

THE GEOLOGY OF THE UPPER DJADJERUD AND LAR VALLEYS
(NORTH IRAN)

II. PALAEONTOLOGY

THE LAR LIMESTONE AND ITS AMMONITE FAUNA
(UPPER OXFORDIAN - LOWER KIMMERIDGIAN)

N. FANTINI SESTINI and R. ASSERETO

Riassunto. Sul versante meridionale dell'Elburz Centrale (Iran), affiora estesamente una unità calcarea che viene denominata Calcare del Lar. Nella parte inferiore la formazione è costituita da depositi pelagici: micriti e micriti fossilifere in strati sottili; superiormente prevalgono invece intramicriti fossilifere, biocalcareni e oomicriti che suggeriscono una deposizione in un bacino a libera circolazione di scarsa profondità. Il Calcare del Lar è ricco in resti fossili di Ammoniti. Queste sono rappresentate prevalentemente da *Perisphinctidae* e secondariamente da *Oppeliidae* e *Aspidoceratidae* che hanno permesso di documentare la presenza dell'Oxfordiano superiore (zone a *Transversarium* e *Bimammatum*) nei livelli basali dell'unità e del Kimmeridgiano inferiore nei livelli sommitali. Sono state identificate in totale 19 specie che vengono descritte ed illustrate. Sono inoltre discusse criticamente le Ammoniti del Giurassico superiore illustrate nella regione dagli AA. precedenti.

Introduction.

This work is part of a research programme being carried out in the Central Elburz by the Geological and Palaeontological Institute of the University of Milan.

— N. Fantini Sestini carried out the palaeontological investigations in the present work and R. Assereto was responsible for the geological aspects.

— N. Fantini Sestini is grateful to Professor C. Rossi Ronchetti, Director of the Palaeontology Institute of the University of Milan, for her kind guidance. Sincere thanks are also due to Dr. Jaeger of the Humboldt University of Berlin, who made available specimens from the Fischer collection (1915) and to Prof. R. Enay of the Lyon University for his valued advice.

— With the grant of the Comitato Nazionale per le Scienze Geologiche e Minerarie del Consiglio Nazionale delle Ricerche - Gruppo di Ricerca per la Paleontologia.

The field work, carried out by one of the authors (R.A.) between the years 1961 and 1963, was initially aimed at the formulation of a practicable lithostratigraphical scheme. This was submitted to and approved by the Iranian Stratigraphic Names Committee, and several formations were formally adopted (Assereto 1963, 1966); however the formations of the Upper Jurassic have not been so far completely defined. One of these units, the Lar Limestone, is widely distributed in the Elburz, and various authors (Lorenz, 1964; Glaus, 1966; Allenbach, 1966; Assereto, 1966; Assereto et al., 1968; Steiger, 1966; Stocklin & Eftekhar-Nezhad, 1969) have employed this term. Lately the palaeontological study of the fauna of the Lar Limestone has been carried out by N. Fantini Sestini, and we can now add to the palaeontological descriptions some general geological data and formally define the formation.

The present paper briefly describes the Lar Limestone in the type area and discusses in some detail the Ammonite fauna it contains.

Definitions.

The Lar Limestone is a term used to denote a succession of thin to massively bedded dense white limestones which frequently contain flint concretions and Ammonites, and occur throughout southern flank of the Central Elburz.

In the type area the formation lies conformably on marls of the Dalichai Formation, and is disconformably overlain by formations of various ages, i.e. the Tiz Kuh Formation (Lower Cretaceous), the unnamed Upper Cretaceous formations, the Ziarat Formation (Eocene) and the Karadj Formation (Eocene).

Type area.

The Lar Limestone has a very uniform lithological character over a large part of the Central Elburz. The name of the formation is derived from the Lar Valley, situated to the west of the Demavend Massif, where the unit outcrops extensively and is extremely fossiliferous. Sections which are particularly well exposed and complete are those of Tiz Kuh, Bandah Kuh and Kamar Dasht (see Assereto, 1966). Since, however, the Lar Valley is almost inaccessible and cannot be reached by road, we

use the section in the high valley of Djadjerud near to the watershed with the Lar Valley, in the neighbourhood of the Vasek Gah coal mine, as the type section. This locality is easily reached by road, and the rocks have a similar character to those of the Lar Valley.

Lithology in the type area.

The Lar Formation can be subdivided into two horizons over the whole of the type area.

The lower horizon consists of micritic limestones, white, pink or pale brown in colour, with local intercalations of bands or nodules of white or violet flint. The horizon is mostly thinly bedded, the beds varying in thickness from 10 to 40 cm, and splitting into prismatic splinters with conchoidal fracture surfaces. Ammonite remains are very frequent in this horizon.

Under the microscope, these rocks can be regrouped into two microfacies. The more widespread microfacies is a biomicrite containing from 10 % to 30 % fine sand or coarse silt sized skeletal debris. The groundmass consists of an organically stained uniform mosaic of micrite. The organic fragments are irregularly distributed throughout the groundmass and comprise fine fragments of Lamellibranchs, Ostracods, Sponge spicules, Radiolarians, Stomiospheres and Lagenids. Small dark-coloured pellets are common in some places. The second microfacies is a nearly pure calcilutite with less than 5 % of skeletal debris and infrequent pellets. The groundmass is an extremely fine dark micrite.

