone/grainstone
silty intra-oo-packstone/grainstone	sandy bio-intra-grainstone
silty bio-oo-packstone/grainstone	bio-oo-packstone/grainstone.

These microfacies have a micritic to sparitic matrix and are composed mainly of ooids, intraclasts, peloids and skeletal grains of a diverse, normal marine fauna, including gastropods, echinoderms, brachiopods, algae, stromatoporiids, bryozoans and foraminifers (*Lenticulina* sp., *Ammobacolites coprolithiformis*, *Pseudocyclammina maynci*, *Nautiloculina* sp., nodosariids, miliolids, and textulariids).

Plate 3.2. Microfacies (shelf lagoon and platform margin) of the Upper Jurassic Lar and Mozduran formations, NNE Iran.

A-D: Shelf lagoon facies

Fig. A. Silty intra-pel-packstone; middle Lar Formation, section 2, M-J-51, x50.

Fig. B. Bio-pel-packstone with peloids (**P**) and ostracods (**O**); upper Mozduran Formation, section 3, M-S-107, x12.5.

Fig. C. Silty bio-pel-wackestone with ostracods (**O**); upper Mozduran Formation, section 3, M-S-117, x12.5.

Fig. D. Bio-pel-intra-packstone/grainstone with echinoderm fragments (**C**) and bahamite grains (**B**); middle Mozduran Formation, section 3, M-S-65, x50.

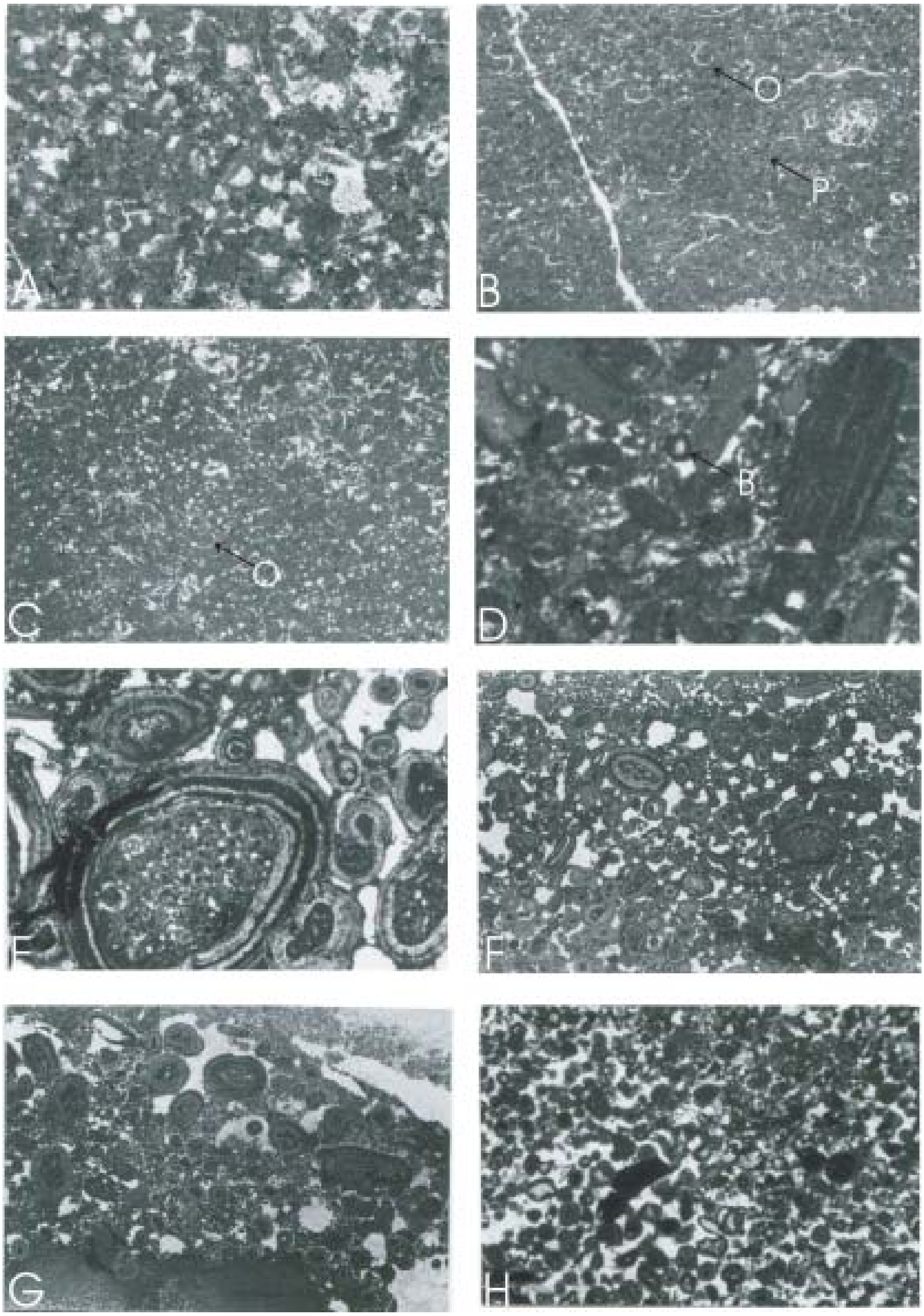
Figs. E-H: Platform margin facies.

Fig. E. Pisoid grainstone; middle Lar Formation, section 2, M-J-65, x12.5.

Fig. F. Oo-grainstone; middle Lar Formation, section 2, M-J-54, x12.5.

Fig. G. Pel-oo-grainstone; upper Lar Formation, section 2, M-J-73, x1.

Fig. H. Pel-oo-grainstone; lower Mozduran Formation, section 3, M-S-40, x12.


A
B
O
P
C
O
D
B
E
F
G
H

Bio-oo-grainstone: This microfacies occurs in thick beds or massive units in the middle parts of the Lar and Mozduran formations, partly exhibiting large-scale trough cross-bedding and erosional bases. They are interpreted to represent ooid shoals at the high-energy platform margin, protecting the extensive platform interior from the open sea. The shoals were deposited in very shallow water and some of them were subject to episodic emersion as is indicated by early diagenetic vadose cements. The radial ooids are generally well-sorted (e. g. Pl. 3.3A-B) and display numerous concentric laminae. Some of the radial ooids are unsorted (e. g. Pl. 3.2F, 3.3E). Their nuclei often consist of small quartz grains (Pl. 3.2H; 13A), bioclasts, and foraminifers (Pl. 3.3B).

Pisoid-grainstone: Pisoids should be separated from the structurally similar ooids because of their remarkable size (generally 2-10 mm diameter). This microfacies is similar to the bio-oo-grainstone except that the radial pisoids are unsorted and their nuclei often consist of small bioclasts or small ooids and peloids (Pl. 3.2E). The shapes of the pisoids are round-oval and their diameter 2-4 mm. Original irregularities of the nucleus were rounded by the accretion of concentric laminae, thus pointing to a high energy environment. According to FLÜGEL (1982), in quiet-water irregularities of the nuclei of pisoids are increased by the addition of new laminae, thus producing irregular lobate forms.

Bio-intra-grainstone: Irregularly shaped lumps of carbonate mud are a common feature of this microfacies. Most are not sufficiently rounded to be classified as peloids and are therefore best described as intraclasts since they are likely to be locally reworked pieces of fine-grained sediment. This facies also contains echinoderm debris and some peloids (Pl. 3.3F).

Bio-pel-oo-grainstone: Layers of grey grainstone occur commonly in the well-bedded middle parts of the Lar and Mozduran formations. The radial ooids are variable in shape and size (Pl. 3.2G). Their nuclei consist of small bioclasts, small ooids, or peloids. Additional components are peloids and micritized bioclasts. The peloids are commonly densely packed, very fine-grained, and well sorted (Pl. 3.2G).

Pel-oo-grainstone: This microfacies forms dispersed layers in thick-bedded parts of the Lar and Mozduran formations. Fine radial ooids and peloids occur. The ooids are superficial ooids with a radial structure in the cortex. They also contain layers and irregular areas of dark micrite. Peloids are small, well-sorted and lack any internal structure (Pl. 3.2H).

Bio-intra-pel-oo-grainstone: This microfacies is common in the middle parts of the Lar and Mozduran formations. It contains superficial ooids with poorly preserved radial structure in the cortex. Many have nuclei of quartz grains or small bioclasts (Pl. 3.3C). Additional components are peloids, intraclasts, and bioclasts (sponge, bryozoan and echinoderm debris) of variable shape and size.

Silty intra-oo-packstone/grainstone: Grey, often medium- to thick-bedded units in the middle parts of the Lar and Mozduran formations with variable amounts of ooids and intraclasts. The ooids are of the superficial type and radially structured in the cortex. The nuclei often consist of small bioclasts and quartz grains. The intraclasts are angular lumps of fine-grained sediment (Pl. 3.3G).

Interpretation: The shoal facies was deposited in a platform margin sub-environment that separated open marine from restricted-marine environments. The abundance of intraclasts indicates rip-up phenomena and erosion of previous deposits by storms or currents. Ooid abundance and the mud-free, sorted and cross-bedded nature of this facies indicate high-energy conditions, in which waves and currents reworked and transported carbonate grains. The shelf margin facies of the Lar and Mozduran formations is analogous to the modern sand shoals of the Bahamas (HINE 1977, TUCKER 1985, LASEMI 1995).

Open marine facies: The open-marine shelf is represented by both platform slope and outer shelf facies. The outer shelf facies consists of a proximal and a distal subfacies:

Platform slope: On the platform slope, the following microfacies are found:

silty *Tubiphytes*-wackestone

microbialite

bio-packstone

bio-intra-rudstone

fine- to medium-grained sandstone

bio-wackestone

bio-oo-pel-grainstone

oo-intra-grainstone.

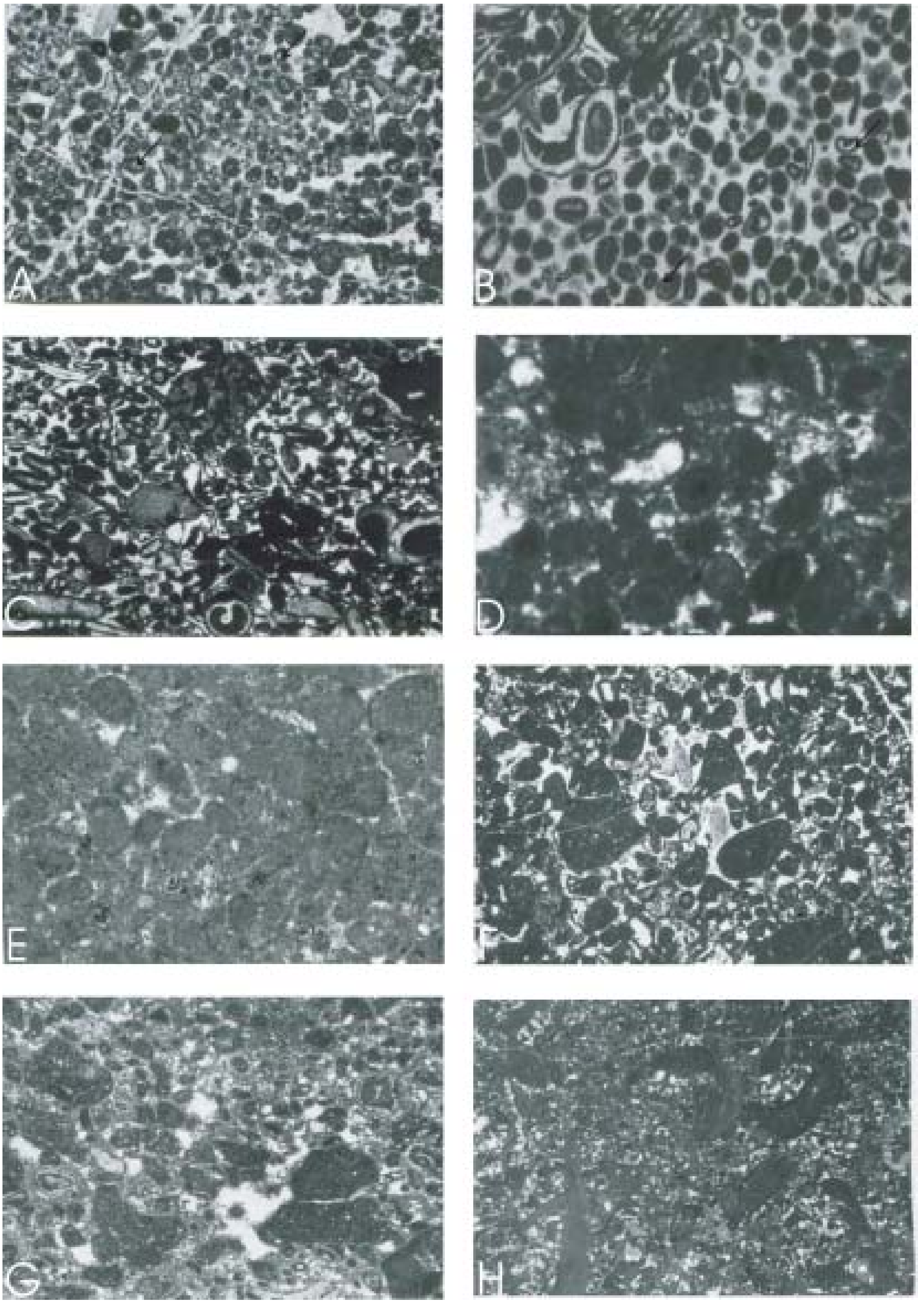
The open-marine bio-wackestone/packstone contains ammonites, belemnites, sponges, sponge spicules, benthic foraminifers (*Lenticulina* sp., rotaliids, nodosariids, miliolids) radiolarians, ostracods and echinoderm debris. The patch reefs are mainly composed of microbial crusts and foraminifers (*Tubiphytes).* Occasionally, the outer facies is heavily bioturbated.

Microbialite: This microfacies occurs as medium- to thick units common at the top of the Dalichai and base of the Lar formations, at the base of the Mozduran Formation and in the upper part of the Chaman Bid Formation. It is characterized by irregular microbial crusts with a clotted fabric and laminar to digitate growth. Siliceous sponges as well as *Tubiphytes* (Text Fig. 3.1C), some of them branched, serpulids, and *Terebella* (Text Fig. 3.1B) are important constituents. Internally, numerous irregularly shaped growth cavities were filled with microbial peloids.

Silty *Tubiphytes*-wackestone: This microfacies is common at the top of the Dalichai, basal part of the Lar and Mozduran formations and uppermost part of the Chaman Bid Formation. The medium to thick beds are composed of bioclastic wackestone with numerous *Tubiphytes* and bivalve debris (Text Fig. 3.1A). This facies occurs in close association with microbialites. Due to the irregular constrictions of the central cavities and the general concentric arrangment of the micritic laminae, the observed *Tubiphytes* can be attributed to *T. morronensis* CRESCENTI (FLÜGEL 1981).

Plate 3.3. Microfacies of the platform margin barrier of the Upper Jurassic Lar and Mozduran formations, NNE Iran.

Fig. A. Bio-oo-grainstone; lower Mozduran Formation, section 3, M-S-40, x12.5.
Fig. B. Oo-grainstone; upper Mozduran Formation, section 3, M-S-103, x12.5.
Fig. C. Intra-pel-oo-grainstone; middle Mozduran Formation, section 3, M-S-68, x12.5.
Fig. D. Oo-grainstone; middle Mozduran Formation, section 3, M-S-72, x50.
Fig. E. Oo-grainstone; lower Lar Formation, section 2, M-J-49, x50.
Fig. F. Bio-intra-grainstone; lower Lar Formation, section 2, M-J-47, x12.5.
Fig. G. Silty intra-oo-packstone/grainstone; middle Lar Formation, section 2, M-J- 63, x12.5.
Fig. H. Intra-pel-grainstone; middle Mozduran Formation, section 3, M-S-65, x12.5.


A
B
C
D
E
F
G
H

Bio-wackestone/packstone: Grey wackestone to packstone with microbioclasts of echinoderm, *Terebella, Tubiphytes,* and brachiopod origin, rare foraminifers (*Lenticulina* sp., *Ammobaculites* sp., nodosariids, *Globuligerina* sp., ophtalmiids, textulariids, rotaliids), and peloids, occurring in medium to thick-bedded units. This microfacies is encountered at the top of the Dalichai, basal part of the Lar and Mozduran formations and the middle and upper parts of the Chaman Bid Formation.

Bio-oo-pel-grainstone, oo-intra-grainstone, and bio-intra-rudstone: These microfacies are common at the top of the Dalichai Formation and middle part of the Chaman Bid Formation. They form graded, sharp-based, rarely also erosional beds, ranging from 0.1 to 1 m in thickness, intercalated between typical basinal sediments. These facies in basinal setting are interpreted as distal calcareous turbidites shed from the Lar and Mozduran platforms. Their allochthonous nature is indicated by shallow-water components such as ooids. An example is the thin-section shown on (Text Fig. 3.1D) in which peloids (small, well-sorted, lacking internal structure) and ooids (small, well-sorted, superficial with a radial structure, their nuclei often consisting of small bioclasts or quartz grains) dominate. In the bio-intra-rudstone facies angular lumps of fine-grained sediment occur and the diameters of the intraclasts usually range between 4 and 5 mm (Text Fig. 3.1F). In the oo-intra-grainstone microfacies (Text Fig. 3.1E) a number of irregularly shaped lumps of carbonate mud are surrounded by radial structure.

Proximal Basin: This facies is characterized by:

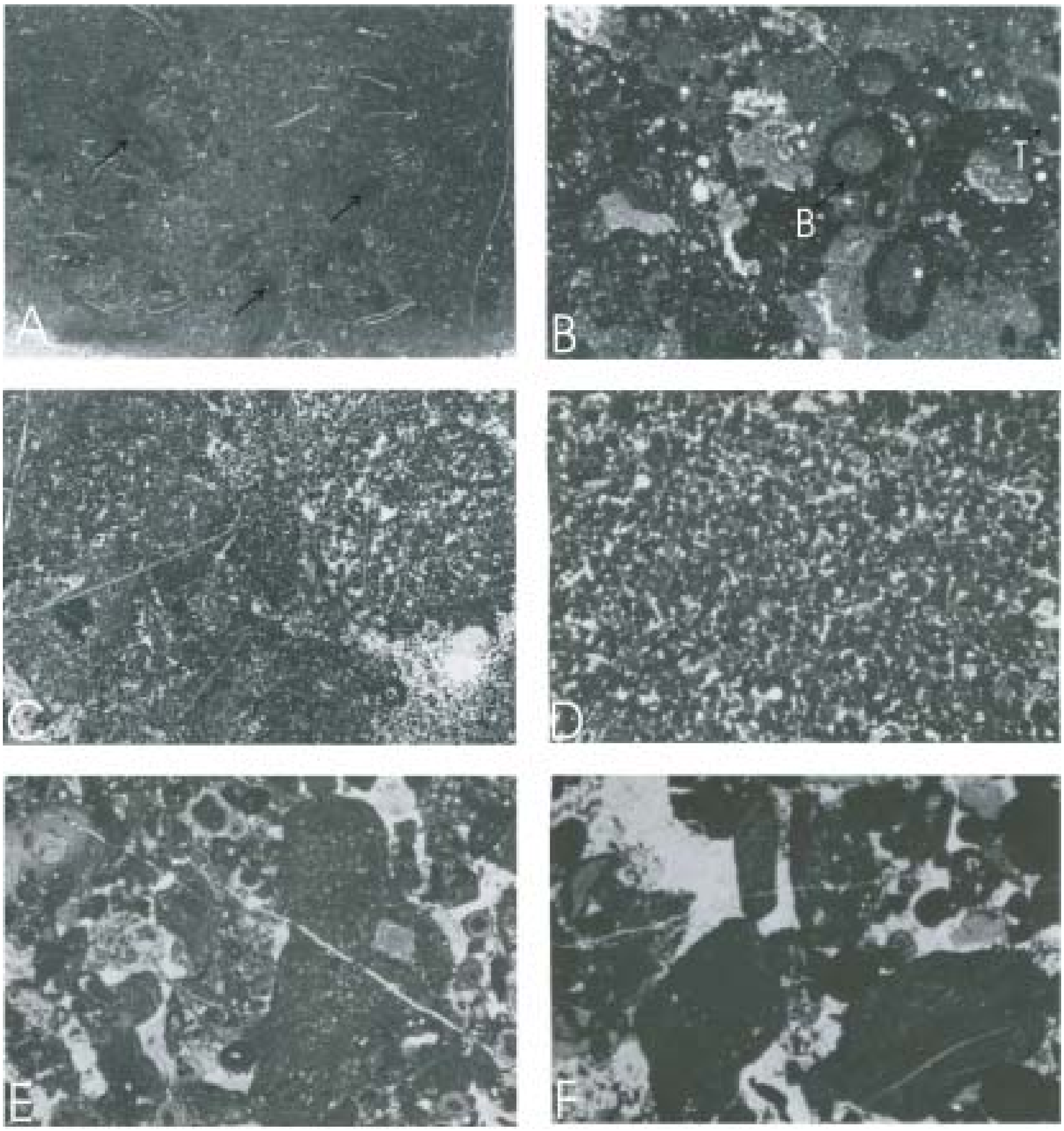
radiolarian wackestone

filament wackestone/packstone

Saccocoma wackestone

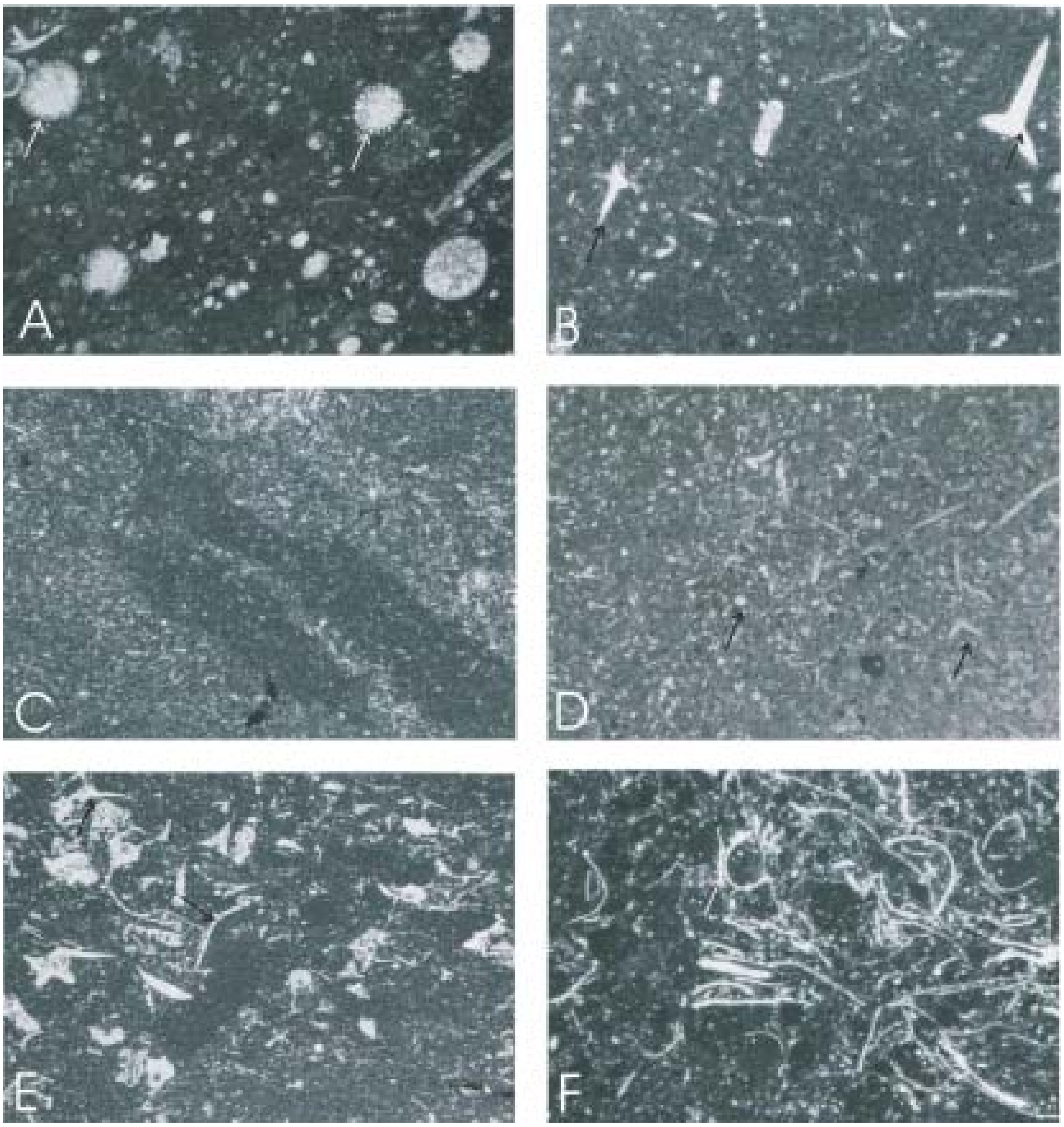
spiculitic wackestone/packstone.

Radiolarian wackestone: This microfacies is common in the middle part of the Dalichai Formation and lower to middle part of the Chaman Bid Formation. It is characterized by well-bedded, partly micro-bioclastic, radiolarian wackestones. Ammonites, belemnites, sponge spicules, thin-shelled ostracods and rare gastropods, echinoderm debris, and foraminifers (*Lenticulina* sp., ophtalmiids, nodosariids, textulariids) may occur. The sediment is commonly bioturbated; trace fossils include *Zoophycos* and *Thalassinoides*. Often chert nodules (in Dalichai and Chaman Bid formations) and pyrite (in Chaman Bid Formation) are developed (Text Fig. 3.2A).



Text Fig. 3.1. Microfacies of the platform slope facies of the Middle and Upper Jurassic Dalichai, Lar, Chaman Bid, and Mozduran formations, NNE Iran.

Fig. A. Bio-*Tubiphytes* wackestone; *Tubiphytes* (arrowed); basal part of Lar Formation, section 2, M-J-39, x1.
Fig. B. Microbialite with *Terebella* (**B**) and *Tubiphytes* (**T**); lower Dalichai Formation, section 2, M-J-6, x12.5.
Fig. C. Microbialite; upper Dalichai Formation, section 2, M-J-29, x12.5.
Fig. D. Oo-pel-grainstone; middle Chaman Bid Formation, section 4, M-Ch-87, x12.5.
Fig. E. Oo-intra-grainstone; middle Chaman Bid Formation, section 4, M-Ch-94, x12.5.
Fig. F. Bio-intra-rudstone; lower Chaman Bid Formation, section 4, M-Ch-43, x12.5.



Text Fig. 3.2. Microfacies of basinal environments of the Middle and Upper Jurassic Dalichai and Chaman Bid formations, NNE Iran.

Fig. A. Radiolarian wackestone; upper Chaman Bid Formation, section 3, M-S-24, x50.
Fig. B Spiculitic wackestone; upper Dalichai Formation, section 2, M-J-27, x50.
Fig. C. Bioturbated spiculitic packstone; lower Chaman Bid Formation, section 3, M-S-10, x12.5.
Fig. D. Spiculitic packstone; lower Chaman Bid Formation, section 4, M-Ch-4, x12.5.
Fig. E. Bioturbated silty *Saccocoma*-wackestone; middle Chaman Bid Formation, section 4, M-Ch-77, x12.5.
Fig. F. Peloidal filament-wackestone/packstone; middle Dalichai Formation, section 2, M-J-15, x12.5.

Saccocoma wackestone: Well-bedded bioturbated *Saccocoma* wackestones occur only in the middle part of the Chaman Bid Formation. Some micro-bioclasts, (radiolarians, sponge spicules) are associated (Text Fig. 3.2E). Pyrite is common.

Spiculitic wackestone/packstone: The microfacies is very similar to that of the radiolarian wackestone recognized in proximal basin sediment of the Dalichai and Chaman Bid formations. The most abundant components are sponge spicules (Text Fig. 3.2B), thin-shelled ostracods, radiolarians, gastropod and echinoderm debris, belemnites and ammonites. The sediment is commonly bioturbated (Text Fig. 3.2C). Trace fossils include *Zoophycos* and *Thalassinoides.*

Filament wackestone/packstone: The fauna of this microfacies is mostly pelagic and includes thin-shelled bivalves (filaments), ammonites, belemnites, sponge spicules, radiolarians, and foraminifers (globigerinids). Occasionally, the sediment is heavily bioturbated (Text Fig. 3.2F).

This facies is characterized by plankton-dominated wackestone/packstones that contain comparatively few skeletal grains including planktic bivalves (filaments), siliceous sponges, radiolarians, *Saccocoma*, ammonites, and belemnites. Non-skeletal grains such as peloids and particles are rare. The peloids are probably platform-derived and could have been transported into the basin. Occasionally pyrite occurs. In some of the thin-sections, the percentage of sponge spicules is very high so that the rock can be called a spiculite. Another characteristic feature of this facies is the common bioturbation (e. g. *Zoophycos*).

Distal Basin: This well-bedded facies is common in the basal part of the Dalichai Formation and in the basal and upper part of the Chaman Bid Formation. It is composed of green to greyish-green marl and thin, finely laminated dark grey mudstone (especially in the Chaman Bid Formation). The fauna of this facies is pelagic and includes ammonites, belemnites, some pelagic crinoids, sponge spicules, and radiolarians.

Interpretation: The dominance of micrite and scarcity of components indicate a considerable depth of water. Rocks of the distal basin facies were deposited some distance beyond the seaward end of the platform margin. Lack of a benthic fauna and the very dark colour of the thin-bedded and laminated mudstone indicate low oxygen conditions at the seafloor.

Siliciclastic unit

The siliciclastic units are over 78 m thick in the Chaman Bid Formation (at the type section) and 45 m in the Chaman Bid Formation (at the Tooy section), their base and top not being exposed. The facies association consists of alternations of thin- to thick-bedded, greenish-grey, fine-grained subangular, well-sorted sandstones and silty marl with intercalations of greenish-grey silt. Characteristic sedimentary features are parallel-lamination, low-angle, large-scale trough cross-bedding, small-scale ripple-bedding (oscillation ripples), hummocky cross-stratification (Pl. 3.4B), and convolute-bedding (Pl. 3.4E). Additional features are flute casts (Pl. 3.4D), load casts and reworked sandstone clasts (Pl. 3.4C). The sandstone bodies usually are stacked, individual beds ranging from 10 to 250 cm. They can be grouped in units that coarsen and thicken upwards. Recognizable trace fossils are *Thalassinoides, Planolites* (Pl. 3.4F, H), *Gyrochorte* in the Chaman Bid Formation (at the type section), and *Zoophycos* and *Rizocorallium* (Pl. 3.4G) in the Chaman Bid Formation (at the Tooy section). The siltstone is greenish-grey and commonly bioturbated.

Interpretation: The coarsening-upward nature of the sedimentary packages, sedimentary structures, bioturbation, and good sorting are characteristic of prodelta to delta front deposits (WRIGHT & COLEMAN 1974, WRIGHT 1985, ELLIOTT 1986).

Plate 3.4. Sedimentary structures and trace fossils in delta facies of the Dalichai and Chaman Bid formations, NNE Iran.

Fig. A. The trace fossil *Zoophycos* in lower sandstones of the Chaman Bid Formation at the type locality.
Fig. B. Hummocky cross-stratification in lower sandstones of the Chaman Bid Formation at the type locality.
Fig. C. Reworked sandstone clasts in lower sandstones of the Chaman Bid Formation at the type locality.
Fig. D. Flute casts in lower sandstones of the Chaman Bid Formation at the type locality.
Fig. E. Convoluted base of lower sandstones unit of the Chaman Bid Formation at the type locality.
Fig. F. The trace fossil *Gyrochorte* in upper sandstones of the Chaman Bid Formation at the type locality.
Fig. G. The trace fossil *Thalassinoides* in sandstones of the Chaman Bid Formation at Tooy.
Fig. H. The trace fossil *Gyrochorte* in sandstones of the Chaman Bid Formation at Tooy.


A
B
C
D
E
F
G
H

Conclusions: The Lar and Mozduran formations entirely consist of medium-bedded to massive carbonates, which were deposited on an extensive carbonate platform in the Middle and Upper Jurassic. In a broad sense, the platform was structured into a high-energy margin facies and a platform interior facies. The tidal flat was characterized by a low to high-energy depositional regime with a corresponding broad range of microfacies types, from fenestral mudstone, fenestral pel-packstone, to stromatolite boundstone and intra pel-packstone/grainstone. The extensive lagoonal platform interior was characterised by low-energy sediments such as bio-pel-mudstone, bio-pel-packstone to -grainstone**,** onco-pel-wackestone, bio-pel-intra-packstone to -grainstone and coralgal framestone. Characteristic features of this facies are peloids and variable amounts of bioclasts, whereas oncoids and intraclasts were less common. The fossil density varied greatly. The lagoon supported a much higher diversity of organism towards the low energy platform interior than the high-energy platform margin. Characteristic sediments at the platform margin are oo-grainstones with variable amounts of bioclasts and intraclasts. The shoals formed in very shallow water.

Open-marine environments of the Dalichai and Chaman Bid formations were separated from the extensive shelf lagoon by a rimmed platform margin. Their sediments were deposited on the slope of the carbonate platform and in the adjacent basin. They are composed of gravitationally transported sediments derived from shallow-water platform areas, autochthonous microbialites, and fine-grained sediments deposited from suspension. The upper slope shows a prevalence of microbial buildups. These are usually accompanied by siliceous sponges, *Tubiphytes*, serpulids and T*erebella*. Microbial-sponge accumulations are thought to indicate a water depth generally greater than 50 m (e.g. REITNER & NEUWEILER 1995) and lowered rates of sedimentation (LEINFELDER et al. 1993b, 1994, SCHMID 1996).

Types of bulk transport on the slopes of the Lar and Mozduran Platform include slides and sediment gravity flows (COOK & MULLINS 1983). The sediment gravity flow deposits include turbiditic graded bio-oo-pel-grainstone, bio-intra-rudstone, oo-intra-grainstone and mud flows. The allodapic limestones were probably deposited from low viscosity turbidity currents flowing down the slope of the Lar and Mozduran Platform. This interpretation is supported by the sharp, sometimes erosional bases (e.g. FÜRSICH et al. 2003).

The proximal basin shows a dominance of radiolarian wackestone, *Saccocoma* wackestone, filament wackestone to packstone, and spiculitic wackestone to packstone. Nektic (belemnites and ammonites) and planktic organisms (radiolarians, filaments, *Saccocoma* and thin-shelled ostracods) prevail.

Basinal areas beyond the reach of the Lar and Mozduran peri-platform muds are characterized by deposition of monotonous greenish marls and well-bedded limestones (mudstone).

Systematic Palaeontology

Abbreviations:

D diameter in mm
U% umbilical width as % of diameter
H% whorl height as % of diameter
W% whorl width as % of diameter
PR/2 primary ribs on a half whorl
SR/2 secondary ribs on a half whorl
N number of tubercles/whorl
(1) Dalichai section (type localityof the Dalichai Formation)
(2) Golbini-Jorbat section (Dalichi Formation)
(3) Tooy-Takhtehbashgheh section (Chaman Bid Formation)
(4) Chaman Bid section (type locality of the Chaman Bid Formation)

The specimens have been numbered according to section (D: Dalichai section; J: Golbini-Jorbat section; S: Tooy-Takhtehbashgheh section; CH: Chaman Bid section), ammonite horizon, and individual specimen (e.g. CH-6-23). All specimens are figured in natural size, except otherwise indicated.

Superfamily Phylloceratinaceae ZITTEL, 1884
Family Phylloceratidae ZITTEL, 1884
Subfamily Phylloceratinae ZITTEL, 1884
Genus *Phylloceras* SUESS, 1865

Phylloceras sp.
Pl. 1, Figs. 1-2

Material: 11 specimens from section (2) (J-30-34, 241, 271-272, 259, 281, 283) and 6 specimens from section (3) (S-23, 28, 44, 85-87).

Dimensions:

specimen	D	U%	H%	W%
S-3-23	65	15	55	43
J-5-259	42	17	55	43
S-2-44 (body chamber)	40	16	55	45
J-6-271	36	17	61	39
S-2-28	32	19	53	37
J-2-32	25	12	52	28

Description: Involute *Phylloceras* with high-ovate whorl section, steep umbilicus, and rounded venter. Shell very thin, with typical phylloceratid suture line.

Stratigraphic distribution: *Phylloceras* occurs worldwide from the Lower Jurassic (Sinemurian) to the Lower Cretaceous (Valanginian) (ARKELL et al. 1957); the present spcimens come from the Upper Bajocian to Upper Kimmeridgian.

Subfamily Calliphylloceratinae SPATH, 1927
Genus *Calliphylloceras* SPATH, 1927

Calliphylloceras sp.
Pl. 1, Figs. 3, 5, 7

Material: 18 specimens from section (2) (J-180-193, 240-243) and 8 specimens from section (3) (S-25, 27, 29-31, 36-37, 43, 73).

Dimensions:

specimen	D	U%	H%	W%
S-3-36	56	11	57	29
J-4-186	51	16	51	39
J-4-191	49	18	51	39
S-6-29	43	14	58	47
J-4-193 (body chamber)	32	16	56	39
J-4-183	31	19	45	35
S-2-43	26	19	54	42
J-4-192	24	21	54	42
J-4-185	23	17	57	43

Description: Involute phylloceratids with smooth shell and steep umbilicus. Usually with 5 sigmoidal constrictions on the last visible whorl. The constrictions are narrow, start from the umbilical shoulder, and terminate at the rounded venter. With typical phylloceratid suture line.

Stratigraphic distribution: *Calliphylloceras* has a worldwide distribution, from the Lower Jurassic (Hettangian) to the Lower Cretaceous (Middle Albian). The present specimens come from the Bathonian to Lower Oxfordian.

Genus *Holcophylloceras* SPATH, 1927

Holcophylloceras indicum LEMOINE, 1910
Pl. 1, Fig. 10

1910 *Phylloceras mediterraneum* sp. nov. – LEMOINE : 3, pl. 1, fig. 1.
1976 *Holcophylloceras indicum* sp. nov. - JOLY : 239, pl. 22, figs. 2-4, pl. 23, fig. 1, pl. 25, figs. 3-5, pl. 26, figs. 2, 5, pl. 27, figs. 1-2, 4-9.

Material: 1 specimen and 1 fragment from section (2) (J-4-155a,155b).

Dimensions:

specimen	D	U%	H%	W%
J-4-155a	75	12	56	28

Description: Involute shell with 5 distinct and sigmoidal constrictions which are narrow and shallow on the last visible whorl. The constrictions start from the umbilical shoulder and terminate on the venter. Fine ribbing starts on about the outer ¾ of the flank and crosses the rounded venter.

Discussion: Based on the shape of the constrictions and fine ribbing on the outer part of the whorl, the specimen closely matches *Holcophylloceras indicum.*

Stratigraphic distribution: Middle Callovian.

Holcophylloceras sp.
Pl. 1, Fig. 9

Material: 1 fragmented specimen from section (2) (J-4-155c) and 4 specimens from section (3) (J-5a-e).

Dimensions:

specimen	D	U%	H%	W%
S-1-5a	80	12	54	31

Description: Involute phylloceratids, venter arched, with deep and sigmoidal constrictions starting from the umbilical shoulder and terminating prorsiradiate on the venter. With typical phylloceratid suture line.

EXPLANATION OF PLATE 1

Figs. 1-2. *Phylloceras* sp.. 1a-b: Specimen S-2-44 with body chamber from the Tooy-Takhtehbashgheh section. 2a-b: Specimen J-5-259 from the Golbini-Jorbat section.
Figs. 3, 5, 7. *Calliphylloceras* sp. 3. Specimen J-4-183 from the Golbini-Jorbat section. 5a-b. Specimen J-4-193 with body chamber from the Golbini-Jorbat section. 7. Specimen S-3-36 from the Tooy-Takhtehbashgheh section.
Figs. 4a-b, 6a-b. *Ptychophylloceras* sp. 4a-b. Specimen S-3-32 from the Tooy-Takhtehbashgheh section. 6a, b. Specimen J-4-168 from the Golbini-Jorbat section.
Fig. 8. *Lytoceras* sp. (S-3-9) from the Tooy-Takhtehbashgheh section; x1.5.
Fig. 9. *Holcophylloceras* sp. (J-4-155c) from the Golbini-Jorbat section.
Fig. 10. *Holcophylloceras indicum* (LEMOINE) (J-4-155a) from the Golbini-Jorbat section.


1a
1b
2a
2b
3
4a
5a
5b
6a
6b
7
4b
8
9
10

Stratigraphic distribution: *Holcophylloceras* occurs worldwide from the Middle Jurassic (Bajocian) to the Lower Cretaceous (Aptian). The present specimens come from the Upper Bajocian and Lower to Middle Callovian.

Genus *Ptychophylloceras* SPATH, 1927

Ptychophylloceras sp.
Pl. 1, Figs. 4, 6

Material: 28 specimens from section (2) (J-35, 102-105, 158-178, 266-267) and 6 specimens from section (3) (S-.32-35, 42, 57, 72).

Dimensions:

specimen	D	U%	H%	W%
S-3-33	85	12	60	36
S-3-32	70	19	49	43
S-2-42	57	16	54	39
J-4-168	54	15	55	37
J-4-166	51	16	45	39
J-4-159	50	16	52	26
J-4-165	47	19	53	25
J-4-172	47	17	51	42
S-3-40	46	15	52	30
J-4-169	46	17	50	39
J-4-170	40	17	52	37
J-4-171	30	17	53	36
J-4-177	26	19	54	42
J-4-176	24	12	54	46

Description: Shell involute, whorl section rounded-quadrate. With narrow and shallow constrictions which start out as concave near the umbilical shoulder and turn convex in a ventral direction. In some of the specimens (e.g. S-2-33) shells with broadly rounded venter crossed by periodic labial the fine ridges in other specimens (e.g. S-2-32) strong ridges are developed on the venter. With typical phylloceratid suture line.

Stratigraphic distribution: The present specimens come from the Bathonian to Lower Oxfordian.

Genus *Sowerbyceras* PARONA & BONARELLI, 1895

Sowerbyceras sp.
Pl. 2, Figs. 1-2

Material: 57 specimens from section (2) (J-247a-e, 248a-g, 249a-k, 250a-g, 251a-l, 252a-i, 253a-l, 254-256, 280), 20 specimens from section (3) (S-74, 142-160).

Dimensions:

specimens	D	U%	H%	W%
J-5-248a	71	18	48	25
J-5-247a	70	20	43	27
J-5-249	60	27	47	30
J-5-250a (body chamber)	54	30	41	31
J-5-248a	52	21	50	42
J-6-253	50	24	46	32
J-5-252	31	32	42	39
J-6-255	25	28	52	44
J-6-256	24	33	42	38
J-6-257	22	32	45	41
J-6-251	14	36	50	43

Description: Shell moderately evolute, umbilical wall steep, umbilical shoulder distinct, whorl section quadrate. The constrictions are deep, wide, and sigmoidal starting at the umbilical shoulder and crossing prorsiradiate over the venter.

Stratigraphic distribution: Worldwide in the Upper Jurassic (Oxfordian-Kimmeridgian). The present specimens come from the Bathonian-Lower-Kimmeridgian.

Superfamily Spirocerataceae HYATT, 1900
Family Spiroceratidae HYATT, 1900
Genus *Spiroceras* QUENSTEDT, 1858

Spiroceras cf. *orbignyi* (BAUGIER & SAUZE, 1843)
Pl. 2, Fig. 4

cf. 1843 *Toxoceras orbignyi* sp.nov. - BAUGER & SAUZE : 6, pl .1, figs. 1-4.
cf. 1978 *Spiroceras orbignyi* BAUGIER & SAUZE - DIETL: 76, pl.1, figs. 1-5, pl. 2, figs. 1-6, pl. 3, figs. 1-2.
cf. 1985 *Spiroceras orbignyi* BAUGIER & SAUZE – SCHLEGELMILCH: 220, pl. 35, fig. 6.
1986 *Spiroceras orbignyi* BAUGIER & SAUZE - Dietl, 42, pl .1, figs. 2-6.

Material: 1 fragmented specimen from section (3) (S-2a).

Description: The fragmentary shell forms an open spiral with rounded whorl section. The ribs are simple with two rows of nodes (lateral and ventrolateral) ending at a ventral smooth band, where they bend slightly forward.

Remarks: Our specimen differs from the holotype in being more finely ribbed and from the specimen figured by DIETL (1978: 78, fig. 5) in the fainter swing of the ribs.

Stratigraphic distribution: The present specimen occurs in the Upper Bajocian Garantiana Zone. In France and Spain the species occurs in the Parkinsoni Zone, Acris Subzone.

Spiroceras annulatum (DESHAYES, 1831)
Pl. 2, Fig. 3

1831 *Hamites annulatus* sp.nov. – DESHAYES : 228, pl .6, fig. 5.
1978 *Spiroceras annulatum* DESHAYES - DIETL : 87, pl. 6, figs. 1-5.
1985 *Spiroceras annulatum* DESHAYES - SCHLEGELMILCH : 223, pl. 36, fig. 2.
1990 *Spiroceras annulatum* DESHAYES - SANDOVAL: 161, pl. 4, fig. 1.

Material: 3 small fragments from section (3) (S-2b-d).

Remarks: The fragmentary shell forms an open spiral with a high-ovate whorl section. The ribbing is strong and simple. It ends at a ventral smooth band.