The thickness of the lower horizon varies; in the type section it is about 55 metres whereas further east, in the Tiz Kuh, it exceeds 200 metres.

The upper horizon consists of hard compact light-coloured limestones, poorly stratified or thick-bedded. They frequently contain bands and nodules of flint of various dimensions and of irregular shape. In the upper part yellowish-grey dolomites and crystalline calcareous dolomites are locally present.

Microscopically the rocks of this horizon exhibit some variation in microfacies. Apart from the two microfacies characteristic of the lower horizon described above, there are:

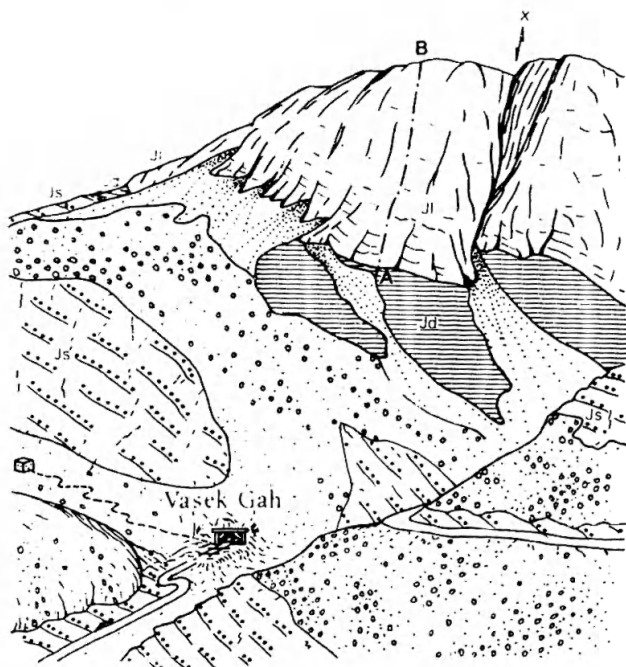


Fig. 1 - Schematic drawing of the environs of Vasek Gah and location (A B) of the type section of Lar Limestone (drawing after a photograph); Js = Shemshak Formation; Jd = Dalichai Formation; Jl = Lar Limestone.

— mud-supported biocalcarenes, composed of a diffuse micritic matrix with abundant skeletal debris dominated by fragments of Echinoderms, calcareous Algae, arenaceous Foraminifera and *Lagenidae*. The skeletal fragments are often coated by micrite probably precipitated by blue-green Algae; algal intraclasts of a similar origin are also locally present.

— fossiliferous intramicrites, formed of micritic intraclasts, dark in colour and without internal structure, rounded or ovoidal in shape, often coated by algally precipitated micrite, in an abundant micritic matrix strewn with small pellets; sparse fragments of Crinoids are frequently associated with the intraclasts.

— mud-supported edgewise conglomerates, with monogenic elongated subrounded grains formed of almost pure micrite. These grains frequently have an algal precipitated micrite coating on one face.

— grain-supported oolitic calcarenites, with micritic cement. The

ooliths are generally of superficial type with nucleus consisting of pellets, intraclasts and skeletal debris.

The last two microfacies described are not very frequent and form isolated layers within the formation.

In the upper horizon the macrofossils are much rarer than in the lower one, and are represented by Ammonites and by rare Lamelli-branches. The thickness of the upper horizon varies from 150 to 250 metres approximately.

Type section.

The type section is situated in the upper valley of the Djadjerud river, near the watershed which it makes with the Lar Valley. The locality is easily reached from Garmabdar along the easterly highway leading to the Vasek Gah mine. The section was taken on the right (western) slope of the valley, starting at 3000 m. The geographical coordinates of the starting point of the section are: Lat. N. 36°1'9"; Long. E. 51°42'08".

The lithological succession is as follows:

Top: *Upper Cretaceous unnamed formation*: micritic limestones, glauconitic, pale grey with scaly fracture; locally with monogenic reddish breccias at the base;
— angular unconformity —

- 10) light-grey or rosy micritic limestones, with thickly-bedded or indistinctly-stratified flint nodules; from the upper part of this lithozone, at about 1 km east of the type section, the fossils *Orthosphinctes* (*Orthosphinctes*) *polygyratus* (Rein.), *Lithacoceras* (*Progeronia*) sp. and *Atarioceras* (*Parataxioceras*) sp. were found (122 m);
- 9) poorly-stratified white micritic limestones with frequent flints occurring as nodules and as beds (38 m);
- 8) rosy or brown micritic limestones, with conchoidal fracture, stratified in poorly-defined beds 40-80 cm thick; frequent indeterminate fragments of Ammonites (27 m);
- 7) grey micritic limestone, in beds 30-40 cm thick, with white flint nodules (12 m);
- 6) grey micritic limestone, in beds 10-20 cm thick, with conchoidal fracture, and with rare nodules of black flint (18 m);
- 5) grey-brown micritic limestone, in beds 1 m thick (6 m);
- 4) brown to rosy micritic limestone, in beds 10-15 cm thick, with frequent nodules and bands of black flint (3.5 m);
- 3) as 4, but without flint nodules (3.7 m);
- 2) brown to rosy micritic limestone, with conchoidal fracture, in beds 10-15 cm thick sometimes subdivided by thin marly partings containing Ammonites of the genus *Perisphinctes* (7.5 m);
- 1) slightly marly light-grey limestone, in beds 30-40 cm thick, with rare flint nodules (4.5 m);

Base: *Dalichai Formation*: greyish marly limestones in thin beds, alternating with greenish-grey marls. Frequent Ammonites: *Reineckea* spp., *Hecticoceras* (*Lunoloceras*) spp., *Choffatia* spp. etc.