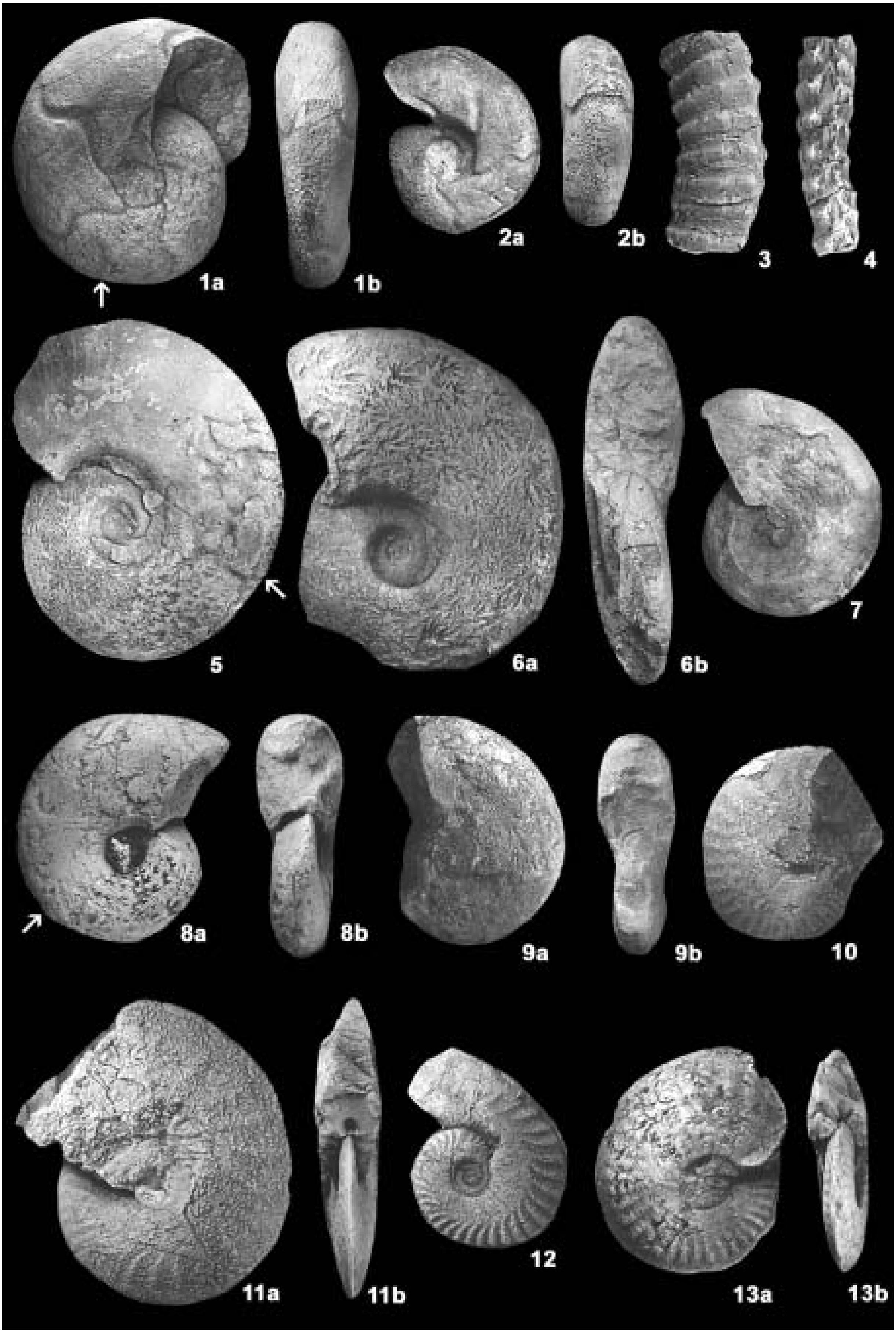
Stratigraphic distribution: The species is widely distributed in Europe (e.g. Germany, France, Spain, England, Italy), North America, and North Africa. The present specimens have been found in the Upper Bajocian Niortense-Garantiana zones.

Superfamily Haplocerataceae ZITTEL, 1884
Family Haploceratidae ZITTEL, 1884
Genus *Lissoceratoides* BUCKMAN, 1924

Lissoceratoides sp.
Pl. 2, Figs. 5-6

EXPLANATION OF PLATE 2

Figs. 1-2. *Sowerbyceras* sp. from the Golbini-Jorbat section. 1a-b. Specimen J-5-250a with body chamber. 2a-b. Specimen J-5-256; x1.5.
Fig. 3. *Spiroceras annulatum* (DESHAYES) (S-1-2b) from the Tooy-Takhtehbashgheh section, Niortense-Garantiana zones.
Fig. 4. *Spiroceras* cf. *orbignyi* (BAUGIER & SAUZE) (S-1-2a), from the Tooy-Takhtehbashgheh section, Garantiana Zone, x3.
Figs. 5-6. *Lissoceratoides* sp. from the Golbini-Jorbat section, Oxfordian to Lower Kimmeridgian. 5. Specimen J-6-268 with body chamber. 6a-b. Specimen J-6-238.
Fig. 7. *Glochiceras* sp. (CH-6-41) from the Tithonian of the Chaman Bid section.
Figs. 8-9. *Pseudolissoceras zitteli* (BURCKHARDT) from the Chaman Bid section, Lower Tithonian. 8a, b. Specimen CH-6-5 with body chamber. 9a-b. Specimen CH-6-4, x1.5.
Fig. 10. *Oxycerites* cf. *oxus* (BUCKMANN) (J-2b-27) from the Golbini-Jorbat section, Tenuiplicatus to Subcontractus Zone.
Fig. 11a-b. *Oxycerites yeovilensis* (ROLLIER) (J-2b-29) from the Golbini-Jorbat section, Zigzag Zone.
Fig. 12. *Oecotraustes (Paroecotraustes)* aff. *serrigerus* (WAAGEN) (J-2c-23) from the Golbini-Jorbat section, Retrocostatum Zone.
Fig. 13a-b. *Eochetoceras* sp. (J-5-236) from the Golbini-Jorbat section, Lower Oxfordian.


1a
1b
2a
2b
3
4
5
6a
6b
7
8a
8b
9a
9b
10
11a
11b
12
13a
13b

Material: 3 specimens and 1 fragment from section (2) (J-268-270, 238-239), 4 specimens from section (3) (S-59-62).

Dimensions:

specimen	D	U%	H%	W%
J-6-238	67	33	40	
J-5-270 (body chamber)	60	27	45	31
J-5-263	48	27	44	27

Description and remarks: Shell subevolute, with ovate whorl section and steep and high umbilical wall. Shell smooth and very thin; suture line visible. Towards the aperture the shell is increasing in height and width. The body chamber in specimen J-7-9-270 seems to occupy about half on the outer whorl. Indistinguishable morphologically from *Lissoceras* but separated from it by a wide stratigraphic gap.

Stratigraphic distribution: Oxfordian to Lower Kimmeridgian.

Genus *Pseudolissoceras* SPATH, 1925

Pseudolissoceras zitteli (BURCKHARDT, 1903)
Pl. 2, Figs. 8-9

1903 *Neumayria zitteli* sp. nov. - BURCKHARDT: 55, pl. 10, figs. 1-8.
1907 *Neumayria zitteli* BURCKHARDT - HAUPT : 200, pl. 7, fig. 3a, b.
cf.1950 *Pseudolissoceras zitteli* (BURCKHARDT) - SPATH : 139, pl. 6, fig. 8a-c.

Material: 3 specimens from section (4) (CH-3-5).

Dimensions:

specimen	D	U%	H%	W%
CH-6-3	50	18	52	36
CH-6-5 (body chamber)	44	18	50	36
CH-6-4	29	20	48	33

Description: Shell involute, cross-section of whorl elliptical, umbilical wall high and vertical, umbilical shoulder distinct, surface smooth, without ribbing. Suture line simple with small, distant lobes. Towards aperture shell becoming increasingly higher and wider. The body chamber in specimen CH-6-5 seems to occupy about 2/3 of the outer whorl.

Remarks: The present specimens very closely resemble the holotype of BURCKHARDT (1903), but differ in having bigger lateral lobes. SPATH (1950) erected the new species *Pseudolissoceras advena*, which is supposed to differ from *Pseudolissoceras zitteli* in having simple ribs. However, according to HAUPT (1907) and in our opinion, this species is merely a variety of *Pseudolissoceras zitteli.*

Stratigraphic distribution: According to SPATH (1950) *Pseudolissoceras zitteli* occurs in the Middle Tithonian (Semiforme/Verruciferrum Zone). The present specimens come from the Lower Tithonian.

Family Oppeliidae BONARELLI, 1894
Genus *Glochiceras* HYATT, 1900

Glochiceras sp.
Pl. 2, Fig. 7

1950 *Glochiceras*(?) sp. juv. ind. – SPATH: 139, pl. 6, fig. 6a, b.

Material: 1 specimen from section (4) (CH-41).

Dimensions:

specimen	D	U%	H%	W%
CH-6-41	41	13	51	13

Description: Shell moderately evolute, compressed, whorl section trigonal, umbilicus wall low. Surface of shell smooth except for a lateral groove at mid-flank.

Discussion: The present specimen is closely similar to *Glochiceras*(?) sp. SPATH (1950: 139, pl. 6, fig. 6a, b) but appears to differ in having a more strongly compressed whorl section. It also resembles *Hildaglochiceras* but, in contrast to the latter, has a prominent median lateral groove.

Stratigraphic distribution: Lower Tithonian.

Subfamily Oppeliinae BONARELLI, 1894

Genus *Oxycerites* ROLLIER, 1909

Oxycerites yeovilensis (ROLLIER, 1911)
Pl. 2, Fig. 11

1911 *Oppelia yeovilensis* n. sp.- ROLLIER: 305.
1968 *Oxycerites yeovilensis* ROLLIER - HAHN: 29, pl .2, figs. 1-4.
1985 *Oxycerites yeovilensis* (ROLLIER) - SEYED-EMAMI et al.: 62, pl. 1, fig. 4a-b.
1989 *Oxycerites yeovilensis* (ROLLIER) - SEYED-EMAMI et al.: 82, pl. 1, figs. 1-3.
1991 *Oxycerites yeovilensis* (ROLLIER) - SEYED-EMAMI et al.: 69, pl. 1, figs. 11-13.

Material: 4 specimens from section (2) (J-24-26, 29).

Dimensions:

specimen	D	U%	H%	W%
J-2b-26	58	9	59	22
J-2b-29	54	7	59	18
J-2b-24	54	9	56	20
J-2b-25	40	10	55	22

Description: Shell involute and oxycone, whorl cross-section trigonal to high-oval. The ribbing is mostly restricted to the outer part of the whorl and consists of distant, rursiradiate ribs, that end at a very sharp keel. The greatest whorl thickness is about mid-flank, from where the flank slopes towards the umbilicus and the sharp keel.

Remarks: This species can be distinguished from *Oxycerites limosus* (HAHN, 1968: 33, pl. 2, fig. 7) by its strong and distinct ribs.

Stratigraphic distribution: Lower Bathonian Zigzag Zone (Parum and Macrescens subzones) and Aurigerus Zone (Recinctus Subzone).

Oxycerites cf. *oxus* (BUCKMANN, 1926)
Pl. 2, Fig. 10

cf. 1926 *Micromphalites oxus* sp. nov. – BUCKMANN: pl. 644.
cf. 1983 *Oxycerites oxus* (BUCKMAN) - DIETL & KAPITZKE: 9, pl.1, fig. 4a, b.
cf. 1987 *Oxycerites oxus* (BUCKMAN) – TORRENS: 96, pl. 1, fig. 6.
cf. 1991 *Oxycerites oxus* (BUCKMAN) - SEYED-EMAMI et al.: 69, pl. 2, figs. 3-4.

Material: 1 specimen from section (2) (J-27).

Dimensions:

specimen	D	U%	H%	W%
J-2b-27	37	8	57	22

Description: Shell involute and oxycone, without ornamentation on the inner flank. The outer flanks has weak falcate ribs that terminate on the ventral shoulder.

Remarks: The specimen is referred to *Oxycerites oxus* with reservation, because it is broken and the whorl cross-section cannot be seen. The specimen is similar to *Oxycerites seebachi* (HAHN: 37, pl. 2. figs. 5, 6) but differs in having a narrower umbilicus and weaker ribs.

Stratigraphic distribution: Lower Bathonian Zigzag Zone. TORRENS (1987: 97) reported the species also from the Tenuiplicatus to Subcontractus Zone.

Genus *Oecotraustes* WAAGEN, 1869
Subgenus *Paroecotraustes* SPATH, 1928

Oecotraustes (Paroecotraustes) aff. *serrigerus* (WAAGEN, 1869)
Pl. 2, Fig. 12

1869 *Oecotraustes serrigerus* n. sp. – WAAGEN: 230, pl. 20, fig. 7.
aff. 1966 *Oecotraustes (Paroecotraustes) serrigerus* WAAGEN – STEPHANOV: 48, pl. 3, figs. 12-14.
cf.1968 *Oecotraustes (Paroecotraustes)* aff. *serrigerus* WAAGEN – HAHN: 60, pl. 5, figs. 4-5.
1972 *Oecotraustes (Paroecotraustes) serrigerus* (WAAGEN) – KRYSTYN: 234, pl. 4, fig. 5.
1985 *Oecotraustes (Paroecotraustes)* aff. *serrigerus* (WAAGEN) – SEYED-EMAMI et al.: 63, pl. 1, fig. 7a, b.

Material: 1 specimen from section (2) (J-23).

Dimensions:

specimen	D	U%	H%	W%
J-2c-23	29	24	55	24

Description: Shell nearly evolute, whorl section ovate with distinct keel, umbilical shoulder rounded, umbilical wall steep with falcoid ribs. Ornamentation of fine and prorsiradiate primary ribs, secondary ribs strong and rursiradiate. The secondary ribs terminate on the venter at a sharp keel.

Remarks: The present specimen with its fine primary ribs closely resembles the specimens figured by KRYSTYN (1972: 48, pl. 3, figs. 12-14) and STEPHANOV (1966: 234: pl. 4, fig. 5). It differs from the specimens figured by HAHN (1968) by its blunt secondary ribs and lack of primary ribs.

Stratigraphic distribution: Lower part of the Upper Bathonian Retrocostatum Zone.

Genus *Eochetoceras* SPATH, 1928

Eochetoceras sp.
Pl. 2, Fig. 13

Material: 1 specimen from section (2), No. J-236.

Dimensions:

specimen	D	U%	H%	W%
J-5-236	42	21	48	24

Description: Shell evolute, whorl cross-section ovate with a sharp keel, umbilical shoulder rounded, umbilical wall vertical. The ribs straight and strong. Suture line only partly preserved.]

Stratigraphic distribution: Middle Oxfordian.

Subfamily Hecticoceratinae SPATH, 1925
Genus *Hecticoceras* BONARELLI, 1893
Subgenus *Lunuloceras* BONARELLI, 1894

Hecticoceras (Lunuloceras) aff. *pseudopunctatum* (LAHUSEN, 1883)
Pl. 3, Fig. 11

aff. 1883 *Harpoceras pseudopunctatum* sp. nov. – LAHUSEN : 73, pl. 11, figs. 10-12.
aff. 1956 *Hecticoceras (Lunuloceras) pseudopunctatum* (LAHUSEN) - ZEISS : 38, pl. 1, figs. 3-4.
1975 *Lunuloceras (Lunuloceras) pseudopunctatum* (LAHUSEN) – LOMINADZE : 75, pl. VII figs. 6-9.
aff. 1985 *Lunuloceras (Lunuloceras) pseudopunctatum* (LAHUSEN) - SCHLEGEMILCH : 42, Pl. 8, fig. 6.
1991 *Hecticoceras (Lunuloceras)* aff. *pseudopunctatum* (LAHUSEN) - SCHAIRER, SEYED EMAMI & ZEISS : 65. pl. 1, fig. 3.
2000 *Lunuloceras (Lunuloceras) pseudopunctatum* (LAHUSEN) – SCHAIRER et al. : 55, fig. 13a-b.

Material: 8 specimens from section (2) (J-79-86).

Dimensions:

specimen	D	U%	H%	W%	PR/2	SR/2
j-3-83	79	27	47	19		30
J-3-84	57	24	45	21	7	25
J-3-82	53	34	39	17	7	
J-3-81	53	25	46	13		26
J-3-79	49	25	48	22	8	31
J-3-80	49	24	51	15	7	25
J-3-86	45	30	44	15		22
J-3-85	37	30	43	17	8	27

Description: Shell nearly evolute, umbilical wall steep and flat, whorl cross-section ovate. Primary ribs slightly bullate, distant and prorsiradiate, terminating at prominent nodes near mid-flank. The strong, prorsiradiate, bundled secondary ribs are mainly bifurcate with some intercalatory ribs, which end at the distinct and narrow keel on the venter.

Remarks: The specimens are similar to the material studied by SCHAIRER et al. (1991), but differ from specimens described by ZEISS (1956) in having stronger ribs and nodes. They differ from the specimen of LAHUSEN (1883) in having stronger nodes.

Stratigraphic distribution: According to ZEISS (1959: 48) the species ranges from the Callovian to the Lower Oxfordian; the specimens from Iran occur in the Callovian.

Hecticoceras (Lunuloceras) cf. *lunuloides* (KILIAN, 1899)
Pl. 3, Fig. 12

cf. 1899 *Harpoceras lunuloides* KILIAN – KILIAN: 118.
cf. 1959 *Hecticoceras (Lunuloceras) compressum* (F.A. QUENSTEDT, 1849) – ZEISS: 30.
1991 *Hecticoceras (Lunuloceras)* cf. *lunuloides* (KILIAN, 1899) - SCHAIRER et al. : 51, pl. 1, fig. 4.

Material: 2 specimens from section (2) (J-87-88).

Dimensions:

specimen	D	U%	H%	W%	PR/2	SR/2
J-3-88	40	25	46	16		28
J-3-87	35	23	48	17		24

Description: Shell small, compressed, involute, with steep umbilical wall and rounded shoulder; whorl cross-section trigonal. On the anterior part of the last whorl a faint rib starts at the umbilical margin and divides about mid-flank into two ribs. The secondary ribs end at a narrow keel and are slightly rursiradiate. On the posterior part of the last whorl the ribbing is fine and dense, while on the anterior part it is coarse and distant.

Discussion: The specimen figured by QUENSTEDT (1849: pl. 8, fig. 3) differs from the present specimens in having fine, dense ribs and a trigonal whorl section. The present material closely resembles the specimen figured by SCHAIRER et al. (1991: pl. 1, fig. 4).

Stratigraphic distribution: According to NIEDERHÖFER (in SCHAIRER et al. 1991: 52) *Hecticoceras (Lunuloceras) lunuloides* occurs in the Middle Callovian Anceps Zone.

Subgenus *Brightia* ROLLIER, 1922

Hecticoceras (Brightia) solinophorum BONARELLI, 1894
Pl. 4, Fig. 5

1894 *Hecticoceras (Lunuloceras) nodosum Bonar.* var. *solinophorum* n. - BONARELLI: 94.
cf.1991 *Hecticoceras (Brightia)* aff. *solinophorum* BONARELLI - SCHAIRER et al.: 50, pl. 1, fig. 2.

Material: 2 specimens from section (2) (J-96-97).

Dimensions:

specimen	D	U%	H%	W%	PR/2	SR/2
J-3-97	42	34	40	15		18
J-3-96	30	43	40	17		

Description: Shell nearly evolute, umbilical wall steep and flat, whorl cross-section high-ovate. The strong, falcate and prorsiradiate primaries begin about mid-flank and terminate at a narrow and trigonal keel on the venter.

Remarks: The present specimens differ from specimens studied by SCHAIRER (1991) in having fainter ribs and from the specimens figured by QUENSTEDT (1858) in having stronger ribs. Most likely, they can be considered as varieties of a single species.

Stratigraphic distribution: According to ZEISS (1959: 7) the species ranges from the Middle Callovian to the Lower Oxfordian. The present specimens come from the Middle to Upper Callovian.

Subgenus *Putealiceras* BUCKMAN, 1922

Hecticoceras (Putealiceras) metomphalum (BONARELLI, 1894)
Pl. 4, Fig. 4

1894 *Hecticoceras (Lunuloceras) metomphalum* sp. nov. – BONARELLI: 90.
1911 *Hecticoceras metomphalum* BONAR. var. multicostata nob. - DE TSYTOVITCH: 62, pl. 5, figs. 13-14.
1956 *Hecticoceras (Rossiensiceras) metomphalum* (BONARELLI) – ZEISS: 107, pl. 2, fig. 7.
1975 *Putealiceras (Putealiceras) metomphalum multicostatum* (DE TSYTOVITCH) – LOMINADZE: 37, pl. 2, figs. 6-7.
1985 *Hecticoceras (Putealiceras) metomphalum* BONARELLI – SCHLEGELMILCH: 42, pl. 8, fig. 3.

Material: 5 specimens and 1 fragment from section (2) (J- 74-78, 78a) and 1 specimen from section (3) (S-108).

Dimensions:

specimen	D	U%	H%	W%	PR/2	SR/2
j-3-73	54	33	41	17	10	26
J-3-79	48	35	40	19	11	26
J-3-74	42	33	40	21	10	29
J-3-78	33	36	36	18		
J-3-77	32	31	41	22	11	27

Description: Whorl cross-section high-ovate, umbilicus wall steep and nearly flat. The primaries begin close to the umbilical shoulder and terminate on the flank about one-third up at prominent lateral tubercles. The secondaries are strong, prorsiradiate, slightly falcate and moderately bifurcate with some intercalatory ribs. They end at the fine keel on the venter.

Remarks: Compared to the holotype our specimens are more evolute.

Stratigraphic distribution: According to DE TSYTOVITCH (1911), the species occurs in the Middle Callovian (Anceps Zone).

Hecticoceras (Putealiceras) schalchi ZEISS 1956
Pl. 3, Fig. 13

1956 *Hecticoceras (Putealiceras) schalchi* sp. nov. – ZEISS: 67, pl. 3, fig. 4.
1975 *Putealiceras (Zieteniceras) schalchi* ZEISS – LOMINADZE: 63, pl. 6, figs. 5-6.

Material: 5 specimens and 1 fragment from section (2) (J-67-72).

Dimensions:

specimen	D	U%	H%	W%	PR/2	SR/2
J-3-67	44	45	34		10	26
J-3-69	33	35	42	21	8	
J-3-68	31	35	42		8	25
J-3-72	30	40	37	20	7	20
J-3-71	25	40	34	22	10	25

Remarks: Umbilical wall steep and flat, whorl cross-section ovate. The radiate primary ribs begin at the umbilical margin and end at about one-third of flank height at prominent, conical lateral tubercles. From there, they mainly bifurcate with some intercalatories. The concave secondary ribs terminate at a narrow and distinct keel on the venter. The secondary ribs are denser than the primaries.

Stratigraphic distribution: Middle Callovian Anceps Zone.

Subgenus *Zieteniceras* ZEISS, 1956

Hecticoceras (Zieteniceras) zieteni DE TSYTOVITCH, 1911
Pl. 4, Fig. 2

1911 *Hecticoceras zieteni* sp. nov. - DE TSYTOVITCH: 25, pl. 1, fig. 2.
1956 *Hecticoceras (Zieteniceras) zieteni* (DE TSYTOVITCH) – ZEISS: 105, pl. 1, fig. 17.
cf.1975 *Putealiceras (Zieteniceras) zieteni* (DE TSYTOVITCH) – LOMINADZE: 52, pl. 4, figs. 5, 7, pl. 5, fig. 1.
1985 *Hecticoceras (Zieteniceras) zieteni* DE TSYTOVITCH – SCHLEGELMILCH: 162, pl. 6, fig. 5.

Material: 2 specimens and 1 fragment from section (2) (J-89-91).

Dimensions:

specimen	D	U%	H%	W%	PR/2	SR/2
J-3-89	53	28	46	23	11	
J-3-91	49	34	42	24	11	24

Description: Whorl cross-section high-ovate, umbilical wall steep, umbilical shoulder rounded, flank relatively flat. Ribbing relatively coarse. The strong, radiate to slightly prorsiradiate primary ribs begin at the umbilical margin and divide about mid-flank into two secondary ribs which, together with some intercalated ribs, end at the fine keel on the venter.

Discussion: The present material is very similar to the holotype but differs from the specimens studied by LOMINADZE (1975), especially his pl. 7, fig. 1, in having coarser and sharper ribs.

Stratigraphic distribution: The species was established by DE TSYTOVITCH (1911) on material from the Middle Callovian Anceps Zone. It has also been recorded from the Middle Callovian Coronatum Zone and the Macrocephalus/Anceps zones (LEMOINE 1932). The specimen from Iran occur in the Callovian Anceps Zone.

Hecticoceras (Zieteniceras) evolutum LEE, 1905
Pl. 3, Fig. 16

1905 *Hecticoceras evolutus* sp. nov. – LEE: 21, pl .1, fig. 6.
1911 *Hecticoceras evolutum* LEE - DE TSYTOVITCH: 21, pl. 2, fig. 9.
1956 *Hecticoceras (Zieteniceras) evolutum* LEE - ZEISS: 105, pl. 1, fig. 19.
1985 *Hecticoceras (Zieteniceras) evolutum* LEE – SCHLEGELMILCH: 163, pl. 6, fig. 7.

Material: 3 specimens and 1 fragment from section (2) (J-93-95).

Dimensions:

specimen	D	U%	H%	W%	PR/2	SR/2
J-3-94	49	32	42	23	8	22
J-3-93	43	38	42	23	9	24
J-3-95	40	32	43	22	8	23

Description: Umbilical wall steep, Umbilical shoulder nearly rounded, whorl cross-section high-ovate. The bullate and prorsiradiate primaries begin at the umbilical margin and divide about mid-flank into 2 or 3 rursiradiate secondaries, which, with some intercalated ribs, end at the fine keel on the venter. The secondary ribs are denser than the primary ones.

Discussion: The present specimens are very similar to the holotype but differ from the specimen figured by ZEISS (1959) in having coarser and stronger primary ribs.

Stratigraphic distribution: Middle Callovian (Anceps and Coronatum zones).

Subfamily Ochetoceratinae SPATH, 1928
Genus *Ochetoceras* HAUG, 1885

Ochetoceras marantianum (D´ ORBIGNY, 1850)
Pl. 3, Fig. 2

1850 *Ammonites marantianus* sp. nov. – D´ ORBIGNY: 533, pl. 207, figs. 3-5.
1929 *Ochetoceras semifalcatum* OPPEL - WEGELE: 141, pl. 25, fig. 3a, b.
1994 *Ochetoceras marantianum* (D´ ORBIGNY) - FISCHER: 174, pl. 75, figs. 5-7.

Material: 1 specimen from section (2) (J-292).

Dimensions:

specimen	D	U%	H%	W%	PR/2	SR/2
J-5-292	68	13	54	18		27

Description: Shell involute and compressed, oxycone, high-triangular-ovate Whorl-section with sharp keel and steep umbilical wall. Greatest whorl thickness about mid-flank from where it slopes towards the umbilicus and the sharp keel, but at the end of the body whorl a narrow shoulder is developed. The ribbing is relatively dense and falcoid. The prorsiradiate primary ribs end at mid-flank at a shallow spiral groove. The secondary ribs mainly bifurcate, are concave-rursiradiate and stronger than the primary ribs.

Discussion: The specimen compares well with the holotype and the material figured by FISCHER (1994: 174, pl. 75, figs. 5-7) and QUENSTEDT (1886-87: pl. 92, fig. 1).

Stratigraphic distribution: Upper Oxfordian Bimammatum Zone.

Ochetoceras semifalcatum (D´ ORBIGNY, 1850)
Pl. 3, Figs. 1, 3

1850 *Ammonites canaliculatus* sp. nov. – D´ ORBIGNY: 525, pl .199, figs. 1-6.
1929 *Ochetoceras semifalcatum* OPPEL - WEGELE: 141, pl. 25, fig. 4.
1994 *Ochetoceras semifalcatum* (OPPEL) - FISCHER: 171, pl. 75, fig. 3a, b.

Material: 2 fragmentary specimens from section (2) (J-290-291).

Dimensions:

specimen	D	U%	H%	W%	PR/2	SR/2
J-5-290	66	11	55	17		28

Description: Shell involute, oxycone,with median lateral groove. Whorl section high triangular-ovate with sharp keel and steep umbilical wall. The prorsiradiate primary ribs end at the median lateral groove. The secondary ribs, which are stronger than the primaries, mainly bifurcate and are rursiradiate, terminating at the sharp keel.

Discussion: The specimens matches the holotype and figured material of FISCHER (1994: 171, pl. 75, fig. 3a, b) and QUENSTEDT (1886-1887: pl. 92, fig. 8).

Stratigraphic distribution: Upper Oxfordian Bimammatum Zone.

Subfamily Taramelliceratinae SPATH, 1928
Genus *Taramelliceras* DEL CAMPANA, 1904
Subgenus *Taramelliceras* DEL CAMPANA, 1905

EXPLANATION OF PLATE 3

Figs. 1, 3. *Ochetoceras semifalcatum* (OPPEL) (J-5-290) from the Golbini-Jorbat section, Bimammatum Zone.
Fig. 2. *Ochetoceras marantianum* (D´ ORBIGNY) (J-5-292) from the Golbini-Jorbat section, Bimammatum Zone.
Figs. 4-5. *Taramelliceras* cf. *anar* (OPPEL) from the Golbini-Jorbat section, Transversarium Zone. 4. Specimen J-5-245. 5a-b. Specimen J-5-99.
Fig. 6 *Lingulaticeras* sp. (S-9-198) from the Tooy-Takhtehbashgheh section, Lower Kimmeridgian, x1.5.
Figs. 7-8. *Taramelliceras (Taramelliceras)* cf. *costatum* (QUENSTEDT) from the Chaman Bid section, Bimammatum Zone. 7. Specimen CH-4-5a. 8. Specimen CH-4-5b.
Fig. 9. *Taramelliceras* cf. *kiderleni* (BERCKHEMER & HÖLDER) (S-9-100a) from the Tooy-Takhtehbashgheh section, Lower to Upper Kimmeridgian, x1.5.
Fig. 10. *Taramelliceras (Richeiceras)* cf. *dentostriatum* (QUENSTEDT) (J-5-246) from the Golbini-Jorbat section, Transversarium Zone.
Fig. 11: *Hecticoceras (Lunuloceras)* aff. *pseudopunctatum* (LAHUSEN) (J-3-79) from the Golbini-Jorbat section, Callovian-Lower Oxfordian.
Fig. 12. *Hecticoceras (Lunuloceras)* cf.*lunuloides* (KILIAN) (J-3-87) from the Golbini-Jorbat section, Jason Zone.
Fig. 13. *Hecticoceras (Putealiceras) schalchi* (ZEISS) f(J-3-67) rom the Golbini-Jorbat section, Jason Zone.
Figs. 14-15. *Taramelliceras (Richeiceras)* sp. from the Tooy-Takhtehbashgheh and Golbini-Jorbat sections, Bifurcatus-Bimammatum zones. 14. Specimen S-6-98. 15a-b. Specimen J-5-100, x1.5.
Fig. 16. *Hecticoceras (Zieteniceras) evolutum* (LEE) (J-3-95) from the Golbini-Jorbat section, Middle Callovian.


1
2a
2b
3a
3b
4
5a
5b
6
7
8
9
10
11a
11b
12a
12b
13a
13b
14
15a
15b
16a
16b

Taramelliceras (Taramelliceras) cf. *kiderleni* BERCKHEMER & HÖLDER, 1959
Pl. 3, Fig. 9

cf. 1959 *Taramelliceras kiderleni* sp. nov. - BERCKHEMER & HÖLDER: 73, pl. 18, figs. 84-87, pl. 20, fig. 103.
cf. 1994 *Taramelliceras kiderleni* BERCKHEMER & HÖLDER – SCHLEGELMILCH: 37, pl. 10, fig. 3.

Material: 1 fragmentary specimen from section (3) (S-100a).

Remarks: The secondary ribs are strong, coarse and a little prorsiradiate and end at the keel. This species is easily distinguished by its keel.

Stratigraphic distribution: Lower to Upper Kimmeridgian.

Taramelliceras (Taramelliceras) aff. *costatum* (QUENSTEDT, 1849)
Pl. 3, Figs. 7-8

1849 *Ammonites flexuosus costatus* sp. nov. – QUENSTEDT: pl. 9, fig. 4.
1887 *Ammonites flexuosus costatus* QUENSTEDT – QUENSTEDT: 903, 918, 919, pl. 97, figs. 8-9, 11-12, 16, pl. 99, figs. 24, 26, 28-33.
cf. 1955 *Taramelliceras (Taramelliceras) costatum* (QUENSTEDT) - HÖLDER: 95, pl. 17, figs. 9-12, 14.
1991 *Taramelliceras (Taramelliceras) costatum* (QUENSTEDT) - SCHLAMPP: 81, pl. 27, fig. 10, pl. 28, fig. 1.
non 1994 *Taramelliceras costatum* (QUENSTEDT) - FISCHER: 172, pl. 75, fig. 1a-c.
1994 *Taramelliceras (Taramelliceras) costatum* (QUENSTEDT) - SCHLEGELMILCH: 35, pl. 8, fig. 10.
1998 *Taramelliceras (Taramelliceras) costatum* (QUENSTEDT) - SEYED-EMAMI et al.: 100, pl. 1, fig. 3.

Material: 1 fragmentary specimen (CH-5a) and 2 external moulds (CH-5b-c) from section (4).

Description: Venter broad, secondary ribs strong, blunt and faintly prorsiradiate, terminating at the beaded keel.

Discussion: The Iranian specimens differ from the specimen figured by FISCHER (1994) in havinga broader venter and blunter ribs. The two external moulds closely resemble the specimen figured by SEYED-EMAMI et al. (1998).

Stratigraphic distribution: Middle Oxfordian Bimammatum Zone and Upper Oxfordian Planula Zone.

Subgenus *Proscaphites* ROLLIER, 1909

Taramelliceras (Proscaphites) cf. *dentostriatum* (QUENSTEDT, 1887)

Pl. 3, Fig. 10

1887 *Ammonites flexuosus* sp. nov. – QUENSTEDT: 856, pl. 93, fig. 10.
cf.. 1955 *Taramelliceras (Taramelliceras) dentostriatum* (QUENSTEDT) - HÖLDER : 85, pl. 16, fig. 7.
1991 *Taramelliceras (Richeiceras) dentostriatum* (QUENSTEDT) - SCHLAMPP : 82, pl. 27, fig. 8.
1994 *Taramelliceras (Proscaphites) dentostriatum* (QUENSTEDT) - SCHLEGELMILCH: 32, pl. 7, fig. 14.

Material: 1 specimen from section (2) (J-246) and 1 specimen from section (3) (S-97).

Dimensions:

specimen	D	U%	H%	W%
J-5-246	43	12	57	
S-6-97	23	14	52	30

Description: Shell involute, developing a beaded keel. Ribbing fine and falcoid. Primary ribs starting around the umbilical margin and dividing into two or three secondary ribs two-thirds up the flank and ending at the keel.

Discussion: The Iranian specimens differ from *Taramelliceras dentostriatum* as described by HÖLDER (1955: pl. 16, fig. 4). In present specimen the outer flank is relatively prominent from inner flank. Also, the ribbing is slightly falcate.

Stratigraphic distribution: Middle Oxfordian Transversarium Zone.

Taramelliceras (Proscaphites) anar (OPPEL, 1863)
Pl. 3, Figs. 4-5

1863 *Ammonites anar* sp.nov. – OPPEL: 860, pl. 93, fig. 30.
non1955 *Ammonites anar* (OPPEL) - HÖLDER: 81, pl. 16, fig. 3.
cf. 1991 *Taramelliceras (Proscaphites) anar* (OPPEL) - SCHLAMPP: 81, pl. 27, fig. 6.
cf. 1994 *Taramelliceras (Proscaphites) anar* (OPPEL) - SCHLEGELMILCH: 32, pl. 7, fig. 13.

Material: 2 specimens from section (2) (J-99, 254).

Dimensions:

specimen	D	U%	H%	W%
J-5-99	36	14	53	43
J-5-245	39	10	56	

Remarks: Shell involute, ribbing fine, dense and falcate. The primaries start from the umbilical margin and divide into two secondaries on mid-flank, crossing the venter. Some of the primary ribs do not divide. On the venter shoulder nodes are present.

Stratigraphic distribution: Middle Oxfordian Transversarium Zone.

Subgenus *Richeiceras* JEANNET, 1951

Taramelliceras (Richeiceras) sp.
Pl. 3, Figs. 14-15

Material: 2 specimens from section (3) (S-98a-b) and 1 specimen from section (2) (J-100).

Dimensions:

specimen	D	U%	H%	W%
S-6-98	23	17	57	43

Remarks: Shell involute, with fine, dense ribbing. The primary ribs are sigmoidal at the umbilical margin and on the inner flank. They divide into 2 to 4 secondaries near mid-flank and end at the keel. Some primary ribs do not divide; intercalatory ribs occur. On the venter, a beaded keel is developed.

Stratigraphic distribution: Middle toUpper Oxfordian (Bifurcatus-Bimammatum zones).

Subfamily Streblitinae SPATH, 1925
Genus *Oxylenticeras* SPATH, 1950

Oxylenticeras cf. *lepidum* SPATH, 1950
Pl. 4, Fig. 7

cf. 1950 *Oxylenticeras lepidum* sp.nov. – SPATH: 99, pl. 6, figs. 1-5.

Material: 1 specimen and 1 fragment from section (4) (CH-7-8).

Dimensions:

specimen	D	U%	H%	W%
CH-6-8	27	15	55	37

Description: Shell involute, smooth, oxycone, with closed umbilicus. Whorl cross-section high-oval. The whorl flank is perfectly smooth, partly because in an endeavour to expose the suture line the delicate growth striae were obliterated. Most of the extremely acute keel is broken off, but it is visible at the beginning of the outer whorl.

Discussion: The present specimens closely resemble the holotype of SPATH (1950: pl. 6, **figs. 1-**5), but differ in lacking the acute venter.

Stratigraphic distribution: According to SPATH (1950) the species occurs in the Tithonian. The specimens from Iran are from the Lower Tithonian. 1977 *Sutneria eumela* (D´ ORBIGNY) – ZIEGLER: 64, pl. 5, fig.4.

Superfamily Stephanocerataceae NEUMAYR, 1875
Family Stephanoceratidae NEUMAYR, 1875
Genus *Cadomites* MUNIER-CHALMAS, 1892
Subgenus Polyplectites MASCKE, 1907

Cadomites (Polyplectites) cf. *dorni* (ROCHE, 1939)
Pl. 4, Fig. 11

1927 *Normannites (Polyplectites) linguiferus* DORN - ROCHE: 13, pl. 5, fig. 6.
cf.1939 *Normannites Dorni* n. nov. – ROCHE : 222.
cf.1966 *Polyplectites dorni* (ROCHE) – STURANI : 29, pl. 6, fig. 4.
1985 *Cadomites (Polyplectites) dorni* (ROCHE) – SCHLEGELMILCH: 83, pl. 30, fig. 1.

Material: 1 fragmentary specimen from section (3) (S-21).

Dimensions:

specimen	D	U%	H%	W%	PR/2	SR/2
S-2a-21	25	40	32	52		

Description: Umbilical wall steep and flat, venter broad. Primary ribs prorsiradiate, fairly strong and dense, starting at the umbilical margin and ending at prominent sharp nodes at around the venter shoulder. From this point they divide into 2 or 3 fairly strong secondary ribs that cross the venter.

Discussion: The present specimen is similar to the holotype but differs in having coarser ribs. Moreover the position of the nodes is closer to the venter. Also, it has finer ribs than STURANI'S (1966: pl. 6, fig. 4) specimen.

Stratigraphic distribution: Upper Bajocian to Lower Bathonian.

Cadomites (Polyplectites) sp.

Pl. 4, Fig. 8

Material: 1 specimen and 3 fragments from section (1) (D-6).

Dimensions:

specimen	D	U%	H%	W%	PR/2	SR/2
DH-1-6	19	42	47	58		

Description: Whorl cross-section trapezoidal, venter broad. The slightly prorsiradiate and dense primaries start at the umbilical margin and end at prominent nodes near mid-flank. The bundled secondaries, which cross the venter, are trifurcate with some intercalatory ribs.

Discussion: These specimens can be compared with specimen of *Cadomites (Cadomites) extinctus* (QUENSTEDT 1887 : 632, pl. 74, fig. 35) but differ in the narrower inner coiling. Since the umbilical area is not seen in the present specimens, it is better to refrain from a specific identification.

Stratigraphic distribution: Upper Bajocian toLower Bathonian.

Cadomites sp. A
Pl. 4, Fig. 9

Material: 2 fragments from section (4) (CH-1a-b).

Remarks: Shell inflated, primary ribs distant, fairly strong, starting at the umbilical margin and ending at prominent lateral nodes at about one-third of flank height. There they divide into 3 or 4 strong and dense secondary ribs that cross straight over the venter, which is fairly broad.

Stratigraphic distribution: Upper Bajocian.

Cadomites sp. B
Pl. 4, Fig. 10

Material: 1 specimen from section (2) (J-88a).

Remarks: Specimen compressed, venter rounded. Ribbing relatively coarse and strong. The slightly rectiradiate primary ribs end mostly at small nodes, from where they bifurcate and trifurcate with some intercalatory ribs, extending across the venter.
Stratigraphic distribution: Upper Bajocian to Bathonian.

Family Sphaeroceratidae BUCKMAN, 1920
Genus *Sphaeroceras* BAYLE, 1878

Sphaeroceras tutthum BUCKMAN, 1921
Pl. 4, Figs. 13-14

1921 *Sphaeroceras tutthum* sp.nov. – BUCKMAN : 258.
cf.1937 *Sphaeroceras tutthum* BUCKMAN - WETZEL: 78, pl. 10, fig. 1.

Material: 32 specimens from section (2) (J-1a-z, 44a-e) and 16 specimens from section (3) (S-1a-p).

Dimensions:

specimen	D	U%	H%	W%		
S-1-1b	10	7	35	100		
S-1-1h	9	6	37	100		
S-1-1c	8	6	46	88		
S-1-1f	9	6	33	89		
J-1-1c°	11	9	55	100		
J-1-1m	7	6	50	93		
J-1-1g°	5	6	40	80		
J-1-1s	10	9	40	98		

Description: Shell evolute, shape rounded to ovate, whorl cross-section broad-ovate, venter broad. The very fine and rectiradiate primaries start at the umbilical margin and divide into 2 or 3 secondaries around one-fourth of flank height, crossing the venter.

Discussion: The specimens are similar to those described by WETZEL & KIEL (1937: pl. 10, fig. 1), but differ in having stronger ribs and a slightly more inflated shell.

Stratigraphic distribution: Upper Bajocian Garantiana-Parkinsoni zones.

Family Tulitidae BUCKMAN, 1921
Genus *Bullatimorphites* BUCKMAN, 1921
Subgenus *Bomburites* ARKELL, 1952

Bullatimorphites (Bomburites) cf. *microstoma* (D´ ORBIGNY, 1846)
Pl. 4, Fig. 12

cf. 1846 *Ammonites microstoma* sp. nov. -D´ ORBIGNY: 413, pl. 129, figs. 3-4.
cf. 1887 *Ammonites microstoma* (D´ORBIGNY) – QUENSTEDT: 661, pl. 78, figs. 3, 4, 6.
cf. 1958 *Bullatimorphites* ? *(Bomburites) microstoma* (D´ORBIGNY) – WESTERMANN: 66, pl. 22, fig. 3.
cf. 1971 *Bullatimorphites (Bomburites) microstoma* (D´ORBIGNY) – HAHN: pl. 9, fig. 8.
cf. 1985 *Bullatimorphites (Bomburites) microstoma* (D´ORBIGNY) – SCHLEGLMILCH: 135, pl. 52, fig. 8.

Material: 1 specimen from section (3) (S-45).

Dimensions:

specimen	D	U%	H%	W%	PR/2	SR/2
S-3-45	35	28	37	43	14	

Description: Shell evolute, inflated, venter broad, umbilicus wall vertical. Primary ribs starting at the umbilical margin. Secondary ribs irregular, some starting around the umbilical margin, others halfway or two-thirds up the flank. In addition, some ribs are single, yet others sinuous.

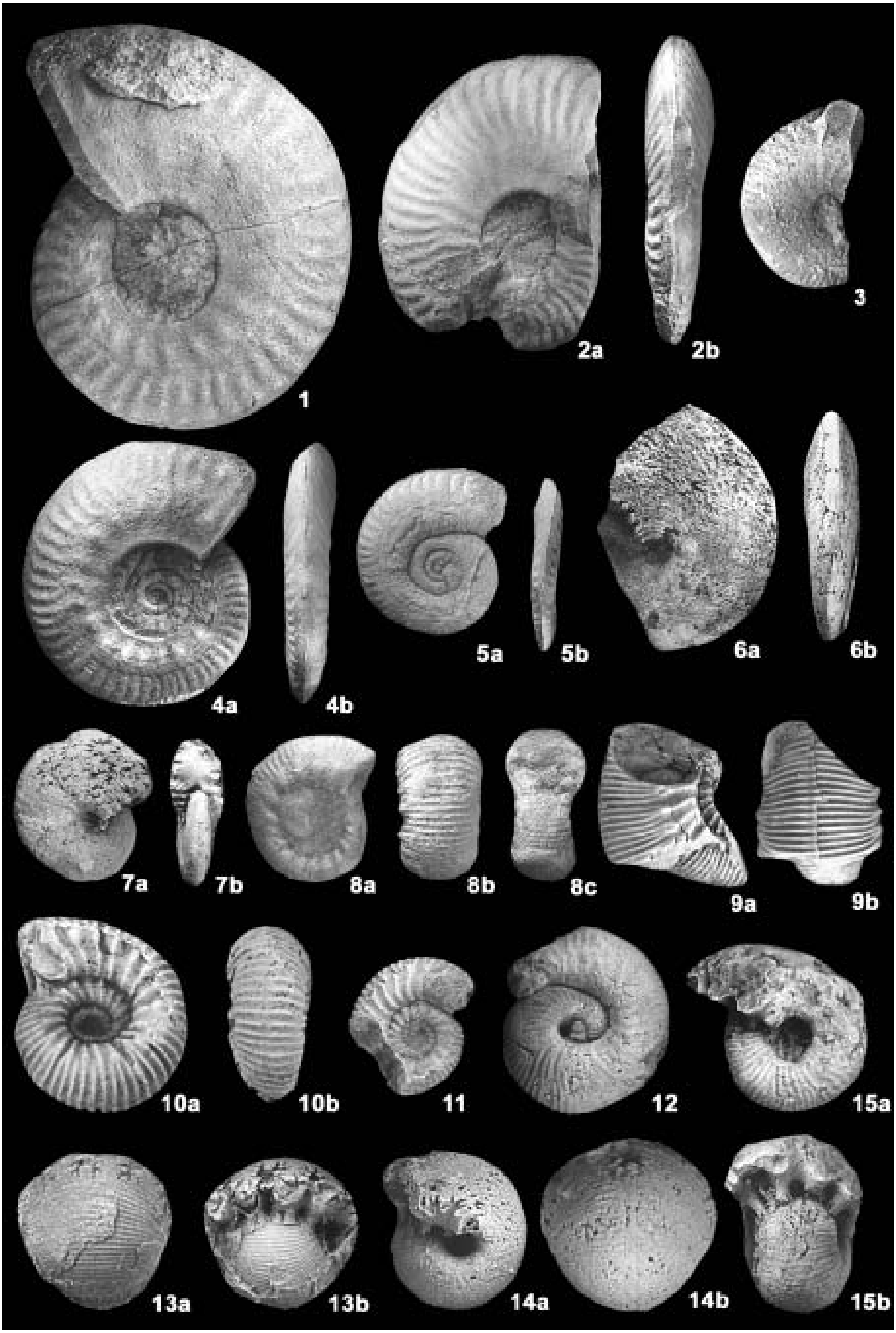
Discussion: The specimen differs somewhat from the specimens figured by QUENSTEDT (1887: pl. 78, figs. 3-4, 6) in having some sinuous ribs, from HAHN´s (1971: pl. 9, fig. 8) specimen in having stronger primary ribs, and from WESTERMANN´s (1958: pl. 22, fig. 2) specimen by its umbilical shape. The present specimen resembles HAHN's (1971: pl. 8, fig. 8) specimen of *Bullatimorphites (Bomburites) suevicus*, but differs in having sinuous and regular ribs.