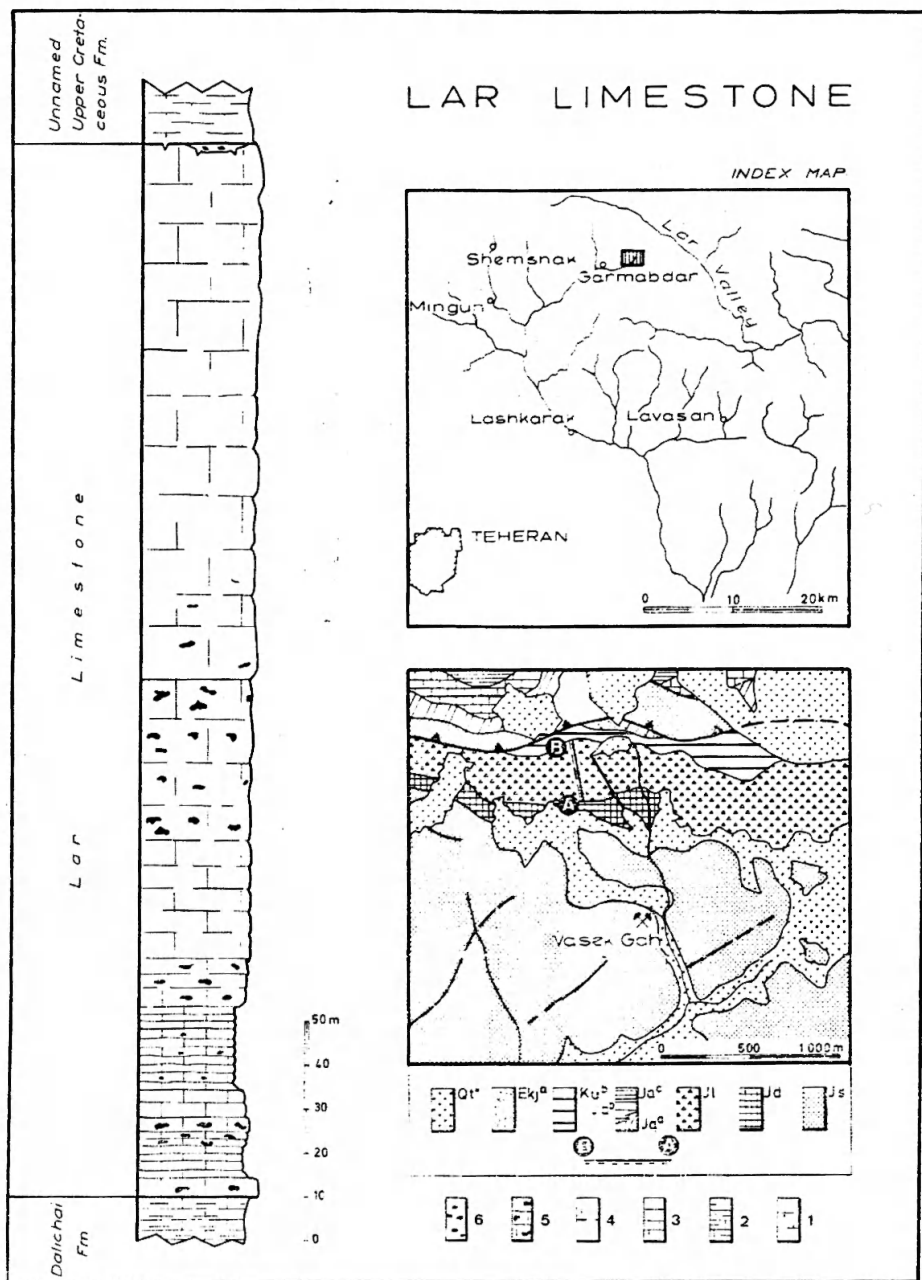


Fig. 2 - Location and lithologic sequence of the type section of Lar Limestone. Explanations of the symbols: Qt' = Scree slope, scree cone, detritus of large blocks; Ekj^a = Karaj Formation (Eocene); Ku^a = Unnamed Upper Cretaceous formation; Ja^a = Abnak Formation, Member A (Upper Dogger); Ja^b = Abnak Formation, Member B (Malm); Ja^c = Abnak Formation, Member C (Malm); Jl = Lar Limestone (Malm); Jd = Dalichai Formation (Dogger); Js = Shemshak Formation (Lias-Lower Dogger); A B, location of the type section; 1 = marls; 2 = marly limestones; 3 = thin bedded limestones; 4 = poorly bedded limestones; 5 = cherty limestones; 6 = conglomerates.

Stratigraphical relations.

LOWER BOUNDARY.

The Lar Limestone merges downwards into the Dalichai Formation. The transition is characterised by the progressive appearance of marly horizons alternating with the pale micritic limestones typical of the Lar Formation: the marls become predominant within 5-10 metres.

UPPER BOUNDARY.

The Lar Limestone in the type area is unconformably overlain by formations of various ages. In the lower Lar Valley, near Tiz Kuh, the unit is covered by polygenic conglomerates, and also by white limestones referable to the Tiz Kuh Formation (Aptian-Albian).

In the middle and upper parts of the Lar Valley and in the eastern part of the Djadgerud Valley the Lar Limestone is overlain by marly micritic limestones of Upper Cretaceous age. At the junction lenses of monogenic breccia or glauconitic arenaceous limestones often occur. In the central western part of Djadgerud Valley, the Lar Limestone is overlain with appreciable angular disconformity by bioclastic limestones containing Alveolinids and Nummulites of Eocene age (Ziarat Formation). Finally, at Fil-i-Zanin, the Lar Limestone is covered with marked angular disconformity (30°) by sandy pink polygenic conglomerates, probably of Palaeocene age (the Fajan Conglomerate).

Horizontal stratigraphical relations.

In the type area, the Lar Limestone is time-equivalent with a dark-coloured calcareo-dolomitic unit termed the Abnak Formation. The lateral transition between the two units cannot be seen in the type area because the two units belong to two different tectonic zones and are separated by a regional important thrust (Assereto, 1965, 1966). To the east of the type area however the tectonic structures are less complex, with only a minor shortening, and the original stratigraphical relationships are easy to reconstruct. According to studies by Steiger (1966), the sedimentary basin of the Abnak Formation is there separated from that of the Lar Limestone by a subsiding rise on which bioherms and platform carbonates formed. Thus proceeding from the north, the shallow water restricted deposits of the Abnak Formation pass into platform white limestones associated with the rise, and then further south these pass into the calcareous rocks of the Lar Formation deposited in the open sea; these gradually assume a more pelagic character southwards.

Depositional interpretation.

LOWER HORIZON.

The abundance of micrite with normal marine biota and the lack of Algae in the lower horizon indicate: a) that currents and the turbulence were gentle enough for the accumulation of calcareous muds; b) that the water was too deep for algal growth; c) that the sea water was of normal salinity, otherwise the fauna of Ammonites, Radiolarians, Lamellibranchs and Sponges would not have been present. A more detailed examination of the biota suggested the assemblage is dominated by Ammonites, which are representatives of the Perisphinctids and to a lesser extent of the Oppeliids; the bivalves are less common and consist exclusively of pelagic forms with slender shells; spicules of siliceous Sponges, Radiolarians and occasional Foraminifera occur. The assemblage has a distinctly pelagic character. According to the Ziegler (1967) Upper Jurassic assemblages of this type were deposited at depths ranging from 80 to 150 metres.

UPPER HORIZON.

This, as already indicated, differs from the lower horizon by containing intercalations of biomicrites, intramicrites and oolitic calcarenites. These lithotypes suggest sedimentation at shallow depth, in the photic zone of an open marine basin. In particular, the mud-supported skeletal calcarenites formed by benthonic biota (Echinoderms, calcareous Algae, Foraminifera) are often encrusted with Algae, suggesting: a) sufficiently shallow water for Algae to flourish; b) sedimentation to beneath wave base in weakly-agitated conditions, as demonstrated by the abundance of micrite and by the irregular distribution of the grains. Conditions of greater energy are only found locally, corresponding to restricted higher zones, as suggested by the irregular occurrence of oolitic calcarenites and of edgewise conglomerates. It is to be noted that the oolites in the Lar Limestone are predominantly of the superficial type.

Palaeontological content.

Ammonites have been often noted in the Lar Limestone by previous authors. Records of Ammonites in the Upper Oxfordian (Transversarium and Bimammatum zones) and in the Lower Kimmeridgian are found in the work of Bogdanowitch (1890), Douvillé (1904), Fischer (1915), Rivière (1934), Furon (1941), Spath (1948), Dellenbach (1964),