Stratigraphic distribution: Lower Callovian Bullatus Zone.

Subgenus *Kheraiceras* SPATH, 1924

EXPLANATION OF PLATE 4

Figs. 1, 4. *Hecticoceras (Putealiceras) metomphalum* (BONARELLI) from the Golbini-Jorbat and Tooy-Takhtehbashgheh sections, Anceps Zone. 1. Specimen S-3-108. 4. Specimen J-3-73.
Fig. 2. *Hecticoceras zieteni* (DE TSYTOVITCH) (J-3-89) from the Golbini-Jorbat section, Anceps Zone.
Fig. 3. *Hecticoceras* sp. (CH-3-5), from the Chaman Bid section, Callovian.
Fig. 5. *Hecticoceras (Brightia) solinophorum* (BONARELLI) (J-3-96) from the Golbini-Jorbat section, Middle Callovian-Lower Oxfordian.
Figs. 6-7. *Oxylenticeras* cf. *lepidum* (SPATH) from the Chaman Bid section, Tithonian, 6. Specimen CH-6-7. 7. Specimen CH-6-8.
Fig. 8. *Cadomites (Polyplectites)* sp. (CH-1-6) from the Chaman Bid section, Upper Bajocian-Lower Bathonian, x1.5.
Fig. 9. *Cadomites* sp. A (CH-0-1a) from the Chaman Bid section, Basheh Kalateh Formation, Upper Bajocian, x1.5.
Fig. 10. Compressed *Cadomites* sp. B (J-2b-88a) from the Golbini-Jorbat section, Bathonian, x3.
Fig. 11. *Cadomites (Polyplectites) dorni* (ROCHE) (S-2a-21) from the Tooy-Takhtehbashghe section, Upper Bajocian-Lower Bathonian.
Fig. 12. *Bullatimorphites (Bomburites)* cf. *microstoma* (D´ ORBIGNY) (S-3-45) from the Tooy-Takhtehbashgheh section, Macrocephalus Zone.
Figs. 13-14. *Sphaeroceras tutthum* (BUCKMAN), Garantiana-Parkinsoni zones, x3. 13. Specimen S-1-1b from the Tooy-Takhtehbashgheh section. 14. Specimen J-1-1c from the Golbini-Jorbat section.
Fig. 15. *Bullatimorphites* sp. (J-2a-17) from the Golbini-Jorbat section, Zigzag Zone, x1.5.


1
2a
2b
3
4a
4b
5a
5b
6a
6b
7a
7b
8a
8b
8c
9a
9b
10a
10b
11
12
15a
13a
13b
14a
14b
15b

Bullatimorphites (Kheraiceras) bullatus (D´ ORBIGNY, 1846)
Pl. 5, Fig. 1

1846 *Ammonites bullatus* sp.nov. – D´ORBIGNY: 12, pl. 142, figs. 1-2.
1887 *Ammonites bullatus* D´ORBIGNY – QUENSTEDT: 658, pl. 77, figs. 7-12, pl. 78, fig. 1.
1887 *Ammonites platystomus globulatus* – QUENSTEDT: 661, pl. 78, fig. 2.
1887 *Ammonites platystomus* – QUENSTEDT: 665, pl. 78, figs. 22-25, 28-30.
1958 *Bullatimorphites bullatus bullatus* (D´ ORBIGNY) – WESTERMANN: 65, pl. 20.
1958 *Bullatimorphites bullatus hannoveranus* (D´ ORBIGNY) - WESTERMANN: 65, pl. 21.
1971 *Bullatimorphites (Kheraiceras) bullatus* (D´ ORBIGNY) - HAHN: 99, pl. 7, figs. 1-3, pl. 8, figs. 1-4.
1985 *Bullatimorphites (Kheraiceras) bullatus* (D´ ORBIGNY) - SCHLEGELMILCH: 143, pl. 52, fig. 4.
1991 *Kheraiceras cf. bullatum* (D´ ORBIGNY). - SEYED-EMAMI et al.: 72, pl. 4, fig. 1.
1994 *Bullatimorphites bullatus* (D´ ORBIGNY) - FISCHER: 131, pl. 56, fig. 1.

Material: 2 specimens and 1 fragment from section (3) (S-12-14).

Dimensions:

specimen	D	U%	H%	W%
S-2b-12	55	22	40	98
S-2b-13	61	20	41	84

Description: Shell inflated, with very broad venter and broad-ovate whorl section. The ribbing is faint. The ribs are rectiradiate, start at the umbilical margin, and cross the venter.

Discussion: The Iranian specimens differ from *Bullatimorphites* aff. *ymir* SEYED-EMAMI et al. (1991: 72, pl. 3, figs. 1-4) in having a smaller umbilical angle and a larger diameter.

Stratigraphic distribution: The species has been recorded by SANDOVAL (1983: 569) from the Upper Bathonian-Lower Callovian. SEYED-EMAMI et al. (1991: 72) recorded it from the Middle Bathonian of Iran.

Bullatimorphites (Kheraiceras) sp.
Pl. 5, Fig. 2

Material: 1 fragment from section (2) (J-37).

Description and remarks: Shell inflated, venter broad. There are rectiradiate, coarse ribs on the venter. Since only the ventral area is visible, a specific identification is not possible. However, the specimen resembles *Kheraiceras* cf. *bullatum* as figured by SEYED-EMAMI et al. (1991: pl. 4, fig.1). Its coarse ribs and broad venter are also similar to *Bullatimorphites (Kheraiceras) hannoveranus* DIETL (1994: pl. 1, fig. 2). The sp ecimen comes from the Lower Callovian.

Bullatimorphites sp.
Pl. 4, Fig. 15

1989 *Bullatimorphites* sp. – SEYED-EMAMI et al.: 84, pl. 2, fig. 4.

Material: 2 specimens from section (2) (J-17-18).

Dimensions:

specimen	D	U%	H%	W%	PR/2	SR/2
J-2a-17	22	27	45	73		
J-2a-18	13	23	27	45		

Description: Shell nearly involute with steep and deep umbilical wall and broad venter. The primaries begin at the umbilical margin and around the venter shoulder they divide mainly into two secondaries, which cross the venter. Some of the primaries do not divide.

Discussion: The present specimen is similar to the specimen figured by SEYED-EMAMI et al. (1989: pl. 2, fig. 4) except forits finer and denser ribbing.

Stratigraphic distribution: Lower Bathonian Zigzag Zone.

Family Macrocephalitidae BUCKMAN, 1922
Genus *Macrocephalites* ZITTEL, 1884
Subgenus *Macrocephalites* ZITTEL, 1884

Macrocephalites (Macrocephalites) jacquoti (DOUVILLE, 1912)
Pl. 5, Fig. 3

1994 *Macrocephalites (Macrocephalites) jacquoti* (DOUVILLE, 1881) – DIETL : 13, pl. 2, fig. 4, pl. 4, figs. 1-3, pl. 5, fig. 1.
1998 *Macrocephalites (Macrocephalites) jacquoti* (DOUVILLE, 1881) - DIETL & GYGI, pl. 3.

Material: 3 fragments from section (2) (J-38-40) and 1 fragment from section (3) (S-16).

Remarks: Shell inflated, whorl cross-section oval, venter rounded, ribs strong and dense. The prorsiradiate primaries divide at about one-third of the height of the flank into two and seldom into three secondaries, which cross the venter.
Stratigraphic distribution: Lower Callovian Bullatus Zone.

Subgenus *Kamptokephalites* BUCKMAN, 1922

Macrocephalites (Kamptokephalites) kamptus (BUCKMAN, 1922)

Pl. 5, Fig. 5

1922 *Kamptokephalites kamptus* sp. nov. – BUCKMAN: pl. 347.
1955 *Macrocephalites (Kamptokephalites)* cf. *kamptus* BUCKMAN – JEANNET : 256, pl. 25, fig. 3.

Material: 1 fragment from section (3) (S-15).

Description and remarks: Whorl cross-section elliptical. Ribbing strong, coarse, blunt, distant, and rectiradiate. The primaries start at the umbilical margin and divide near mid-flank into two or three secondaries.
The present specimen is similar to *Macrocephalites (Kamptokephalites) lamellosus* THIERRY (1978: 399, pl. 34, fig. 1) but differs in having strong, distant ribs and ib being smaller.

Stratigraphic distribution: Lower Callovian.

Macrocephalites (Kamptokephalites) cf. *subtrapezinus* (WAAGEN, 1875)
Pl. 5, Fig. 6

cf. 1875 *Stephanoceras subtrapezinus* sp. nov – WAAGEN: 137, pl. 33, fig. 4.
1978 *Macrocephalites subtrapezinus* WAAGEN – THIERRY: 155, pl. 2, fig. 1, pl. 4, fig. 2.

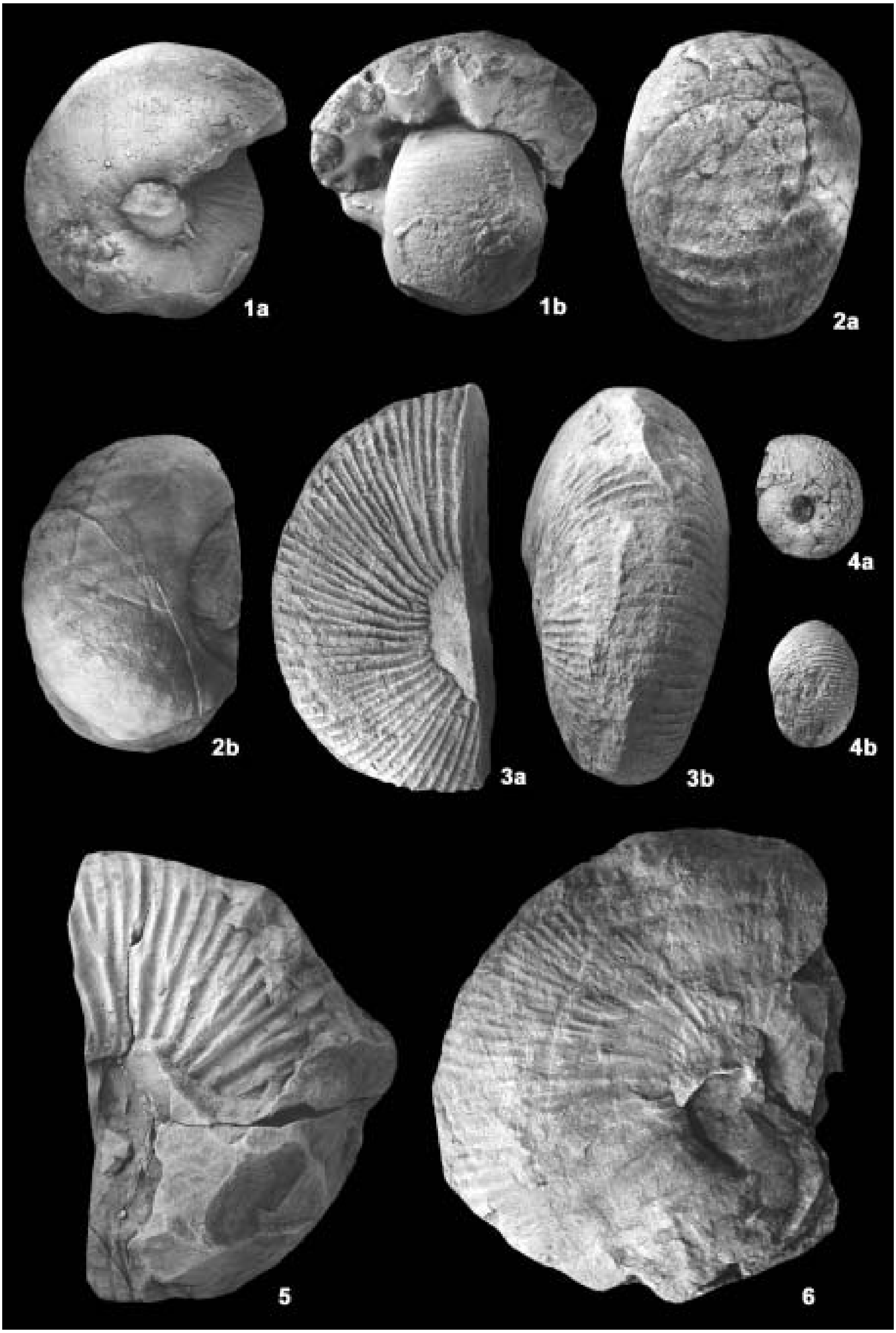
Material: 1 fragment from section (3) (S-17).

Description: The distant primaries start at the umbilical margin: At around one-third of the height of the flank they divide into two or three dense secondaries with some intercalatory ribs.

Discussion: The specimen from Iran resembles the specimen figured by THIERRY (1978) on his plate 4, fig. 2, but differs from the specimen figured by him on his plate 2, fig. 1 in having finer and thinner primary ribs.

EXPLANATION OF PLATE 5

Fig. 1a-b. *Kheraiceras* cf. *bullatum* (D´ORBIGNY) (S-2b-12) from the Tooy-Takhtehbashgheh section, Middle Bathonian-Lower Callovian.
Fig. 2. *Bullatimorphites (Kheraiceras)* sp. (J-3-37) from the Golbini-Jorbat section, Upper Bathonian-Lower Callovian.
Fig. 3. *Macrocephalites (Macrocephalites) jacquoti* (DOUVILLE) (S-3-16) from the Tooy-Takhtehbashgheh section, Macrocephalus Zone.
Fig. 4. *Macrocephalites* sp. (S-3-18) from the Tooy-Takhtehbashgheh section, Macrocephalus Zone.
Fig. 5. *Macrocephalites (Kamptokephalites)* cf. *kamptus* (BUCKMAN) (S-3-15) from the Tooy-Takhtehbashgheh section, Lower Callovian.
Fig. 6. *Macrocephalites* cf. *subtrapezinus* (WAAGEN) (S-3-17) from the Tooy-Takhtehbashgheh section, Lower Callovian.


1a
1b
2a
2b
3a
3b
4a
4b
5
6

Stratigraphic distribution: According to THIERRY (1978: 175) *Macrocephalites subtrapezinus* appears in the Lower Callovian.

Dolikephalites BUCKMAN, 1923

Macrocephalites (Dolikephalites) cf. *perseverans* KUHN, 1939
Pl. 6, Fig. 1

cf. 1939 *Macrocephalites perseverans* MODEL – KUHN: 480, pl. 3, fig. 7.
1955 *Macrocephalites perseverans* (MODEL) – JEANNET: pl. 25, fig. 4.
1955 *Macrocephalites (Indocephalites) perseverans* (MODEL) – JEANNET:pl. 24, fig. 5, pl. 25, fig. 4.
1985 *Macrocephalites (Dolikephalites) perseverans* KUHN -SCHLEGELMILCH: pl. 39, fig. 3.

Material: 1 specimen from section (3) (S-22).

Dimensions:

specimen	D	U%	H%	W%	PR/2	SR/2
S-3-22	60	28	43	78	17	37

Description and remarks: Shell inflated, with very broad venter and oval whorl cross-section. The ribbing is strong and coarse. The slightly concave primaries begin at around mid-flank and divide into two and occasionally three secondaries, which cross in a slightly convex manner over the venter.
The specimen can be compared with holotype of KUHN (1939: 480, pl. 3, fig. 7) but differs in being smaller.

Stratigraphic distirbution: Lower Callovian.

Family Pachyceratidae BUCKMAN, 1918
Genus *Pachyceras* BAYLE, 1844

Pachyceras lalandei (D' ORBIGNY 1848)
Pl. 6, Fig. 2

1848 *Ammonites lalandeanus* sp. nov. - D' ORBIGNY : 477, pl. 175, figs. 1-3.
1966 *Pachyceras lalandei* D' ORBIGNY) – DOUVILLE : 44, pl. 8, figs. 1-2.

Material: 1 specimen from section (2) (J-101).

Dimensions:

specimen	D	U%	H%	W%	PR/2	SR/2
J-4-101	52	12	56	35		30

Description and remarks: Shell evolute with steep umbilical wall and rounded umbilical shoulder; venter arched. The distinct primaries begin at about one-third of flank height and split into two secondaries halfway or two-thirds up the flank. They cross the venter as strong, coarse, and slightly prorsiradiate ribs.

Stratigraphic distribution: According to DOUVILLE (1966: 47) *Pachyceras lalandei* is known from the Upper Callovian Lamberti Zone.

Family Cardioceratidae SIEMIRADZKI, 1891
Subfamily Cardioceratinae SIEMIRADZKI, 1891
Genus *Cardioceras* NEUMAYR & UHLIG, 1881
Subgenus *Scarburgiceras* BUCKMAN, 1924

Cardioceras (Scarburgiceras) praecordatum (DOUVILLE, 1912)
Pl. 6, Fig. 3

1912 *Quenstedticeras praecordatum* n. sp. – DOUVILLE : 62, pl. 4, figs. 10-20.
1994 *Cardioceras (Scarburgiceras) praecordatum* (DOUVILLE) – SCHLEGELMILCH : 24, pl. 3, fig. 4.
1990 *Cardioceras (Scarburgiceras) praecordatum* (DOUVILLE) – GYGI : pl. 4, fig. 8.

Material: 1 specimen from section (3) (S-109).

Dimensions:

specimen	D	U%	H%	W%	PR/2	SR/2
S-5-109	39	26	49	28	13	24

Description: Umbilical wall steep, whorl cross-section oval, outer whorl large. The slightly prorsiradiate primary ribs start at the umbilical margin and divide about mid-flank into two prorsiradiate secondary ribs ending very prorsiradiate (nearly V-shaped) at the sharp keel.

Discussion: The specimen from Iran closely resembles the specimen figured by SCHLEGELMILCH (1994: pl. 3, fig. 4) and GYGI (1990: pl. 4, fig. 8) but differs from WESTERMANN´s (1992: pl. 89, figs.1-3) figures in having a different keel and rib shape.

Stratigraphic distribution: Lower Oxfordian Minax to Paturattensi Zone.

Superfamily Perisphinctaceae STEINMANN, 1890
Family Parkinsoniidae BUCKMAN, 1920
Genus *Strenoceras* HYATT, 1900

Strenoceras sp.

Pl. 6, Fig. 4

Material: 2 fragments from section (2) (J-2a, b).

Description: The ribs are very strong, sharp, rectiradiate to slightly prorsiradiate and mainly simple with lateral and ventral tubercles. The primaries begin at the umbilical margin and end at prominent lateral tubercles, from where they continue as secondaries, which are usually simple, seldom bifurcating. There are also tubercles on the venter shoulder. The secondaries terminate at a ventral furrow.

Discussion: The present material is compressed and deformed. The specimens can be compared with *Strenoceras bentzi* of DIETL (1983: 11, pl. 1, figs. 1-4) but differ in having finer ribs and a higher position of lateral tubercles.

Stratigraphic distribution: Upper Bajocian Niortense Zone.

Genus *Garantiana* MASCKE, 1907
Subgenus *Orthogarantiana* BENTZ, 1928

Garantiana (Orthogarantiana) cf. *densicostata* (QUENSTEDT 1886)
Pl. 6, Fig. 5

1886 *Ammonites Garantianus densicostatus* – QUENSTEDT: 593, pl. 71, fig. 9.
1974 *Garantiana (Orthogarantiana) densicostata* (QUENSTEDT) – DIETL: 13, pl. 2, fig. 4.
1985 *Orthogarantiana* gr. *densicostata* (QUENSTEDT) – FERNANDEZ-LOPEZ: pl. 45, fig. 3.

Material: 39 specimens and 10 fragments from section (2) (J-3a-z, 4a-w).

Dimensions:

specimen	D	U%	H%	W%	PR/2	SR/2
J-1-3a	13	38	38	46	9	19
J-1-3m	12	42	37	42	10	22
J-1-4l	10	30	45	50	9	20
J-1-4d	11	35	39	40	10	23
J-1-4e	9	33	41	55	9	20
J-1-3j	9	39	36	51	10	23
J-1-4g	9	40	39	48	12	26
J-1-3h	11	34	45	46	9	21
J-1-3t	10	32	36	40	10	22

Description: Shell evolute with rounded umbilical shoulder and steep umbilicus wall. Ribs sharp, slightly prorsiradiate and mostly bifurcating, with only a few of them simple or trifurcating. Prominent, sharp nodes developed at the point of bifurcation (at one-third of flank height). Secondaries prorsiradiate, terminating on the venter at a small furrow.

Discussion: Some of the specimens are compressed and deformed. The present material is similar to the specimens figured by DIETL (1974: pl. 2, fig. 4) and FERNANDEZ LOPEZ (1985: pl. 45, fig. 5) except for their lower position of lateral tubercles and somewhat stronger ribs.

Stratigraphic distribution: Upper Bajocian Niortense Zone.

Subgenus *Pseudogarantiana* BENTZ, 1928

Garantiana (Pseudogarantiana) dichotoma BENTZ, 1928
Pl. 6, Fig. 6

1928 *Garantiana (Pseudogarantiana) dichotoma* sp. nov. – BENTZ: 200, pl. 19, figs. 2-6.
1972 *Garantiana (Pseudogarantiana) dichotoma* BENTZ – PAVIA: 109, pl. 19, fig. 5.
1974 *Garantiana (Pseudogarantiana) dichotoma* BENTZ – DIETL: 12, pl. 2, fig. 3.
1989 *Garantiana (Pseudogarantiana) dichotoma* BENTZ - MORTON & DIETL: 157, figs. 1E, H.

Material: 4 specimens and 32 fragments from section (3), No. S-3a-z, 4a-l.

Dimensions:

	D	U%	H%	W%	PR/2	SR/2
S-1-3a	22	41	36	23	15	27
S-1-3d	12	42	33	25	14	26

Description: Shell evolute with subquadrangular whorl cross-section. Ribs sharp, mostly bifurcating and only a few simple. The ribs are prorsiradiate, only slightly curved, and terminate in small tubercles. Fine and sharp nodes developed at the point of bifurcation (around mid-flank). On the venter there is a small furrow, which is typical of *Pseudogarantiana.*

Discussion: The present material is very similar to that figured by MORTON & DIETL (1989: fig.1E, H) and DIETL (1974: pl. 2, fig. 3). The specimens differ from PAVIA´s figure (1971: pl. 19, fig. 5) by the more ventral position of the lateral tubercles and from SCHLEGELMILCH´s (1985: pl. 32, fig. 7) figure by the dense and more commonly bifurcating ribs.

Stratigraphic distribution: *Garantiana (Pseudogarantiana) dichotoma* is very widely distributed in the Submediterranean and Subboreal faunal provinces, from southern Germany and Spain to northwest Scotland. The species occurs mainly in the lower and middle parts of the Garantiana Zone.

Genus *Parkinsonia* BAYLE, 1878

Parkinsonia radiata RENZ, 1904
Pl. 6, Fig. 7

1886 *Ammonites Parkinsonia planulatus* – QUENSTEDT: 599, pl. 71, fig. 19.

1904 *Parkinsonia parkinsonia* SOW. var. *radiata* RENZ- RENZ: 77.
1913 *Parkinsonia radiata* RENZ – RENZ: 690, pl. 28, fig. 3.
1985 *Parkinsonia radiata* RENZ – SEYED – SEYED-EMAMI et al.: 66, pl. 3, fig. 2.
1985 *Parkinsonia (Parkinsonia) radiata* RENZ – SCHLEGELMILCH: 94, pl. 33, figs. 4-5.

Material: 1 specimen from section (1) (D-1).

Dimensions:

specimen	D	U%	H%	W%	PR/2	SR/2
DH-1-1	50	46	34	32	16	30

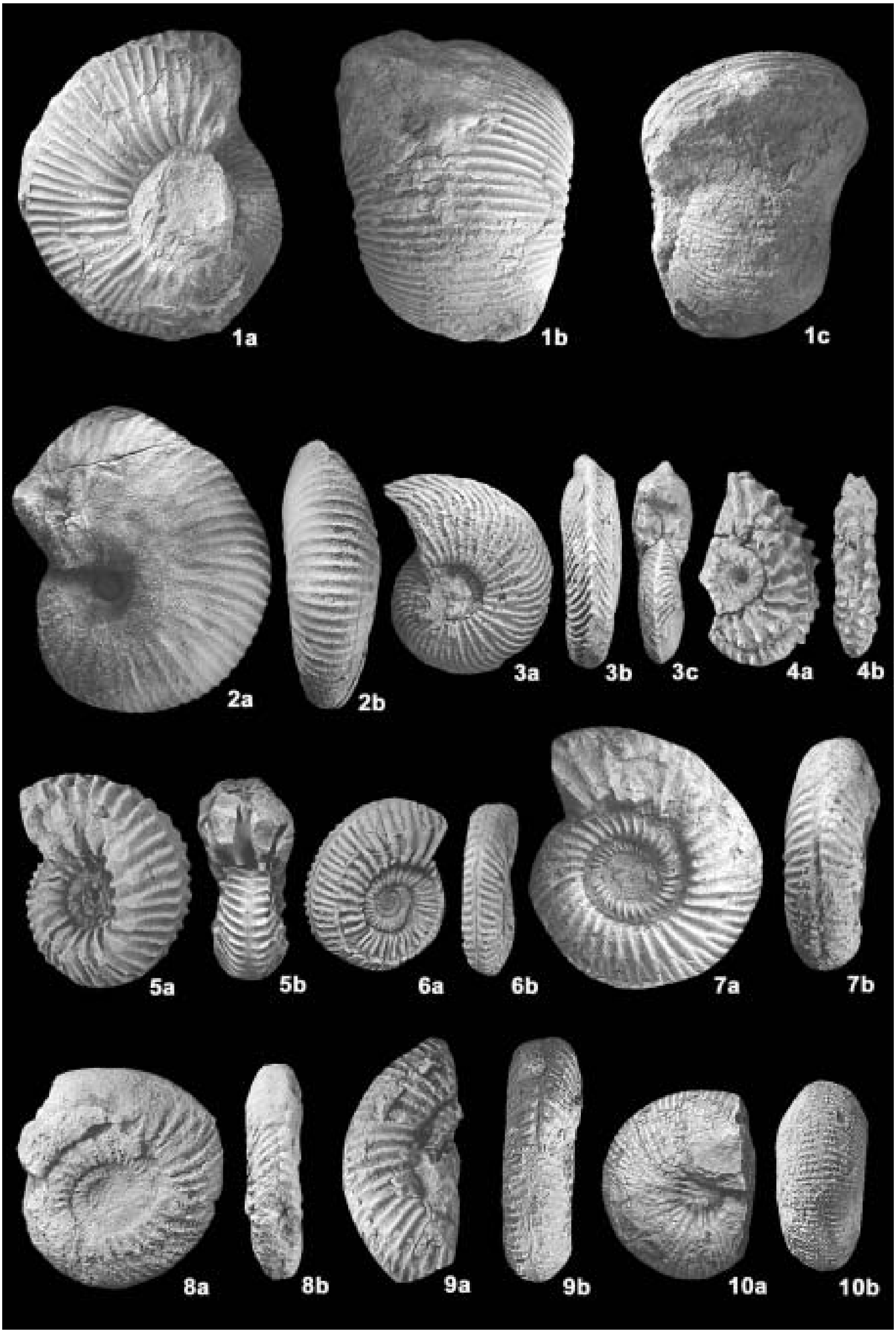
Description: Umbilicus wall vertical, whorl cross-section rectangular-ovate. The inner whorls are wider than high but near the body chamber the width equals height. The sharp, strong and prorsiradiate primary ribs begin at the umbilical margin and terminate at about mid-flank. They split into two prorsiradiate secondaries, which end at a furrow on the venter.

Discussion: The inner whorls of this specimen are very similar to that of the holotype. According to GALACZ (1980: 91) *Parkinsonia depressa* (QUENSTEDT) and *Parkinsonia subarietis* (WETZEL) belong to *Parkinsonia rarecostata* (QUENSTEDT) and differ from *Parkinsonia radiata* in being more evolute, having a wider whorl cross-section and less terminal growth. *Parkinsonia bigoti* of NICOLESO (1928: 17, pl. 1, figs. 1-2) can be considered as a synonym of *Parkinsonia radiata.*

Distribution: Upper Bajocian Garantiana to Parkinsoni Zone.

EXPLANATION OF PLATE 6

Fig. 1. *Macrocephalites* (*Dolikephalites*) cf. *perseverans* (KUHN) (S-3-22) from the Tooy-Takhtehbashgheh section, Lower Callovian.
Fig. 2. *Pachyceras lalandei* (D' ORBIGNY) (J-4-101) from the Golbini-Jorbat section, Lamberti Zone.
Fig. 3. *Cardioceras (Scarburgiceras) praecordatum* (DOUVILLE) (S-5-109) from the Tooy-Takhtehbashgheh section, Cordatum Zone.
Fig. 4. *Strenoceras* sp. (J-1-2a) from the Golbini-Jorbat section, Niortense Zone, x1.5.
Fig. 5. *Garantiana (Orthogarantiana)* cf. *densicostata* (QUENSTEDT) (J-1-3a) from the Golbini-Jorbat section, Niortense Zone, specimen compressed, x3.
Fig. 6. *Garantiana (Pseudogarantiana) dichotoma* (BENTZ) (S-1-3a) from the Tooy-Takhtehbashgheh section, Garantiana Zone, x1.5.
Fig. 7. *Parkinsonia radiata* (RENZ) (CH-1-1) from the Chaman Bid section, ? Garantiana-Parkinsoni zones.
Fig. 8. Parkinsonia cf. *depressa* (QUENSTEDT) (CH-1-2) from the Chaman Bid section, Upper Bajocian (Parkinsoni Zone) to ?Lower Bathonian.
Fig. 9. *Parkinsonia parkinsoni* (SOWERBY) (S-1-20) from the Tooy-Takhtehbashgheh section, Parkinsoni Zone.
Fig. 10. *Morphoceras macrescens* (BUCKMAN) (J-2b-2) from the Golbini-Jorbat section, Zigzag Zone.


1a
1b
1c
2a
2b
3a
3b
3c
4a
4b
5a
5b
6a
6b
7a
7b
8a
8b
9a
9b
10a
10b

Parkinsonia cf. *depressa* (QUENSTEDT 1858)
Pl. 6, Fig. 8

1858 *Ammonites Parkinsoni depressus* sp. nov. – QUENSTEDT: 472, pl. 63, fig. 9.
1973 *Parkinsonia (P)* cf. *depressa* (QUENSTEDT) – PAVIA: 121, pl. 23, fig. 3.
1985 *Parkinsonia* cf. *depressa* (QUENSTEDT) - SEYED-EMAMI et al.: 67, pl. 3, fig. 7.

Material: 2 specimens from section (1) (D-2, 20).

Dimensions:

specimen	D	U%	H%	W%	PR/2	SR/2
DH-1-2	41	49	34	24	17	
DH-1-20	47	47	34	28	17	

Description: Whorl cross-section broad-ovate. Primaries prorsiradiate and sharp, starting at the umbilical margin, dividing into two sharp and prorsiradiate secondaries at about two-thirds of flank height, and ending at a narrow and shallow furrow on the venter.

Discussion: The specimens are very close to the holotype but differ in being more involute and having slightly coarser ribs. They also can be compared with *Parkinsonia rarecostata* SCHLEGELMILCH (1985: 93, pl. 33, fig. 3) except for being somewhat more involute and having a wider whorl cross-section.

Stratigraphic distribution: Upper Bajocian (Parkinsoni Zone) to ?Lower Bathonian.

Parkinsonia parkinsoni (J. DE C. SOWERBY, 1823)
Pl. 6, Fig. 9

1823 *Ammonites Parkinsoni* sp. nov. – J. DE C. SOWERBY: 1, pl. 307, fig. 1.
1980 *Parkinsonia (Parkinsonia) parkinsoni* (SOWERBY) – GALACZ: 93, pl. 22, fig. 5.
1985 *Parkinsonia parkinsoni* (SOWERBY) - SEYED-EMAMI et al.: 67, pl. 3, fig. 1.
1985 *Parkinsonia (Parkinsonia) parkinsoni* (SOWERBY) – SCHLEGELMILCH: 94, pl. 33, fig. 7.

Material: 1 fragment from section (3) (S-20).

Description: Shell relatively evolute, with rectangular-oval whorl cross-section. The primary ribs are strong, sharp and fairly distant, starting at the umbilical margin and dividing at around two-thirds of flank height into prorsiradiate secondary ribs that terminate at a narrow, sharp furrow on the venter.

Stratigraphic distribution: Upper Bajocian Parkinsoni Zone.

Family Morphoceratidae HYATT, 1900
Genus *Morphoceras* DOUVILLE, 1880

Morphoceras multiforme ARKELL, 1951
Pl. 7, Fig. 1

1846 *Ammonites polymorphus* sp. nov. - D' ORBIGNY: 379, pl. 124, fig. 1.
1951 *Morphoceras multiforme* nom. nov. – ARKELL : 17.
1954 *Morphoceras multiforme* ARKELL – ARKELL : 132, pl. 16, figs. 1-2.
1971 *Morphoceras multiforme* ARKELL – HAHN : 33, Pl. 5, figs. 1-5.
1985 *Morphoceras multiforme* ARKELL - SEYED-EMAMI et al. : 67, pl. 4, figs. 6-7.

Material: 2 specimens from section (2) (J-1, 4).

Dimensions:

specimen	D	U%	H%	W%	PR/2	SR/2
J-2b-1	36	19	50	53		42
J-2b-4	45	16	54	57		

Description: Whorl cross-section nearly rectangular. Umbilical wall close to vertical. The ribbing consists of 3-5 primary ribs each that originate from small nodes near the umbilical margin. Most primary ribs divide into two prorsiradiate secondary ribs at about one-fourth of flank height, which terminate at a faint furrow on the venter. There are three deep and prorsiradiate constrictions on the last visible whorl.

Discussion: The inner whorls are similar to *Morphoceras macrescens* (BUCKMAN, 1923) (see below) but their width exceeds the height. The beginning body chamber in *Morphoceras macrescens* is distinctly evolute.

Stratigraphic distribution: Lower Bathonian Zigzag Zone.

Morphoceras macrescens (BUCKMAN, 1923)
Pl. 6, Fig. 10

1923 *Patemorphoceras macrescens* sp. nov. – BUCKMAN: 376.
1971 *Morphoceras macrescens* (BUCKMAN) - HAHN: 35, pl. 5, figs. 10-15.
1985 *Morphoceras macrescens* (BUCKMAN) - SEYED-EMAMI: 68, pl. 4, figs. 3-4.

Material: 2 fragments from section (2) (J-2-3).

Dimensions:

specimen	D	U%	H%	W%
J-2b-2	34	21	50	44
J-2b-3	33	21	45	

Description: Whorl cross-section rounded to ovate. The ribbing is fine and dense. The primaries start at the umbilical margin, divide mostly into two prorsiradiate secondaries at about one-fourth of flank height, and end at a shallow furrow on the venter. There are five shallow spaced constrictions on the last visible whorl. The first rib after a constriction is parallel to it, the subsequent ones form an angle.

Discussion: The inner whorls are similar to *Morphoceras multiforme* ARKELL, 1951 but the height exceeds the width, and the constrictions are shallow. According to WETZEL (1937) *Morphoceras egrediens* WETZEL, 1937 somewhat differs from *Morphoceras macrescens* in having less terminal growth. According to HAHN (1971: 40) *Morphoceras egrediens* is a variant of *M. macrescens.*

Stratigraphic distribution: Lower Bathonian Zigzag Zone.

Morphoceras egrediens WETZEL, 1937
Pl. 7, Fig. 2

1937 *Morphoceras inflatum* var. *egrediens* var. nov. – WETZEL: 132.
1970 *Morphoceras egrediens* WETZEL – MANGOLD: 66, pl. 5, figs. 4-5, 10.

Material: 1 specimen from the section (2), No. J-20.

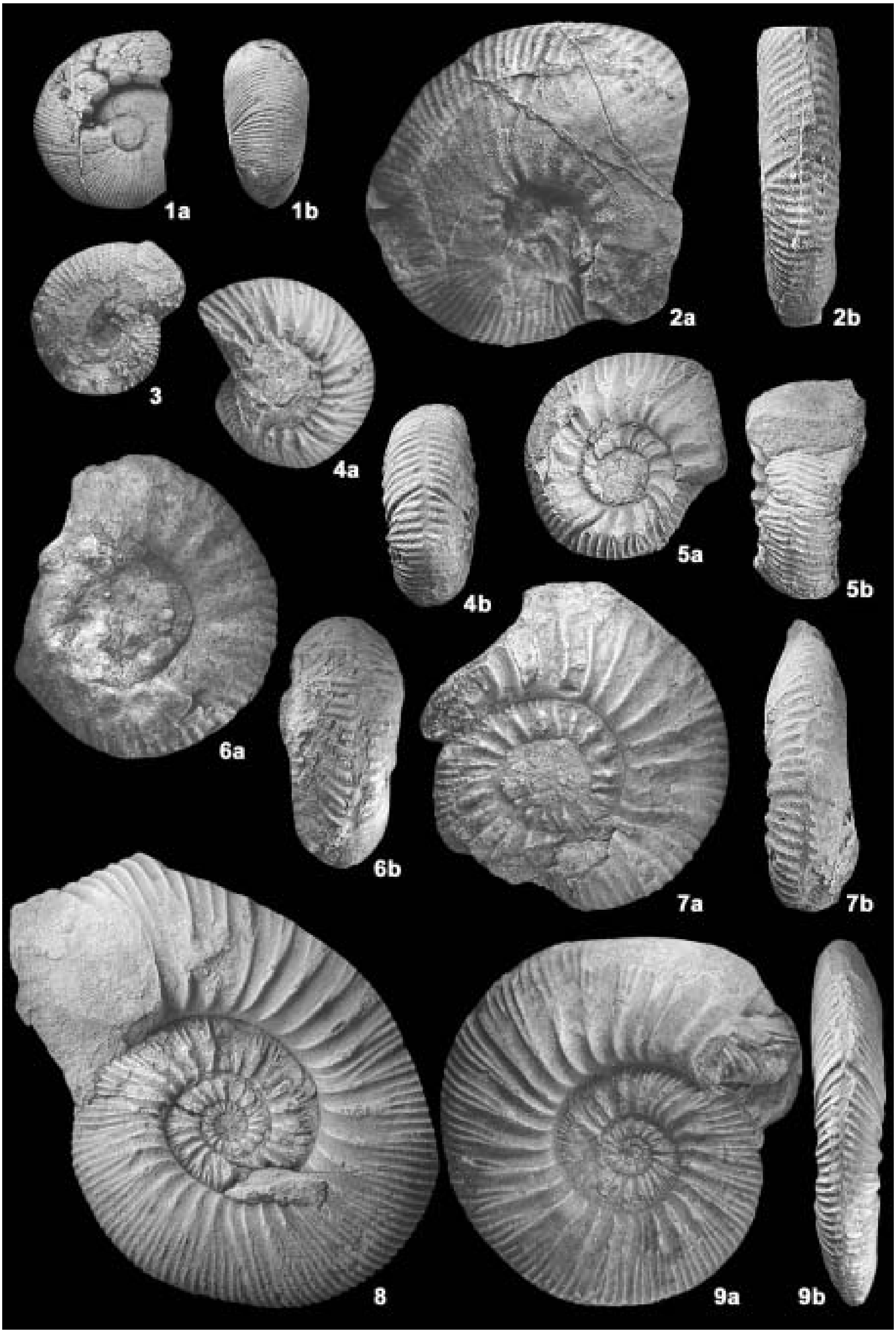
Dimensions:

specimen	D	U%	H%	W%	PR/2	SR/2
J-2b-20	65	18	51	23		47

Description: Whorl cross-section oval, venter arched. The narrow inner flank is covered by coarse, blunt ribs. The ribs divide at around one-fourth of flank height into two or three prorsiradiate and dense secondaries that end at a faint furrow on the venter. There are three relatively shallow constrictions on the last visible whorl and also some intercalatory ribs.

EXPLANATION OF PLATE 7

Fig. 1. *Morphoceras multiforme* (ARKELL) (J-2b-1) from the Golbini-Jorbat section, Zigzag Zone, x1.
Fig. 2. *Morphoceras* cf. *egrediens* (WETZEL) (J-2b-20) from the Golbini-Jorbat section, Zigzag Zone.
Fig. 3. *Ebrayiceras* cf. *sulcatum* (ZIETEN) with lappet (J-2b-20a) from the Golbini-Jorbat section, Zigzag Zone.
Figs. 4-5. *Reineckeia (Reineckeia) anceps* (REINECKE), Anceps Zone. 4. Specimen S-3-122 from the Tooy-Takhtehbashgheh section. 5. Specimen J-3-106 from the Golbini-Jorbat section, x1.5.
Fig. 6. *Reineckeia* sp. (S-3-123) from the Tooy-Takhtehbashgheh section, Callovian.
Fig. 7. *Reineckeia (Reineckeia)* cf. *anceps* (REINECKE) (S-3-112) from the Tooy-Takhtehbashgheh section, Anceps Zone.
Figs. 8-9. *Reineckeia (Tyrannites)* sp. from the Golbini-Jorbat section, Lower Callovian. 8. Specimen J-3-142. 9a-b. Specimen J-3-141.


1a
1b
2a
2b
3
4a
4b
5a
5b
6a
6b
7a
7b
8
9a
9b

Discussion: The specimen can be compared with *Morphoceras macrescens* (BUCKMAN, 1923), but differ in a greater height-width ratio and blunt primaries at the umbilical margin.

Stratigraphic distribution: Lower Bathonian Zigzag Zone.

Genus *Ebrayiceras* BUCKMAN,1920

Ebrayiceras cf. *sulcatum* (ZIETEN, 1830)
Pl. 7, Fig. 3

cf. 1830 *Ammonites sulcatus* sp.nov. - ZIETEN: 6, pl. 5, fig. 3.
1970 *Ebrayiceras sulcatum* (ZIETEN) – HAHN: 42, pl. 6, figs. 1-6.
1970 *Ebrayiceras sulcatum* (ZIETEN) – MANGOLD: 89, pl. 7, fig. 6.
1985 *Ebrayiceras sulcatum* (ZIETEN) – SEYED-EMAMI et al.: 69, pl. 3, figs. 8-10.
1985 *Morphoceras (Ebrayiceras) sulcatum* (ZIETEN) – SCHLEGELMILCH: 103, pl. 36, fig. 15.
1991 *Ebrayiceras sulcatum* (ZIETEN) – SEYED-EMAMI et al.: 73, pl. 4, figs. 3, 8.

Material: 1 specimen from section (2) (J-20a).

Dimensions:

specimen	D	U%	H%	W%	PR/2	SR/2
J-2b-20a	28	25	46	31		27

Description: Shell relatively evolute, but inner whorls nearly involute; with faint constrictions and with lappet. The primary ribs start at faint and regular nodes near the umbilical margin and divide mainly into two secondary ribs at about one-fourth of flank height. They terminate at a distinct furrow on the venter.

Discussion: The specimen can be compared with the holotype but differs somewhat in having finer ribs and nodes. *Ebrayiceras* cf. *sulcatum* is similar to *E. filicostatum* SEYED-EMAMI et al. (1985: 70, pl. 3, figs. 5-6) but differs in having coarser and more distant ribs.

Stratigraphic distribution: Lower Bathonian Zigzag Zone.

Family Reineckeiidae HYATT, 1900
Genus *Rehmannia,* SCHIRARDIN, 1956
Subgenus *Loczyceras* BOURQUIN, 1968

Rehmannia (Loczyceras) segestana (GEMMELLARO, 1872)
Pl. 9, Fig.1

1872 *Perisphinctes segestana* sp. nov. – GEMMELLARO: 246, pl. 13, figs. 1-3.
1984 *Rehmannia (Loczyceras) segestana* (GEMMELLARO) – CARIOU: 72, pl. 7, figs. 3-4, pl. 8, fig. 1.

Material: 6 specimens and 2 fragments from section (2) (J-126-132a).

Dimensions:

specimen	D	U%	H%	W%	N	PR/2	SR/2
J-3-126	59	41	37	24	20	15	42
J-3-131	59	41	36	20	17	12	35
J-3-130	51	45	37	25	24	18	
J-3-127	53	45	32	23	19	18	
J-3-129	53	40	32	26	18	12	34

Description: Umbilical wall low and steep, whorl cross-section nearly ellipsoidal. The ribbing is relatively coarse and distant. The bullate and radiate primary ribs end at prominent and pyramidal lateral tubercles at one-third of flank height, from where they bifurcate or trifurcate with some intercalatory ribs. The rectiradiate secondary ribs terminate at a ventral furrow.The secondary ribs are fainter and denser than the primaries. Some of the primary ribs do not divide.

Stratigraphic distribution: Middle Callovian Anceps Zone, Stuebeli Subzone and Bannense horizon.

Rehmannia (Loczyceras) sequanica (BOURQUIN, 1968)
Pl. 9, Fig. 2

1968 *Rehmannia (Loczyceras) sequanica* sp. nov. – BOURQUIN: pl. 24, fig. 3.
cf.1984 *Rehmannia (Loczyceras) sequanica densicostata* nov. subsp. – CARIOU: 172, pl. 24, figs. 4-5.

Material: 6 specimens and 1 fragment from section (2) (J-133-140).

Dimensions:

specimen	D	U%	H%	W%	N	PR/2	SR/2
J-3-139	60	43	38	29	19	15	42
J-3-135	61	41	38	25	16	13	39
J-3-134	57	42	35	23	16	11	36
J-3-138	56	41	37	25	19	13	38

Description: Umbilical wall steep, whorl cross-section nearly rectangular. The bullate and radiate primary ribs end at faint lateral tubercles at around one-third of flank height, from where they bifurcate to quadrifurcate with some intercalatory ribs. The rectiradiate secondary ribs terminate at a ventral furrow.The secondary ribs are fainter and denser than the primaries. Some of the primary ribs do not divide.

Discussion: *Rehmannia (Loczyceras) sequanica* is similar to *Rehmannia (Loczyceras) segestana* (GEMMELLARO), but differs in having fainter and thinner ribs and tubercles and in possessing quadrifurcating secondaries.

Stratigraphic distribution: Middle Callovian Coronatum Zone, Baylei Subzone.

Rehmannia (Loczyceras) cf. *hungarica* (TILL, 1907)
Pl. 8, Fig. 1

cf. 1907 *Reineckia hungarica* sp. nov. – TILL: 125.
cf. 1910 *Reineckia hungarica* TILL – TILL: 10, pl. 1 (5), fig. 1.
cf. 1984 *Rehmannia (Loczyceras*) cf. *hungarica* (TILL) - CARIOU: 79, pl. 8, fig. 9.

Material: 1 specimen and 1 fragment from section (2) (J-114-115).