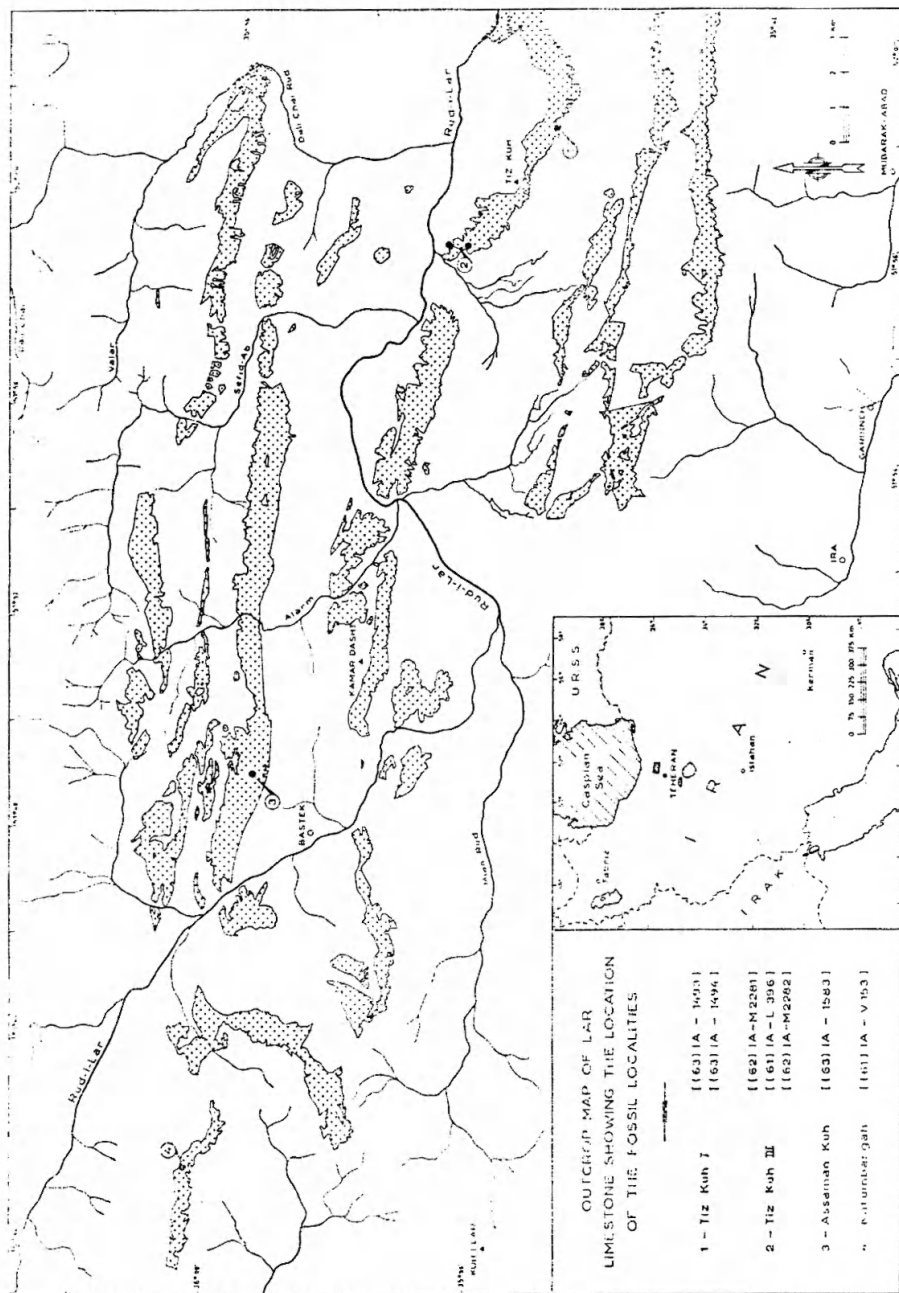


Fig. 3.

Allenbach (1966) and Steiger (1966). The palaeontological material has however only been illustrated by a few authors, such as Bogdanowitch, Douvillé, Fischer and Rivière. The complete list of species identified is reported in the work dealing with the stratigraphy of the Jurassic in Central Elburz (Assereto R., Barnard P. D. W. & Fantini Sestini N., 1968). In the next chapter there will be a consideration of those of the specimens illustrated whose specific attribution may give rise to discussion.

The palaeontological material dealt with in this report originates from many localities, which are listed below in order from east to west and whose topographical position is indicated in Fig. 3. The fossils found at each locality are indicated.

Nuclei of *Perisphinctidae* were found in many localities not quoted in the present report; their small size has not permitted a more precise identification.

Loc. Tiz KUH I: (63) IA-1493 and (63) IA-1494.

Location: descending towards Pulur from the pass of the Lar and Pulur Valleys, taking the third stream, about 50 metres above the locality (63) IA-1492 (Dalichai Formation, Mariae zone), there is the locality (63) IA-1493. 230 m above this is the locality (63) IA-1494.

Geographical co-ordinates: Long. E. 51° 58' 06"; Lat. N. 35° 52' 16".

Loc. (63) IA-1493.

Ochetoceras canaliculatum (v. Buch)
Trimarginites arolicus (Oppel)
Taramelliceras (*Proscaphites*) cf. *anar* (Oppel)
Perisphinctes (*Otosphinctes*) sp.

Loc. (63) IA-1494.

Lithacoceras (*Progeronia*) sp.
Ataxioceras (*Parataxioceras*) sp.

Loc. Tiz KUH III: (62) IA-M2281, (61) IA-L396 and (62) IA-M2282.

Location: on the north-east spur of Tiz Kuh, a few metres above the alluvium, at 2550 metres is the locality (62) IA-M2281, and a few metres above it is the locality (61) IA-L396. About 20 metres above these localities is the locality (62) IA-M2282 (fossils in detritus).

Geographical co-ordinates: Long. E. 51° 57' 34"; Lat. N. 35° 53' 31".

Loc. (62) IA-M2281.

Perisphinctes (*Perisphinctes*) sp.
Perisphinctes (*Dichotomoceras*) sp.
Lithacoceras (*Discosphinctes*) sp.
 ? *Lithacoceras* (*Larcheria*) sp.

Loc. (61) IA-L396.

Orthosphinctes (*Orthosphinctes*) cf. *laufenensis* (Siemiradzki)

Loc. (62) IA-M2282.