Dimensions:

specimen	D	U%	H%	W%	N	PR/2	SR/2
J-3-114	108	42	34	18	14	9	51

Description and remarks: Umbilicus wall steep, whorl cross-section oval. The bullate, distant and prorsiradiate primary ribs end mostly at conical and sharp tubercles at around one-third of flank height. The slightly prorsiradiate secondaries are bifurcating or trifurcating with some intercalatory ribs, ending at a smooth ventral band. Some of the primary ribs do not divide; they are also more distant than the secondaries. On the outer part of the last whorl the ribs are irregular.

Stratigraphic distribution: Middle Callovian Anceps Zone.

Rehmannia (Loczyceras) intermedia (BOURQUIN, 1968)
Pl. 9, Fig. 3

1968 *Reineckia intermedia* nov. sp. – BOURQUIN: 100, pl. 23, fig. 6, pl. 2, fig. 12, pl. 22, fig. 10.
1984 *Rehmannia (Loczyceras) intermedia intermedia* (BOURQUIN) – CARIOU: 144, pl. 19, figs. 1-4.

Material: 1 specimen and 2 fragments from section (2) (J-116-118).

Dimensions:

specimen	D	U%	H%	W%	N	PR/2	SR/2
J-3-116	62	39	37	27	14	10	41

Description: Umbilical wall steep, whorl cross-section broad-ovate to rectangular. The bullate and distant primary ribs end mostly at pyramidal and sharp tubercles at around one-third of flank height. The prorsiradiate secondaries are trifurcate, quadrifurcate, seldom quinquefurcate, ending at a ventral furrow. There are also some single intercalatory ribs. The secondary ribs are denser than the primary ribs.

Stratigraphic distribution: Middle Callovian Anceps Zone Subzone, and horizon.

Genus *Reineckeia* BAYLE, 1878

Subgenus *Tyrannites* CARIOU, 1984

Reineckeia (Tyrannites) sp.
Pl. 7, Figs. 8-9

Material: 2 specimens and 5 fragments from section (2) (J-142-147).

Dimensions:

specimen	D	U%	H%	W%	N	PR/2	SR/2
J-3-142	94	40	36	27	19	14	45
J-3-141	72	40	35	18	16	15	51

Description: Umbilical wall steep. Ribbing relatively coarse, strong and distant .Primary ribs on the inner flank slightly bullate, terminating at around one-third of flank height in small and weak tubercles. From there they bifurcate to quadrifurcate in a prorsiradiate fashion (specimen J-5-142; Pl. 7, Fig. 8) or bifurcate or trifurcate in a prorsiradiate fashion (specimen J-5-141; Pl. 7, Fig. 9). The secondaries have intercalatory ribs and end at the ventral furrow. The secondaries are denser than the primaries.

Discussion: This specimen differ of *Reineckeia (Tyrannites) convex* CARIOU, 1984 in having stronger, blunter and more rectiradiate ribs.

Stratigraphic distribution: Lower Callovian.

Reineckeia (Tyrannites) convex CARIOU, 1984
Pl. 8, Fig. 2

1984 *Reineckeia (Tyrannites) convex* sp. nov. - CARIOU: 197, pl. 28, figs. 3-4, pl. 29, figs. 1-4.

Material: 1 specimen from section (2) (J-119).

Dimensions:

specimen	D	U%	H%	W%	N	PR/2	SR/2
J-3-119	78	38	35	32	15	11	37

Description: Umbilical wall steep, whorl cross-section rectangular, venter rounded to broad. The bullate and distant primary ribs end mostly at conical and sharp tubercles at around one-third of flank height. The rectiradiate secondaries are bifurcating or trifurcating with single intercalatory ribs, all ending at a ventral furrow. The secondary ribs are denser than the primaries. Rarely, primary ribs do not divide.

Discussion: The blunt, coarse and strong ribs distinguish this species from other species.

Stratigraphic distribution: Lower Callovian Gracilis Zone, Pictava Subzone and horizon.

Reineckeia (Reineckeia) cf. *fehlmanni* JEANNET, 1951
Pl. 8, Fig. 3

cf. 1951 *Reineckeia fehlmanni* sp. nov. – JEANNET: 134, pl. 53, figs. 316-317.
cf. 1984 *Reineckeia (Reineckeia) fehlmanni* JEANNET – CARIOU: 278, pl. 42, figs. 1-3.

Material: 3 fragments from section (2) (J-108-113).

Description: Umbilical wall low and steep, whorl cross-section broad-ovate to rectangular, venter broad. Nearly all of the bullate and distant primary ribs end at pyramidal, sharp tubercles at around one-third of flank height. The bullate secondaries bifurcate or trifurcate with single intercalatory ribs, ending at a smooth ventral band. The ribs on the inner part in the last visible whorl are rectiradiate and on the outer part prorsiradiate.

Discussion: The fragments described here differ from the holotype with respect to the bullate and long ribs and the sharp and big tubercles. Moreover the ribs are first rectiradiate and then prorsiradiate while in the specimens described by CARIOU (1984: pl. 42) and JEANNET (1951: pl. 53) the ribs are usually rectiradiate.

Stratigraphic distribution: Lower Callovian.

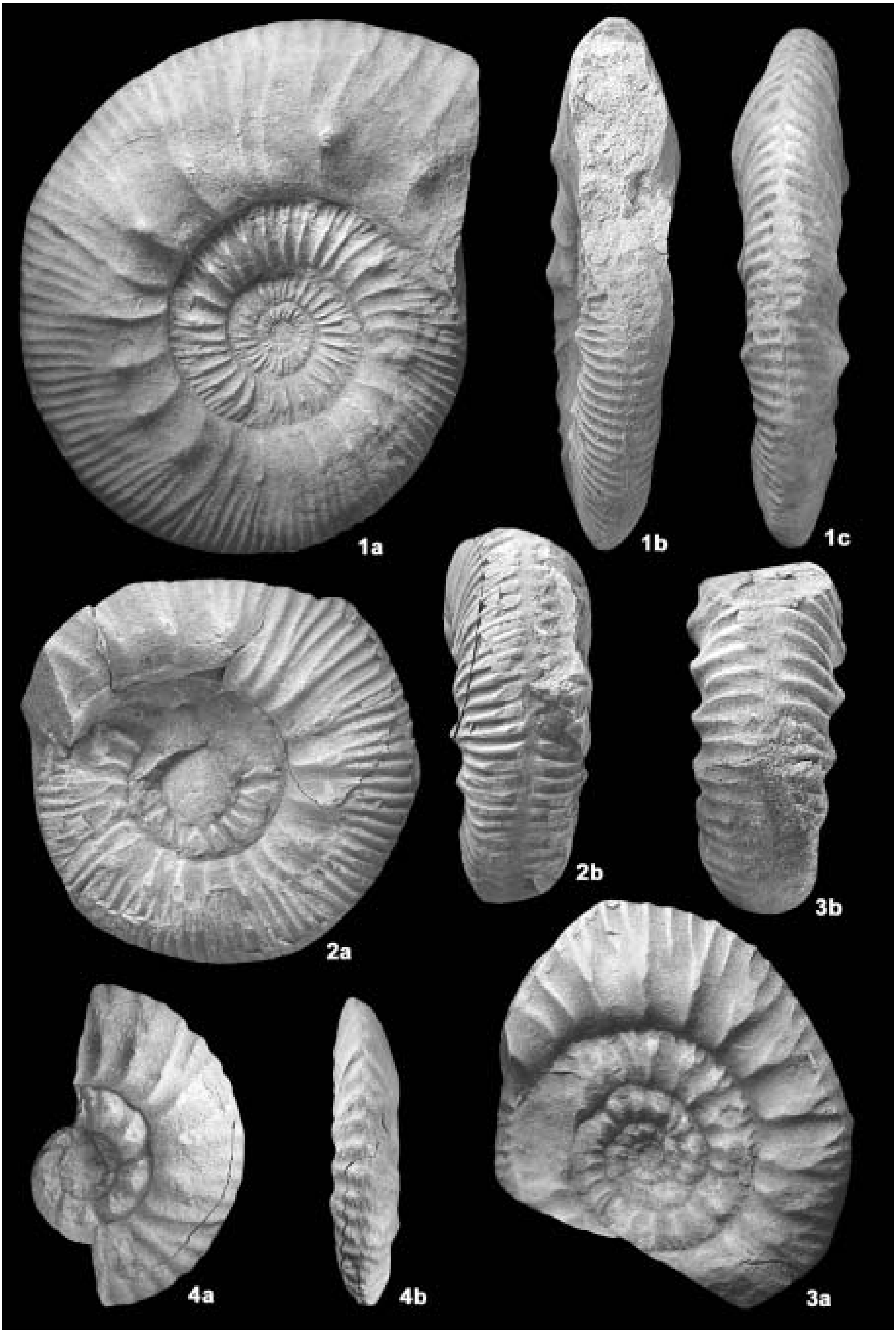
Subgenus *Reineckeia* CARIOU, 1984

Reineckeia (Reineckeia) anceps (REINECKE, 1818)
Pl. 7, Figs. 4, 5, 7

1818 *Nautilus anceps* – REINECKE: 82, pl. 7, fig. 61.

EXPLANATION OF PLATE 8

Fig. 1a-c. *Rehmannia (Loczyceras)* cf. *hungarica* (TILL) (J-3-114) from the section, Jason Zone.
Fig. 2a-b. *Reineckeia (Tyrannites) convex* (CARIOU) (J-3-119) from the section, Gracilis Zone.
Fig. 3a-b. *Reineckeia (Reineckeia)* cf. *fehlmanni* (JEANNET) (J-3-108) from the section, Callovian.
Fig. 4. *Reineckeia* sp. (J-3-149) from the section, Callovian.


1a
1b
1c
2a
2b
3b
4a
4b
3a

1951 *Reineckeia anceps* REINECKE – JEANNET: 127, pl. 48, figs. 2-3.
1984 *Reineckeia (Reineckia) anceps anceps* (REINECKE) – CARIOU: 220, pl. 33, figs. 4-5, pl. 34, figs. 1-2, 5, pl. 35, figs. 1, 4-5.
1988 *Reineckeia (Reineckeia) anceps* (REINECKE) - CARIOU & KRISHNA: 160, pl. 2, figs. 2-3, pl. 3, fig. 1.
1995 *Reineckeia (Reineckeia)* sp. ex gr. *R (R.) anceps* (REINECKE) - SEYED-EMAMI et al.: 43, pl. 2, fig. 1.
2002 *Reineckeia (Reineckeia) anceps* (REINECKE) - SEYED-EMAMI et al.: 185, figs. 2-4.

Material: 1 specimen and 1 fragment from section (2) (J-106-107) and 3 specimens and 3 fragments from section (3) (S-122a-f).

Dimensions:

specimen	D	U%	H%	W%	N	PR/2	SR/2
S-3-122	38	34	47	47	19	12	31
J-3-106	27	44	33	48	18	12	30

Description: Moderately evolute, coronate *Reineckeia* with broad-oval to broad rectangular whorl cross-section. Umbilical wall low and vertical, umbilical shoulder distinct. Ribbing relatively coarse. The slightly bullate and somewhat prorsiradiate primary ribs end at prominent and pyramidal lateral tubercles at one-third of the flank height, from where they trifurcate in a somewhat prorsiradiate manner Seldom they quadrifurcate with some intercalatory ribs. The slightly incurved secondary ribs terminate at a smooth ventral band. There are four prorsiradiate constrictions per whorl.

Remarks: With respect to the prominent conical tubercles and rather strict trifurcate secondaries, our specimens match well the inner whorls of *R. (R.) anceps* as figured by CARIOU (1984: pl. 34, fig. 5; 1994: pl. 61, figs. 1-3), JEANNET (1951: pl. 48, figs. 2-3), and KUHN (1939: pl. 2, figs. 2, 11, 15).

Stratigraphic distribution: Middle Callovian Anceps Zone.

Reineckeia (Reineckeia) aff. *polycosta* KUHN, 1939
Pl. 9, Fig. 5

aff. 1939 *Reineckeia polycosta* sp. nov. – KUHN: 483, pl. 2, fig. 24.
cf.1984 *Reineckeia (Reineckeia)* cf. *polycosta* KUHN – CARIOU: 281, pl. 42, fig. 4.

Material: 1 specimen from section (3) (S-127).

Dimensions:

specimen	D	U%	H%	W%	PR/2	SR/2
S-3-127	33	42	36	42		34

Description: Umbilical wall vertical, whorl cross-section broad-oval. The bullate primary ribs end at prominent, conical, and sharp lateral tubercles near the umbilical margin, from where they form trifurcate, seldom quadrifurcate and quinquefurcate bundles. The rectiradiate secondary ribs terminate at a ventral furrow. There are four deep and prorsiradiate constrictions on the last visible whorl.

Discussion: The present specimen closely resembles the holotype figured by KUHN (1939: pl. 2, fig. 24), but differ in the rectiradiate secondaries while the secondaries in the holotype are prorsiradiate.

Stratigraphic distribution: Middle Callovian Anceps Zone.

Reineckeia (Reineckeia) nodosa TILL, 1907
Pl. 9, Fig. 4

1907 *Reineckeia nodosa* n. sp. – TILL: 124.
1939 *Reineckeia nodosa* TILL – KUHN: 34, pl. 2, fig. 14.
1984 *Reineckeia (Reineckeia) nodosa* TILL – CARIOU: 246, pl. 37, figs. 5-6.

Material: 2 specimens from section (3) (S-120-121).

Dimensions:

specimen	D	U%	H%	W%	N	PR/2	SR/2
S-3-120	27	44	33	55	11	6	25
S-3-121	27	48	30	44	11	6	

Description: Whorl cross-section oval, venter rounded and broad. The bullate and distant primary ribs end at prominent and sharp tubercles at around mid-flank, from where they usually form quadrifurcate bundles. The secondary ribs terminate at a ventral furrow. There are three deep and prorsiradiate constrictions on the last visible whorl.

Discussion: The present specimens resemble the holotype (KUHN 1939: pl. 2, fig. 14), and the material figured by CARIOU (1984: pl. 37, figs. 5-6). However, the holotype exhibits nearly prorsiradiate ribs. *R. nodosa* differs from *Reineckeia (Reineckia) anceps* by its strong and coarse tubercles.

Stratigraphic distribution: Upper Callovian Athleta Zone, Collotiformis Subzone.

cf. *Reineckeia* sp.
Pl. 9, Fig. 6a-b, Pl. 10, Figs. 1a-b, 2

Material: 1 specimen and 2 fragments from section (2) (J-120, 121, 123).

Description and remarks: Shell large, whorl cross-section rectangular-oval, venter broad, umbilical wall low and steep, ribbing coarse and very strong. The rectiradiate, bullate, distant and somewhat prorsiradiate primary ribs end at prominent and pyramidal lateral tubercles at one-third of the flank height. From there the bullate secondaries bifurcate with single intercalatory ribs, crossing somewhat prorsiradiate over the venter. There are prorsiradiate constrictions on the last visible whorl. The ribbing on the last visible whorl (large specimen J-3-120 is nearly fully grown) is stronger and more distant than on earlier whorls (e.g. Pl. 9, figs. 6a-b).

Stratigraphic distribution: Lower Callovian.

Family Perisphinctidae STEINMANN, 1890
Genus *Microbajocisphinctes* FERNANDEZ LOPEZ, 1985

Microbajocisphinctes cf. *pseudointerruptus* FERNANDEZ LOPEZ, 1985
Pl. 10, Fig. 4

cf. 1985 *Microbajocisphinctes pseudointerruptus* sp. nov. - FERNANDEZ LOPEZ : 20, pl. 49, fig. 9.

Material: 1 specimen and 9 fragments from section (3) (S-2a-I).

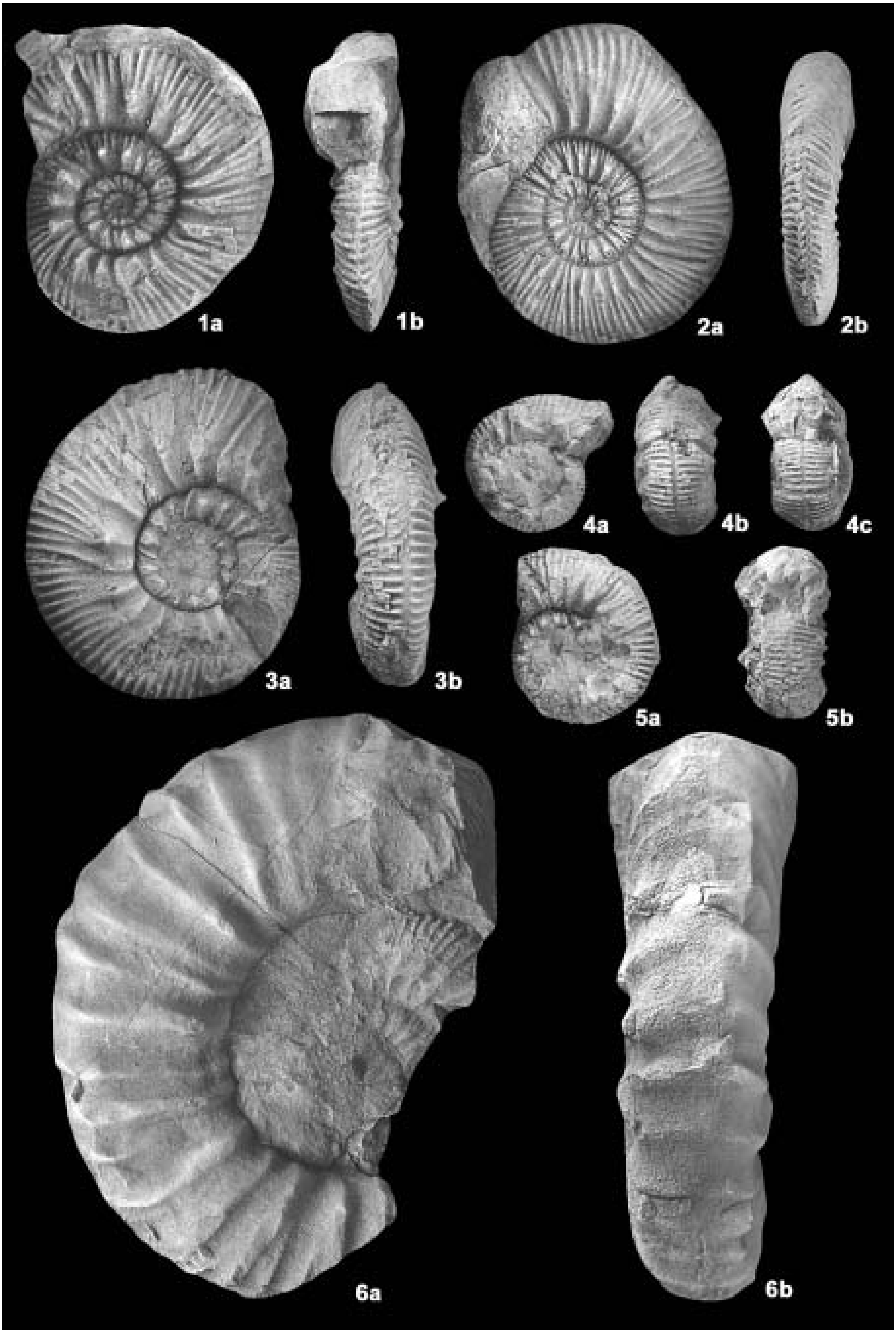
Dimensions:

specimen	D	U%	H%	W%	PR/2	SR/2
S-1-2	40	46	34	32	15	

Description and remarks: Whorl section subrounded. Primaries strong, coarse, fairly distant and prorsiradiate, starting at the umbilical margin and dividing into two and occasionally three prorsiradiate secondaries at around two-thirds of flank height. Ribbing more dense in the posterior half of the anterior part of the last visible whorl.
The present specimens are very similar to the specimen described and figured by FERNANDEZ

EXPLANATION OF PLATE 9

Fig. 1. *Rehmannia (Loczyceras) segestana* (GEMMELLARO) (J-3-126) from the Golbini-Jorbat section, Anceps Zone.
Fig. 2. *Rehmannia (Loczyceras) sequanica* (CARIOU) (J-3-135) from the Golbini-Jorbat section, Coronatum Zone.
Fig. 3. *Rehmannia (Loczyceras) intermedia* (BOURQUIN) (J-3-116) from the Golbini-Jorbat section, Jason Zone.
Fig. 4. *Reineckeia (Reineckeia) nodosa* (TILL) (S-3-120) from the Tooy-Takhtehbashgheh section, Athleta Zone.
Fig. 5. *Reineckeia (Reineckeia)* aff. *polycosta* (KUHN) (S-3-127) from the Tooy-Takhtehbashgheh section, Anceps Zone.
Fig. 6. cf. *Reineckeia* sp. (J-3-120) from the Golbini-Jorbat section, Callovian.


1a
1b
2a
2b
3a
3b
4a
4b
4c
5a
5b
6a
6b

LOPEZ (1985: pl. 49, fig. 9), but differ somewhat in being smaller and having slightly prorsiradiate ribs.

Stratigraphic distribution: According to FERNANDEZ LOPEZ (1985: 20) *Microbajocisphinctes pseudointerruptus* occurs in the Upper Bajocian Garantiana Zone.

Microbajocisphinctes sp. A
Pl. 10, Figs. 9-10

1985 *Microbajocisphinctes* sp. - FERNANDEZ LOPEZ : 20, pl. 49, fig. 6.

Material: 2 specimens from section (3) (S-4, 7).

Dimensions:

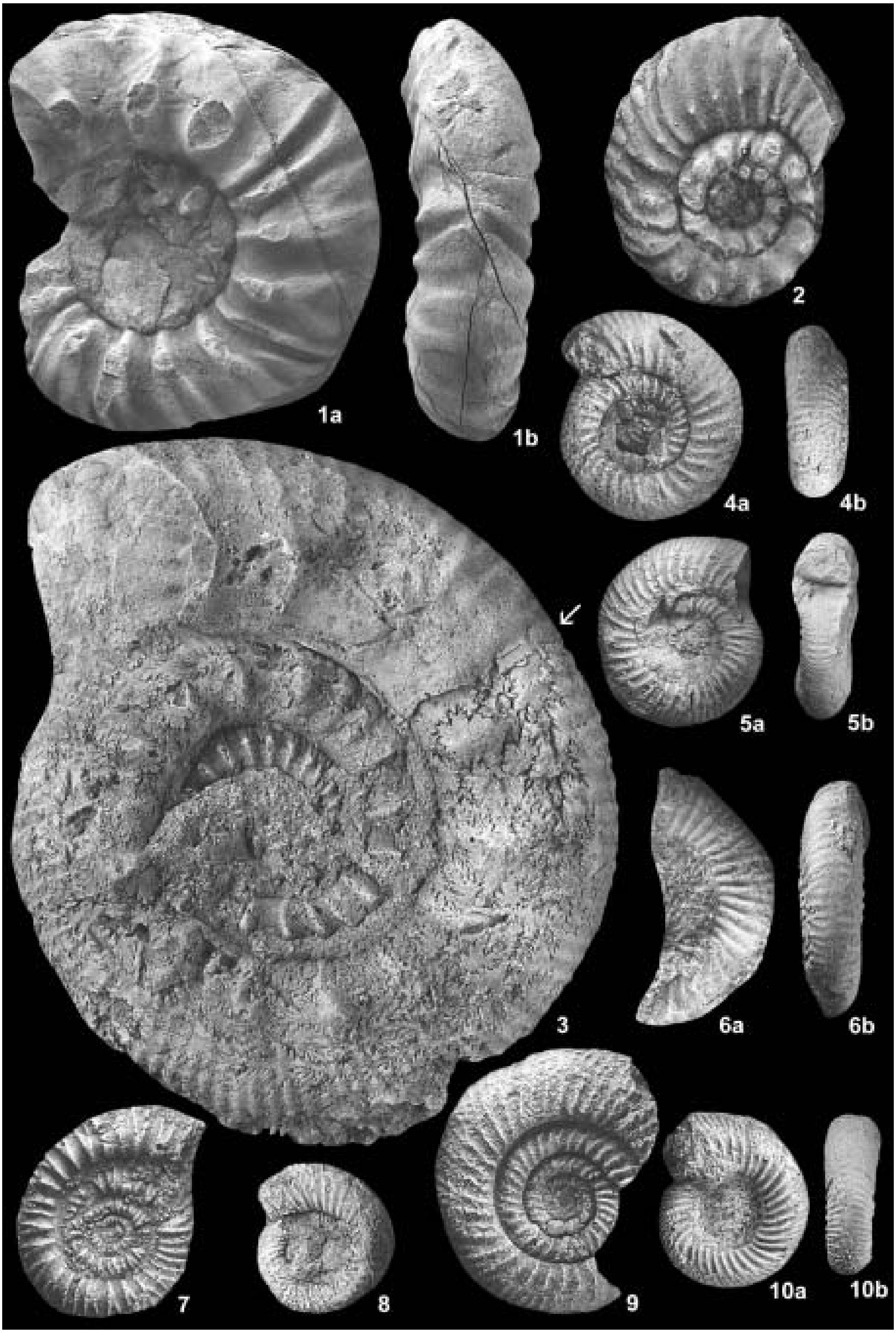
specimen	D	U%	H%	W%	PR/2	SR/2
S-1-4	50	54	29	26	19	
S-1-7	33	41	36	35	18	36

Description and remarks: Whorl cross-section rounded, venter fairly broad. The primaries are strong and prorsiradiate, starting at the umbilical margin and dividing into two prorsiradiate secondaries at about three-fourth of flank height, crossing prorsiradiate over the venter. Towards the aperture ribs become more prorsiradiate. There are two prorsiradiate constrictions on the last visible whorl.
Microbajocisphinctes is close to the specimen figured by FERNANDEZ LOPEZ (1985: pl. 49, fig. 6), but differs in having constrictions. According to FERNANDEZ LOPEZ (1985: 20) the taxon occurs in the Upper Bajocian Garantiana Zone.

Microbajocisphinctes sp. B
Pl. 10, Fig. 5

EXPLANATION OF PLATE 10

Fig. 1. cf. *Reineckeia* sp. (J-3-121) from the Golbini-Jorbat section, Callovian.
Fig. 2.: cf. *Reineckeia* sp. (J-3-123) from the Golbini-Jorbat section, Callovian.
Fig. 3. *Reineckeia* sp. (S-3-128) with body chamber from the Tooy-Takhtehbashgheh section, Callovian.
Fig. 4. *Microbajocisphinctes* cf. *pseudointerruptus* (FERNANDEZ LOPEZ) (S-1-2) from the Tooy-Takhtehbashgheh section, Garantiana Zone.
Fig. 5. *Microbajocisphinctes* sp. B (S-1-3) from the Tooy-Takhtehbashgheh section, Garantiana Zone.
Fig. 6. *Microbajocisphinctes* sp. C (S-1-9) from the Tooy-Takhtehbashgheh section, Garantiana Zone.
Fig. 7. cf. *Hubertoceras* sp. (S-3-110) from the Tooy-Takhtehbashgheh section, Middle Callovian.
Fig. 8. *Procerites* sp. (J-2b-15) from the Golbini-Jorbat section, Bathonian.
Figs. 9-10. *Microbajocisphinctes* sp. A from the Tooy-Takhtehbashgheh section, Garantiana Zone. 9. Specimen S-1-4. 10. Specimen S-1-7.


1a
1b
2
3
4a
4b
5a
5b
6a
6b
7
8
9
10a
10b

Material: 1 specimen and 7 fragments from section (3) (S-3a-h).

Dimensions:

specimen	D	U%	H%	W%	PR/2	SR/2
S-1-3a	36	47	31	31	19	*40*

Description and remarks: Whorl section rounded. The prorsiradiate primaries divide at around two-thirds of flank height into two prorsiradiate secondaries; rarely intercalated ribs occur. *Microbajocisphinctes* sp. B is similar to *Microbajocisphinctes* sp. A (Pl. 10, Figs. 9-10), but lacks constrictions and has fainter prorsiradiate ribs.

Stratigraphic distribution: Upper Bajocian.

Microbajocisphinctes sp. C
Pl. 10, Fig. 6

Material: 4 fragmentary specimens from section (3) (S-6a-e).

Description and remarks: Whorl section high-ovate, primary ribs strong, coarse, distant and prorsiradiate. Most of them split into two prorsiradiate secondary ribs at around three-fourth of the flank height and cross the venter. *Microbajocisphinctes* sp. C differs from *Microbajocisphinctes* sp. A and B in having a higher whorl section and distant ribs.

Stratigraphic distribution: Upper Bajocian Garantiana Zone.

Subfamily Proplanulitinae BUCKMAN, 1921
Genus *Hubertoceras* SPATH, 1930

cf. *Hubertoceras* sp.
Pl. 10, Fig. 7

Material: 1 specimen from section (3) (S-110).

Description and remarks: Umbilical wall vertical, whorl cross-section rounded. The primaries are strong and rectiradiate, dividing into two secondaries (some of the ribs do not divide) near mid-flank and cross the venter. The ribbing is denser at the posterior part of the last whorl.

Stratigraphic distribution: *Hubertoceras* has been recorded from the Middle Callovian.

Subfamily Zigzagiceratinae BUCKMAN, 1920
Genus *Procerites* SIEMIRADZKI, 1898
Procerites sp.

Pl. 11, Fig. 2a-b

Material: 1 specimen from section (2) (J-21).

Description: Whorl cross-section high-oval, umbilical wall steep, shell medium-sized. The primary ribs are relatively coarse, distant and prorsiradiate. Most of them split into two prorsiradiate secondary ribs at around three-fourth of the flank height and cross the venter.

Stratigraphic distribution: Bathonian.

Genus *Planisphinctes* BUCKMAN, 1922
Planisphinctes sp.
Pl. 11, Fig. 3a-b

Material: 1 specimen from section (3) (J-12).

Description: Whorl cross-section nearly oval, shell medium-sized, umbilical wall steep, venter rounded. The ribbing is denser and finer on the inner whorls. The dense primaries divide at around three-fourth of flank height into two prorsiradiate secondaries which, together with some intercalated ribs, cross the venter. The secondaries are denser and fainter than the primaries.

Stratigraphic distribution: Bathonian.

Subfamily Pseudoperisphinctinae SCHINDEWOLF, 1925
Genus *Loboplanulites* BUCKMAN, 1925

Loboplanulites cf. *collociaris* (QUENSTEDT 1887) [m]
Pl. 11, Fig. 1

1887 *Ammonites triplicatus colliciaris* sp. nov. – QUENSTEDT: 680, pl. 80, fig. 1.

Material: 1 fragment from section (3) (S-54).

Description and remarks: Whorl cross-section nearly subrounded. The strong and blunt primaries divide at around two-thirds of the flank height into two slightly rursiradiate secondaries (some of the ribs do not divide) and cross the venter. Primary and secondary ribs are equally coarse. According to DIETL & SCHWEIGERT (pers. comm. 2002) this species is a microconch.
L. collociaris has been recorded from the Lower Callovian.

Genus *Choffatia* SIEMIRADZKI, 1898
Subgenus *Choffatia* SIEMIRADZKI, 1898

Choffatia (Choffatia) sakuntala SPATH, 1931 [M]

Pl. 11, Figs. 5, 7

1931 *Choffatia (Choffatia) sakuntala* sp. nov. – SPATH: 351, pl. 48, fig. 4.
1970 *Choffatia (*M. *Choffatia) sakuntala* SPATH – MANGOLD: 152, pl. 12, fig. 1, pl. 13, fig. 3.

Material: 2 fragments from section (3) (S-50-51).

Description: Umbilical wall vertical, whorl cross-section fairly deep and ovate, venter broad. Ribbing on outer whorls stronger, coarser, and more distant than on inner whorls. The strong, coarse distant primaries divide at around three-fourth of flank height into two or three secondaries which, together with some intercalated ribs, cross the venter. The secondaries are denser and fainter than the primaries.

Discussion: The specimens resemble the holotype (SPATH 1931: pl. 48, fig. 4) and material figured by MANGOLD (1970: pl. 13, fig. 3). The present specimens are considered to be macroconchs.

Stratigraphic distribution: Lower Callovian Gracilis Zone (MANGOLD 1970: 154).

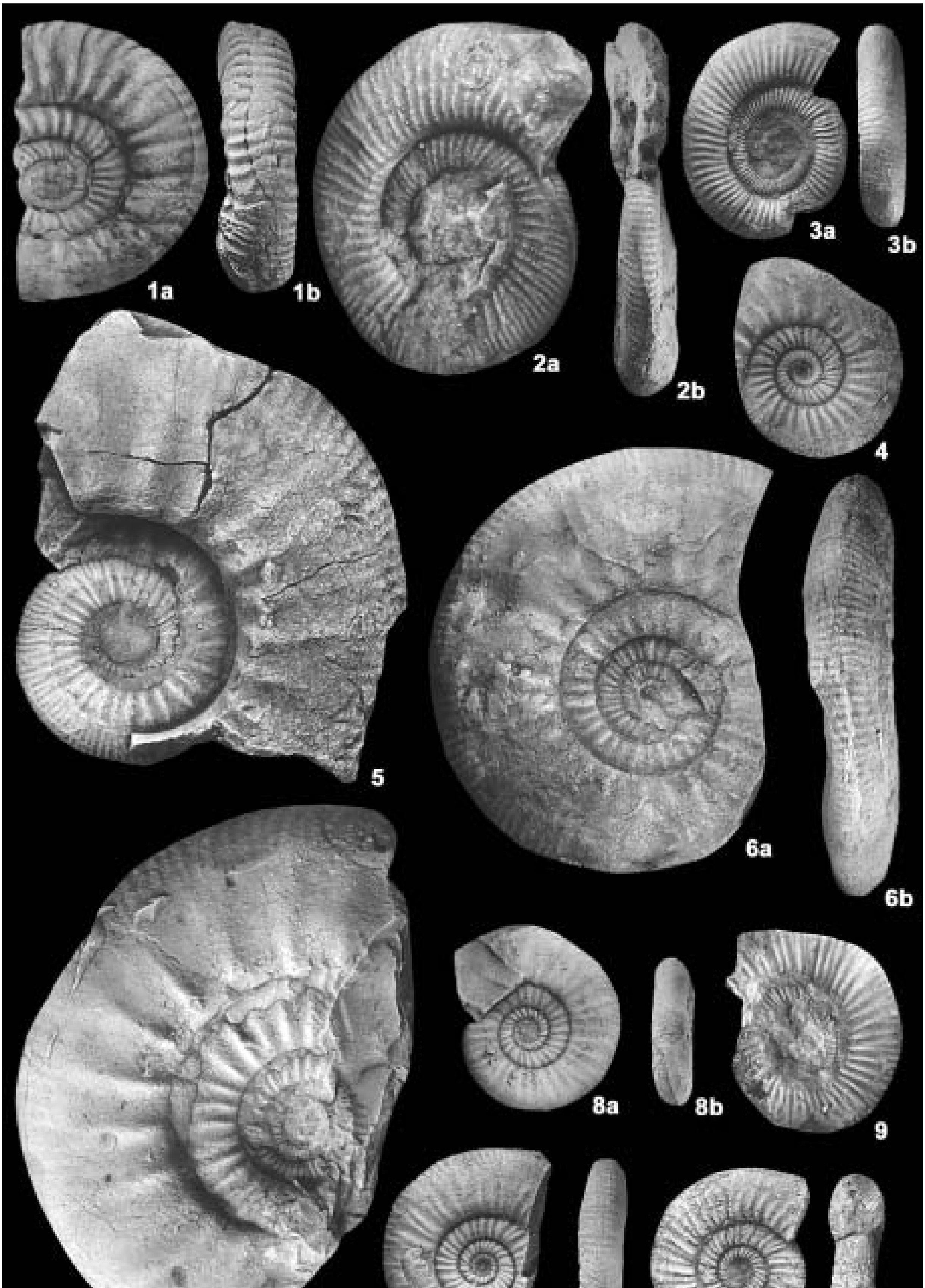
Choffatia kontkiewiczi (SIEMIRADZKI, 1894)
Pl. 11, Figs. 4, 6, 8, 10; Pl. 13, Fig. 4

1894 *Perisphinctes kontkiewiczi* sp. nov. – SIEMIRADZKI: 513, pl. 38, figs. 3-4.
1931 *Grossouvria* aff. *kontkiewiczi* (SIEMIRADZKI) – SPATH: 368, pl. 60, fig. 2, pl. 63, fig. 7.
1985 *Choffatia (Grossouvria) kontkiewiczi* (SIEMIRADZKI) – SCHLEGELMILCH: 130, pl. 49, fig. 10.

Material: 22 specimens and 5 fragments from section (2) (J-194-200, 204-208, 210, 233).

EXPLANATION OF PLATE 11

Fig. 1. *Loboplanulites* cf. *collociaris* (QUENSTEDT) (S-3-54) from the Tooy-Takhtehbashgheh section, Lower Callovian, microconch, x1.5.
Fig. 2. *Procerites* sp. (J-2b-21) from the Golbini-Jorbat section, Bathonian.
Fig. 3. *Planisphinctes* sp. (J-2b-12) from the Golbini-Jorbat section, Bathonian.
Figs. 4, 6, 8, 10. *Choffatia (Grossouvria) kontkiewiczi* (SIEMIRADZKI) from the Golbini-Jorbat section, Coronatum Zone. 4. Specimen J-3-195. 6. Specimen J-3-210. 8. SpecimenJ-3-208. 10. Specimen J-3-194.
Figs. 5, 7. *Choffatia (Choffatia) sakuntala* (SPATH), macroconchs, from the Tooy-Takhtehbashgheh section, Patina Zone. 5. Specimen S-3-51. 7. Specimen S-3-50.
Fig. 9. *Homoeoplanulites (Homoeoplanulites)* sp. B, microconch (S-3-48) from the Tooy-Takhtehbashgheh section, Lower Callovian.
Fig. 11. *Homoeoplanulites (Homoeoplanulites)* sp. A, microconch (J-2b-201) from the Golbini-Jorbat section, Upper Bathonian.


1a
1b
2a
2b
3a
3b
4
5
6a
6b
7
8a
8b
9
10a
10b
11a
11b

Dimensions:

specimen	D	U%	H%	W%	PR/2	SR/2
J-3-210	79	43	33	20	13	
J-3-195	38	45	34	17	15	
J-3-194	37	49	35	22	18	41
J-3-208	32	47	34	21	16	
J-3-196	30	47	30	27	17	
J-3-197	23	43	35	30	16	
J-3-199	21	48	29	27	18	
J-3-198	21	48	33	29	18	
J-3-200	15	49	35	33	15	

Description: Umbilical wall nearly vertical, whorl cross-section subrounded. The blunt, strong and slightly parabolic primaries divide mainly at around three-fourth of the flank height into two or three secondaries which, together with some intercalated ribs, cross rursiradiate over the venter. Some of the primary ribs have a common origin close to the umbilical margin. On inner whorls the ribbing is denser and more prorsiradiate than on outer whorls. Towards the aperture the primaries are distant and the whorl height increases.

Discussion: MANGOLD (1970: 175) distinguished this species from others by its distinctly parabolic ribs.

Stratigraphic distribution: Upper part of the Middle Callovian Coronatum Zone, Obductum Subzone (MANGOLD 1970: 175).

Genus *Homoeoplanulites* BUCKMAN, 1922
Subgenus *Homoeoplanulites* BUCKMAN, 1922

Homoeoplanulites (Homoeoplanulites) cf. *bugesiacus* (DOMINJON, 1969)
Pl. 12, Figs. 2, 5

1969 *Choffatia (Homoeoplanulites) bugesiaca* sp. nov. – DOMINJON: 16, pl. 2, figs. 4-6.
cf. 1970 *Homoeoplanulites (*m. *Homoeoplanulites) bugesiacus* (DOMINJON) – MANGOLD: 59, pl. 2, figs. 2, 7-9.
cf. 1994 *Homoeoplanulites (Homoeoplanulites)* cf. *bugesiacus* DOMINJON – DIETL: pl. 5, fig. 2.

Material: 1 specimen and 1 fragment from section (3) (S-47, 49).

Dimensions:

specimen	D	U%	H%	W%	PR/2	SR/2
S-2b-47	72	37	32	26	21	
S-2b-49	64	37	39	23	25	

Description: Ribs irregular. The ribbing is fine and dense in the posterior part of the last visible whorl. The coarse primaries divide around two-thirds of flank height into two or three secondaries which cross the venter. Some of the ribs do not divide. Rarely, ribs divide about mid-flank. The ribbing is slightly prorsiradiate on the anterior part of the last visible whorl.

Discussion: The specimens from Iran differ from those studied by DIETL (1994: pl. 5, fig. 2) with respect to possessing a flat flank, more irregular ribs and a more compressed shell. The specimen S-2-49 (Pl. 12, Fig. 5) is smaller than the other specimen, also the ribbing is denser on the posterior part of the last visible whorl.

Stratigraphic distribution: Upper Bathonian Discus Zone and Subzone.

Homoeoplanulites (Homoeoplanulites) sp. [m] A
Pl. 11, Fig. 11

Material: 3 specimens from section (2) (J-201-203).

Dimensions:

specimen	D	U%	H%	W%	PR/2	SR/2
J-2c-201	35	36	29	26	19	
J-2c-202	26	42	35	23	17	
J-2c-203	26	42	35	31		

Description and remarks: Whorl cross-section nearly rectangular, umbilical wall vertical. On inner whorls the ribbing is denser than on outer whorls. The strong and slightly prorsiradiate primaries usually divide at around three-fourth of flank height into two secondaries that cross the venter. Compared with specimens studied by MANGOLD (1970: 54-56, pl. 1, fig. 3) the present specimens are microconchs.
Stratigraphic distribution: Upper Bathonian.

Homoeoplanulites (Homoeoplanulites) sp. B [m]
Pl. 11, Fig. 9

Material: 1 fragment from section (3) (S-201).

Description and remarks: Whorl cross-section oval, with flat flank. The primary ribs start at the umbilical margin, divide around two-thirds of flank height into two secondaries except for a few, and cross the venter. The present specimen is considered to be a microconch, based on similar specimens studied by MANGOLD (1970: 54-56, pl. 1, figs. 3-7). *Homoeoplanulites (Homoeoplanulites)* sp. B differs from *Homoeoplanulites (Homoeoplanulites)* sp. A in its whorl section and in having dense and sharp ribs.

Stratigraphic distribution: Lower Callovian.

Subgenus *Parachoffatia* MANGOLD, 1970

Homoeoplanulites (Parachoffatia) arkelli MANGOLD, 1970
Pl. 12, Fig. 1

1970 *Homoeoplanulites (*M. *Parachoffatia) arkelli* sp. nov. – MANGOLD: 77, pl. 3, fig. 2.
1994 *Homoeoplanulites (Parachoffatia) arkelli* MANGOLD – DIETL: pl. 6, fig. 2, pl. 9, figs. 1-2.

Material: 1 specimen from section (3) (S-46).

Dimensions:

specimen	D	U%	H%	W%	PR/2	SR/2
S-2b-46	62	45	31	34	19	

Description: Umbilical wall vertical, venter broad-rounded. Primary ribs dense, coarse and bullate, dividing near mid-flank into two or three finer secondaries.

Discussion: The Iranian specimen resembles the holotype (MANGOLD 1970: pl. 3, fig. 2) but is smaller. It also differs from specimens studied by DIETL (1994: pl. 6, fig. 2) in having denser ribs on the inner whorls.

Stratigraphic distribution: Upper Bathonian Discus Zone and Subzone (MANGOLD 1970: 79).

Siemiradzkia HYATT, 1900

Siemiradzkia sp.
Pl. 12, Fig. 6a-b

Material: 1 specimen from section (2) (J-10).

Description and remarks: Shell medium-sized, umbilical wall low and steep, venter broad. The fine but sharp primaries divide at around two-thirds of flank height into secondaries which, together with some intercalated ribs, cross straight over the venter. Some of the ribs do not divide. Primary and secondary ribs are equally coarse, but the secondaries are finer than the primaries. There are four weak nodes on the last visible whorl.
Stratigraphic distribution: Bathonian.

Genus *Grossouvria* SIEMIRADZKI, 1898

Grossouvria sp. A
Pl. 12, Fig. 11

Material: 1 specimen from section (3) (S-53).

Dimensions:

specimen	D	U%	H%	W%	PR/2	SR/2
S-3-53	33	42	35	33	23	46

Description and remarks: Umbilical wall vertical, whorl cross-section rounded. The primaries are dense and slightly prorsiradiate, starting at the umbilical margin, dividing into two secondaries near mid-flank, and crossing the venter. Primary and secondary ribs are equally coarse, but the ribs on the inner whorls are denser than those on the outer whorls. There are three prorsiradiate and fairly deep constrictions on the last visible whorl.
Stratigraphic distribution: Middle Callovian.

Grossouvria sp. B [m]
Pl. 12, Fig. 4

Material: 1 specimen from section (3) (S-55).

Description and remarks: Umbilical wall steep. The primary ribs are prorsiradiate, very fine and dense, starting at the umbilical margin, dividing into two secondary ribs at about three-fourth of flank height, and cross the venter. As the specimen has lappets, it is a microconch. *Grossouvria* sp. B differs from *Grossouvria* sp. A in having finer and denser ribs.
Stratigraphic distribution: Callovian.

Grossouvria sp. C
Pl. 12, Fig. 8

Material: 1 fragment from section (3) (S-52).

Description and remarks: Umbilical wall vertical, whorl cross-section subrounded, venter broad. The thin but strong and distant primaries divide at around two-thirds of flank height into secondaries which, together with some intercalated ribs, cross straight over the venter. Some of the ribs do not divide. Primary and secondary ribs are equally coarse, but the secondaries are denser than the primaries.

Stratigraphic distribution: Middle Callovian.

Mirosphinctes SCHINDEWOLF, 1926

cf. *Mirosphinctes* sp.
Pl. 12, Fig. 9

Material: 1 specimens from section (3) (S-69).

Description: Shell small, umbilical wall steep, whorl cross-section high-oval, with flat flank. The simple and relatively coarse primary ribs start at the umbilical margin, divide mainly into two rursiradiate ribs at around two-thirds of flank height, and cross the venter. Its characteristic ornamentation is rursiradiate secondary ribs.

Stratigraphic distribution: Lower Oxfordian.

Genus *Binatisphinctes* BUCKMAN, 1921
Subgenus *Okaites* SASONOV, 1961

Binatisphinctes (Okaites) cf. *mosquensis* (FISCHER, 1843)
Pl. 12, Fig. 7; Pl. 13, Fig. 3

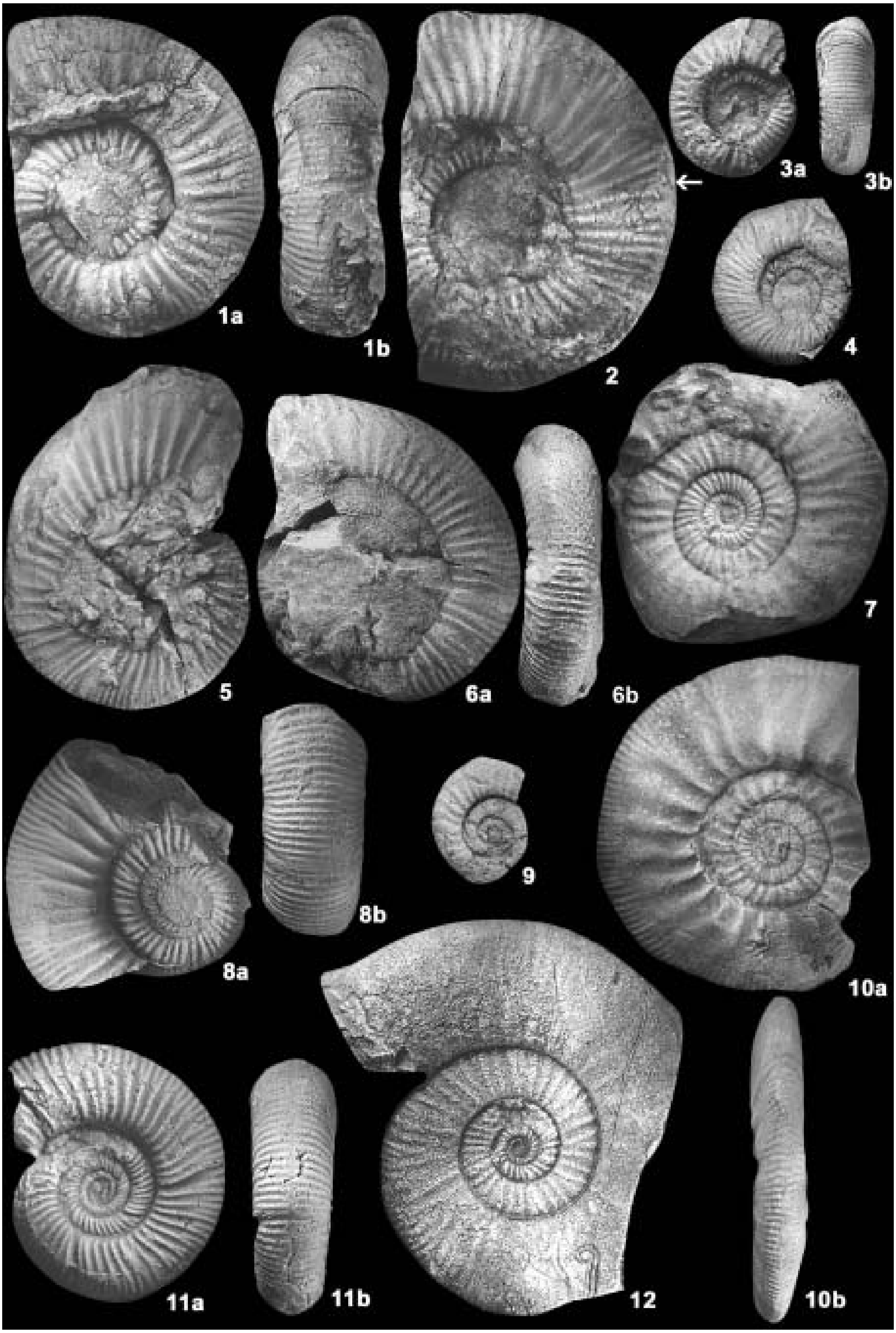
1843 *Ammonites mosquensis* nov sp. – FISCHER : 110, pl. 3, figs. 4-7.
cf. 1898 *Perisphinctes mosquesis* FISCHER - SIEMIRADZKI : 104, pl. 21, fig. 13.
cf. 1970 *Binatisphinctes (Okaites)* cf. *mosquensis* (FISCHER in SIEMIRADZKI) - MANGOLD : 204, pl. 10, fig. 4.
cf. 1987 *Binatisphinctes (Okaites) mosquensis* FISCHER – MELEDINA : 74, pl. 20, fig. 6, pl. 22, fig. 3, pl. 23, fig. 2.

Material: 2 fragments from section (2) (J-232, 225).

Dimensions:

EXPLANATION OF PLATE 12

Fig. 1. *Homoeoplanulites (Parachoffatia) arkelli* (MANGOLD) (S-2b-46) from the Tooy-Takhtehbashgheh section, Discus Zone.
Figs. 2, 5. *Homoeoplanulites (Homoeoplanulites)* cf. *bugesiacus* (DOMINJON) from the Tooy-Takhtehbashgheh section, Discus Zone. 2. Specimen S-2b-47, with body chamber. 5. Specimen S-2b-49.
Fig. 3. *Homoeoplanulites* sp. (J-2b-11) from the Golbini-Jorbat section, Bathonian.
Fig. 4. *Grossouvria* sp. B, microconch (S-3-55) from the Tooy-Takhtehbashgheh section, Bathonian, x1.5.
Fig. 6. *Siemiradzkia* sp. (J-2b-10) from the Golbini-Jorbat section, Bathonian.
Fig. 7. *Binatisphinctes (Okaites)* cf. *mosquensis* (SIEMIRADZKI) (J-3-232) from the Golbini-Jorbat section, Coronatum Zone.
Fig. 8. *Grossouvria* sp. C (S-3-52) f rom the Tooy-Takhtehbashgheh section, Upper Callovian, x1.5.
Fig. 9. cf. *Mirosphinctes* sp. (S-5-69) from the Tooy-Takhtehbashgheh section, Lower Oxfordian.
Fig. 10. *Indosphinctes (Elatmites)* cf. *revili* (MANGOLD) (J-3-224) from the Golbini-Jorbat section, Patina Zone.
Fig. 11. *Grossouvria* sp. A (S-3-53) from the Tooy-Takhtehbashgheh section, Upper Callovian, x1.5.
Fig. 12. *Indosphinctes (Elatmites)* sp. (J-3-209) from the Golbini-Jorbat section, Middle Callovian.


1a
1b
2
3a
3b
4
5
6a
6b
7
8a
8b
9
10a
10b
11a
11b
12

specimen	D	U%	H%	W%	PR/2	SR/2
J-3-232	55	49	33	18	17	
J-3-225	49	45	35	20	16	

Description: Umbilical wall steep, whorl cross-section oval, ribs irregular. The coarse, fine and rectiradiate primaries start at the umbilical margin, divide mainly into two rursiradiate ribs at around two-thirds of flank height, and cross the venter. Some of the ribs do not divide. The secondary ribs are finer and denser than the primaries. On the last visible whorl the ribbing is increasingly distant.

Discussion: The present material is similar to the specimens described by SIEMIRADZKI (1898: 104) and MELEDINA (1987: 74), but differs in having a narrow venter and in being of large size. The specimens can also be compared with MANGOLD'S (1970: 204) material.

Stratigraphic distribution: Upper part of the Middle Callovian, Coronatum Zone and Obductum Subzone.

Genus *Indosphinctes* SPATH, 1930
Subgenus *Elatmites* SHEVYREV, 1960

Indosphinctes (Elatmites) cf. *revili* MANGOLD, 1970
Pl. 12, Fig. 10

cf. 1970 *Indosphinctes (Elatmites) revili* sp. nov. – MANGOLD: 111, pl. 7, fig. 2.
cf. 1985 *Indosphinctes (Elatmites) revili* MANGOLD - SCHLEGELMILCH: 126, pl. 48, fig. 1.

Material: 1 fragment from section (2) (J-224).

Dimensions:

specimen	D	U%	H%	W%	PR/2	SR/2
J-3-224	61	43	33	15	12	70

Description: Umbilical wall steep, whorl cross-section high-ovate, flank flat, and venter fairly narrow. Ribbing on inner whorls denser and more regular than on outer whorls. The primaries are strong, coarse, distant and bullate up to about mid-flank but gradual faint and split at around two-thirds of flank height into fine and dense secondaries which, together with some intercalated ribs, continue across the venter. One constriction can be seen on the last visible whorl.

Discussion: The present specimen resembles the holotype (MANGOLD 1970: pl. 7, fig. 2) but differs in being smaller and having slightly weaker primaries.

Stratigraphic distribution: Lower Callovian Gracilis Zone (MANGOLD 1970: 115).

Indosphinctes (Elatmites) sp.

Pl. 12, Fig. 12

Material: 1 fragment from section (2) (J-209).

Description and remarks: Umbilical wall steep, flank flat, venter fairly narrow. The ribbing is irregular and denser and slightly prorsiradiate on inner whorls. The primaries are distinct up to around one-third of flank height, then gradually faint and divide around two-thirds of flank height into secondaries that, together with some intercalated ribs, continue towards the venter.
The subgenus is known from the Middle Callovian.

Genus *Flabellisphinctes* MANGOLD, 1970
Subgenus *Flabellia* MANGOLD, 1970

Flabellisphinctes (Flabellia) tsytovitchae MANGOLD, 1970 [m]
Pl. 13, Figs. 1-2, 5

1938 *Grossouvria curvicosta* (OPPEL) var. *variabilis* (LAHUSEN) - PFAEHLER-ERATH : 10, pl. 1, fig. 7.
1970 *Flabellisphinctes (Flabellia) tuberosus* sp. nov. – MANGOLD : 196, pl. 15, fig. 3, pl. 16, figs. 3-4.
1970 *Flabellisphinctes (Flabellia) tsytovitchae* sp. nov. – MANGOLD : 195, pl. 16, figs. 7-8.

Material: 7 specimens and 3 fragments from section (2) (J-218-228).

Dimensions:

specimen	D	U%	H%	W%	PR/2	SR/2
J-3-226	70	41	31	20	9	51
J-3-218	60	40	33	23	13	52
J-3-219	65	41	35	14	11	
J-3-223	72	35	37	22	10	
J-3-227	69	42	29	20	10	
J-3-221	51	43	33	16	13	
J-3-228	47	40	34	15	9	

Description: Whorl cross-section vertical, flank flat. Primaries on outer whorls coarse, strong and bullate mainly up to one-fourth of flank height and rarely up to mid-flank, then gradually vanishing. The primary ribs start at the umbilical margin, divide into fine and dense secondary ribs with some intercalated ribs at around three-fourth of flank height, and thereafter cross the venter. Towards the aperture the primaries are strong and distant.

Discussion: MANGOLD (1970: 195) introduced *Flabellisphinctes (Flabellia) tuberosus and Flabellisphinctes (Flabellia) tsytovitchae*, mentioning as a distinguishing feature between the two species the more evolute nature and stronger ribs at the umbilical margin of the former. However, this difference is very small, and it appears more appropriate to regard the two as variants of one

species, i.e. *Flabellisphinctes (Flabellia) tsytovitchae*. Specimen J-5-226 (Pl. 13, Fig. 5) exhibits on the last whorl a constriction with lappet and therefore is a microconch.
Flabellisphinctes (Flabellia) tsytovitchae differs from *Flabellisphinctes (Flabellia) lineatus* (MANGOLD 1970) in being more evolute and having strong ribs at the umbilical margin.

Stratigraphic distribution: Upper part of Middle Callovian, Coronatum Zone and Obductum Subzone (MANGOLD 1970: 198).

Genus *Geyssantia* MELENDEZ, 1989

Geyssantia geyssanti MELENDEZ, 1989
Pl. 14, Fig. 1

1989 *Geyssantia geyssanti* sp. nov. – MELENDEZ: 203, pl. 19, figs. 2-7.

Material: 1 specimen from section (3) (S-94).

Dimensions:

specimen	D	U%	H%	W%	PR/2	SR/2
S-6-94 (body chamber)	61	56	26	25	15	

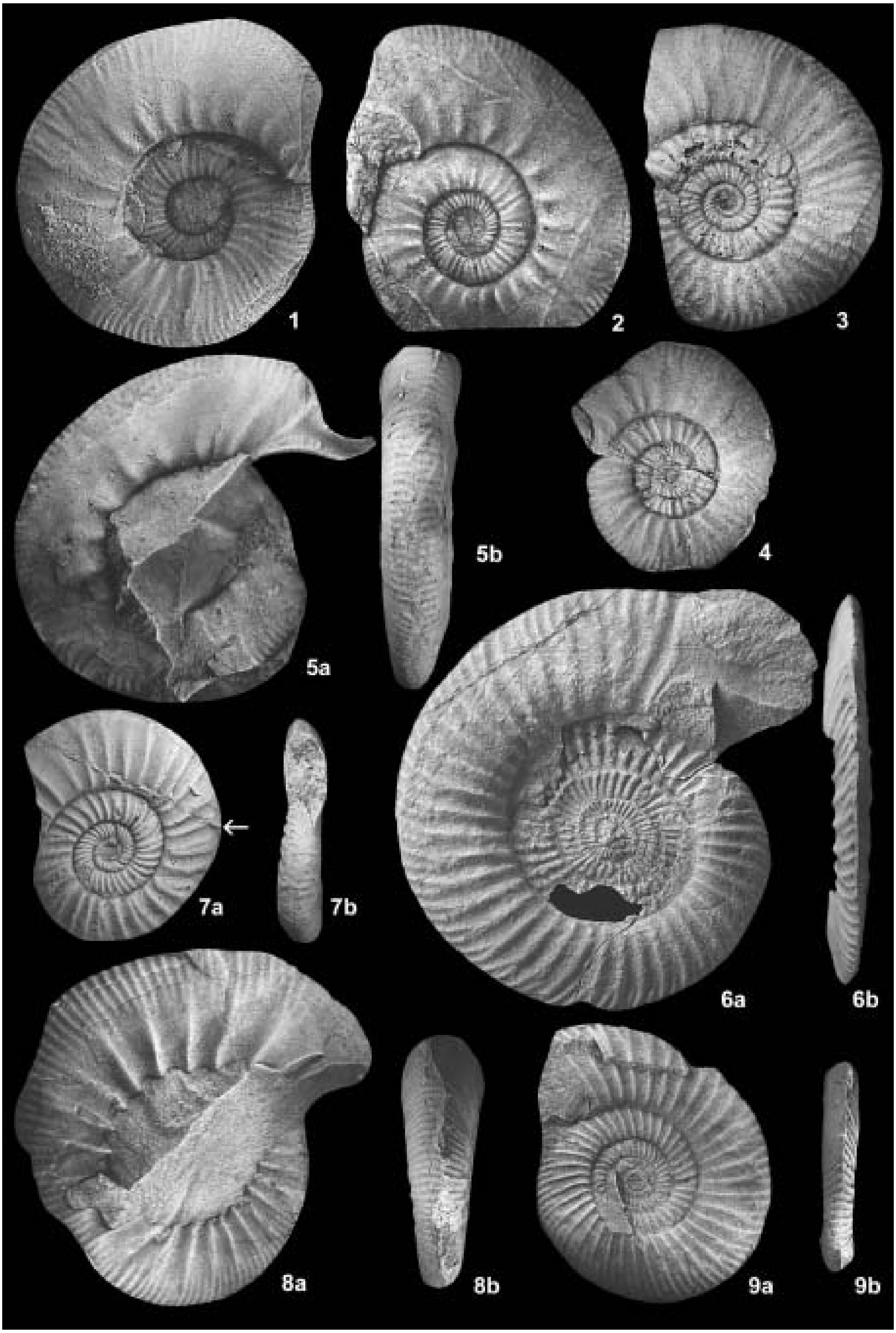
Description: Umbilical wall vertical, whorl cross-section rectangular. The ribbing on the inner whorls is somewhat prorsiradiate. The strong, dense and rectiradiate primary ribs start at the umbilical margin and, at around the venter shoulder, usually divide into two secondaries, which cross the venter. There are three constrictions on the last visible whorl.

Discussion: The present specimen resembles the holotype figured by MELENDEZ (1989: pl. 19, fig. 3). The species differs from other species of the genus by its rectiradiate, strong, coarse and distant ribs.

Stratigraphic distribution: Upper Oxfordian Bimammatum Zone.

EXPLANATION OF PLATE 13

Figs. 1, 2, 5. *Flabellisphinctes (Flabellia) tsytovitchae* (MANGOLD) from the Golbini-Jorbat section, Coronatum Zone. 1. Specimen J-3-218. 2. Specimen J-3-219. 5. Specimen J-3-220, with lappet.
Fig. 3. *Binatisphinctes (Okaites)* cf. *mosquensis* (SIEMIRADZKI) (J-3-232) from the Golbini-Jorbat section, Coronatum Zone.
Fig. 4. *Choffatia (Grossouvria) kontkiewiczi* (SIEMIRADZKI) (J-3-233) from the Golbini-Jorbat section, Coronatum Zone.
Figs. 6, 9. *Idoceras (Subnebrodites) schroederi* (WEGELE) from the Tooy-Takhtehbashgheh section, Planula Zone. 6.Specimen S-8-82a, with lappet. 9. Specimen S-8-82b.
Fig. 7. *Geyssantia* sp. (S-8-96) with body chamber from the Tooy-Takhtehbashgheh section, Oxfordian.
Fig. 8. *Perisphinctes* sp. (CH-3-1) from the Chaman Bid section, Callovian.


1
2
3
5b
4
5a
7a
7b
6a
6b
8a
8b
9a
9b

Geyssantia sp.
Pl. 13, Fig. 7

Material: 1 specimen and 2 fragments from section (3) (S-94-96).

Dimensions:

specimen	D	U%	H%	W%	PR/2	SR/2
S-8-95	62	48	32	19	20	
S-8-96 (body chamber)	44	48	32	18	17	

Description and remarks: Whorl cross-section oval, umbilical wall vertical, ribs irregular. On inner whorls the ribbing is slightly prorsiradiate and dense. The strong and distant primaries start at the umbilical margin and, at around the venter shoulder, divide into two or three secondaries which cross the venter. Some of the ribs divide already near the umbilical margin. There are three constrictions on the last whorl.

Stratigraphic distribution: Upper Oxfordian.

Subfamily Perisphinctinae STEINMANN, 1890
Genus *Perisphinctes* WAAGEN, 1869
Subgenus *Dichotomosphinctes* BUCKMAN, 1926

Perisphinctes (Dichotomosphinctes) buckmani ARKELL 1937
Pl. 14, Fig. 4

1937 *Perisphinctes (Dichotomosphinctes) buckmani* sp. nov. – ARKELL: 447, 454.
1937 *Perisphinctes (Dichotomosphinctes)* ARKELL - ARKELL: 79, pl. 14, figs. 1-4.

Material: 1 specimen from section (2) (J-265).

Dimensions:

specimen	D	U%	H%	W%	PR/2	SR/2
J-5-265	72	46	29	24	35	63

Description: Whorl cross-section nearly subrectangular, umbilical shoulder fairly rounded, umbilical wall steep, flank flat, and venter arched. The slightly prorsiradiate primaries divide at around three-fourth of flank height into two secondaries (rarely, the ribs remain simple), which cross straight over the venter. There are three fairly deep constrictions per whorl.

Discussion: The specimen is large for the subgenus, in which the body chamber can occupy a whorl (ARKELL 1937). It differs from the holotype in having dense and fine ribs.]

Stratigraphic distribution: Middle Oxfordian.

Perisphinctes (Dichotomosphinctes) sp. A
Pl. 14, Fig. 3

Material: 2 specimens and 4 fragments from section (2) (J-235a-d).

Dimensions:

specimen	D	U%	H%	W%	PR/2	SR/"
J-5-235a	58	53	28	29	24	
J-5-235b	53	51	26	32		

Description and remarks: Umbilical wall vertical, umbilical shoulder rounded, whorl cross-section rectangular, venter broad. The distant, strong and rectiradiate primaries split at around the ventral shoulder into two secondaries which cross the venter. There are three to four constrictions per whorl.

Stratigraphic distribution: Middle Oxfordian.

Perisphinctes (Dichotomosphinctes) sp. B
Pl. 14, Fig. 5

Material: 1 specimen from section (3) (S-56).

Dimensions:

specimen	D	U%	H%	W%	PR/2	SR/2
S-4-56	62	50	29	16	26	

Description and remarks: Specimen somewhat compressed, with low and steep umbilical wall and narrow venter. On inner whorls the ribs are prorsiradiate, on outer whorls they are rursiradiate. The strong primaries split at around three-fourth of flank height into two secondaries which cross, especially in the anterior part of the last visible whorl, over the venter in a prorsiradiate fashion. There are three relatively prorsiradiate constrictions on the last visible whorl. *Perisphinctes (Dichotomosphinctes)* sp. B differs from *Perisphinctes (Dichotomosphinctes)* sp. A in having prorsiradiate ribs and in being more compressed.

Stratigraphic distribution: Lower to Upper Oxfordian.

Genus *Orthosphinctes* SCHINDEWOLF, 1925
Subgenus *Orthosphinctes* SCHINDEWOLF, 1925

Orthosphinctes (Orthosphinctes) sp.
Pl. 15, Fig. 1

Material: 1 specimen from section (2) (J-277).

Dimensions:

specimen	D	U%	H%	W%	PR/2	SR/2
J-6-277	80	49	28	29	28	60

Description and remarks: Umbilical wall nearly vertical, venter broad. The primary ribs are strong, distant, coarse and rectiradiate, starting at the umbilical margin and usually splitting into two or three secondaries, which cross the venter, at around the venter shoulder. One constriction visible on the last whorl.
The Iranian specimen is close to *Orthosphinctes (Orthosphinctes) suevicus* of SIEMIRADZKI (1898) but because the inner whorls cannot be seen it has been identified only at the subgeneric level.

Stratigraphic distribution: Lower Kimmeridgian Platynota Zone.

Orthosphinctes sp.
Pl. 14, Figs. 2, 6

Material: 2 specimens from section (2) (J-237, 294).

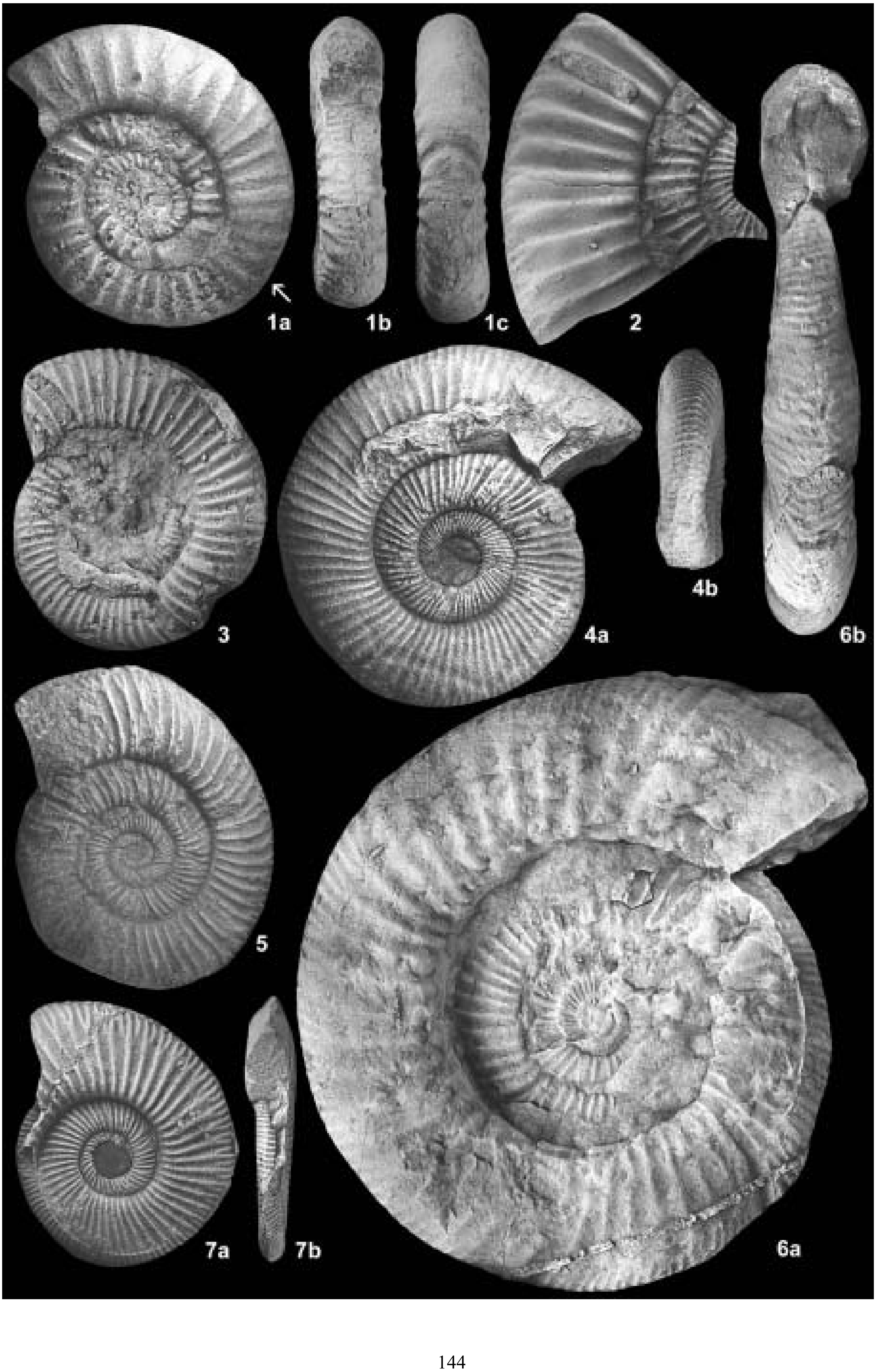
Dimensions:

specimen	D	U%	H%	W%	PR/2	SR/2
J-6-294	120	49	27	16	21	55

Description and remarks: Umbilical wall nearly vertical, whorl cross-section oval, venter fairly narrow. On inner whorls the ribbing is denser than on outer whorls. The strong, coarse and distant primaries divide at around two-thirds of flank height into two or three secondaries which, together with single intercalated ribs, cross over the venter. There are four constrictions on the last visible whorl.

EXPLANATION OF PLATE 14

Fig. 1. *Geyssantia geyssanti* (MELENDEZ) (S-6-94) with body chamber from the Tooy-Takhtehbashgheh section, Bimammatum Zone.
Figs. 2, 6. *Orthosphinctes* sp. from the Golbini-Jorbat section, Platynota Zone. 2. Specimen J-6-237. 6. Specimen J-6-294.
Fig. 3. *Dichotomosphictes* sp. A (J-5-235a) from the Golbini-Jorbat section, Oxfordian.
Fig. 4. *Perisphinctes (Dichotomosphinctes) buckmani* (ARKELL) (J-5-265) from the Golbini-Jorbat section, Oxfordian.
Fig. 5. *Dichotomosphictes* sp. B (J-5-265) from the Golbini-Jorbat section, Oxfordian.
Fig. 7. *Orthosphinctes (Ardescia)* cf. *thieuloyi* (ATROPS), microconch (J-6-278), from the Golbini-Jorbat section, Platynota Zone.


1a
1b
1c
2
3
4a
4b
6b
5
7a
7b
6a

Stratigraphic distribution: Lower Kimmeridgian Platynota Zone.

Subgenus *Ardescia* ATROPS, 1982
Orthosphinctes (Ardescia) schaireri ATROPS, 1982
Pl. 15, Fig. 2

1982 *Orthosphinctes (Ardescia) schaireri* sp. nov. – ATROPS: 97, pl. 4, figs. 3-4, pl. 28, figs. 2-3.
1997 *Orthosphinctes (Ardescia) schaireri* ATROPS – SCHAIRER: 16, pl. 4, fig. 2.

Material: 1 specimen from section (2) (J-274).

Dimensions:

specimen	D	U%	H%	W%	PR/2	SR/2
J-6-274	64	48	28	22	23	52

Description and remarks: Umbilical wall steep, whorl cross-section oval. The fairly coarse primaries start at the umbilical margin and divide into two or three secondaries around three-fourth of flank height. Together with single intercalated ribs they cross the venter. Three constrictions can be seen on the last visible whorl. The present specimen closely resembles the holotype.

Stratigraphic distribution: Kimmeridgian, upper part of the Platynota Zone, Guilherandense Subzone (ATROPS 1982: 102).

Orthosphinctes (Ardescia) proinconditus (WEGELE, 1929)
Pl. 15, Fig. 3

1929 *Ataxioceras proinconditum* sp. nov. – WEGELE : 66, pl. 7, figs. 5-6.
1982 *Orthosphinctes (*m. *Ardescia) proinconditus* (WEGELE) – ATROPS : 91, pl. 1, fig. 1, pl. 20, figs. 1, 5.
1991 *Orthosphinctes (Ardescia) proinconditus* (WEGELE) – SCHLAMPP :pl. 7, fig. 2.
1997 *Orthosphinctes (Ardescia) proinconditus* (WEGELE) - GRADL & SCHAIRER: 14, pl. 2, fig. 11.

Material: 1 specimen from section (2) (J-275).

Description: Umbilical wall nearly vertical, whorl cross-section nearly subrectangular, venter broad. Ribbing on inner whorls denser and more prorsiradiate than on outer whorls. The primaries are strong, coarse and distant, splitting at around three-fourth of flank height into two or three secondaries which, together with single intercalated ribs, cross straight over the venter. Constrictions are only sporadically seen.

Discussion: The present specimen resembles the holotype figured by WEGELE (1929) and the specimen figured by GRADL & SCHAIRER (1997), but differs from material studied by ATROPS (1982) in being smaller and more finely ribbed.

Stratigraphic distribution: Kimmeridgian, middle part of the Platynota Zone, Desmoides Subzone (ATROPS 1982: 95).

Orthosphinctes (Ardescia) cf. *thieuloyi* ATROPS, 1982 [m]
Pl. 14, Fig. 7

1982 *Orthosphinctes (m. Ardescia) thieuloyi* sp. nov. – ATROPS: 87, pl. 5, figs. 7-8, pl. 6, figs. 7-8, pl. 18, figs. 5-6.

Material: 1 specimen from section (2) (J-278).

Dimensions:

specimen	D	U%	H%	W%	PR/2	SR/2
J-6-278	51	39	37	18	21	46

Description: Shell fairly evolute, umbilical wall nearly vertical, whorl cross-section high-ovate, and venter narrow. The ribbing is denser on the posterior part of the last visible whorl and also on inner whorls. The slightly prorsiradiate primary ribs start at the umbilical margin and split into two secondaries at around two-thirds of flank height. Together with single intercalated ribs, these cross the venter.

Discussion: The specimen differs from the holotype in having a narrower venter.

Stratigraphic distribution: Lower Kimmeridgian Platynota Zone, Guilherandense Subzone (ATROPS 1982: 87).

Orthosphinctes (Ardescia) sp.
Pl. 16, Fig. 2

Material: 1 specimen from section (2) (J-273).

Dimensions:

specimen	D	U%	H%	W%	PR/2	SR/2
J-6-273	53	45	30	23	23	

Description and remarks: Venter fairly narrow. Ribbing prorsiradiate on the anterior part of the last visible whorl. The dense primaries split at around two-thirds of flank height into two secondaries which, together with single intercalated ribs, cross over the venter. There are three deep prorsiradiate constrictions on the last visible whorl.

Stratigraphic distribution: According to ATROPS (1982: 334), *Orthosphinctes (Ardescia)* occurs in the Lower Kimmeridgian Platynota Zone, lower part of the Desmoides Subzone.

Genus *Dichotomoceras* BUCKMAN, 1919

Perisphinctes (Dichotomoceras) bifurcatus (QUENSTEDT, 1847)
Pl. 15, Figs. 6-7; Pl. 16, Fig. 1

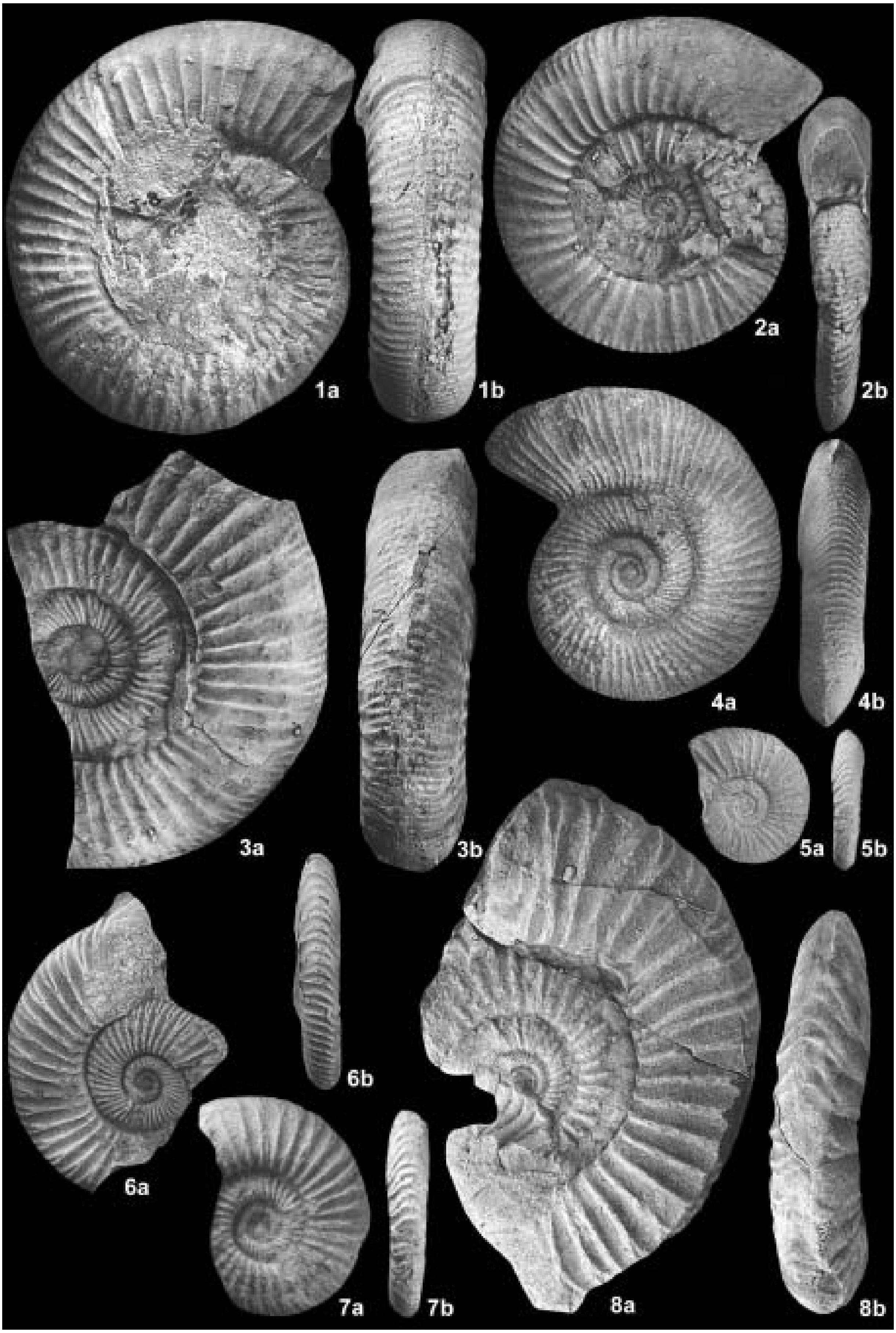
1847 *Ammonites biplex bifurcatus* sp. nov. – QUENSTEDT: 163, pl. 12, fig. 11.
1979 *Perisphinctes (Dichotomoceras) bifurcatus* (QUENSTEDT) - SAPUNOV: 84, pl. 20, figs. 1-3.
1984 *Perisphinctes (Dichotomoceras) bifurcatus* (QUENSTEDT) -ATROPS & BENEST: pl. 1, fig. 1.
1989 *Perisphinctes (Dichotomoceras) bifurcates* (QUENSTEDT)– SCHAIRER: 116, pl. 3, fig. 3.
1989 *Perisphinctes (Dichotomoceras) bifurcates* (QUENSTEDT) – MELENDEZ: 343, pl. 60, figs. 1-7, 9, pl. 59, fig. 6.
1991 *Perisphinctes (Dichotomoceras) bifurcates* (QUENSTEDT) – SCHLAMPP: 39, pl. 3, fig. 3.
1994 *Perisphinctes (Dichotomoceras) bifurcatus* (QUENSTEDT – SCHLEGELMILCH: 61, pl. 20, fig. 3.
1995 *Perisphinctes (Dichotomoceras) bifurcatus* (QUENSTEDT) – GYGI: 36, fig.17:2.
2001 *Perisphinctes (Dichotomoceras) bifurcatus* (QUENSTEDT) - ENAY & GYGI: 458, pl. 1, figs. 1-14, pl. 2, figs. 1-4.

Material: 1 specimen and 2 fragments from section (2) (J-258a-c), 1specimen and 1 fragment from section (3) (S-67-68).

Dimensions:

EXPLANATION OF PLATE 15

Fig. 1. *Orthosphinctes (Orthosphinctes)* sp. (J-6-277) from the Golbini-Jorbat section, Platynota Zone.
Fig. 2. *Orthosphinctes (Ardescia) schaireri* (ATROPS) (J-6-274) from the Golbini-Jorbat section, Platynota Zone.
Fig .3. *Orthosphinctes (Ardescia) proinconditus* (WEGELE) (J-6-275) from the Golbini-Jorbat section, Platynota Zone.
Fig. 4. *Dichotomoceras* sp. (CH-4-2) from the Chaman Bid section, Oxfordian.
Fig. 5. *Perisphinctes (Dichotomoceras)* cf. *microplicatilis* (QUENSTEDT) (S-8-71) from the Tooy-Takhtehbashgheh section, Middle Oxfordian.
Figs. 6-7. *Perisphinctes (Dichotomoceras) bifurcatus* (QUENSTEDT) from the Golbini-Jorbat section, Bifurcatus Zone. 6. Specimen J-5-258. 7. Specimen S-7-67.
Fig. 8. *Perisphinctes (Dichotomoceras)* cf. *bifurcatoides* (ENAY) (S-6-126) from the Tooy-Takhtehbashgheh section, Bifurcatus Zone.


1a
1b
2a
2b
3a
3b
4a
4b
5a
5b
6a
6b
7a
7b
8a
8b

specimen	D	U%	H%	W%	PR/2	SR/2
S-7-68	51	47	29	18		
S-7-67	44	43	34	25	16	32

Description: Umbilical wall vertical, umbilical shoulder rounded, whorl cross-section oval. Ribbing relatively sharp and dense. The primaries are rectiradiate at the umbilical margin, divide into two secondaries at around two-thirds of flank height, and cross the venter. In specimen S-4,5-68 the secondary ribs are rectiradiate, in the specimens S-4,5-67 and J-7,9-258b they are prorsiradiate.

Discussion: The present specimens closely resemble the holotype, but differ from the material studied by GYGI (1995) in being densely ribbbed. The characteristic features of this species are sharp ribs which are hollow at the point of bifurcation.

Stratigraphic distribution: Middle Oxfordian Bifurcatus Zone.

Perisphinctes (Dichotomoceras) cf. *microplicatilis* (QUENSTEDT, 1887)
Pl. 15, Fig. 5

1887 *Ammonites microplicatilis* sp. nov. – QUENSTEDT : 877, pl. 94, fig. 37.
1994 *Perisphinctes (Dichotomoceras) microplicatilis* (QUENSTEDT) - SCHLEGELMICH: 62, pl. 21, fig. 1.

Material: 1 specimen from section (3) (S-71).

Dimensions:

specimen	D	U%	H%	W%	PR/2	SR/2
S-8-71	27	37	37	22	15	31

Description: Umbilical shoulder fairly rounded, umbilical wall vertical, whorl cross-section high-oval, flank flat. Ribbing on inner whorls prorsiradiate. Primaries slightly prorsiradiate, dense and fine at the umbilical margin, splitting into two prorsiradiate secondaries, which cross the venter, at around two-thirds of flank height. Single intercalated ribs are also present.

Discussion: The present specimen differs from the holotype in having intercalatory ribs but no single ribs. Moreover the whorl cross-section of the holotype is somewhat wider.

Stratigraphic distribution: Upper Oxfordian.

Perisphinctes (Dichotomoceras) cf. *bifurcatoides* ENAY, 1966
Pl. 15, Fig. 8

1966 *Perisphinctes (Dichotomoceras) bifurcatoides* sp. nov. – ENAY: 509, pl. 34, fig. 155-2.

1981 *Perisphinctes (Dichotomoceras) bifurcatoides* ENAY - ENAY & BOULLIER: 753, pl. 6, figs. 1-2; pl. 2, fig. 2.
1989 *Perisphinctes (Dichotomoceras) bifurcatoides* ENAY – MELENDEZ: 315, pl. 52, figs. 1-3, pl. 53, figs. 1-3, pl. 54, figs. 1-4.
1994 *Perisphinctes (Dichotomoceras) bifurcatoides* ENAY – SCHLEGELMILCH: 62, pl. 20, fig. 5.

Material: 1 fragment from section (3) (S-126).

Description: Umbilical wall steep, whorl cross-section high-oval. Ribbing on inner whorls somewhat prorsiradiate. The primaries are strong, distant, coarse, and rectiradiate. Generally at around three-fourth, rarely at two-thirds of flank height they divide into two prorsiradiate secondaries, which cross prorsiradiate over the venter. Single ribs are rare.

Discussion: The specimen can be compared with MELENDEZ' (1989: pl. 52, figs. 1, 3) specimens in having distant, coarse, and strong ribs. However, his specimens differ somewhat in having strong and dense ribs. The specimen from Iran has finer ribs than *Perisphinctes (Dichotomoceras) bifurcatoides* of ENAY & BOULLIER (1981: pl. 2, fig. 2) but it resembles the specimen figured by them on pl. 6, figs. 1-2.

Stratigraphic distribution: Middle Oxfordian Bifurcatus Zone.

Perisphinctes (Dichotomoceras) sp.
Pl. 15, Fig. 4

Material: 1 specimen from section (4) (CH-2).

Dimensions:

specimen	D	U%	H%	W%	PR/2	SR/2
CH-4-2	61	46	33	23	32	61

Description and remarks: Umbilical wall nearly vertical, umbilical shoulder rounded. The ribbing is fairly dense and fine. The primaries begin at the umbilical margin and divide at around two-thirds of flank height into two secondaries, which cross the venter. On inner whorls the ribbing is somewhat prorsiradiate. Single ribs are present, and towards the aperture the whorl height increases.

Stratigraphic distribution: The taxon is usually recorded from the Oxfordian.

Genus *Larcheria* TINTANT, 1961

Larcheria schilli (OPPEL, 1863)

Pl. 16, Fig. 7

1863 *Pericphinctes schilli* sp.nov. – OPPEL:pl. 65, fig. 7.
1991 *Larcheria schilli* (OPPEL) - SCHLAMPP: 42, pl. 3, fig. 5.

Material: 1 specimen from section (3) (S-92).

Dimensions:

specimen	D	U%	H%	W%	PR/2	SR/2
S-6-92	63	36	30	38	17	

Description: Umbilicus wall vertical, whorl cross-section oval. The strong and coarse primaries divide at around two-thirds of flank height mainly into three secondaries which, together with intercalated ribs, cross the venter. The secondaries are thinner and fainter than the primaries. On the posterior part of the last visible whorl the primary ribs are denser than on the anterior. Towards the aperture shell width increases.

Discussion: The present specimen closely resembles the holotype (OPPEL 1863: pl. 65, fig. 7) except that the primaries are slightly more distant.

Stratigraphic distribution: Middle Oxfordian Transversarium Zone.

Subfamily Ataxioceratinae BUCKMAN, 1921
Genus *Idoceras* BURCKHARDT, 1906
Subgenus *Subnebrodites* SPATH, 1925

Idoceras (Subnebrodites) schroederi WEGELE, 1929
Pl. 13, Figs. 6, 9

1929 *Idoceras schroederi* sp. nov. – WEGELE: 77, pl. 9, figs. 5-6.
1977 *Idoceras schroederi* WEGELE – KEUPP: 172, fig. 5.
1994 *Idoceras schroederi* WEGELE – SCHLEGEMILCH: 71, pl. 26, fig. 2.
1989 *Idoceras (Subnebrodites) schroederi* WEGELE – SCHAIRER: 104, pl. 7, figs. 1-8.

Material: 3 specimens and 2 fragments from section (3) (S-8-82a-e).

Dimensions:

specimen	D	U%	H%	W%	PR/2	SR/2
S-8-82a	77	41	30	10	21	43
S-8-82b	73	45	32	18	24	46
S-8-82c	57	44	32		19	

Description: Whorl cross-section high-oval. The primaries divide, except for some, at about two-thirds of flank height into two prorsiradiate secondaries which, together with some intercalated ribs, cross prorsiradiate over the venter. The ribbing is strong and relatively dense, on the inner whorls denser than on the outer whorls. There is a shallow, oblique constriction.

Discussion: As the specimens are compressed they have a narrow venter. The present material is very similar to specimens studied by WEGELE (1929: 77) and SCHAIRER (1989: 104), but the specimens are somewhat thinner. According to SCHAIRER (1989: 104) *Idoceras planula* and *I. laxevolutum* have a wider whorl cross-section and are more evolute. Moreover *I. planula* is larger and *I. minutum* smaller. The specimen S-8-82 (Pl. 13, Fig. 6) exhibits lappets and is thereforea microconch.

Stratigraphic distribution: Upper Oxfordian Planula Zone.

Subfamily Passendorferiinae MELENDEZ, 1989
Genus Passendorferia BROCHWICZ-LEWINSKI, 1973
Subgenus Enayites BROCHWICZ-LEWINSKI & ROZAK, 1976

Passendorferia (Enayites) sp.
Pl. 16, Fig. 4

Material: 1 fragment from section (2) (J-278a), 1 specimen and 5 fragments from section (3) (S-8-93a-f).

Dimensions:

specimen	D	U%	H%	W%	PR/2	SR/2
S-8-93a	37	49	27	28	22	

Description and remarks: Umbilical wall vertical, umbilical shoulder rounded, whorl cross-section subrectangular. The primaries are strong and rectiradiate to prorsiradiate. They start at the umbilical margin and divide at around the venter shoulder into two secondaries which cross over the venter. Towards the aperture the ribbing is dense and strong. There are two prorsiradiate constrictions on the last visible whorl.

Stratigraphic distribution: Upper Oxfordian.

Genus *Sequeirosia* MELENDEZ, 1989
Subgenus *Gemmellarites* MELENDEZ, 1989

Sequeirosia (Gemmellarites) sp.
Pl. 16, Fig. 3

Material: 1 specimen from section (2) (J-276).

Dimensions:

specimen	D	U%	H%	W%	SR/2	PR/2
J-6-276	58	45	31		30	

]

Description and remarks: Umbilicus wall nearly vertical and low. The inner whorls are somewhat prorsiradiate. The dense and fine primaries divide usually at around three-fourth of flank height into two secondaries which cross the venter. There are four constrictions per whorl.

Stratigraphic distribution: Lower Kimmeridgian.

Genus *Subdiscosphinctes* MALINOWSKA, 1972

Subdiscosphinctes sp.
Pl. 16, Figs. 5-6, 8

Material: 1 specimen and 1 fragment from section (2) (J-260, 264), 2 fragments from section (3) (S-125a-b).