Lithacoceras (*Progeronia*) cf. *triplex* (Quenstedt)

Lithacoceras (*Progeronia*) sp.

Katroliceras (*Torquatisphinctes*) sp.

Loc. ASSAMAN KUH: (63) IA-1583.

Location: north slope of Assaman Kuh, about 160 metres below the pointed mountain top in an N.E. direction.

Geographical co-ordinates: Long. E. 51° 48' 10"; Lat. N. 35° 57' 16".

Orthosphinctes (*Orthosphinctes*) *fischeri* sp. n.

Orthosphinctes (*Orthosphinctes*) *virgulatus* (Quenstedt)

Euspidoceras sp.

Loc. KATUMBARGAH: (61) IA-V153.

Location: N.E. of Katumbargah on the watershed, below the contact with the Cretaceous, on the crag which separates the two hollow gorges converging in correspondance with the road leading to Katumbargah, about 1 km after the crossroads by the mine of Vaseh Gah.

Geographical co-ordinates: Long. E. 51° 41' 03"; Lat. N. 36° 00' 02".

Orthosphinctes (*Orthosphinctes*) *polygyratus* (Reinecke)

Lithacoceras (*Progeronia*) sp.

Ataxioceras (*Parataxioceras*) sp.

Discussion on age.

Most of the fossiliferous localities just listed are situated on Tiz Kuh; of these the localities (62) IA-M2281, (62) IA-2282 and (61) IA-L396 are situated on the N.W. slope, while the localities (63) IA-1493 and (63) IA-1494 are situated on the steep southern slope. Below these last localities is situated (63) IA-1492, positioned at the top of the Dalichai Formation; it has yielded a limited fauna of Ammonites, which has shown it to correspond to the Mariae zone (Fantini Sestini, 1968). In the locality (63) IA-1493 the following have been identified: *Ochetoceras canaliculatum* (v. Buch), *Trimarginites arolicus* (Oppel) and *Perisphinctes* (*Otsphinctes*) sp. Among these only *Trimarginites arolicus* has a reasonably wide distribution; it is present throughout the whole of the Upper Oxfordian; the remaining species are however limited to the Transversarium zone and it seems likely that they are more particularly associated with the lower part of this zone, corresponding to the Parandieri-Canaliculatum subzone (= Canaliculatum zone of de Grossouvre).

In the locality (62) IA-M2281 there occur the subgenera *Larcheria*

and *Discosphinctes*, whose association indicates (according to Enay, 1966) the top of the Parandieri-Canaliculatum subzone. Numerous specimens of the subgenus *Dichotomoceras* were found in the same place; the subgenus appears to be restricted to the upper part of the Transversarium zone (Bifurcatus subzone).

In locality (61) IA-L396 was found one specimen which has been assigned to *Orthosphinctes* (*Orthosphinctes*) cf. *laufenensis* (Siemiradzki), which may be indicative of the Bimammatum zone, and is in any event confirmative of the Upper Oxfordian.

From localities (63) IA-1494 and (62) IA-2282, situated on the south and north-east slopes respectively of Tiz Kuh, there originate faunas assignable to the base of the Kimmeridgian owing to the presence of *Ataxioceras* (*Parataxioceras*) sp. and *Katroliceras* (*Torquatisphinctes*) sp. The presence of the basal part of this stage is also indicated by forms encountered further north, in the neighbourhood of Katumbargah (locality (61) IA-V153). Among these are *Orthosphinctes* (*Orthosphinctes*) *polygyratus* (Reinecke) and *Ataxioceras* (*Parataxioceras*) sp., indicative of the Lower Kimmeridgian.

From the locality further to the north-west, (63) IA-1583, on the northern slope of Assaman Kuh, the fauna includes *Orthosphinctes* (*Orthosphinctes*) *virgulatus* (Quenstedt) and *Euaspidoceras* sp., which could be considered to belong to the Bimammatum zone.

It is concluded from the data given above that in the zone between the Lar Valley and Demavend all of the Oxfordian is present, and that a more concentrated search for fossils, particularly on the slopes of Tiz Kuh, could lead to the identification of all or almost all of the palaeontological zones distinguished in the distribution of this stage. On the basis of the fauna studied by the present author it has been possible to recognize the presence of the Mariae, Transversarium and Bimammatum zones, while the presence of the Cordatum and Plicatilis zones can only be surmised, in that they have not been so far confirmed. The boundary between the Oxfordian and the Kimmeridgian could also be better defined even if not on the basis of the fauna studied here, which fauna has nevertheless enabled the position of the basal part of the Kimmeridgian to be established with confidence.

Discussion of previous work.

Bogdanowitch (1890) described Ammonites of Oxfordian or Titonic age. Not all of the identifications are however accepted; in particular the specimen illustrated in plate 5, fig. 5 as *Simoceras* aff. *albertinum* Ca-

tullo has become the holotype of *Virgatosimoceras elbursense* Spath (1925), while the specimen in plate 6, fig. 1, identified as *Perisphinctes* aff. *plicatilis* Sowerby corresponds (according to Enay, 1966) to *Orthosphinctes* (*Orthosphinctes*) *tiziani* (Oppel). In general however the dating proposed by Bogdanowitch has met with acceptance.