Dimensions:

specimen	D	U%	H%	W%	PR/2	SR/2
J-5-260	79	32	39	25	47	

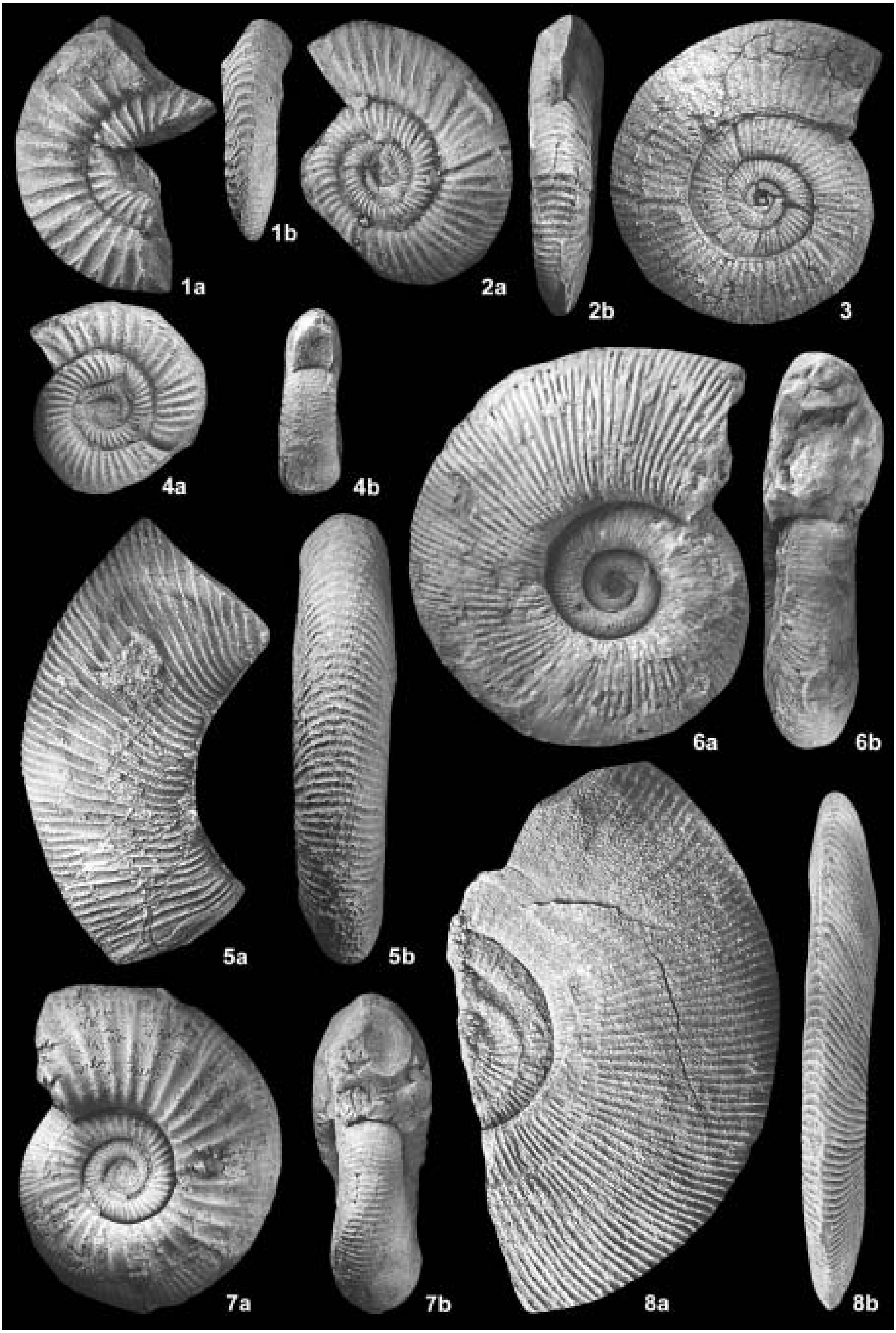
Description and remarks: Umbilical wall vertical, whorl cross-section subrectangular, flank flat, and venter arched. The dense and prorsiradiate primaries start at the umbilical margin and divide at around two-thirds of flank height into two secondaries which, together with some simple ribs, cross the venter.

Stratigraphic distribution: According to CARIOU et al. (1997: 82) *Subdiscosphinctes* occurs in the upper part of the Middle Oxfordian (Transversarium Zone, mainly Luciaeformis and Schilli subzones). The specimens mentioned by BEZNOSOV & MITTA (1995) appear to have come from the Upper Oxfordian Bimammatum Zone.

Subfamily Aulacostephaninae SPATH, 1924
Genus *Sutneria* ZITTEL, 1884

EXPLANATION OF PLATE 16

Fig. 1. *Perisphinctes (Dichotomoceras) bifurcatus* (QUENSTEDT) (S-6-66) from the Tooy-Takhtehbashgheh section, Bifurcatus Zone.
Fig. 2. *Orthosphinctes (Ardescia)* sp. (J-6-273) from the Golbini-Jorbat section, Platynota Zone.
Fig. 3. *Sequeirosia (Gemmellarites)* sp. (J-6-276) from the Golbini-Jorbat section, Transversarium Zone.
Fig. 4. *Passendorferia (Enayites)* sp. (S-8-93) from the Tooy-Takhtehbashgheh section, Oxfordian.
Figs. 5-6, 8. *Subdiscosphinctes* sp. from the Tooy-Takhtehbashgheh section, Bimammatum Zone. 5. Specimen S-8-125b. 6. Specimen S-8-93. 8. Specimen S-8-125a.
Fig. 7. *Larcheria schilli* (OPPEL) (S-6-92) from the Tooy-Takhtehbashgheh section, Transversarium Zone.


1a
1b
2a
2b
3
4a
4b
5a
5b
6a
6b
7a
7b
8a
8b

Sutneria eumela (D´ORBIGNY, 1847)
Pl. 17, Figs. 3-6

1847 *Ammonites eumelus* sp. nov. - D´ORBIGNY: 554, pl. 216, figs. 1-3.
1979 *Sutneria eumela* (D´ORBIGNY) – SAPUNOV: 104, pl. 27, fig. 2.
1979 *Sutneria eumela* (D´ORBIGNY) – ZEISS: 269, fig. 2/2, , fig. 3/1-13.
1994 *Sutneria* (*Enosphinctes) eumela* (D´ORBIGNY) – SCHLEGELMILCH: 114, pl. 59, fig. 11.
1998 *Sutneria eumela*(D´ORBIGNY)- SEYED-EMAMI et al.: 104, pl. 1, fig. 8.

Material: 4 specimens from section (3), No. S-102-103, 105-106.

Dimensions:

specimen	D	U%	H%	W%	PR/2	SR/2
S-9-102	19	26	53	37	8	17
S-9-103	27	37	44	22	10	21
S-9-105	25	44	40	20	10	23
S-9-106	25	36	40	24		23

Description: Shell fairly involute, umbilical shoulder rounded. Primary ribs prorsiradiate, dense and slightly blunt at the umbilical margin, usually dividing into two rectiradiate to rursiradiate secondaries at around one-third of flank height with intercalatory ribs. The ribbing continues towards the venter. There are faint nodes at one-third of flank height.

Discussion: The specimens S-9-103 and 106 are very compressed, specimen S-9-105 less so. Specimen S-7-105 exhibits trifurcate ribs and somewhat finer secondaries than the other specimens.

Stratigraphic distribution: Lower Kimmeridgian.

Sutneria lorioli ZEISS, 1979
Pl. 17, Figs. 1-2

1977 *Sutneria eumela* (D´ ORBIGNY) – ZIEGLER: 64, pl. 5, fig.4.
1979 *Sutneria lorioli* sp. nov. – ZEISS: 272, fig. 2 (1, 4-5).

Material: 2 fragments from section (3) (S-100-101).

Description: Shell nearly involute, umbilical shoulder rounded. The bullate and prorsiradiate primary ribs begin at the umbilical margin and end in nodes at one-third of flank height, from where they bifurcate. The secondaries are rursiradiate, especially towards the end of the last visible whorl, and continue towards the venter, but do not cross. Rarely, single intercalated ribs are present.

Discussion: The specimens from Iran resemble the holotype. The two fragments are compressed. They differ from *Sutneria eumela* (D´ORBIGNY, 1847) in having stronger and more rursiradiate ribs. Compared to *Sutneria batalleri* they have radial and denser ribs.

Stratigraphic distribution: According to ZEISS (1979) *Sutneria lorioli* occurs in the Lower-Middle Kimmeridgian. The present specimens come from the Lower Kimmeridgian.

Subfamily Virgatosphinctinae SPATH, 1923
Genus *Sublithacoceras* SPATH, 1925

Sublithacoceras sp.
Pl. 17, Fig. 7

Material: 1 specimen from section (4) (CH-42).

Dimensions:

specimen	D	U%	H%	W%
CH-7-42	58	19	21	7

Description and remarks: Shell compressed, venter very narrow. The inner whorls are finely, densely and regularly ribbed with long secondaries. The primaries start at the umbilical margin and divide, except for a few, into two secondaries, which cross the venter, at around mid-flank.
Stratigraphic distribution: *Sublithacoceras* is known from the upper part of the Lower Tithonian Penicillatum/Rothpletzi Zone (= Semiforme/Verruciferum Zone + Fallauxi Zone, Richteri Subzone; GEYSSANT 1997: 99). The present specimen comes from the Richteri Zone.

Genus *Phanerostephanus* SPATH, 1950

Phanerostephanus subsenex SPATH, 1950
Pl. 18, Figs. 6, 8

1950 *Phanerostephanus subsenex* sp. nov. – SPATH: 105, pl. 6, fig. 15, pl. 7, figs. 5-7.
1992 *Phanerostephanus subsenex* SPATH – HOWARTH: pl. 1, figs. 7-8.

Material: 6 specimens and 2 fragments from section (4) (CH-6-12-16, 33-35).

Dimensions:

specimen	D	U%	H%	W%	PR	SR
CH-6-13(body whorl)	107	41	33	25	10	
CH-6-14(body whorl)	83	42	31		17	
CH-6-15(body whorl)	72	40	33	29	12	
CH-6-16 (body whorl)	67	36	37	31	16	
CH-6-33	62	43	34	26	25	57

CH-6-35	59	41	32		25	54

Description: Shell relatively evolute, whorl cross-section little higher than wide and oval, flank nearly flat, venter arched, umbilical wall nearly vertical, and umbilical margin broadly rounded. The ribbing on the inner whorls consists of regular, relatively dense and prorsiradiate ribs, starting at the seam and bifurcating near the outer part of the flank, with few intercalatory ribs. Close to the body whorl the ribs become coarser and distant and split into three to four secondary ribs. Towards the outer whorls, the primary ribs rapidly give way to prorsiradiate, irregular bullate ribs starting at the umbilical margin and vanishing about mid-flank. At this stage no secondary ribs are developed and the venter is smooth. Some of the primary ribs may continue towards the venter. A few constrictions can be seen. The body chamber seems to occupy about four-fifth of the outer whorl.

Discussion: The large specimen CH-6-13 is fully grown with D=107 mm at the end of the body whorl. It closely resembles the holotype figured by SPATH (1950: pl. 7, fig. 5).
Stratigraphic distribution: According to SPATH (1950) *Phanerostephanus subsenex* occurs in the upper part of the Lower Tithonian to lower part of the Upper Tithonian of Kurdistan (northern Iraq). The present specimens come from the Lower Tithonian because at the top of its stratigraphic range *Ph. subsenex* co-occurs with abundant *Richterella richteri* which indicates Lower Tithonian (CECCA 1986). Therefore, *Ph. subsenex* is older than *R. richteri*.

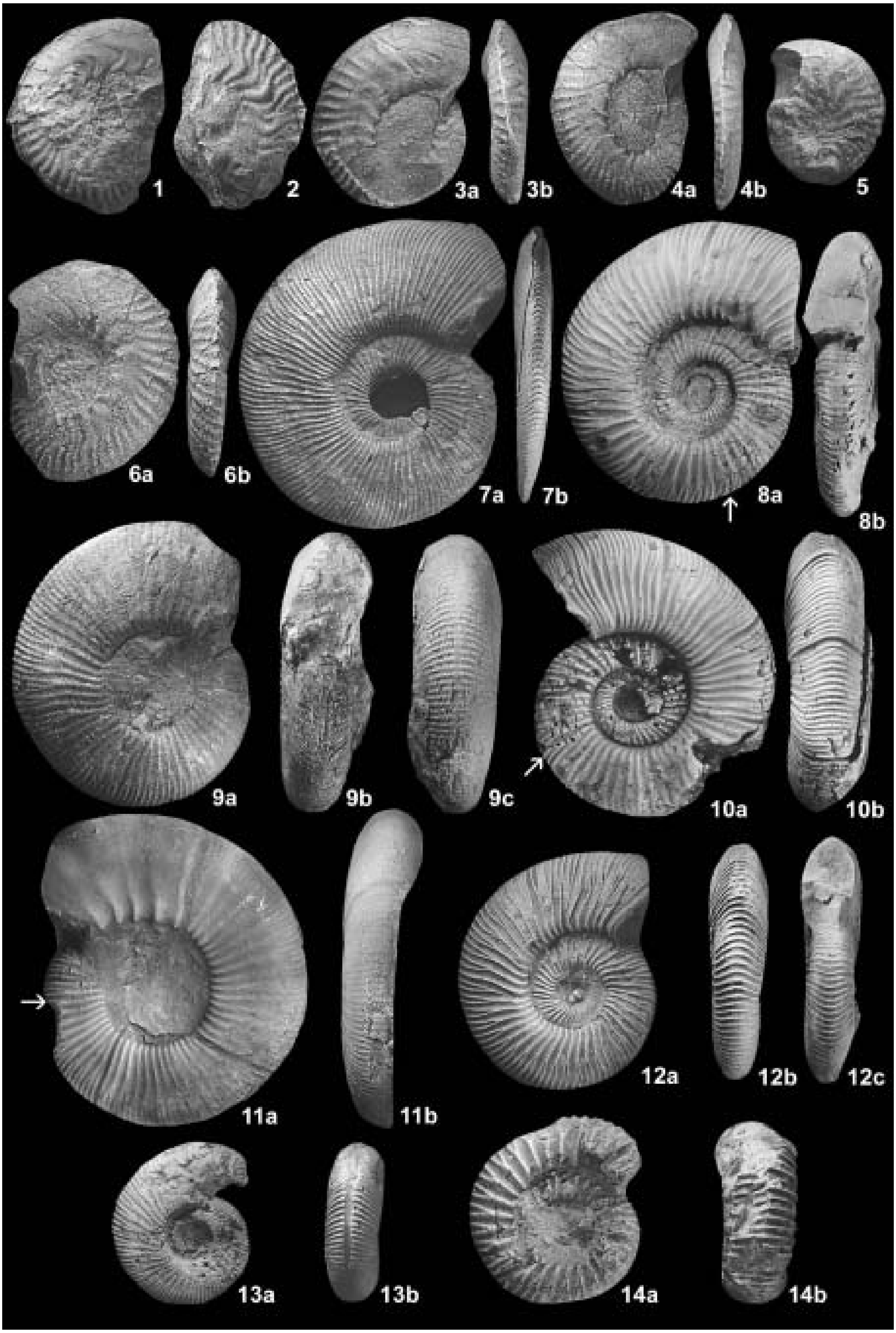
Phanerostephanus sp. A
Pl. 17, Fig. 12, Pl. 18, Fig. 2

Material: 4 specimens and 2 fragments from section (4) (CH-6-10a-d, 32a-b).

Dimensions:

EXPLANATION OF PLATE 17

Figs. 1, 2. *Sutneria lorioli* (ZEISS) from the Tooy-Takhtehbashgheh section, Eudoxus Zone. 1. Specimen S-9-100. 2. Specimen S-9-101, x1.5.
Figs. 3-6. *Sutneria eumela* (D´ORBIGNY) from the Tooy-Takhtehbashgheh section, Kimmeridgian. 3. Specimen S-9-106. 4. Specimen S-9-105. 5. Specimen S-9-102. 6. Specimen S-9-103, x1.5.
Fig. 7. *Sublithacoceras* sp. (CH-7-42) from the Chaman Bid section, Penicillatum/Rothpletzi Zone.
Figs. 8, 10, 11. *Phanerostephanus* sp. B from the Chaman Bid section, Lower Tithonian. 8. Specimen CH-6-25a, with body chamber. 10. Specimen CH-6-26a. 11. Specimen CH-6-27, with body chamber.
Fig. 9. *Phanerostephanus* sp. C (CH-6-23) from the Chaman Bid section, Lower Tithonian.
Fig. 12.*Phanerostephanus* sp. A (CH-6-10a) from the Chaman Bid section, Lower Tithonian.
Fig. 13. *Nothostephanus* sp. (Ch-6-9a) from the Chaman Bid section, Lower Tithonian.
Fig. 14. *Nannostephanus* cf. *subcornutus* (SPATH) (CH-6-13b) from the Chaman Bid section, Lower Tithonian.


1
2
3a
3b
4a
4b
5
6a
6b
7a
7b
8a
8b
9a
9b
9c
10a
10b
11a
11b
12a
12b
12c
13a
13b
14a
14b

specimen	D	U%	H%	W%	PR	SR
CH-6-32a	50	44	34	28	26	54
CH-6-10a	48	40	33	25	25	

Description and remarks: Shell relatively evolute with ovate whorl cross-section, low and rounded umbilicus, flat flank, and arched venter. The ribbing is slightly prorsiradiate, fine and sharp. The primaries begin at the umbilical margin and divide usually into two secondaries near mid-flank and cross the venter.

Stratigraphic distribution: Lower Tithonian.

Phanerostephanus sp. B
Pl. 17, Figs. 8, 10, 11

Material: 5 specimens and 8 fragments from section (4) (CH-25a-e, 26a-h).

Dimensions:

specimen	D	U%	H%	W%	PR	SR
CH-6-25a (body whorl)	54	44	35	28	28	58
CH-6-26a (body whorl)	55	40	36	28	28	

Remarks: Shell relatively evolute with high-ovate whorl cross-section, low and rounded umbilicus, flat flank, and arched, broad venter. The ribbing is slightly prorsiradiate and coarse. The primaries begin at the umbilical margin and split mainly into two, rarely three, secondaries at around two-thirds of flank height, which cross the venter. There are four prorsiradiate, deep constrictions on the last whorl. The body chamber seems to occupy about four-fifth of the outer whorl. *Phanerostephanus* sp. B differs from *Phanerostephanus* sp. A in having constrictions and relatively coarse ribs.

Stratigraphic distribution: Lower Tithonian.

Phanerostephanus sp. C
Pl. 17, Fig. 9

Material: 2 specimens from section (4) (CH-22-23).

Dimensions:

specimen	D	U%	H%	W%	PR	SR
CH-6-22	52	33	40	37	26	55
CH-6-23	54	33	39	31	28	61

Description: Shell relatively evolute with an ovate whorl cross-section which is higher than broad. Venter rounded and arched. Primary ribs dense and prorsiradiate. They start at the umbilical margin and divide into two or three dense secondaries at around two-thirds of flank height and continue towards the venter. There are three prorsiradiate constrictions on the last visible whorl.

Discussion: The present specimens closely resemble *Phanerostephanus intermedius* (SPATH 1950) but as inner whorls and umbilical area cannot be observed, it is better to keep them informally as *Phanerostephanus* sp. C. *Phanerostephanus* sp. C differs from *Phanerostephanus* sp. A and B in being more inflated and more involute.

Stratigraphic distribution: Lower Tithonian.

Genus *Nothostephanus* SPATH, 1950
Nothostephanus sp.
Pl. 17, Fig. 13; Pl. 18, Fig. 1

Material: 1 specimen and 1 fragment from section (4) (CH-9a-b).

Dimensions:

specimen	D	U%	H%	W%	PR	SR
Ch-6-9a	50	30	44		28	56

Description: Shell fairly involute with ovate whorl cross-section and nearly flat flank. The ribbing is prorsiradiate, regular, and dense. The primaries begin at the umbilical margin and divide into two and rarely into three secondaries at around two-thirds of flank height. Some ribs remain simple.

Discussion: With regard to its dense ribbing, increasing height on the last visible whorl and nearly involute coiling the specimens fit into *Nothostephanus.* This genus is connected with *Phanerostephanus* by transitions.

Stratigraphic distribution: *Nothostephanus* sp. co-occurs with *Phanerostephanus subsenex* in the Lower Tithonian.

Genus *Nannostephanus* SPATH, 1950
Nannostephanus cf. *subcornutus* SPATH, 1950
Pl. 17, Fig. 14, Pl. 18, Fig. 3

1950 *Nannostephanus subcornutus* sp. nov. – SPATH: 111, pl. 10, figs. 7-10.
1992 *Nannostephanus subcornutus* SPATH – HOWARTH: pl. 1, figs. 3-4.

Material: 2 specimens from section (4) (13a-b).

Dimensions:

specimen	D	U%	H%	W%	PR	SR
CH-6-13a	49	43	35		17	
CH-6-13b	25	52	24	36	16	32

Description: Shell evolute with approximately rectangular whorl cross-section, rounded umbilical shoulder, nearly vertical umbilical wall, and broad rounded venter. The ribbing on the inner whorls is fine, but coarse, strong and distant on the middle and outer whorls. The prorsiradiate primaries begin at the umbilical margin and end at faint tubercles near the venter shoulder, from where they bifurcate. The prorsiradiate ribbing continues towards the venter.

Discussion: The specimens have slightly denser ribs than the holotype figured by SPATH (1950: pl. 10, figs. 7-10).

Stratigraphic distribution. *Nannostephanus* cf. *subcornutus* co-occurs with *Phanerostephanus subsenex* in the Lower Tithonian.

Family Ataxioceratidae BUCKMAN, 1921
Subfamily *Lithacoceratinae* ZEISS, 1968

Richterella richteri (OPPEL, 1865)
Pl. 18, Figs. 4-5, 7, Pl. 19, Figs. 1-3, 6-8

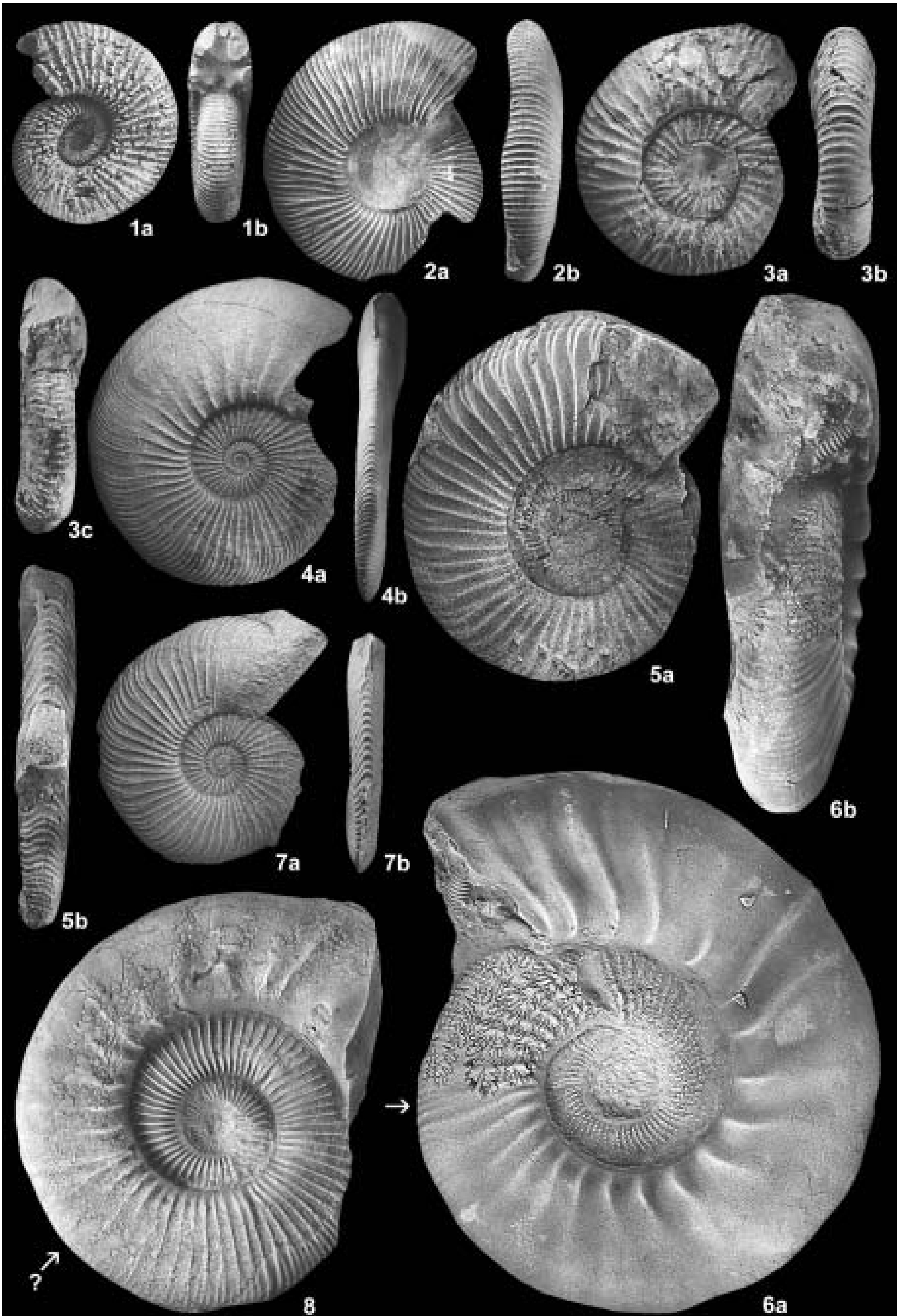
1865 *Ammonites Richteri* sp. nov. – OPPEL: 556.
1889 *Perisphinctes Richteri* (OPPEL) – BOGDANOWITCH: 175, pl. 4, figs. 1-2.
1979 *Richterella richteri* (OPPEL) – SAPUNOV: 136, pl. 40, fig. 7.
1986 *Richterella richteri* (OPPEL) – CECCA: pl. 1, figs. 1-2, 4-5, 7-8, 10-12.
1993 *Richterella richteri* (OPPEL) – SCHAIRER: 41, pl. 3, fig. 3.
1999 *Richterella richteri*(OPPEL)- SCHAIRER et al.: 27, pl. 2, figs. 3-6.

Material: 16 specimens and 75 fragments from section (4), (CH-37-39, 44-45, 51-60, 65-141), 1 specimen and 3 fragments from section (2) (J-7-293, 294a-c).

Dimensions:

EXPLANATION OF PLATE 18

Fig. 1. *Nothostephanus* sp. (Ch-6-9b) from the Chaman Bid section, Lower Tithonian, x1.5.
Fig. 2. *Phanerostephanus* sp. A (CH-6-9) from the Chaman Bid section, Lower Tithonian.
Fig. 3. *Nannostephanus* cf. *subcornutus* (SPATH) (CH-6-13a) from the Chaman Bid section, Lower Tithonian.
Figs. 4-5, 7. *Richterella richteri* (OPPEL) from the Chaman Bid (4, 7)and Golbini-Jorbat (5) sections, Fallauxi Zone. 4. Specimen CH-7-38. 5. Specimen J-7-293. 7. Specimen CH-7-44.
Figs. 6, 8. *Phanerostephanus subsenex* (SPATH) with body chamber from the Chaman Bid section, Lower Tithonian. 6. Specimen CH-6-13. 8. Specimen CH-6-14.


1a
1b
2a
2b
3a
3b
3c
4a
4b
5a
6b
7a
7b
5b
?
8
6a

specimen	D	U%	H%	W%	SR	PR
J-7-293	69	41	36	14	27	58
CH-7-38	61	31	39	15	23	
CH-7-53	55	35	40	15	28	60
CH-7-37	52	38	35	15	22	44
CH-7-39	52	36	35	13	22	49
CH-7-44	47	34	38	13	24	44
CH-7-45	48	37	38	12	26	51
CH-7-52	40	40	38	15	20	40
CH-7-51	50	30	40	12	22	44
CH-7-55	46	37	37	11	22	44
CH-7-57	45	31	40	13	26	54
CH-7-54	44	34	41	18	24	48
CH-7-56	37	32	43	13	23	46
CH-7-60	40	30	43	12	22	45
CH-7-58	28	36	39	21	17	32
CH-7-59	29	38	38	17	16	

Description: Shell evolute with high and compressed oval whorl cross-section, rounded umbilical margin, and nearly vertical umbilical wall. The ribbing is relatively dense, regular, fine, and slightly rectiradiate. The primary ribs begin at the umbilical margin and divide usually into two (rarely into three) falcoid and prorsiradiate secondaries at around mid-flank to two-thirds of flank height, from where they continue towards the venter. In a few cases the ribs remain single. There are one or two intercalatory ribs that begin at the mid-flank.

Discussion: The specimens can be compared with the material described and figured by CECCA (1986). The specimens J-7-293 (Pl. 18, Fig. 5) and CH-7-37 (Pl. 19, Fig. 1) have coarser and stronger ribs than the other specimens. For this reason they are referred to *Richterella richteri* with reservation. Some of the specimens, e.g. J-7-293 and CH-7-37, have only bifurcating ribs whereas others, such as specimen CH-7-44 and 45, have mainly bifurcating and rarely single ribs. Yet other specimens such as CH-8-96 have mainly bifurcating and rarely trifurcating ribs. There is another difference between the present specimens in that the secondaries start at mid- flank in some of them (e.g. CH-7-69) and at around two-thirds of flank height in some others (e.g. CH-7-37, 44).

Stratigraphic distribution: Lower Tithonian Fallauxi Zone (OLORIZ 1978; CECCA 1986), Richteri Subzone (GEYSSANT 1997: 98).

Family Aspidoceratidae ZITTEL, 1895
Subfamily Peltoceratinae SPATH, 1924
Genus *Parawedekindia* SCHINDEWOLF, 1925

Parawedekindia callomoni SAPUNOV, 1979
Pl. 19, Fig. 5

1979 *Parawedekindia callomoni* sp. nov. – SAPUNOV: 154, pl. 47, fig. 5.

Material: 1 specimen from section (3) (S-58).

Dimensions:

specimen	D	U%	H%	W%	PR/2	SR/2
S-3-58	83	45	34		21	35

Description and remarks: Umbilical wall vertical. Primary ribs strong and coarse, dividing near umbilical margin into two convex secondaries that cross straight over the venter. The ribs on inner whorls are finer than those on outer whorls. The present species is easily distinguished from other species of the genus by its fine and dense ribs on the inner whorls. The specimen is slightly smaller than the holotype (SAPUNOV 1979: pl. 47, fig. 5).

Stratigraphic distribution: According to SAPUNOV (1979: 154) *Parawedekindia callomoni* occurs in the ?Lower or ?Middle Oxfordian. However, the present specimen comes from the ?Upper Callovian.

Parawedekindia stephanovi SAPUNOV, 1979
Pl. 19, Fig. 4

1979 *Parawedekindia stephanovi* sp. nov. – SAPUNOV: 156, pl. 48, fig. 2.

Material: 1 specimen from section (3) (S-118).

Dimensions:

specimen	D	U%	H%	W%	PR/2	SR/2
S-4-118	56	47	31			27

Description: Umbilical wall vertical, whorl cross-section oval, venter relatively narrow. The primaries start at the umbilical margin. Some of them divide near the umbilical margin into two slightly rursiradiate secondaries, other ribs do not divide and cross over the venter. The ribs on inner whorls are finer than those on outer whorls. On inner whorls the primaries divide at around mid-flank.

Discussion: The specimen is slightly smaller than the holotype, and differs from *Parawedekindia callomoni* in having distant ribs and a smaller height/width ratio.

Stratigraphic distribution: Oxfordian.

Genus *Epipeltoceras* SPATH, 1924

Epipeltoceras cf. *berrense* (FAVRE, 1876)
Pl. 20, Fig. 4

1876 *Ammonites (Peltoceras) berrensis* sp. nov.– FAVRE: 59, pl. 3, fig. 11, pl. 4, fig. 8.
1994 *Epipeltoceras berrense* (FAVRE) - SCHLEGELMILCH: 67, pl. 23, fig. 9.

Material: 1 specimen from section (3) (S-69).

Description and remarks: The ribbing is simple, strong, and radial. There are distinct rounded tubercles at the venter shoulder. The venter is smooth and broad. The present specimen closely resembles the holotype figured by FAVRE (1876: pl. 3, fig. 11), but differs slightly in having dense ribs. *Epipeltoceras berrense* occurs in the Middle Oxfordian.

Genus *Peltoceras* WAAGEN, 1871

Peltoceras sp.
Pl. 20, Fig. 1

Material: 1 specimen from section (3) (S-117).

Dimensions:

specimen	D	U%	H%	W%
S-3-117	43	37	35	35

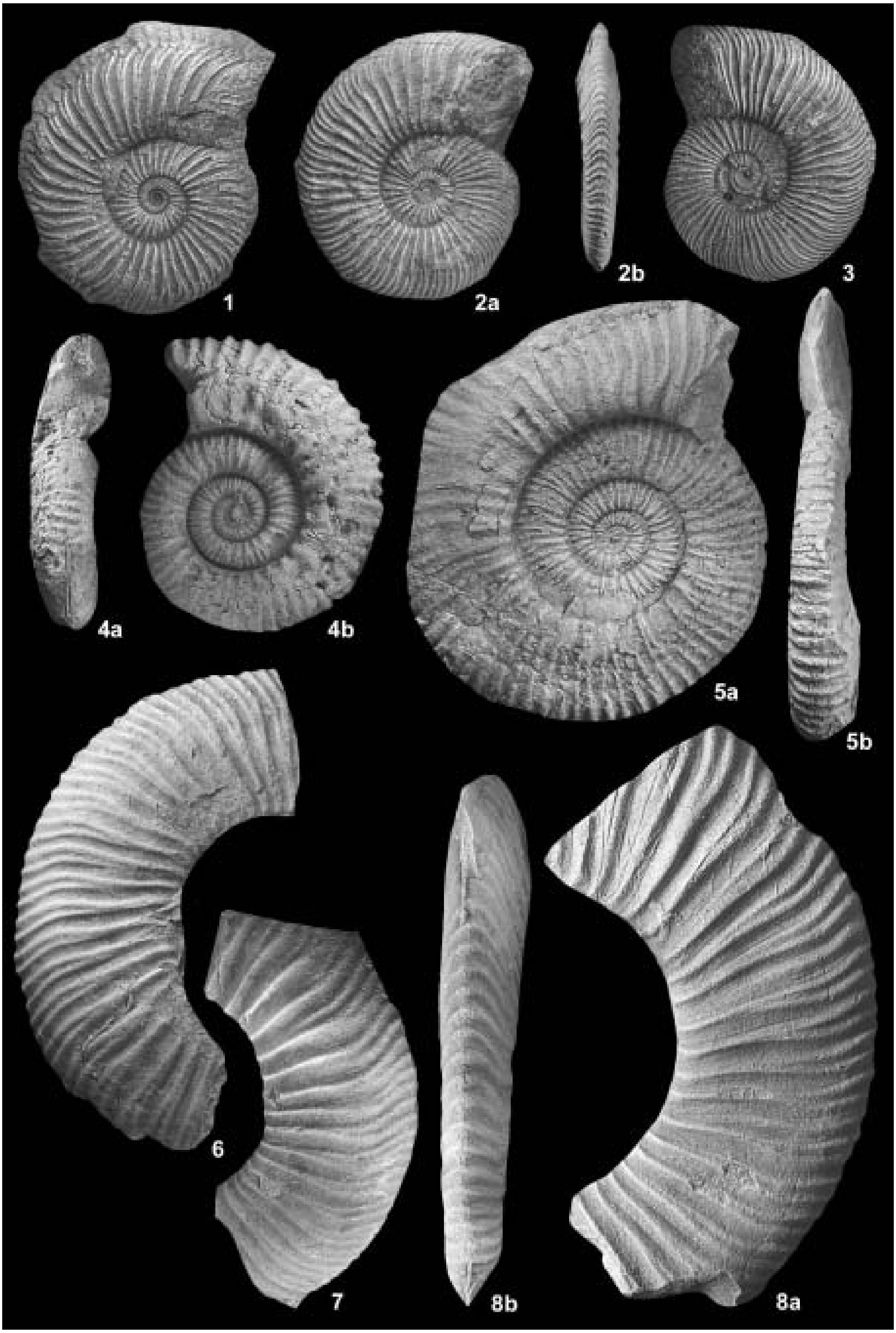
Description and remarks: The poorly preserved specimen has a distinctly rectangular whorl cross-section and a broad venter. There are spines at the venter shoulder. The inner whorls are depressed and carry fine ribs.

Stratigraphic distribution: Upper Callovian to Lower Oxfordian.

Subfamily Aspidoceratinae ZITTEL, 1895
Genus *Pseudowaagenia* SPATH, 1931

EXPLANATION OF PLATE 19

Figs. 1-3, 6-8. *Richterella richteri* (OPPEL) from the Chaman Bid section, Fallauxi Zone. 1. Specimen CH-7-37. 2. Specimen CH-7-36. 3. Specimen CH-7-45. 6. Specimen CH-7-39. 7. Specimen CH-7-40, a questionable macroconch. 8. Specimen CH-7-43, macroconch.
Fig. 4. *Parawedekindia stephanovi* (SAPUNOV) (S-4-118) from the Tooy-Takhtehbashgheh section, Oxfordian.
Fig. 5. *Parawedekindia callomoni* (SAPUNOV) (S-3-58) from the Tooy-Takhtehbashgheh section, ?Lower or ?Middle Oxfordian.


1
2a
2b
3
4a
4b
5a
5b
6
7
8b
8a

Pseudowaagenia tietzei NEUMAYR, 1871

Pl. 20, Fig. 2

cf 1871 *Aspidoceras Tietzei* nov. sp. – NEUMAYR: 374, pl. 18, figs. 8-9.
1907 *Aspidoceras Tietzei* NEUMAYR – OPPENHEIMER: 242, pl. 2, fig. 18.

Material: 1 specimen from section (2) (J-262).

Dimensions:

specimen	D	U%	H%	W%
J-9-262	63	38	38	

Description: There are rounded tubercles close to the umbilical margin and venter shoulder. The ventral tubercles are slightly stronger than the lateral tubercles. The venter is fairly narrow.
The Iranian specimen can be compared with the specimen figured by OPPENHEIMER (1907: 242, pl. 2, fig. 18) in having rounded tubercles at the umbilical margin and venter shoulder. It has finer ribs than the holotype of NEUMAYR (1871: 374, pl. 18, figs. 8-9).

Genus *Physodoceras* HYATT, 1900

Physodoceras sp.
Pl. 20, Fig. 5a-b

Material: 3 fragments from section (3) (S-106a-c).

Description and remarks: Shell small, poorly preserved. There are spines at the umbilical margin and at mid-flank flank, and also fine ribs that start from the spines at the umbilical margin. The spines at the umbilical margin are more numerous and smaller than spines at mid- flank.

Stratigraphic distribution: Lower to Middle Kimmeridgian.

Subfamily Euaspidoceratinae SPATH, 1931

Extrenodites sp.
Pl. 20, Fig. 6a-b

Material: 1 specimen from section (3) (S-6-70).

Dimensions:

specimen	D	U%	H%	W%	PR/2	SR/2
S-6-70	44	38	36	19	13	

Description and remarks: Umbilicus and venter fairly narrow. Ribbing simple, strong, distant, coarse, and rectiradiate. The ribs terminate in distinct tubercles on the venter. The ribs on the inner whorls are denser and fainter than those on the outer whorls.

Stratigraphic distribution: Middle Oxfordian.

Genus *Euaspidoceras* SPATH, 1931

Euaspidoceras hypselum (OPPEL, 1863)
Pl. 20, Fig. 3

1863 *Ammonites hypselum* sp. nov. – OPPEL : 229, pl. 64, fig. 2.
1887 *Ammonites perarmatus* – QUENSTEDT : 886, pl. 96, fig. 1.
1979 *Euaspidoceras hypselum* (OPPEL) – SAPUNOV : 148, pl. 45, fig. 2, pl. 46, fig. 1.
1991 *Euaspidoceras (Euaspidoceras) hypselum* (OPPEL) – SCHLAMPP: 75, pl. 24, fig. 3.
1994 *Euaspidoceras hypselum* (OPPEL) - SCHLEGELMILCH: 120, pl. 63, fig. 1.

Material: 1 specimen from section (2) (J-5-261).

Dimensions:

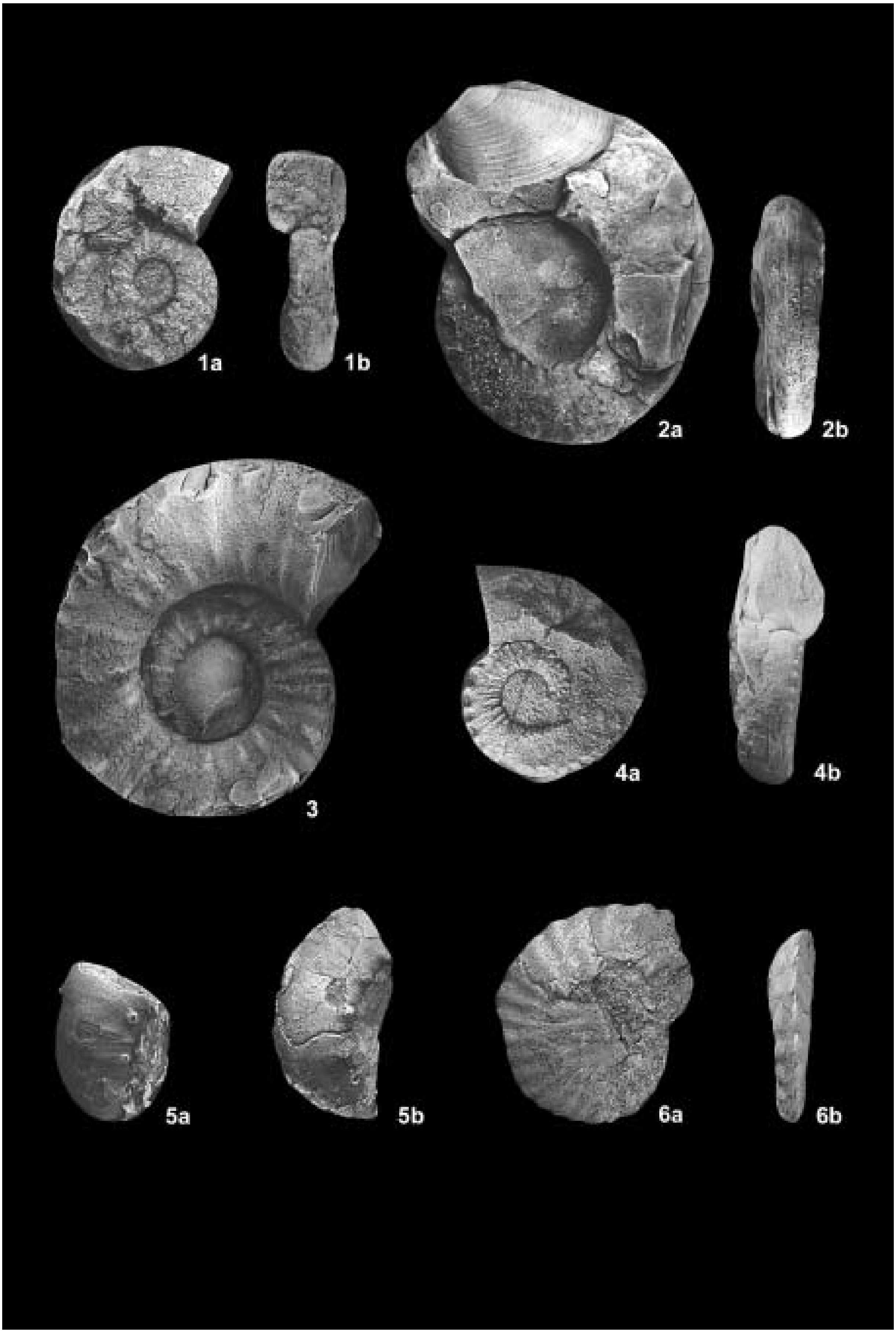
specimen	D	U%	H%	W%	N	
J-5-261	72	42	35	33	11	

Description and remarks: Shell evolute with nearly vertical umbilical wall, rectangular whorl cross-section, and broad venter. There are rounded tubercles close to the umbilical margin and venter shoulder. The tubercles are stronger and larger on the anterior part than posterior part of the last visible whorl. The ribs are faint on the flank and unknown on the venter.
The present specimen differs from other species by its rounded and strong tubercles and the rectangular whorl cross-section.

Stratigraphic distribution: Lower part of the Upper Oxfordian Bimammatum Zone.

EXPLANATION OF PLATE 20

Fig.1. *Peltoceras* sp. (S-3-117) from the Tooy-Takhtehbashgheh section, Upper Callovian.
Fig. 2. *Pseudowaagenia tietzei* (NEUMAYR) (J-9-262) from the Golbini-Jorbat section, Oxfordian.
Fig. 3. *Euaspidoceras hypselum* (OPPEL) (J-5-261) from the Golbini-Jorbat section, Bimammatum Zone.
Fig. 4. *Epipeltoceras* cf. *berrense* (FAVRE) (S-5-69) from the Tooy-Takhtehbashgheh section, Middle Oxfordian.
Fig. 5. *Physodoceras* sp. from the Tooy-Takhtehbashgheh section, Lower to Middle Kimmeridgian. 5a. Specimen S-9-106a. 5b. Specimen S-9-106b, x1.5.
Fig. 6. *Extrenodites* sp. (S-6-70) from the Tooy-Takhtehbashgheh section, Middle Oxfordian.