Fischer (1915) described a very good fauna from various places in the central and eastern parts of Elburz. The species identified permitted the identification of the Upper Oxfordian (Transversarium, Bimammatum and, possibly, Planula zones) and of the Lower Kimmeridgian. The work was published posthumously, because Fischer died during the First World War, and it is therefore understandable that some attributions may no longer appear correct. Several observations can be made on the basis of the examination of some of his specimens. Fischer recorded as occurring at Diktasch *Perisphinctes mogosensis* Choffat and *Perisphinctes* of the group *ernesti*. The specimen identified as *P. mogosensis* in fact belongs to a new species, which is instituted here and is designated *Orthosphinctes* (*Orthosphinctes*) *fischeri*; it has also been found at Assaman Kuh in association with the Bimammatum zone, to which Fischer had referred his specimens. At Aschref Fischer has again identified the Bimammatum zone on the basis of the presence of *Oppelia* cf. *culminis* Fontannes, *Perisphinctes alterneplicatus* Waagen, and *Aspidoceras* sp. On the basis of the examination of the original material it would however appear more correct to attribute them to the Transversarium zone. In fact the specimen identified as *P. alterneplicatus* seems to correspond better to *P.* (*Dichotomosphinctes*) *elisabethae* (de Riaz) (Malinowska, 1963, p. 66, pl. 34, fig. 165). This dating does not conflict with the identification of the nucleus of *Euaspidoceras* sp. From Ben-e-Burida there originated several specimens attributed to *Perisphinctes rhodanicus* Dumortier and to *Perisphinctes obliqueplicatus* Waagen, considered by Fischer as characteristic of the Transversarium zone. As regards the specimens illustrated in pl. 20, fig. 3 as *P. obliqueplicatus*, Spath (1927-33) nevertheless confirms that « the Persian form figured by Fischer acquires more distant ribbing at an earlier stage and may represent the inner whorls of one of the numerous forms of the *rota* group, but it was also assigned to a later date ». Even though the specimen is very small and incomplete this nevertheless seems to confirm its attribution to the subgenus *Otosphinctes* Buckman, to which the group *rota* directly belongs. In this case one of the oldest forms of the Oxfordian recorded in the region by previous authors appears to be involved (*Plicatilis* zone or the lower part of the Transversarium zone). It is never-

theless noteworthy that too much importance cannot be attributed to the specimen under examination, on account of its small dimensions and also because it is preserved in a grey limestone rather than in reddish white limestone as are the other specimens. In the material from Pulus, which is the nearest locality to ours on the Tiz Kuh, Fischer has established two new species: *Perisphinctes morgani* and *P. peluricus*. The first species appears to be unquestionably valid, but the small size renders a generic attribution uncertain; of the other species nothing certain can be said in that it is based on a single specimen whose poor state of preservation do not permit to establish its morphological features. The date proposed by Fischer for the fossils of Pulus (Bimammatum zone) can in any case be confirmed. In addition to these species, Fischer identified a juvenile specimen of *Sutneria* sp., which leads to the conclusion that the top of the Oxfordian (Planula zone) or, rather, the Lower Kimmeridgian, is present here.

Only one of the specimens found by Furon (1941) has been illustrated. It originated from Firuzkuh (pl. 3, fig. 3), determined as *Perisphinctes plicatilis* Waagen (not Sowerby) and considered typical of the Upper Argovian. According to Arkell (1956) it is a species related to *Ataxioceras praecox* Spath and is thus indicative of the Lower Kimmeridgian.

Palaeontological descriptions (1)

Order AMMONOIDEA

Suborder AMMONITINA

Superfamily *Haplocerataceae*

Family *Oppeliidae*

Genus *Ochetoceras* Haug, 1885

Ochetoceras canaliculatum (v. Buch, 1831)

Pl. 19, fig. 3

1830 *Ammonites canaliculatum* - Münster in Zieten, p. 37, pl. 28, fig. 6.

(1) The fauna examined in the present work largely consists of very incomplete specimens. It has therefore not always been possible to obtain the measurements and relative ratios of individuals. When the state of preservation has permitted it, the following parameters have been investigated: D = diameter; H = whorl height; W = whorl breadth; U = width of umbilicus, and also the corresponding ratios H/D, W/D and U/D. The nomenclature proposed by Geyer (1961) has been adopted in the description of the ornament of representatives of the family *Perisphinctidae*. The following abbreviations have been used for the costae: PR = primary ribs or umbilical ribs; SR = secondary ribs, external ribs or intercalatory ribs; SR/PR = ratio of number of secondary ribs to number of primary ribs.

- 1831 *Ammonites canaliculatum* Buch, p. 2, pl. 1, figs. 6-8.
 1847 *Ammonites canaliculatum* - d'Orbigny, p. 525, pl. 199, figs. 1, 2.
 1862 *Ammonites canaliculatum* - Oppel, p. 157, pl. 51, fig. 3.
 1904 *Ochetoceras canaliculatum* - Douville, p. 205, pl. 26, fig. 12.
 1931 *Ochetoceras canaliculatum* - Dorn, p. 57, pl. 31, figs. 5, 8 a, b, 9, 11; pl. 31, figs. 1, 9, 13.
 1951 *Ochetoceras canaliculatum* - Jeannet, p. 87, pl. 20, figs. 3-7; text-fig. 196.
 1963 *Ochetoceras canaliculatum* - Malinowska, p. 35, pl. 7, fig. 49.