1a
1b
2a
2b
3
4a
4b
5a
5b
6a
6b

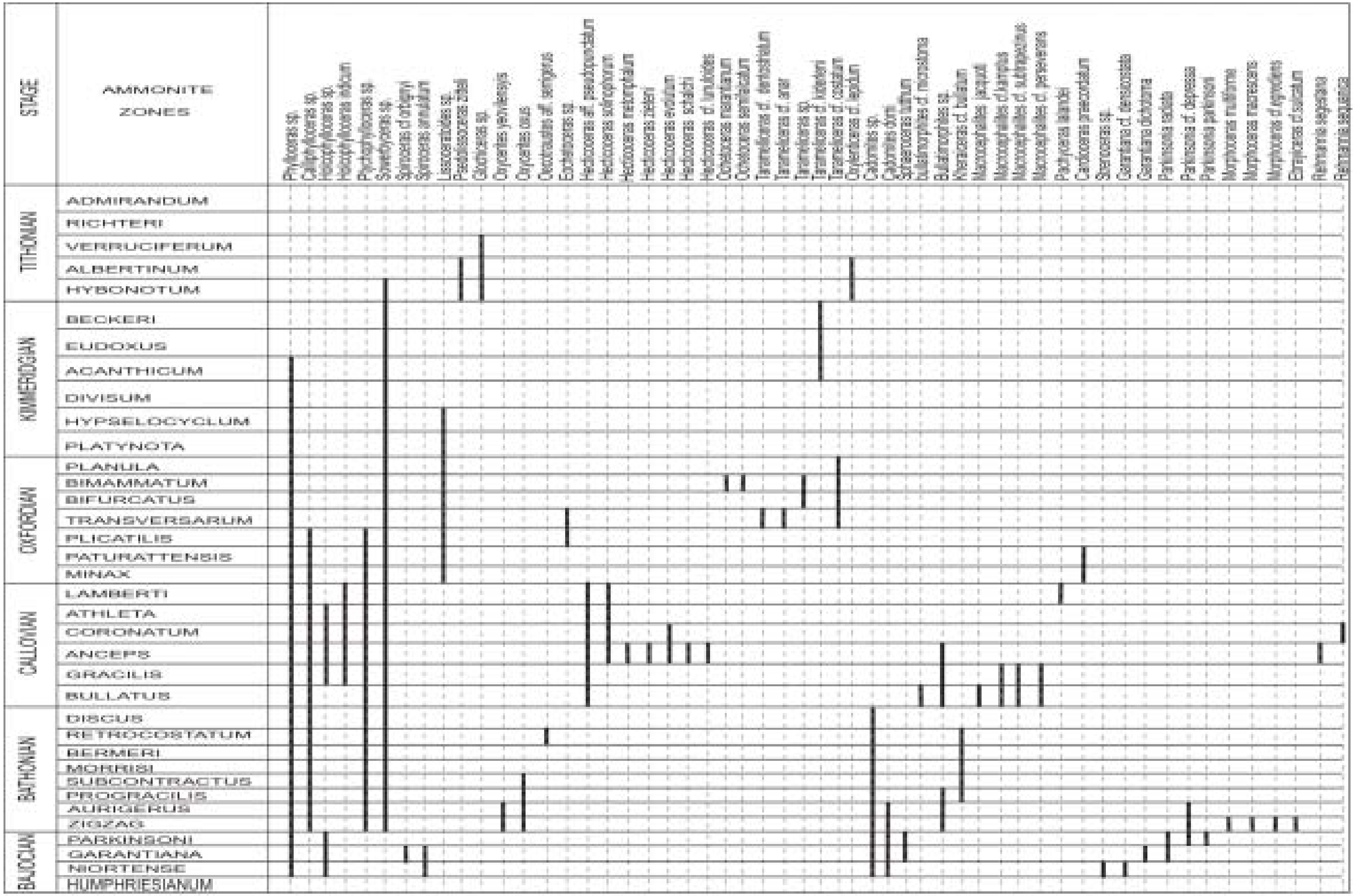
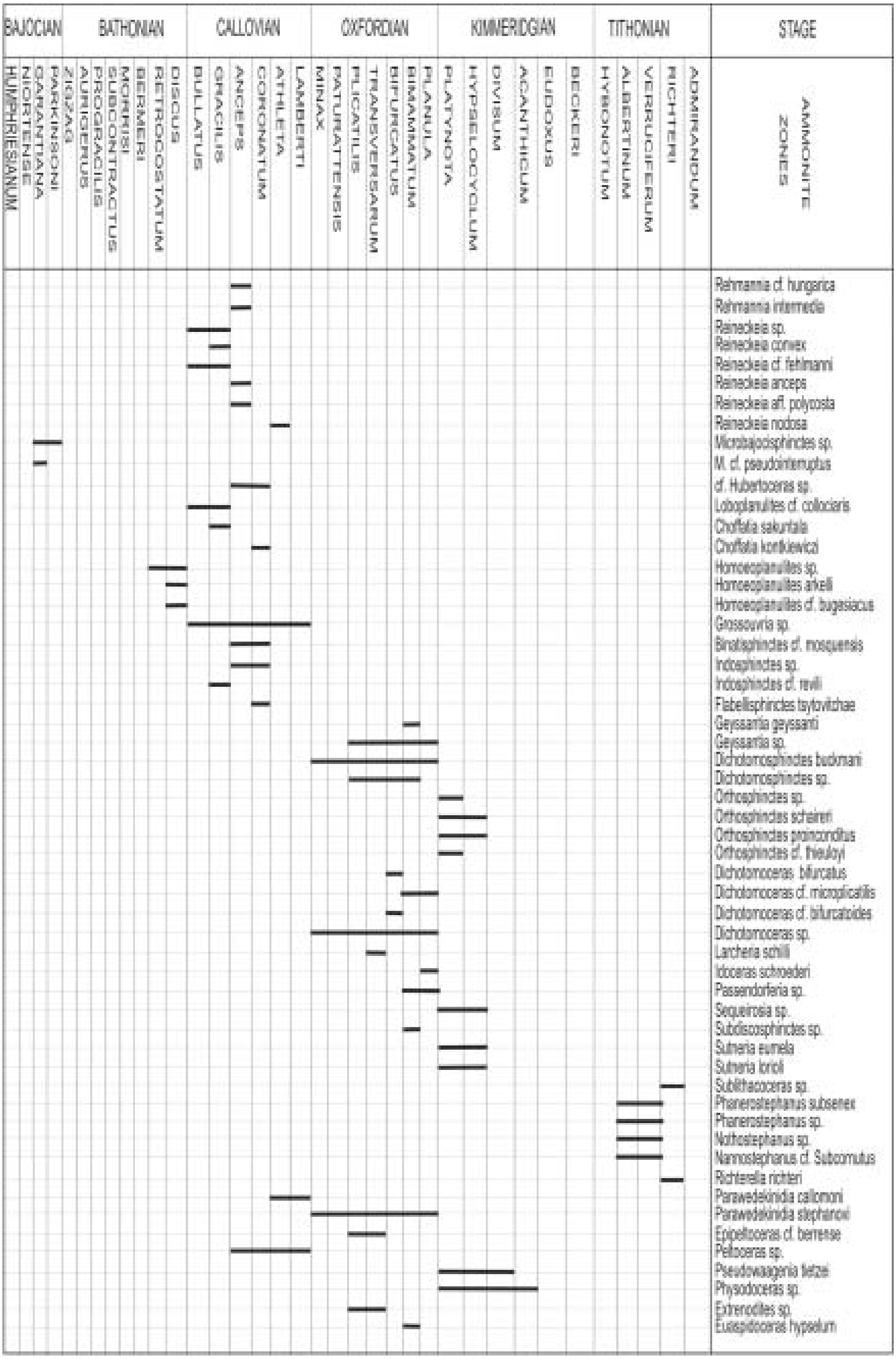


Table 4.1. Range chart of ammonites in the Middle and Upper Jurassic rocks of the study area.

Table 4.1. Continue.



Palaeobiogeography

Biozonation of the Middle and Upper Jurassic sedimentary sequences is fully based on ammonites, which are abundant in the Jurassic rocks of the study area and thus are the ideal tool for reconstructing palaeobiogeographic relationships.

In general, two bioprovinces have been recognized during the Jurassic period (e.g. ENAY & CARIOU 1997):

1- the Boreal bioprovince in the north and

2- theTethyan bioprovince at low latitudes.

The difference is related to the latitude and resulting differing climatic conditions. Since the middle Liassic three faunal assemblages appears gradually in the northern hemisphere (e.g. ENAY & CARIOU 1997):

1- A Boreal faunal assemblage in north,

2- a Subboreal faunal assemblage, usually known as northwest European fauna, and

3- a Mediterranean faunal assemblage in the western Tethys.

At the beginning of Middle Jurassic differences between and within the two bioprovinces increased. As a result, two ecoprovinces within the nektic faunas of the Mediterranean area were recognized by (e.g. ENAY & CARIOU 1997) which apparently were controlled by water depth:

1- The Sub-Mediterranean province, including middle-cratonic and epicontinental platform basins of southern Europe, and

2- the Mediterranean province, which includes the fauna of the continental slope margin and that of deep sea areas.

ARKELL (1956) remarked that a fauna collected by WHITE from the Dalichai Formation could have come from the Zigzag Zone anywhere in Europe. From south-centeral Iran near Kerman, SEYED-EMAMI (1971) described an ammonite fauna identical with that know from northwestern Europe. KENNEDY & COBBAN (1976) recognized two types of faunistic function, one gradational the other one abrupt. The latter type is interpreted as indicative of a plate suture. The Zagros Mountains are cited by them as an example of an abrupt faunal discontinuity. WHEELER et al. (1990) reported that palaeobiogeographic data provided by the dinoflagellate cysts and angiosperm pollen recovered from the Lower Jurassic Pol-e-Dochtar Formation was compared with the published records of plant fossils from the Shemshak coals and the ammonite faunas from the Dalichai Formation. The cyst and pollen grain data strongly supports the evidence provided by the other fossil groups that northern and central Iran were intimately associated with the Laurasian land mass.

Disscussion

The Upper Bajocian-Tithonian ammonite faunas the NNE Iran are mostly of Submediterranean affinity, but elements of Subboreal, Mediterranean, and Ethiopian provinces are occasionally intermingled. Among the 30 genera only a few can be regarded as belonging to the so-called Subboreal, Mediterranean or Ethiopian provinces. In order to unravel the origin of the faunal elements and their migration routes, the relationship of the ammonite fauna of Iran to that of other regions was analysed. On the whole, at the species level the Toarcian to early Bajocian ammonite faunas of northern and central Iran show a close relationship to that of northwestern Europe (SEYED-EMAMI 1988, 2001). A characteristic feature of this fauna is the scarcity of Phylloceratidae (accounting for less than 1% up to 3%) and the total absence of Lytoceratidae family. In contrast, from the Late Bajocian to Oxfordian Phylloceratidae account for more than 50% of the ammonites fauna in the studied sections (Fig. 5.1). This feature can be explained by differing depth preferences of the groups, because in central and northern Iran very shallow water conditions prevailed during the Aalenian to Early Bajocian (Shemshak Sea). As a result of the Late Bajocian sea level rise following the Mid-Cimmerian tectonic event (HALLAM 1988, JACQUIN et al. 1998) fairly deep marine environments were established especially in the Alborz and Koppeh Dagh basins ((Dalichai and Chaman Bid formations, respectively).The dominating ammonites inhabiting these basins show a clear relationship to the Submediterranean province (SEYED-EMAMI et al. 1985, 1989, 1991, 1994, 1995, 1996, 2001). This is supported by the occurrence of Submediterranean ammonites such as *Garantiana, Macrocephalites, Morphoceras, Pachyceras, Larcheria, Orthosphinctes, Dichotomoceras and Richterella* and some cosmopolitan taxa such as *Cadomites, Oxycerites, Taramelliceras, Hecticoceras,* and *Reineckeia* (Fig. 5.1, 2). Moreover, palaeogeographic reconstructions place the Iranian platform at a latitude of 30° N during the Jurassic, which is equivalant to European areas situated at the southern margin of Eurasia (e.g. ENAY & CARIOU 1997).

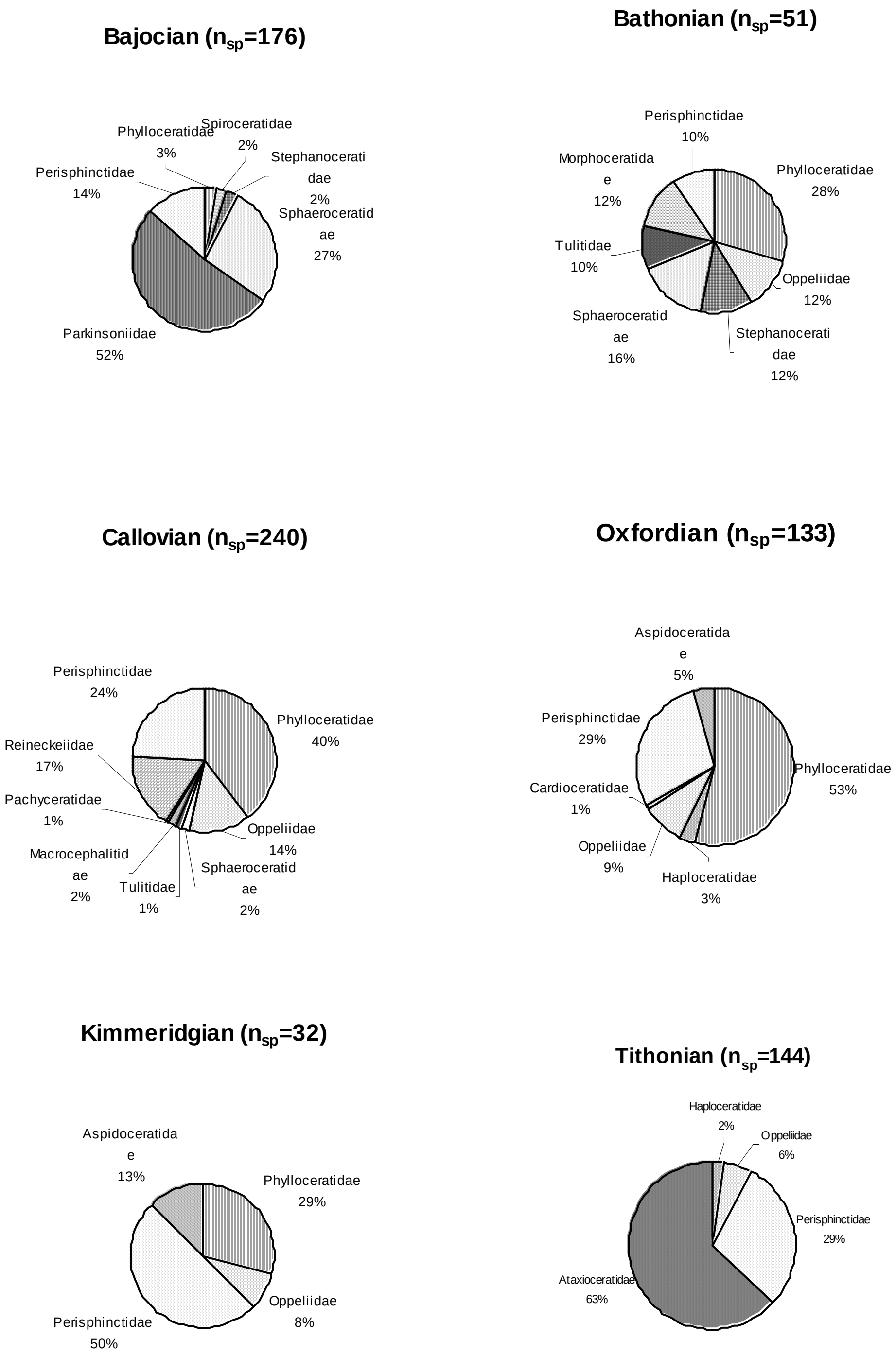


Fig. 5.1. Relative abundances of ammonite families at the studied sections from the Bajocian to the Tithonian.

At the type section of the Chaman Bid Formation several ammonite genera and species are recorded from Iran for the first time. These include *Phanerostephanus*, *Nothostephanus*, *Nannostephanus, Pseudolissoceras, Glochiceras*, and *Oxylenticeras* (Fig. 5.1, 2).They were described for the first time by SPATH (1970) from northern Iraq and show a close relationship to the Ethiopean Province.

Some taxa from the Dalichai Formation at Tooy belong to the Western Tethys Province (*Sequeirosia* and *Passendorferia*) or Subboreal Province (*Cardioceras*). It is remarkable that, besides some cosmopolitan ammonites, there is no direct connection with faunas from southwestern Iran (south Tethys), western India and the southern Tethys in general (e.g. KRISHNA 1983, 1987, CARIOU et al. 1990). Thus the majority of genera in the study area are of Submediterranean origin, but some are members of the Subboreal, Submediterranean and Ethiopean provinces.

The existence of these "exotic" taxa can be explained by three factors: 1- Active rift systems of that time establishing new marine connections (SEYED-EMAMI et al. 2001). 2- A change in ecological conditions and considerable increase of sea-level of the sedimentary basins (ENAY & CARIOU 1997) due to a progressive eustatic rise in sea level during Middle and Upper Jurassic. Thus the influence of ammonites from the Ethiopean and Subboreal provinces (in different age) in the study area was greatest during the maximum transgression from the Oxfordian to the early Tithonian. 3-The co-occurrence of Subboreal, Submediterranean and Ethiopean ammonites in the Oxfordian to early Tithonian in northeastern Iran can be explained by the presumed palaeocurrent direction (SEYED-EMAMI et al. 2001). Therefore, ammonite palaeobiogeography may be approached in three major ways. The first describes the distributions of taxa or groups of taxa without ecological or historical consideration. The second ecological causal approach. This approach consists of mapping the is the relative abundance of the different taxa constituting the natural communities and later comparing the results with palaeogeographical data in order to determine the main ecological affinities of the taxa. The third historical causal approach has been used occasionally to explain the main palaeogeographical causes of individualisation of the major biotas (DOMMERGUES & MARCHAND, 1988).

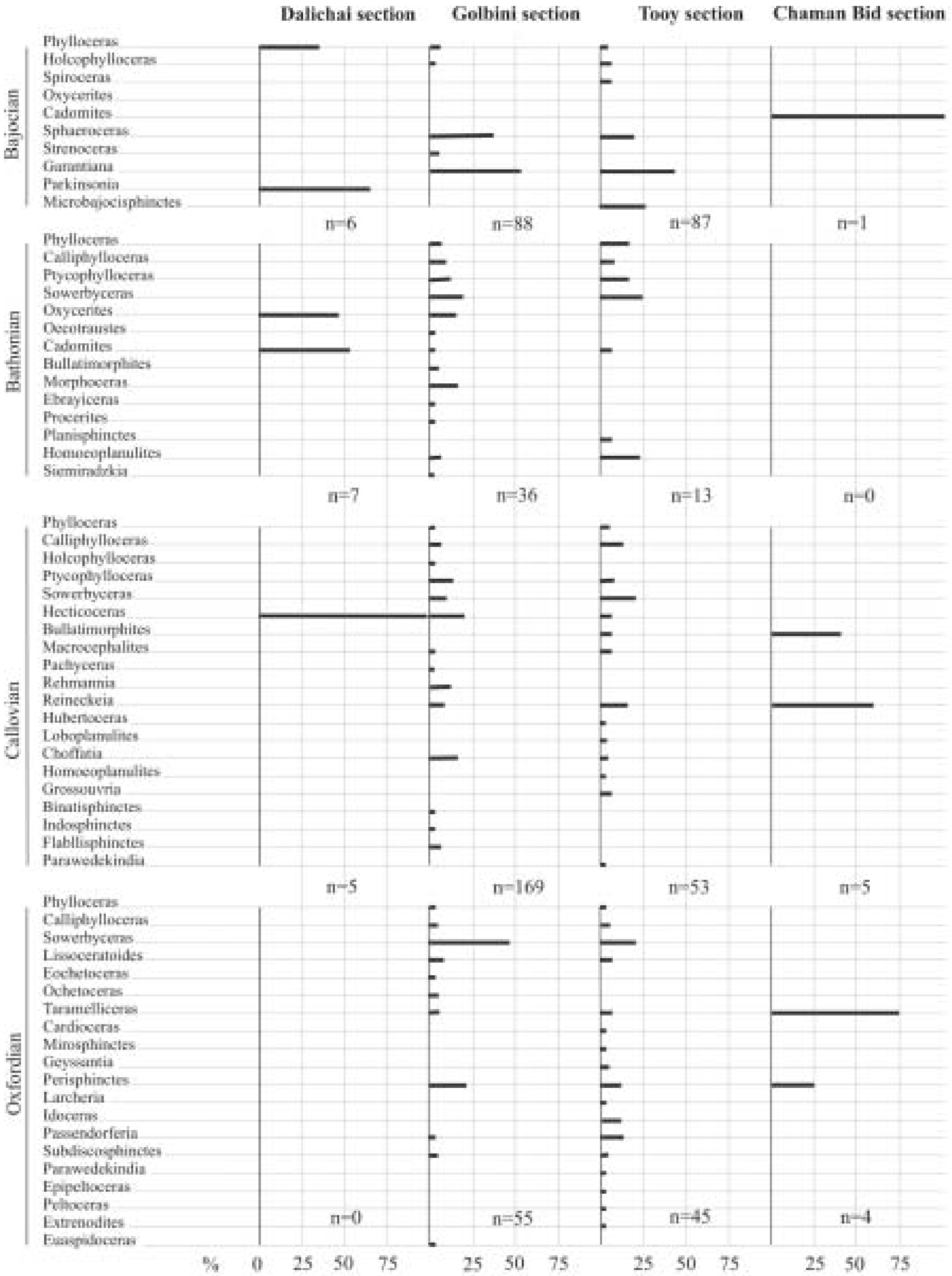


Fig. 5.2. Relative abundances of ammonite genera at the studied section from the Bajocian to the Tithonian.

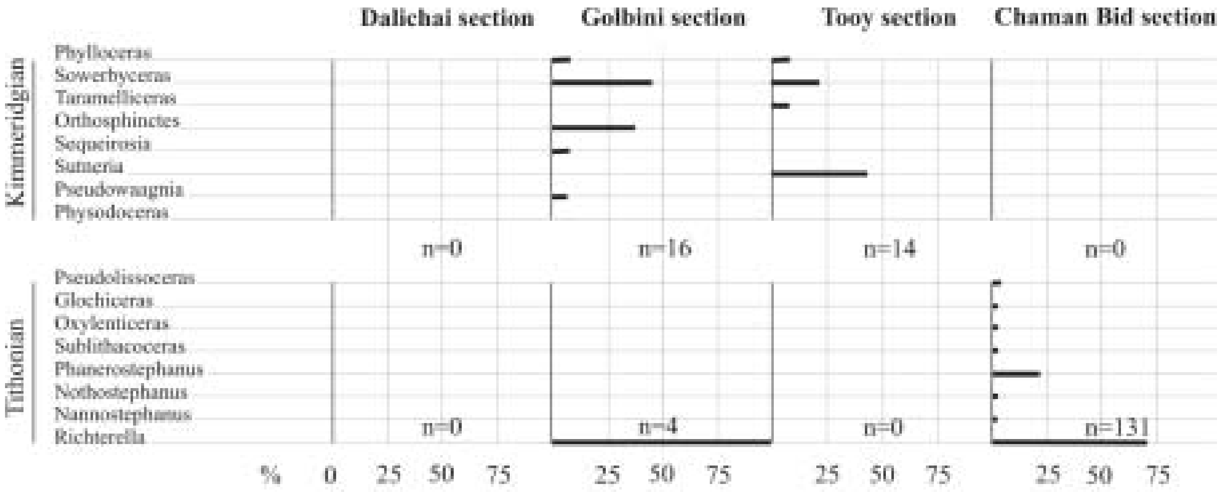

Dalichai section
Golbini section
Tooy section
Chaman Bid section
Kimmeridgian
Phylloceras
Sowerbyceras
Taramelliceras
Orthosphinctes
Sequeirosia
Sutneria
Pseudowaagnia
Physodoceras
n=0
n=16
n=14
n=0
Tithonian
Pseudolissoceras
Glochiceras
Oxylenticeras
Sublithacoceras
Phanerostephanus
Nothostephanus
Nannostephanus
Richterella
n=0
n=4
n=0
n=131
% 0 25 50 75
25 50 75
25 50 75
25 50 75

Fig. 5.2.(cont.)

Conclusions

(1) Base and top of the Dalichai and Chaman Bid formations are diachronous at the studied sections. For instance, the age of the top of the formation is Callovian at the Dalichai section, Early Tithonian at the Golbini section, Middle Kimmeridgian at the Tooy section, and Early Tithonian at the Chaman Bid section.

(2) Thickness of the formations increases towards the east: The thickness of the Dalichai and Chaman Bid formations at the Dalichai, Golbini and Tooy sections are 97 m, 449 m and 567 m, respectively. The thickness of the Lar and Mozduran formations is 414 m at Jorbat and 1092 m and the Takhtehbashgheh section, respectively.

(3) The Dalichai, Chaman Bid, Bashkalateh and Kashafrud formations laterally grade into each other. The Dalichai Formation is mainly composed of carbonates (limestone, marl, silty marl), the Chaman Bid Formation contains, in addition, some sandstone intercalations, and the Bashkalateh and Kashafrud formations of the Koppeh Dagh are siliciclastic units.

(4) There is some evidence of Mid-Cimmerian tectonic movements in the study area. Thus, the contact between the Shemshak and Chaman Bid formations at Tooy is an angular unconformity and at Golbini there is a relict conglomerate at the top of the Shemshak Formation.

(5) Some of the ammonite genera and species of the studied stratigraphic interval are recorded for the first time from Iran. They include *Spiroceras* cf. *orbignyi, Spiroceras annulatum, Pseudolissoceras zitteli, Hecticoceras (Putealiceras) metomphalum, Ochetoceras marantianum*, *Taramelliceras (Taramelliceras)* cf. *kiderleni, Oxylenticeras* cf. *lepidum, Cadomites (Polyplectites)* cf. *dorni, Sphaeroceras tutthum, Macrocephalites (Macrocephalites) jacquoti, Garantiana (Orthogarantiana)* cf. *densicostata, Morphoceras egrediens, Rehmannia (Loczyceras) segestana, Reineckeia (Tyrannites) convex, Reineckeia (Reineckeia)* aff. *polycosta, Pachyceras lalandei*, *Cardioceras praecordatum, Microbajocisphinctes* sp., *Geyssantia geyssanti, Larcheria schilli, Passendorferia* sp., *Sequeirosia* sp., *Phanerostephanus subsenex, Nothostephanus* sp., *Nannostephanus* cf. *subcomutus, Parawedekindia callomoni* and *Physodoceras* sp. etc..

(6) Based on their stratigraphic position, *Pseudolissoceras zitteli*, *Glochiceras* sp., *Oxylenticeras* cf. *lepidum*, *Phanerostephanus subsenex*, *Nothostephanus* sp., *Phanerostephanus* sp., and *Nannostephanus* cf. *subcornutus* occur in the Early Tithonian. This is in contrast with the late Early Tithonian and the early Late Tithonian age proposed by SPATH (1970).

(7) The Middle and Upper Jurassic ammonite fauna of the northern and northeastern Iran is very similar to the ammonite assemblages of the Northwest European and Submediterranean faunal provinces.

(8) The Dalichai and Chaman Bid formations consist of slope and basin sediments, the Lar and Mozduran formations of and tidal flat, lagoon and margin barrier sediments.

(9) The Chaman Bid and Dalichai formations represent slope and basinal environments. Characteristic facies are alternations of argillaceous mudstone to skeletal packstone with marl. The Mozduran and Lar formations represent more carbonate platform environments (sometime especially in the lower part the Mozduran and Lar formations represting slope enviroment) with peritidal, lagoonal, and barrier facies belts in close neighbourhood to the basinal sediments of the Chaman Bid and Dalichai formations. This is demonstrated by the presence of calciturbidites within the carbonates of the Chaman Bid and Dalichai formations. These calciturbidites originated at the margins of the carbonate platform and reflect shedding of platform material during sea-level highstand.

Acknowledgments

I would like to thank the staff of the Institut für Paläontologie der Universität Würzburg. In particular, I thank my supervisor, Prof. F.T. FÜRSICH, who provided the opportunity for me to study in Würzburg. I benefitted from his valuable discussions, critical review and constructive comments on the manuscript. I am very grateful for his financial support during my stay in Germany. I also appreciate the help, hospitality and kindness of his family toward my family during our stay in Würzburg.

I am very much indebted to Prof. K. SEYED-EMAMI (Tehran University), who provided the opportunity for me to study in Germany. I appreciate his helpful comments, valuable discussions and advice. I would like to thank Dr. M. WILMSEN, Würzburg, Dr. G. DIETL and Dr. G. SCHWEIGERT, Stuttgart, Dr. G. SCHAIRER, München, Prof. B. SENOWBARI-DARYAN, Erlangen, Prof. J.H. CALLOMON, London, Prof. F. CECCA, Paris, Prof. A. ZEISS, Erlangen and Dr. M. MEHDI, Kenitra- Morocco for useful discussions.

I am grateful to Dr. M. WILMSEN, Dr. B. NIEBUHR (Sarah), P. MANSOURIE, S. SCHLIRF, and M. SCHLIRF for help and kindness toward my family. My great appreciation to R. SAITO, who never was annoyed by my frequent computer problems and questions.

I would like to extend my thanks to Dr. M. HEINZE, Prof. G. GEYER and Mr. G. EL QOT for their help in the institute, and to Mrs. H. SCHOENIG, B. SCHROEDER, and M. STRIFLER, Würzburg, for photographic work and preparation of the plates.

My thesis was financially supported by the Deutsche Akademische Austauschdienst (DAAD), which I gratefully acknowledge.

My appreciation goes to M. T. KOREHIE, Head of Geological Survey of Iran and Dr. M. GHORESHI and Dr. A. SAEIDI, past and present Geological Deputy, respectively, Dr. S. A. AGHANABATI and Dr. M. GHASEMI, for their help and encouragement and for supporting the fieldwork in Iran. R. KAZEMI and M. AFSHA had been excellent drivers during the long field seasons. I thank all my friends in Iran, especially Dr.R. SHEIKHOLESLAMI, A. NAVABMOTLAGH, P. NAVABPOUR, Dr. S.H. VAZIRI, M. LOTFPOUR, S.A. MOFID, Dr. N. KOHANSAL, and Dr.D. JAHANI for their help.

Last, but not least, my deepest gratitude and respect go to my wife, SIMA and my daughter NIKI for her love, support, encouragement and understanding throughout this toil. Sima, you know that "we did all this together". Many thanks go to my parents for all their love and support in Iran and particularly to my parents-in-law for invaluable support and help at

home and particularly in those hard moments when our daughter NIKI was born in Würzburg far away from home. I am indebted to both of them for every thing.

References

ADAMS, A.E. & MACKENZIE, W.S. 1998. A color atlas of carbonate sediments and rocks under the microscope. – 180 pp., 330 photos; London.

ADAMS, A.E., MACKENZIE, W.S. & GUILFORD, C. 1984. Atlas of sedimentary rocks under the microscope. – 104 pp; London.

AFSHAR-HARB, A. 1979. The stratigraphy, tectonics and petroleum geology of the Koppeh-Dagh region, northern Iran. - Unpublished Ph. D. Thesis, University of London: 316 .pp., 40 figs.; London.

AFSHAR-HARB, A. 1994. Geology of the Koppeh-Dagh. - Treatise on the Geology of Iran **11**: 1-276, 61 figs.; Tehran. [In Farsi]

AGHANABATI, A. 1998. Jurassic stratigraphy of Iran. – Geological Survey of Iran,: 1-746; Tehran. [In Farsi]

ALAVI, M. 1996. Tectonostratigraphic synthesis and structural style of the Alborz Mountains system in northern Iran. – Journal of Geodynamics **21**: 1-33, 16 figs.; London.

ALLENBACH, P. 1966. Geologie and Petrographie des Demavand und seiner Umgebung (Zentral-Elburz, Iran). – Mitteilungen aus dem Geologischen Institut der Eidgenössischen Technischen Hochschule und der Uuniversität Zürich : 1-144; Zürich.

ARKELL, W.J. 1935-1948. A monograph on the ammonites of the English Corallian Beds. - Palaeontographical Society Monographs,: 1-420, pls. 1-78; London.

ARKELL, W.J. 1951-1958. A monograph of the English Bathonian ammonites. – Palaeontographical Society Monographs,: 1-264, pls.1-33, tab. 1-83; London.

ARKELL, W.J. 1951a. A Middle Bathonian ammonite fauna from Schwandorf, northern Bavaria. - Schweizerische Paläontologische Abhandlungen 69: 1-18, pls. 1-3; Basel.

ARKELL, W.J. 1956. Jurassic Geology of the world. – 806 pp.; Edinburgh (Oliver and Boyd).

ARKELL, W.J., KUMMEL, B. & WRIGHT, C.W. 1957. Mesozoic Ammonoidea. In: MOORE, R.C. (ed.) Treatise on Invertebrate Paleontology. Part L, Mollusca 4, Cephalopoda, Ammonoidea: 80-465; Boulder, Co. & Lawrence, Kansas (Geological Society of America & University of Kansas Press).

ASSERETO, R. 1966. The Jurassic Shemshak Formation in central Elburz (Iran). - Rivista Italiana di Paleontologia e Stratigrafia **72**: 1133-1182; Milano.

ATROPS, F. 1982. La sous-famille des Ataxioceratinae dans le Kimmeridgien inférieur du sud-est de la France; systématique, evolution, chronostratigraphie des genres *Orthosphinctes* et *Ataxioceras*. - Documents des Laboratoires de Géologie Lyon **83**:1-463, 45 pls.; Lyon.

ATROPS, F. & BENEST, M. 1982. Decouverte des faunes d'ammonites de la zone à platynota (Kimmeridgien inférieur) dans les monts de Chellala (Avant Pays tellien Algérie) - consequences stratigraphiques et paléogéographiques. - Geobios **15**: 951-957,. 2 figs., 1 pl.; Lyon.

ATROPS, F. & BENEST, M. 1984. Les formations du Jurassique supérieur du Bou Rheddeou au nord de Tiaret (bordure sud-tellienne, Algérie) - age et milieux de dépot. - Geobios **17**: 207-216, 2 figs., 1 pl.; Lyon.

ATROPS, F. & BENEST, M. 1986. Stratigraphie du Jurassique supérieur du djebel Bechtout au nord-ouest de bordure sud-tellienne, Algérie, comparaison avec le Bou Rheddou. – Geobios **19**: 855-862, 1 fig., 1 pl.; Lyon.

ATROPS, F. & MARQUES, B. 1986. Mise en évidence de la zone à platynota (Kimméridgien inférieur) dans le massif du Montejunto (Portugal), consequences stratigraphiques et paléontologiques. – Geobios **19**: 537-547, 3 figs, 1 pl.; Lyon.

ATROPS, F. & MARQUES, B. 1988. Precisions stratigraphiques sur les formations à ammonites du Jurassique supérieur dans le massif du Montejunto (Nord du Tage, Portugal). - 2nd International Symposium on Jurassic Stratigraphy: 505-516; Lisboa.

BARATTOLO, F. & PARENTE, M. 2000. New observations on *Uragiella liasica* (LEBOUCHÉ & LEMOINE) (Green Algae, Dasycladales) from the type-locality (Canders, Languedoc - Southern France). - Bollettino della Società Paleontologica Italiana **39**: 123-137, 6 pls.; Modena.

BARTHEL, K.W. & SCHAIRER, G. 1980. Zur Verbreitung von *Idoceras balderum* (OPPEL) (Ammonoidea, oberstes Unterkimmeridge) im südlichen Fränkischen Jura. – Mitteilungen der Bayerischen Staatssammlung für Paläontologie und. historische Geologie **20**: 11-15, 1 fig., 1 pl.; München.

BASSOULLET, J.P., BERNIER, P., CONRAD, M.A., DELOFFRE, R. & JAFFREZO, M. 1978. Les algues Dasycladales du Jurassique et du Crétacé. - Geobios, Mémoire spécial **2**:1-330, 40 pls.; Lyon.

BAUGIER, A. & SAUZE, M. 1843. Notice sur quelques coquilles de la famille des ammonidées - Memoire de la Société de Statistique: 1-16, 4 pls.; Lyon.

BENEST, M. 1985. Evolution de la plate-forme de l ouest Algerien et du nord-est Marocain au cours du Jurassique supérieur et au debut du Crétacé: Stratigraphie, milieux de depot et dynamique sédimentaire. - Documents des Laboratoires de Géologie **95**: 1-580, 23 pls.; Lyon.

BERCKHEMER, F. & HÖLDER, H. 1959. Ammoniten aus dem oberen Weissen Jura Süddeutschlands. – Beihefte, Geologisches Jahrbuch **35**: 1-135, 27 pls.; Hannover.

BHARGAVA, N. & BASI, U.K. 1985. Upper Triassic coral knoll reefs: Middle Norian, Spiti-Kinnaur, Himachal Himalaya, India. – Facies **12**: 219-242, 4 figs., pls. 24-28; Erlangen.

BOGDANOWITCH, C. 1889. Notes sur la Géologie de l'Asie centrale. I. Déscription de quelques depots sédimentaires de la contrée transcaspienne et d'une partie de la Perse septentrional. – 192 pp., 13 figs, 8 pls.; Petersburg.

BONARELLI, G. 1894. *Hecticoceras novum* genus Ammonidarum. – Bolletino della Società Malacologia. Italiana **18**: 73-108; Pisa.

BONNOT, A. & GYGI, R. 1998. Les Euaspidoceratinae (Ammonitina, Aspidoceratidae) d'Herznach (Suisse septentrionale) a la fin de la zone à Cordatum (Oxfordien inférieur). - Eclogae Geologicae Helvetiae **91**: 493-507, 3 pls.; Bale.

BOURQUIN, J. 1968. Les Reineckeides – Annales des Sciences de l´Université Bésançon (4): 1-169, 51 pls.; Besançon.

BUCKMAN, S.S. 1909-1930. Yorkshire type ammonites. - 7 volumes, 773 pls; London (Wesley).

BUCUR, I.I., SENOWBARI-DARYAN, B. & ABATE, B. 1996. Remarks on some foraminifera from the Upper Jurassic (Tithonian) reef limestone of Madonie Mountains (Sicily). - Bollettino della Società Paleontologica Italiana **35**: 65-80,. 6 pls.; Modena.

BURCKHARDT, C. 1903. Beiträge zur Kenntniss der Jura-und Kreideformation der Cordillere. - Palaeontolographica **50**: 1-44, 16 pls; Stuttgart.

CALLOMON, J.H. 1971. On the type of Macrocephalites Zittel 1884 and the type specimen of Ammonites Macrocephalus Schlothteim 1813. – Palaentology **14**: 114-130, 15-18 pls.; London.

CALLOMON, J.H. 1994. Jurassic ammonite biochronology of Greenland and the Arctic. - Bulletin of the Geological Society of Denmark **41**: 128-137; Copenhagen.

CALLOMON, J.H., DIETL, G. & NIEDERHÖFER, H.J. 1989. Die Ammonitenfaunen-Horizonte im Grenzbereich Bathonium/Callovium des Schwäbischen Juras und deren Korrelation mit W-Frankreich und England. - Stuttgarter Beiträge zur Naturkunde **148**: 1-13, 2 figs.; Stuttgart.

CALLOMON, J.H. & DIETL, G. & NIEDERHÖFER, H.J. 1992. On the true stratigraphic position of *Macrocephalites macrocephalus* (SCHLOTHEIM, 1813) and nomenclature of the standard Middle Jurassic "Macrocephalus Zone". - Stuttgarter Beiträge zur Naturkunde **185**: 1-65, 13 figs., 10 pls.; Stuttgart.

CALLOMON, J.H., DIETL, G., GALACZ, A., GRADL, H., NIEDERHÖFER, H.J. & ZEISS, A. 1987. Zur Stratigraphie des Mittel-und unteren Oberjuras in Sengenthal bei Neumarkt/Opf. (Fränkische Alb). - Stuttgarter Beiträge zur Naturkunde **132**: 1-53, 5 pls.; Stuttgart.

CARIOU, E. 1984. Les Reineckeiidae (Ammonoidea, Callovien) de la Tethys occidentales. Dimorphisme et evolution. Etude a partir des gisements du centre-ouest de la France. - Documents des Laboratoires de Géologie Lyon **8**: 1-599, 244 figs., 69 pls.; Lyon.

CARIOU, E. & KRISHNA, J. 1988. The Tethyan Reineckeiinae of Kachchh and Jaisalmer (West India) - systematic, biostratigraphic and biogeographic implications. Palaeontographica A, **203**: 149-170, 4 figs., 5 pls.; Stuttgart.

CARIOU, E. & HANTZPERGUE, P. 1997. Biostratigraphie du Jurassique ouest-européen et Mediterranéen. – zonations parallèles et distribution des invertébrés et microfossiles. Elf Aquitaine édition: 1-440, 49 pl.; Pau.

CECCA, F. 1986. Le genre *Richterella* AVRAM Ammonitina, Perisphinctides) dans le Tithonique inférieur de la bordure Ardechoise (sud-est de la France): Dimorphisme et variabilité. – Geobios 19: 33-44, 4 figs., 1 pl.; Lyon.

CHIOCCHINI, M. & MANCINELLI, A. 2000. *Marzoella ficcarellii* n. gen., n. sp. (Foraminiferida) nel Dogger del Lazio nord-orientale (Italia). - Bollettino della Società Paleontologica Italiana **39**: 21-28, 3 pls.; Modena.

COOK, H.E. & MULLINS, H.T. 1983. Basin margin environment.- In: SCHOLLE, P.A., BEBOUT, D.G. & MOORE, C.H. (eds.): Carbonate depositional environments. – American Association of Petroleum Geologists, Memoir **33**: 539-617; Tulsa.

COX, B.M. 1988. English Callovian (Middle Jurassic) perisphinctid ammonites. – Palaeontographical Society Memoirs:1-54, 23 pls.; London.

DAVIES, R.G., JONES, C.R., HAMPZEPOUR, B. & CLARK, G.C. 1972. Geology of the Masuleh Sheet 1:100.000, Northwest Iran. - Geological Survey of Iran, Report **24**: 1-110, 13 figs., 1 map; Tehran.

DAVOUDZADEH, M & SCHMIDT, K. 1983. Contribution to the paleogeography, stratigraphy and tectonics of the Middle and Upper Jurassic of Iran – Neues Jahrbuch für Geologie und Paläontologie, Abhandlungen **166**: 327-346; Stuttgart.

DAVOUDZADEH, M & SCHMIDT, K. 1984. A review of the Mesozoic paleogeogeraphy and paleotectonic evolution of Iran. – Neues Jahrbuch für Geologie und Paläontologie, Abhandlungen **168**: 182-207; Stuttgart.

DERIN, B. & REISS, Z. 1966. Jurassic microfacies of Israel. - The Special Publication Institute of the Petroleum: 1-43; Jerusalem.

DESHAYES, G.P. 1831. Déscription de coquilles caracteristiques des terrains. - :264 pp., 14 pls.; Paris (Levrault).

DIETL, G. 1974. Zur Stratigraphie und Ammonitenfauna des Dogger, insbesondere des Oberbajocium der westlichen Keltiberischen Ketten (Spanien). - Stuttgarter Beiträge zur Naturkunde **14**: 1-21, 7 figs., 3 pls.; Stuttgart.

DIETL, G. 1977. The Braunjura (Brown Jurassic) in Southwest Germany. - Stuttgarter Beiträge zur Naturkunde **25**: 1-41, 7 pls., 14 figs.; Stuttgart.

DIETL, G. 1978. Die heteromorphen Ammoniten des Dogger. - Stuttgarter Beiträge zur Naturkunde **33**: 1-97, 11 pls.; Stuttgart.

DIETL, G. 1980. Die Ammoniten-Gattung *Leptosphinctes* aus dem südwestdeutschen Subfurcaten-Oolith (Bajocium, Mittl. Jura). - Stuttgarter Beiträge zur Naturkunde **66**: 1-49, 7 figs., 10 pls.; Stuttgart.

DIETL, G. 1981. Über *Macrocephalites* (Ammonoidea) aus dem Aspidoides-Oolith und die Bathonium/Callovium-Grenzschichten der Zollernalb (SW-Deutschland). - Stuttgarter Beiträge zur Naturkunde **68**: 1-15, 5 figs., 1 pl.; Stuttgart.

DIETL, G. 1983. Die Ammoniten-Gattung *Strenoceras* aus dem südwestdeutschen Subfurcaten-Oolith (Bajocium, Mittl. Jura). - Stuttgarter Beiträge zur Naturkunde **90**: 1-37, 5 figs., 4 pls.; Stuttgart.

DIETL, G. & KAPITZKE, M. 1983. Das Bathonium (Mittlerer Jura) zwischen Aalen und Bopfingen, östl. Schwäb. Alb. 1. Mittel-Bathonium. - Stuttgarter Beiträge zur Naturkunde **93**: 1-27, 5 pls., 3 figs.; Stuttgart.

DIETL, G. 1986. Die entrollten Ammoniten des Schwäbischen Juras. - Stuttgarter Beiträge zur Naturkunde **4**: 36-44, 1 pl.; Stuttgart.

DIETL, G. & CALLOMAN, H. 1988. Der Orbis-Oolith (Ober-Bathonium, Mittl. Jura) von Sengenthal/Opf., Fränk. Alb, und seine Bedeutung für die Korrelation und Gliederung der Orbis-Zone. - Stuttgarter Beiträge zur Naturkunde **142**: 1-31, 5 figs., 4 pls.; Stuttgart.

DIETL, G. 1994. Der hochstetteri-Horizont - ein Ammonitenfaunen-Horizont (Discus-zone, Ober-Bathonium, Dogger) aus dem Schwäbischen Jura. – Stuttgarter Beiträge zur Naturkunde **202**: 1-39, 13 pls.; Stuttgart.

DIETL, G. & GYGI, R. 1998. Die Basis des Callovium (Mittlerer Jura) bei Liesberg BL, Nordschweiz. - Eclogae Geologicae Helvetiae **91**: 247-254, 5 pls.; Basel.

DOMINJON, P. 1969. Essais de paléontologie bugiste - II- *Homoeoplanulites* du Bugey. Le Bugey, Belley **56**: 1-23, 4 pls.; Paris.

DOMMERGUES, J.L. & MARCHAND, D. 1988. Paléobiogéographie historique et écologique: application aux ammonites du Jurassique. - In: WIEDMANN, J. & KULLMANN, J. (eds.) Cephalopods - Present and Past: 351-364, 5 figs.; Stuttgart (Schweizerbart).

DORN, P. 1931. Die Ammonitenfauna des untersten Malm der Frankenalb. – Palaeontographica **73**: 1-92, 20 pls.; Stuttgart.

DORN, P. 1927. Die Ammonitenfauna der Parkinsonien-Schichten bei Thalmässing (Frankenalb) – Jahresbericht und Mitteilungen des oberrheinischen geologischen Vereins, neue Folge **12**: 13-14; Berlin.

D´ORBIGNY, A. 1842-1850. Paleontologie francaise, terrains jurassiques - I, Cephalopodes. – 642 pp., 234 pls.; Paris.

DOUVILLE, H. 1912. Etudes sur les Cardioceratides de Dives, Villers-sur-Mer et quelques autres gisements. - Mémoires de la Societé Géologique de France **45**: 1-70, pls. 7-11; France.

DUNHAM, R.J. 1962. Classification of carbonate rocks according to depositional texture. - In: W.E. HAM (ed.) Classification of Carbonate Rocks. - American Association of Petroleum Geologists Memoir **1**: 108-121; Tulsa, Ok.

DUPRAZ, C. & STRASSER, A. 1999. Microbialites and micro-encrusters in shallow coral bioherms (Middle to Late Oxfordian, Swiss Jura Mountains). - Facies **40**: 101-130, pls. 11-13, 18 figs.; Erlangen.

ELLIOTT, T. 1986. Deltas. – In: READING, H.G. (ed.): Sedimentary environments and facies. - 113-154; Oxford (Blackwell).

ELMI, E. 1967. Le Lias supérieur et le Jurassique moyen de l´Ardèche. - Documents des Laboratoires de Géologie de la Faculté des Sciences de Lyon **19**: 509-845, 17 pls., 98 figs; Lyon.

ENAY, R. 1966. L´Oxfordien dans la moitié sud du Jura français. Etude stratigraphique. - Nouvelle Architecture des Musèes d´Histoire Naturelle de Lyon **8**, I (Stratigraphie): 1-324, II (Paléontologie): 324-624; Lyon._ fascicule VII tome

ENAY, R. & BOULLIER, A. 1981. L´age du complexe recifal des côtes de Meuse entre Verdun et Commercy et la stratigraphie de l´Oxfordien. – Geobios: **14**: 727-771, 6 pls.; Lyon.

ENAY, R. & CARIOU, E. 1997. Ammonite faunas and palaeobiogeography of the Himalayan belt during the Jurassic: Initiation of a late Jurassic austral ammonite fauna. – Palaeogeography, Palaeoclimatology, Palaeoecology **134**: 1-38; Elsevier.

ENAY, R. & GYGI, R. 2001. Les ammonites de la zone à Bifurcatus (Jurassique supérieur, Oxfordien) de Hinterstein, près de Oberehrndingen (canton d´Argovie, Suisse). - Eclogae Geologicae Helvetiae: **94**: 447-478, 4 pls.; Bâle.

ERNI, A. 1931. Découverte du Bathonien fossilifère dans l´Elburz. - Eclogae geolicae Helvetiae **24**: 165-167; Bâle.

FAVRE, E. 1876. Déscription des fossiles du terrain Oxfordien des Alpes fribourgeoises – Mémoires de la Societé paléontologique de Suisse **3**: 1-76, 7 pls., Bâle.
FERNÁNDEZ-LÓPEZ, S. 1985. El Bajociense en la Cordillera Iberica. - 23 pp., 67 pls.; Madrid (Universidad Complutense de Madrid, Facultad de Ciencias Geológicas).

FERNÁNDEZ-LÓPEZ, S.R. 1996. Phylloceratina ammonoids in the Iberian Basin during the Middle Jurassic: a model of biogeographical and taphonomic dispersal related to relative sea-level changes. – Palaeogeography, Palaeoclimatology, Palaeoecology **120**: 291-302, Amsterdam.

FERNÁNDEZ-LÓPEZ, S.R. 2000. Lower Bathonian of Serra de Creu (Tivissa, Catalan Basin, Spain). - Revue de Paléobiologie **8**: 45-52, Genève.

FISCHER, V.W. 1843. Revue des fossiles du Gouvernement de Moscou. – Bulletin de la Société Naturelle 1: 145 pp.; Moscou.

FISCHER, J.C. 1994. Révision critique. Paleontologie Francaise (d´A.d´Orbigny). 1, Cephalopodes jurassiques. – 338 pp., 90 pls.; Paris (Muséum National d´ Histoire Naturelle).

FOURCADE, E., AZEMA, J., CECCA, F., BONNEAU, M., PEYBERNES, B. & DERCOURT, J. 1991. Essai de réconstitution cartographique de la paléogéographie et des paléoénvironnements de la Tethys au Tithonique supérieur (138 à 135 Ma). – Bulletin de la .Société Géologique deFrance **162**: 1197-1208; Paris.

FOURCADE, E., AZEMA, J., BASSOULLET, J.P., CECCA, F. & DERCOURT, J. 1995. Paleogeography and paleoenvironment of the Tethyan realm during the Jurassic breakup of the Pangea. - The Ocean Basins and Margins **8**: 191-214; New York.

FÜRSICH, F.T. WILMSEN, M. SEYED-EMAMI, K. SCHAIRER, G. & MAJIDIFARD, M.R. 2003. Platform-basin transect of a Middle to Late Jurassic large-scale carbonate platform system (Shotori Mountains, Tabas area, east-central Iran). - Facies **48**: 171-198; Erlangen.

GALACZ, A. 1980: Bajocian and Bathonian ammonites of Gyenespuszta - Bakony Mts., Hungary. - Geologica Hungarica, Series Palaeontologica, Fasciculus **39**: 1-227, 110 figs., 36 pls.; Budapest.

GEMMELLARO, G.G. 1872. Sopra i fossils della zona con *Aspidoceras acanthicum*, Opp. sp. di Burgilamuni, presso Favara, Provincia di Girgenti. Giornale Science Naturalist di Econnomic Palermo **8**: 137-159; Palermo.

GEYSSANTI, J. 1997. Tithonian. - In: CARIOU, E. & HANTZPERGUE, P.: Biostratigraphie du Jurassique ouest-européen et mediterranéen. Zonations paralleles distribution des invertébrés et microfossiles. - Elf Aquitaine édition: 97-102, pls. 25-26; Pau.

GILL, G.A., THIERRY, J. & TINTANT, H. 1985. Ammonites calloviennes du sud d'Israel: systématique, biostratigraphie et paléobiogéographie. – Geobios **18**: 705-751, 8 figs., 8 pls., Lyon.

GRADL, H. & SCHAIRER, G. 1997. Ammoniten von Kälberberg (Nördliche Frankenalb) (Oberoxford bis Unterkimmeridge). – Mitteilungen der Bayerischen Staatssammlung für Paläontologie und historische Geologie **37**: 9-26, 2 figs., 4 pls., München.

GRÖSCHKE, M. & ZEISS, A. 1990. Die ersten Hecticoceraten und Distichoceraten (Ammonitina) aus dem Callovium der Zentral-Anden. – Neues Jahrbuch für Geologie und Paläontologie, Abhandlungen **178**: 267-283, 3 figs.; Stuttgart.

GYGI, R.A. 1990. The Oxfordian ammonite succession near Liesberg BE and Pery BE, northern Switzerland. - Eclogae geologicae Helvetiae **83**: 177-184, 7 pls.; Bâle.

GYGI, R.A. 1995. Datierung von Seichtwassersedimenten des Späten Jura in der Nordschweiz mit Ammoniten. - Eclogae geologicae Helvetiae **88**: 1-58; Bâle.

HAHN, W. 1968. Die Oppeliidae BONARELLI und Haploceratidae ZITTEL (Ammonoidea) (Brauner Jura) im südwestdeutschen Jura. - Jahreshefte des Geologischen Landesamtes Baden-Württemberg **10**: 7-72, 10 figs., 5 pls.; Freiburg.

HAHN, W. 1969. Die Perisphinctidae STEINMANN (Ammonoidea) des Bathoniums (Brauner Jura) im südwestdeutschen Jura. - Jahreshefte des Geologischen Landesamtes Baden-Württemberg **11**: 29-86, 11 figs., 9 pls.; Freiburg.

HAHN, W. 1970. Die Parkinsoniidae S. BUCKMAN und Morphoceratidae HYATT (Ammonoidea) des Bathoniums (Brauner Jura) im südwestdeutschen Jura. - Jahreshefte des Geologischen Landesamtes Baden-Württemberg **12**: 7-62, 8 figs., 8 pls.; Freiburg.

HAHN, W. 1971. Die Tulitidae S. BUCKMAN, Sphaeroceratidae S.BUCKMAN und Clydoniceratidae S. BUCKMAN (Ammonoidea) des Bathoniums (Brauner Jura) im südwestdeutschen Jura. – Jahreshefte des Geologischen Landesamtes Baden-Württemberg **13**: 55-122, 13 figs., 9 pls.; Freiburg.

HAHN, W., WESTERMANN, G.E.G. & JORDAN, R. 1990. Ammonite fauna of the Upper Bathonian hodsoni Zone (Middle Jurassic) at Lechstedt near Hildesheim, Northwest Germany. - Geologisches Jahrbuch **121**: 21-63, 5 figs., 5 pls.; Hannover.

HALL, R.L. & SMITH, P.L. 2000. Advances in Jurassic research 2000: Proceedings of the Fifth International Symposium on the Jurassic System. – Geo-Research Forum **6**: 1-543; Vancouver

HAUPT, O. 1907. Beiträge zur Fauna des oberen Malm und der unteren Kreide in der argentinschen Cordillere. – Neues Jahrbuch für Mineralogie, Geologie und Paläontologie **23**: 187-236, pls. 7-10; Stuttgart.

HINE, A.C. 1977. Lily Bank, Bahamas: history of an active oolite sand shoal. Journal of Sedimentary Petrology **47**: 1544-1581; Tulsa, Ok.

HILLEBRANDT, A. 2001. Ammonite stratigraphy of the Bajocian in Northern Chile. - Hantkeniana **3**: 49-87, 10 pls.; Budapest.

HÖLDER H. 1955. Die Ammoniten-Gattung *Taramelliceras* im südwestdeutschen Unter- und Mittelmalm. Morphologische und taxinomische Studien an *Ammonites flexuosus* BUCH (Oppeliidae). – Palaeontographica **A 106**: 37-153, 82 figs., pls. 16-19; Stuttgart.

HOSSEINIUN, M. 1996. Biostratigraphy and sedimentology of the Kashafrud Formation in the eastern and southeastern Koppeh Dagh basin, with special attention to the ammonite fauna. - Unpublished M. Sc. thesis, Tehran Azad University: 1-175, 19 figs, 21 pls.; Tehran. [In Farsi]

HOWARTH, M. K. 1992. Tithonian and Berriasian ammonites from the Chia Gara Formation in northern Iraq. – Palaeontology **35**: 597-655, 12 pls.; London..

HÜSSNER, H. 1985. Jurassische Karbonate des westlichen Hohen Atlas (Marakko): Mikrofaziesanalyse und plattentektonischer Rahmen. - Facies **12**: 141-218, 17 figs, pls. 14-23; Erlangen.

JAIN, S., CALLOMON, J.H. & PANDEY, D.K. 1995. Contributions to the Jurassic of the Kachchh, Western India. III. The Middle Bathonian ammonite families Clydoniceratidae and Perisphinctidae from Pachchham Island. - Beringeria **16**: 125-145,. 4 figs., 5 pls.; Würzburg.

JAIN, S., CALLOMON, J.H. & PANDEY, D.K. 1996. On the earliest known occurrence of the Middle Jurassic ammonite genus *Reineckeia* in the Upper Bathonian of Jumara, Kachchh, western India. – Paläontologische Zeitschrift **70**: 129-143; Stuttgart.

JEANNET, A. 1951. Stratigraphie und Palaeontologie des oolitischen Eisenerzlagers von Herznach und seiner Umgebung. – Beiträge zur geologischen Karte der Schweiz **13** (5):1-240, 544 figs., 107 pls.; Bern.

JEANNET, A. 1955. Die Macrocephaliten des Callovium von Herznach (Aargau). - Eclogae Geologicae Helvetiae **47**: 223-268, pls. 13-27; Basel.

JOHNSON, J.H. 1964. The Jurassic algae. - Quarterly of the Colorado School of Mines **59**: 1-129, 45 pls.; Golden, Co.

JOLY, B. 1976. Les Phylloceratidae malgaches au Jurassique. Généralites sur les Phylloceratidae et quelques Juraphyllitidae. - Documents des Laboratoires de Géologie Lyon **67**: 1-471, 147 figs., 70 pls.; Lyon

JOLY, B. 1993. Les Phyllocerataceae Malgaches au Cretacé (Phylloceratina, Ammonoidea). - Documents des Laboratoires de Géologie Lyon **127**: 1-171, 10 figs., 35 pls.; Lyon.

KENNEDY, W.J. & COBBAN, W.A. 1976. Aspects of ammonite biology, biogeography, and biostratigraphy. – Palaeontology **17**: 49-92, 24 figs., 11 pls.; London.

KESHANI, F. 1988. New investigation about Jurassic-Cretaceous boundary and its biostratigraphy in central Alborz (Damavand-Firuzkuh). –Unpublished M.Sc Thesis, Tehran University: 147 pp.; Tehran.

KEUPP, H. 1977. *Simosphinctes tieringensis* (FISCHER)- ein seltener Ammonit von Gräfenberg (Mittlere Frankenalb) - Geologische Blätter von Nordost-Bayern **27**: 169-173, 1 pl.; Erlangen.

KILIAN, W. 1889. Déscription géologique de la Montagne de Lure (Basses-Alpes). – 458 pp., 4 pls.; Paris (Masson).

KÖSTLER, L. & SCHAIRER,G. 1996: *Morphoceras* aus dem "Parkinsonien-Oolith" (Mittlerer Jura) von Sengenthal/Opf. - Mitteilungen der Bayerischen Staatssammlung für Paläontologie und. historische Geologie **36**: 81-85, 2 figs.; München.

KRYSTYN, L. 1972. Die Oberbajocium- und Bathonium-Ammoniten der Klaus-Schichten des Steinbruches Neumühle bei Wien (Österreich). – Annalen des naturhistorischen Museum Wien **76**: 195-310, 24 pls.; Wien.

KUHN, O. 1939. Die Ammoniten des fränkischen Calloviums - Nova Acta Leopoldina, Neue Folge **6**: 451-532, 10 pls.; Halle.

KUSS, J. 1990. Middle Jurassic calcareous algae from the circum-Arabian area. – Facies **22**: 59-86, 5 figs., 16-21 pls.; Erlangen.

LAHUSEN, I. 1883. Die Fauna der jurassischen Bildungen des rjasanschen Gouvernments. - Mem. Com. geol. Petersburg **1**: 1-94, 11 pls.; Petersburg. [In Russian]

LANDMAN, N.H., TANABE, K. & DAVIS, R.A. 1996. Ammonoid paleobiology. - Topics in Geobiology **13**: 1-857; New York.

Lang, B. 1989. Die Schwamm-Biohermfazies der Nördlichen Frankenalb (Urspring; Oxford, Malm) - Mikrofazies, Palökologie, Paläontologie. - Facies **20**: 199-274, 26 figs., pls. 58-66; Erlangen.

LASEMI, Y. 1995. Platform carbonates of the Upper Jurassic Mozduran Formation in the Koppeh Dagh Basin, NE Iran: facies, paleoenvironments and sequences. – Sedimentary Geology **99**: 151-164, 9 figs.; Amsterdam.

LEE, G. 1905. Contribution a l‘etude stratigraphique et paléontologique de la chaine de la Faucille. – Mémoires de la Société paléontologique suisse **32**: 1-91, 3 pls.; Basel.

LEINFELDER, R.R., (ed.), KRAUTTER, M., LATERNSER, R., NOSE, M., SCHMID, D.U., SCHWEIGERT, G., WERNER, W., KEUPP, H., BRUGGER, H., HERMANN, R., REHFELD, U., SCHROEDER, J.H., REINHOLD, C., Koch, R., ZEISS, A., SCHWEIZER, V., CHRISTMANN, H., MENGES, G. & LUTERBACHER, H. 1994. The origin of Jurassic reefs: Current research developments and results. - Facies **31**: 1-56; Erlangen.

LEMOINE, P. 1910. Ammonites du Jurassique supérieur du Cercle d´Analalava (Madagascar). – Annales de Paléontologie. **5**: 1-52, 50 figs., 8 pls.; Paris.

LEMOINE, E. 1932. Essai sur l‘evolution du genera *Hecticoceras* dans le Callovien de la chaine du Mont-du-Chat. - Traveaux Laboratoire de la Géologie de Lyon **19**: 1-527, 24 pls.; Paris.

LOMINADZE, T. A. 1975. The Calloway Hecticoceratinae of the northern Caucasus: 1-99, 9 pls.; Tbilisi.

MADANI, M. 1977. A study of the sedimentology, stratigraphy and regional geology of the Jurassic rocks of eastern Koppeh Dagh (NE Iran). - Unpublished Ph. D. thesis, Royal School of Mines, Imperial College London: 1-246 pp.; London.

MANGOLD, C. 1970. Morphoceratidae (Ammonitina-Perisphinctaceae) bathoniens du Jura méridional, de la Nievre et du Portugal – Geobios **3**: 43-130, 38 figs., pls. 3-7; Lyon.

MANGOLD, C. 1970. Stratigraphie des étages bathoniens et callovien du Jura méridional. - Documents des Laboratoires de Géologie Lyon **41**: 1-376, 119 figs.; Lyon.

MANGOLD, C. 1970. Les Perisphinctidae (Ammonitina) du Jura méridional au bathonien et au Callovien. - Documents des Laboratoires de Geologie Lyon **41**: 1-246, 160 figs., 16 pls.; Lyon.

MANGOLD, C., MARCHAND, D., THIERRY J. & TARKOWSKI, R. 1996. Les ammonites de l´oolite de Balin (Pologne); nouvelles données et réinterpretation stratigraphique. - Revue de Paléobiologie **15**: 55-77, 3 pls.; Génève.

MELEDINA, S.V. 1987. Ammonites and zonal stratigraphy of the Callovian of subboreal regions of the USSR. - Academy of Sciences of the USSR, Siberian Branch, Institute of Geology and Geophysics **691**: 1-181, 32 pls.; Novosibirsk.

MELENDEZ, G. 1989. El Oxfordiense en el sector central de la Cordillera Iberica (Provincas de Zaragoza y Teruel). -: 418 pp., 62 pls.; Teruel (Institucion Fernando Catolico Instituto de Estudios Turolenses).

MITTA, V.V. 2001. Distribution of the Bajocian-Bathonian ammonites in the southwest chains of Hussar Range. - Hantkenina **3**: 105-129, 9 pls.; Budapest.

MORTON, N. & DIETL, G. 1989. Age of the Garantiana Clay (Middle Jurassic) in the Hebrides Basin. – Scottish Journal of Geology **25**: 153-159; London.

NABAVIYEH, M. 1994. Study of the petrography, sedimentary environment and diagenesis of the Upper Jurassic carbonates (Mozduran Formation) north of Mashad. – Unpublished M.Sc. Thesis, Tehran Azad University: 1-180, Tehran. [In Farsi]

NEUMAYR, M. 1871. Jurastudien 3. Die Phylloceraten des Dogger und Malm - Jahrbuch der Kaiserlich-Königlichen geologischen Reichsanstalt **21**: 297-378, 21 pls.; Wien.

NITZOPOULOS, G. 1974. Faunistisch-ökologische, stratigraphische und sedimentologische Untersuchungen am Schwammstotzen-Komplex bei Spielberg am Hahnenkamm. - Stuttgarter Beiträge zur Naturkunde **16**: 1-143, 18 figs., 11 pls.; Stuttgart.

O´DOGHERTY, L., SANDOVAL, J. & VERA, J.A. 2000. Ammonite faunal turnover tracing sea-level changes during the Jurassic (Betic Cordillera, southern Spain). - Journal of the Geological Society **157**: 723-736; London.

OLORIZ SAEZ, F. 1978. Kimmeridgiense-Tithonico inferior en el sector central de las Cordilleras Beticas (Zona Subbetica). Paleontologia. Bioestratigrafia. - Tesis doctorales, University of Granada **184**: I+II, 1-758, 29+72 figs., 57 pls.; Granada.

OPPEL, A. 1856-1858. Die Juraformation Englands, Frankreichs und des südwestlichen Deutschlands – Jahreshefte der Vereins für Väterlandische Naturkunde **12-14**: 1-857; Wurttemberg

OPPEL, A. 1862-1863. Über jurassische Cephalopoden - Paläontologische Mitteilungen des Museums des koniglichen bayerischen Staates. **3**: 127-266, pls. 40-47; München.

OPPENHEIMER, J. 1907. Der Malm der Schwedenschanze bei Brünn – Beiträge zur Paläontologie und Geologie Österreich-Ungarns **20**: 221-271, pls. 20-22; Ungarn.

PARONA, C.F. & BONARELLI, G. 1895. Sur la fauna du Callovien inférieur (Chanazien) de Savoie - Memoire de la Academie Science Savoie **4**: 1-183, 11 pls.; Chambery.

PAVIA, G 1973. Ammoniti del Baiociano superiore di Dinge (Francia SE, dip. Basses-Alpes). - Bollettino della Società Paleontologica Italiana **10**: 75-142, 8 figs., pls. 13-29; Torino.

PFAEHLER-ERATH, I. 1938. Sur quelques *Grossouvria* et *Choffatia* du Callovien de Chezery (Jura francais) – Mémoires de la Société paléontologique Suisse 60: 1-29, 9 figs., 4 pls.; Génève.

POMONI-PAPAIOANNOU, F., FLÜGEL, E. & KOCH, R. 1989. Depositional environments and diagenesis of Upper Jurassic.subsurface sponge- and *Tubiphytes* reef limestones: Altensteig 1 Well, Western Molasse Basin, Southern Germany. - Facies **21**: 263-284, 5 figs., pls. 57-62; Erlangen.

QUENSTEDT, F.A. 1845-1849. Petrefaktenkunde Deutschlands: Die Cephalopoden. –580 pp., 36 pls.; Tübingen (Fues).

QUENSTEDT, F.A. 1856-1857. Der Jura. – 842 pp., 100 pls.; Tübingen (Laupp).

QUENSTEDT, F.A. 1887-1888. Die Ammoniten des Schwäbischen Jura, Bd. III: Der Weisse Jura. - 817-1101, 91-126 pls.; Stuttgart (Schweizerbart).

REINECKE, D.J.C.M. 1818. Maris protagaei Nautilos et Argonautas vulgo Cornua Ammonis. – 90 pp., 76 figs., 13 pls.; Coburg.

RENZ, C. 1904. Der Jura von Daghestan. – Neues Jahrbuch für Mineralogie, Geologie und Palaeontologie **1904**: 71-85, 4 figs.; Stuttgart.

RENZ, C. 1913. Zur Geologie des östlichen Kaukasus. - Neues Jahrbuch für Mineralogie, Geologie und Palaeontologie, Beilagen-Band **36**: 651-703, 27-29 pls.; Stuttgart.

REPIN, J. 1978. Stratigraphy and paleogeography of coal-bearing sediments of Iran. – Upublished Report National Iranian Steel Company **1**: 1-326; **2**: 1-198; **3**: 37 pls.; Tehran.

REITNER, J., NEUWEILER, F., (Coordination), FLAJS, G., VIGENER, M., KEUPP, H., MEISCHNER, D., PAUL, J., WARNKE, K., WELLER, H., DINGLE, P., HENSEN, C., SCHÄFER, P., GAUTRET, P., LEINFELDER, R.R., HÜSSNER, H. & KAUFMANN, B. 1995. Mud mounds: A phylogenetic spectrum of the fine-grain carbonate buildups. – Facies **32**: 1-70; Erlangen.

RICCARDI, A. & WESTERMANN, G.E.G. 1999. An early Bathonian Tethyan ammonite fauna from Argentina. – Palaentology **42**: 193-209, 3 pls.; London.

ROCHE, P. 1939. Aalenien et Bajocian du Maconnaise et de quelques regions voisins - Traveaux Laboratoire de la Géologie de Lyon **35**: 1-355, 13 pls.; Lyon.

ROLLIER, L. 1911. Les facies du Dogger ou oolithique dans le Jura et les régions voisins. – 352 pp.; Zürich.

SANDOVAL, J. 1979. The Bajocian Stage in the Island of Majorca: biostratigraphy and ammonite assemblages. - Miscellanea del Servizio Geologio Nazionale **5**: 203-215, 4 figs., 2 pls.; Granada.

SANDOVAL, J. 1990. A revision of the Bajocian divisions in the Subbetic Domain (southern Spain). - Memoire Descrittive Carta Geologica d'I **40**: 141-162, 4 pls.; Roma.

SAPUNOW, I.G. & ZIEGLER, B. 1979. Stratigraphische Probleme im Oberjura des westlichen Balkangebirges. - Stuttgarter Beiträge zur Naturkunde **18**: 1-47, 3 pls.; Stuttgart.

SAPUNOW, I.G. 1979. Les fossiles de Bulgarie 3. Jurassique supérieur Ammonoidea. - Academie Bulgare des Sciences: 263 pp., 59 pls.; Sofia.

SARTORIO, D. & VENTURINI, S. 1988. Southern Tethys biofacies. - 235 pp.; Milano.

SCHAIRER, G. 1984. Die Cephalopodenfauna der Schwammkalke von Biburg (Oberoxford, Südliche Frankenalb): *Glochiceras*, *Ochetoceras* (Ammonoidea, Haploceratacea). - Mitteilungen der Bayerischen Staatssammlung für Paläontologie und historische Geologie **24**: 27-38, 2 pls.; München.

SCHAIRER, G. 1985. Die Cephalopodenfauna der Schwammkalke von Biburg (Oberoxford, Südliche Frankenalb): *Pseudaganides* (NAUTILOIDEA), *Amoeboceras*, *Paraspidoceras*, *Physodoceras*, *Orthosphinctes*, Aptychen (AMMONOIDEA), *Hibolithes* (COLEOIDEA). - Münchner Geowissenschaftliche Abhandlungen **A 6**: 1-28, 2 figs., 6 pls.; München.

SCHAIRER, G. 1988. Bemerkungen zum höheren Oxford (bifurcatus-/bimammatum-Zone; oberer Jura) von Sengenthal. - Mitteilungen der Bayerischen Staatssammlung für Paläontologie und historische Geologie **28**: 39-48, 1 fig., 2 pls.; München.

SCHAIRER, G. 1989. Ammoniten aus dem Braunen und Weißen Jura von Sengenthal. - Mitteilungen der Bayerischen Staatssammlung für Paläontologie und. historische Geologie **29**: 109-131, 4 figs., 3 pls.; München.

SCHAIRER, G. 1989. Die Cephalopodenfauna der Schwammkalke von Biburg (Oberoxford, Südliche Frankenalb): Idoceratinae (Ammonitina). - Münchner Geowissenschaftliche Abhandlungen **A 15**: 97-113, 6 figs., 12 pls.; München.

SCHAIRER, G., SEYED-EMAMI, K. & ZEISS 1992. Ammoniten aus der oberen Dalichai Formation (Callov) östlich von Semnan (SE-Alborz, Iran). - Mitteilungen der Bayerischen Staatssammlung für Paläontologie und historische Geologie **31**: 47-67, 3 figs., 3 pls.; München.

SCHAIRER, G. 1993. Jura-Ammoniten aus dem "Wildflysch" des Oberndorfer Grabens (Haunsberg, Salzburg). - Mitteilungen der Bayerischen Staatssammlung für Paläontologie und. historische Geologie **33**: 31-50, 5 figs., 5 pls.; München.

SCHAIRER, G. 1994. *Polysphinctites polysphinctus* BUCKMAN aus dem "Parkinsonien-Oolith" (Mittlerer Jura) von Sengenthal. - Mitteilungen der Bayerischen Staatssammlung für Paläontologie und historische Geologie **34**: 159-162, 1 fig.; München.

SCHAIRER, G. 2000. Die Ammonitenfauna des Schurfs von Mantlach (Oberoxfordium-Unterkimmeridgium, Südliche Frankenalb, Bayern). - Mitteilungen der Bayerischen Staatssammlung für Paläontologie und historische Geologie **40**: 81-107, 3 figs., 7 pls.; München.

SCHAIRER, G. & JÜRGEN, S. 1996. Zum Alter der Kalke von Saal a. d. Donau. - Mitteilungen der Bayerischen Staatssammlung für Paläontologie und historische Geologie **36**: 73-80, 2 figs., 1 pl.; München.

SCHAIRER,G. & SCHLAMPP, V. 1995. *Idoceras* (*Subnebrodites*) in der Platynota-Zone (Unterkimmeridge) von Hartmannshof/Mfr. - Mitteilungen der Bayerischen Staatssammlung für Paläontologie und historische Geologie **35**: 53-58, 1 fig., 1 pl.; München.

SCHAIRER, G., SEYED-EMAMI, K., MAJIDIFARD, M.R. & MONFARED, M. 1999. Erster Nachweis von Untertithon in der Chaman Bid-Formation an der Typuslokalität bei Bash Kalateh (Zentral-Koppeh Dagh, NE Iran). - Mitteilungen der Bayerischen Staatssammlung für Paläontologie und historische Geologie **39**: 21-32, 2 pls.; München.

SCHAIRER, G., SEYED-EMAMI, K., FÜRSICH, F.T., SENOWBARI, B., AGHANABATI, S.A. & MAJIDIFARD, M.R. 2000. Stratigraphy, facies analysis and ammonite fauna of the Qaleh Dokhtar Formation (Middle-Upper Jurassic) at the type locality west of Boshrouyeh (east-central Iran). – Neues Jahrbuch für Geologie und Paläontologie Abhandlungen **216**: 35-66, 32 figs.; Stuttgart.

SCHLAMPP, V. 1991. Malm-Ammoniten. Bestimmungsatlas der Gattungen und Untergattungen aus dem Oberjura Süddeutschlands, der Schweiz und angrenzender Gebiete: 184 pp., 35 pls.; Stuttgart (Goldschneck-Verlag).

SCHLEGELMILCH, R. 1985. Die Ammoniten des süddeutschen Doggers, ein Bestimmungsbuch für Fossiliensammler und Geologen: 283 pp., 15 figs., 59 pls., 950 photos; Stuttgart (Gustav Fischer).

SCHLEGELMILCH, R. 1994. Die Ammoniten des süddeutschen Malms, ein Bestimmungsbuch für Geowissenschaftler und Fossiliensammler: 296 pp., 9 figs., 73 pls., 501 photos; Stuttgart (Gustav Fischer).

SCHMID, D.U. 1996. Marine Mikrobolithe und Mikroinkrustierer aus dem Oberjura. – Profil **9**: 101-251; Stuttgart.

SCHWEITZER, H.J. & KIRCHNER, M. 1995. Die rhäto-jurassischen Floren des Iran und Afghanistans: 8 Ginkgophyta. - Palaontographica **B 237**: 1-58, 25 figs., 13 pls.; Stuttgart.

SCHWEITZER, H.J. & KIRCHNER, M. 1996. Die rhäto-jurassischen Floren des Iran und Afghanistans: 9 Ginkgophyta.-Palaontographica **238**: 77-139, 26 figs., 15 pls.; Stuttgart.

SCHWEIGERT, G. & CALLOMON, J.H. 1997. Der baubini-Faunenhorizont und seine Bedeutung für die Korrelation zwischen tethyalem und subborealem Oberjura - Stuttgarter Beiträge zur Naturkunde **247**: 1-69, 10 figs., 7 pls.; Stuttgart.

SCHWEIGERT, G. 1998. Die Ammonitenfauna des Nusplinger Plattenkalks (Ober-Kimmeridgium, Beckeri-Zone, Ulmense-Subzone, Baden-Württemberg). - Stuttgarter Beiträge zur Naturkunde **276**: 1-61, 3 figs., 12 pls.; Stuttgart.

SDZUY, K. & MONNINGER, W. 1985. Neue Modelle des Jakobstabes. – Neues Jahrbuch für Geologie und Paläontologie, Monatshefte **1985** : 300-320; Stuttgart.

SENGÖR, A.M.C. 1990. A new model for the Paleozoic-Mesozoic tectonic evolution of Iran and implication for Oman. -In: ROBERTSON, A.H.F., SEARLE, M.P. & RIES, A.C. (eds.) The Geology and tectonic of the Oman region. - Geological Society London, Special Publication **49**: 797-831, 7 figs.; London.

SEYED-EMAMI, K. 1971. The Jurassic Badamu Formation in the Kerman region with remarks on the Jurassic stratigraphy of Iran. – Report,. Geological Survey of Iran **19**: 5-79; Tehran.

SEYED-EMAMI, K. 1975. Jurassic-Cretaceous Boundary in Iran.- American Association of Petroleum Geologists. – **59**: 231-238, 4 figs.; Tulsa.

SEYED-EMAMI K. 1988. Jurassic and Cretaceous ammonite faunas of Iran and their paleobiogeographic significance. - In: WIEDMANN, J. & KULLMANN, J. (eds.) Cephalopods - Present and Past: 599-606, 3 figs.; Stuttgart (Schweizerbart).

SEYED-EMAMI, K. & ALAVI-NAINI, M. 1990. Bajocian stage in Iran. - Memorie Decriptive Della Carta Geologica D'Italia **40**: 215-221, 3 figs.; Rome.

SEYED-EMAMI, K. & NABAVI, M.H. 1985. *Dumortieria* und *Pleydellia* (Ammonoidea) aus der Shemshak Formation (Obertrias bis mittlerer Jura) östlich von Shahmirzad (SE Alborz, Iran). – Neues Jahrbuch für Geologie und Paläontologie, Abhandlungen **107**: 243-272, 42 figs.; Stuttgart.

SEYED-EMAMI, K., SCHAIRER, G. & ALAVI-NAINI, M. 1989. Ammoniten aus der unteren Dalichai-Formation (Unterbathon) östlich von Semnan (SE-Alborz, Iran). - Münchner Geowissenschaftliche Abhandlungen **A 15**: 79-91, 4 figs., 3 pls.; München.

SEYED-EMAMI, K., SCHAIRER, G. & BOLOURCHI, M.H. 1985. Ammoniten aus der unteren Dalichy-Formation (oberes Bajocium bis unteres Bathonium) der Umgebung von Abe-garm (Avaj, NW-Zentraliran). - Zitteliana **12**: 57-85, 5 pls.; München.

SEYED-EMAMI, K., SCHAIRER, G. & ZEISS, A. 1991. Ammoniten aus der oberen Dalichai-Formation (Callov) östlich von Semnan (SE-Alborz, Iran). - Mitteilungen der Bayerischen Staatssammlung für Paläontologie und historische Geologie **31**: 47-67, 3 figs., 3 pls.; München.

SEYED-EMAMI, K., SCHAIRER, G. & AGHANABATI ,S.A. 1997. Ammoniten aus der Baghmshah-Formation (Callov,Mittlerer Jura) NW Tabas (Zentraliran). - Mitteilungen der Bayerischen Staatssammlung für Paläontologie und. historische Geologie **37**: 27-40, 4 figs., 3 pls.; München.

SEYED-EMAMI, K., SCHAIRER, G. & AGHANABATI, S.A. 1998. *Bullatimorphites* aus dem Oberbathon (Mittlerer Jura) SW Tabas (Zentraliran). - Mitteilungen der Bayerischen Staatssammlung für Paläontologie und historischeGeologie **38**: 121-134, 4 pls.; München.

SEYED-EMAMI, K. & SCHAIRER, G. & BEHROOZI, A. 1994. Einige Ammoniten aus der Kashafrud-Formation (Mittlerer Jura) E Mashhad (NE-Iran). - Mitteilungen der Bayerischen Staatssammlung für Paläontologie und historische Geologie **34**: 145-158, 4 figs., 1 pl.; München.

SEYED-EMAMI, K., SCHAIRER, G. & BEHROOZI, A. 1996. Ammoniten aus der Bajoc (Mittlerer Jura) des SE-Koppeh Dagh und SE Alborz (NE-Iran). - Mitteilungen der Bayerischen Staatssammlung für Paläontologie und historische Geologie **36**: 87-106, 6 figs., 3 pls.; München.

SEYED-EMAMI, K., SCHAIRER, G. & ZEISS, A. 1995. Ammoniten aus der Dalichai-Formation (Mittlerer bis Oberer Jura) und der Lar-Formation (Oberer Jura) N Emamzadeh Hashem (Zentralalborz, Nordiran). - Mitteilungen der Bayerischen Staatssammlung für Paläontologie und historische Geologie **35**: 39-52, 2 pls.; München.

SEYED-EMAMI, K., SCHAIRER, G., AGHANABATI, S.A. & FAZL, M. 1991. Ammoniten aus dem Bathon der Gegend von Tabas – Nayband (Zentraliran). - Münchner Geowissenschaftliche Abhandlungen **A 19**: 65-100, 3 figs., 8 pls.; München.

SEYED-EMAMI, K., SCHAIRER, G. & MOHAMMADI-MONFARED, M. 1998. Ammoniten aus dem Oberen Jura des Nordiran. - Mitteilungen der Bayerischen Staatssammlung für Paläontologie und historische Geologie **38**: 97-110, 1 fig., 2 pls.; München.

SEYED-EMAMI, K. & FÜRSICH, F.T. & SCHAIRER, G. 2001. Lithostratigraphy, ammonite faunas and palaeoenvironments of Middle Jurassic strata in north and Central Iran. – Newsletters on Stratigraphy **38**: 163-184, 11 figs.; Stuttgart.

SEYED-EMAMI, K., & SCHAIRER, G., AGHANABATI, S.A., FÜRSICH, F.T., SENOWBARI-DARYAN, B. & MAJIDIFARD, M.R. 1998. *Cadomites* aus der unteren Baghamshah-Formation (Oberbathon, Mittlerer Jura) SW Tabas (Zentraliran). - Mitteilungen der Bayerischen Staatssammlung für Paläontologie und historische Geologie **38**: 111-119, 2 figs., 1 pl.; München.

SEYED-EMAMI, K., SCHAIRER, G., FÜRSICH, F.T., WILMSEN, M. & MAJIDIFARD, M.R. 2002. Reineckeiidae (Ammonoidea)from the Callovian (Middle Jurassic)of the Shotori Range (East-Central Iran). – Neues Jahrbuch für Geologie und Paläontologie, Monatshefte **2002**: 184-192, 7 figs.; Stuttgart.

SHINN, E.A. 1983a. Tidal flat environments. In: SCHOLLE, P.A., BEBOUT, D. G. &. MOORE, C. H. (eds.) Carbonate Depositional Environments. – American Association of Petroleum Geologists, Memoir **33**: 173-210; Tulsa, Ok..

SHINN, E.A. 1986. Modern carbonate tidal flats: their diagnostic features – Quarterly Journal of the Colorado School of Mines **81**: 7-35; Golden, Co.

SIEMIRADZKI, J. 1898-1899. Monographische Beschreibung der Ammonitengattung *Perisphinctes*. - Palaeontographica **45** (1898): 69-296, pls. 20-25; **46** (1899): 297-352, 85 figs., pls. 26-28; Stuttgart.

SIEMIRADZKI, J. 1894. Neue Beiträge zur Kenntniss der Ammonitenfauna der polnischen Eisenoolithe. – Zeitschrift der deutschen geologischen Gesellschaft **46**: 501-536: Stuttgart.

SOWERBY, J. 1823. The mineral conchology of Great Britain **4**: 1-160, pls. 307-407; London.

SPATH, L.F. 1925. Ammonites and Aptychi. I. The collection of fossils and rocks from Somaliland. - Monogr. Gelo. Dep. Hunterian Museum: 111-164, pls. 14-15; Glasgow.

SPATH, L.F. 1927-1933. Revision of the Jurassic cephalopod fauna of Kachh (Cutch). – Memoirs of Geological Survey of India, Palaeontologia Indica, New Series **9**, Memoir 2: 1-945, 9 figs., 130 pls.; Calcutta.

SPATH, L.F. 1950. A new Tithonian ammonoid fauna from Kurdistan, northern Iraq. - Bulletin of the British Museum (Natural History), Geology **1**: 96-137, pls. 6-10; London.

STAMPLI, G.M. 1978. Etude géologique générale de l´Elburz oriental au S de Gonbad-e-Qabus, (Iran, NE). – These, Faculté des Sciences, Université de Génève: 315 pp.; Génève.

STEIGER, R. 1966. Die Geologie der west-Firuzkuh-Area (Zentralelburz, Iran). – Mitteilungen aus dem geologischen Institut der E.T.H. und Universität Zürich, Neue Serie: 1-145, 54 figs., 5 pls.; Zürich.

STEPHANOV, J. 1966. The middle Jurassic ammonite genus *Oecotraustes* WAAGEN. - Travaux sur la Géologie de Bulgarie – Serie Paléontologie **8**: 26-69, 7 pls.; Sofia.

STEPHANOV, J. 1972. Monograph on the Bathonian ammonite genus *Siemiradzkia* HYATT. - Bulletin of the Geological Institute, Palaeontology **21**: 5-82, 16 pls.; Sofia.

STÖCKLIN, J. 1972. Iran central, septentrional et oriental. -Léxique stratigraphique international **lll**: 1-238; Paris.

STURANI, C. 1966. Ammonites and stratigraphy of the Bathonian in the Digne-Barrême area (south-eastern France, Dépt. Basses-Alpes). - Bollettino della Società Paleontologica Italiana **5**: 3-57, 4 figs., 24 pls.; Modena.

THIERRY, J. 1978. Le genre *Macrocephalites,* Callovian inferieur (ammonites jurassique moyen). - Mémoires géologiques de l´universite de Dijon **4**: 1-490, 36 pls.; Dijon.

TILL, A. 1907. Die Cephalopodengebisse. – Jahrbuch der kaiserlich-königlichen geologischen Reichsanstalt Wien **57**: 535-682, 8 figs., pls. 12-13; Wien.

TILL, A. 1910-1911. Die Ammonitenfauna des Kelloway von Vilany (Ungarn) – Beiträge zur Paläontologie und. Geologie Österrreich-Ungarns und des Orients **23** (1910): 251-272, pls. 16-19; **24** (1911): 1-45, 8 pls.; Wien.

TORRENS, H. 1987. Ammonites and stratigraphy of the Bathonian rocks in the Digne-Barréme area (South-Eastern France, Dept. Alpes de Haute Provence). (Notes for a revision constructed from material left by Carlo Sturani). - Bollettino della Societa´ Paleontologica Italiana **26**: 93-108, 9 pls.; Modena.

TSYTOVITCH, X. DE 1911. *Hecticoceras* du Callovien de Chezery – Mémoires de la Société paléontologique Suisse 37: 142-198; Génève.

TUCKER, M.E. 1985. Shallow marine carbonate facies and facies models. In: BRENCHLEY, P.J. & WILLIAMS, B.P.J. (eds.) - Recent developments and applied aspects. - Geological Society London, Special Publication **18**: 139-161; London.

VOLLMER, T. 1987. Zur Geologie des nördlichen Zentral-Elburz zwischen Chalus-und Haraz-Tal, Iran. – Mitteilungen aus dem Geologisch-Paläontologischen Institut der Universität Hamburg **63**: 1-125, 63 figs.; Hamburg.

WAAGEN, W. 1869. Die Formenreihe des *Ammonites subradiatus*. – Geognostisch-palaeontologische. Beitraege **2**: 179-356, pls. 16-20; München.

WAAGEN, W. 1873-1875. Jurassic fauna of Kutch, Cephalopoda – Memoirs of Geological Survey of India, Palaentologia Indica **9**: 1-274, 60 pls.; Calcutta.

WENDT, J. 1963. Stratigraphisch-Paläontologische Untersuchungen im Dogger Westsiziliens.- Bollettino della Società Paleontologica Italiana **2**: 57-145, 4 figs., pls. 6-24; Modena.

WESTERMANN, G.E.G. 1958. Ammonitenfauna und Stratigraphie des Bathonium NW Deutschlands. - Geologisches Jahrbuch, Beihefte **32**: 1-103, 9 figs., 49 pls.; Hannover.

WESTERMANN, G.E.G. 1980. Ammonite biochronology and biogeography of the Circum-Pacific Middle Jurassic. - Systematics Association, Special Publication **18**: 459-498; London and New York.

WESTERMANN, G.E.G. 1992. The Jurassic of the Circum-Pacific. – 676 pp., 133 pls.; Cambridge.

WESTERMANN, G.E.G. 2000. Marine faunal realms of the Mesozoic: review and revision under the new guidelines for biogeographic classification and nomenclature. – Palaeogeography, Palaeoclimatology, Palaeoecology **163**: 49-68; Amsterdam.

WESTERMANN, G.E.G. 2001. Modes of extinction, pseudo-extinction and distribution in Middle Jurassic ammonites: terminology. – Earth Science Canada **38**: 187-195; Calgary.

WESTERMANN, G.E.G. & TSUJITA, C. 1999. Life habits of ammonoids. – In: Landman, N.H., Tanabe, K. and Davis, R.A., (ed.) Functional morphology of the invertebrate skeleton: 229-325; London (John Wiley & Sons).

WEGELE, L. 1929. Stratigraphische und faunistische Untersuchungen im Oberoxford und Unterkimmeridge Mittelfrankens. – Palaeontographica **72**: 1-94, pls. 1-11; Stuttgart.

WETZEL, W. 1937. Studien zur Paläontologie des nordwesteuropäischen Bathonian. – Palaeontographica **A 87**: 77-157, pls. 10-15; Stuttgart.

WRIGHT, L.D. & COLEMAN, J.M. 1974. Mississippi river mouth processes: Effluent dynamics and morphologic development. – Journal of Geology **82**: 751-778; Chicago.

WHEELER, J.W. & SARJEANT, W.A.S. 1990. Jurassic and Cretaceous palynomorphs from the central Alborz Mountains, Iran: Their significance in biostratigraphy and palaeogeography. - Modern Geology **14**: 267-374; London.

WRIGHT, L.D. 1985. River deltas. - In: DAVIES, R.A. (ed.), Costal sedimentary environments. - 1-76; New York (Springer).

ZANY, D., ATROPS, F., MARCHAND, D. & THIERRY, J. (1990): Nouvelles données biostratigraphiques sur les séries du Bathonien et du Callovien des énvirons de Digne (Alpes-de-Haute-Provence). - Geologie Mediterranéenne **17**: 39-53, 1 pl.; Marseille.

ZEISS, A. 1956. *Hecticoceras* und *Reineckeia* im Mittel-und Ober-Callovien von Blumberg (Südbaden). – Abhandlungen, Bayerische Akademie der Wissenschaften, mathematisch-naturwissenschaftliche Klasse **80**: 1-101, 4 figs., 4 pls.; München.

ZEISS, A. 1959. Hecticoceratinae (Ammonoidea jurassica); In: Fossilium Catalogus. I: Animalia, Pars **96**: 1-155; S-Gravenhage (Junk).

ZEISS, A. 1979. Neue Sutnerien-Funde aus Ostafrika. Ihre Bedeutung für Taxonomie und Phylogenie der Gattung. - Paläontologische Zeitschrift **53**: 259-280; Stuttgart.

ZEISS, A. 1994. Neue Ammonitenfunde aus dem oberen Malm Süddeutschlands. – Abhandlungen der Geologischen Bundes-Anstalt Wien **50**: 509-528; Wien.

ZIEGLER, B. 1977. The White (Upper) Jurassic in southern Germany. - Stuttgarter Beiträge zur Naturkunde **26**: 1-79, 11 pls.; Stuttgart.

ZIEGLER, B. 1980. Ammonoid biostratigraphy and provincialism: Jurassic - old World. - Systematics Association, Special Publication **18**: 433-457; London & New York.

ZIEGLER, B. 1986. Über Ammoniten des Schwäbischen Juras. - Stuttgarter Beiträge zur Naturkunde **4**: 1-35, 5 pls.; Stuttgart.

ZIEGLER, B. 1987. Der Weiße Jura der Schwäbischen Alb. - Stuttgarter Beiträge zur Naturkunde **23**: 1-71, 51 figs., 11 pls.; Stuttgart.

ZIETEN, C.H.V. 1830. Die Versteinerungen Württembergs. – 102 pp., 72 pls.; Stuttgart.

ZITTEL, K.A. 1884. Cephalopoden. – In:. OLDENBOURG, R (ed.) Handbuch der Paläontologie **2**: 329-522; Leipzig.