MATERIAL. (63) IA-1493a (1 specimen).

LOCALITY. Tiz Kuh I.

One internal mould of about 48 mm diameter.

Involute shell, with lanceolate section, acute venter with sharp keel. Spiral groove shallow, positioned at one third of the sides, starting at the umbilicus. Primary ribs straight, much broader near the groove than near the umbilical suture; secondary ribs rursiradiate, concave ad-orally, 5 in 1 centimetre, more distant on the extreme part of the final whorl preserved (body chamber?).

OCCURRENCE. *O. canaliculatum* (v. Buch) has been found in the Transversarium zone of Germany, Poland, Switzerland and Iran.

Genus *Trimarginites* Rollier, 1909

Trimarginites arolicus (Oppel, 1863)

Pl. 19, fig. 1

- 1863 *Ammonites arolicus* Oppel, p. 188, pl. 51, figs. 1, 2.
 1876 *Ammonites (Harpoceras) arolicus* - Favre, p. 38, pl. 2, figs. 13, 14.
 1877 *Harpoceras arolicum* - Gemmellaro, p. 160, pl. 20, fig. 11.
 1881 *Ammonites (Harpoceras) arolicus* - Uhlig, p. 150, pl. 13, fig. 7.
 1888 *Ammonites complanatus* - Quenstedt, p. 832, pl. 91, figs. 31-33.
 1898 *Oppelia arolica* - de Riaz, p. 42, pl. 16, figs. 13, 14.
 1908 *Ammonites (Harpoceras) arolicus* - Engel, p. 377, pl. 4, fig. 18.
 1951 *Trimarginites arolicus* - Jeannet, p. 84, pl. 24, figs. 4, 5.
 1960 *Trimarginites arolicus* - Christ, p. 78, pl. 4, fig. 3.
 1961 *Trimarginites arolicus* - Christ, p. 283, pl. 16, figs. 2, 3; text-figs. 1-3.
 1963 *Trimarginites arolicus* - Malinowska, p. 38, pl. 10, figs. 65, 66.
 1964 *Trimarginites arolicus* - Enay & Dominjon, p. 324, text-figs. A-C.

MATERIAL. (63) IA-1493b (1 specimen).

LOCALITY. Tiz Kuh I.

One specimen, incomplete and partly compressed, about 90 mm in diameter.

Shell strongly involute, with lanceolate section, and very narrow umbilicus with rounded umbilical angle. Venter narrow with three sharp keels separated from one another by deep grooves.

On the external half of the sides there occur strong ribs, well spaced rursiradial, adorally concave.

OCCURRENCE. *T. arolicus* (Oppel) has been found from the Transversarium zone to the Planula zone (Planula subzone) of France, Germany, Switzerland and Italy and in the Excavatum zone of Poland (Malinowska, 1963).

Genus *Taramelliceras* Del Campana, 1904

Subgenus *Proscaphites* Rollier, 1909

Taramelliceras (*Proscaphites*) cf. *anar* (Oppel, 1863)

cf. 1863 *Ammonites anar* Oppel, p. 207, pl. 55, figs. 1 a-d.

cf. 1887 *Ammonites anar* - Quenstedt, p. 860, pl. 93, figs. 30, 31.

cf. 1955 *Taramelliceras* (*Proscaphites*) *anar* - Hölder, p. 81, pl. 16, fig. 3; text-fig. 1/29.

MATERIAL. (63) IA-1493c (1 specimen).

LOCALITY. Tiz Kuh I.

An external cast, very incomplete, belonging to a specimen of about 50 mm diameter.

Falcoid ribs, irregular, tending to reunite in a group near the umbilicus, very slender internally, broader ventrally. Elongated ventro-lateral clavi, involving 4 ribs.

OCCURRENCE. *T. (Proscaphites) anar* (Oppel) has been found in the Transversarium zone of Germany.

Superfamily *Perisphinctaceae*

Family *Perisphinctidae*

Genus *Perisphinctes* Waagen, 1869

Subgenus *Perisphinctes* Waagen, 1869

Perisphinctes (*Perisphinctes*) sp.

MATERIAL. (62) IA-M2281d (5 specimens).

LOCALITY. Tiz Kuh III.

Numerous small fragments, very deformed, probably belonging to nuclei of *Perisphinctes* (*Perisphinctes*) sp.

Primary ribs rectiradial or slightly prorsiradial, straight, distanced, bipartite or also tripartite with numerous external intercalatory ribs.

OCCURRENCE. The subgenus *Perisphinctes* Waagen occurs in the Transversarium zone.

Subgenus *Otosphinctes* Buckman, 1926*Perisphinctes* (*Otosphinctes*) sp.

Pl. 19, fig. 2

MATERIAL. (63) IA-1493d (1 specimen).

LOCALITY. Tiz Kuh I.

One small specimen, complete. Shell evolute with whorl section subrectangular and flat flanks, venter broad and very weakly convex, and ventro-lateral shoulder rounded. Umbilicus broad and shallow.

Primary ribs very dense, strongly prorsiradiate in the internal whorls then more distant, tending to reunite in pairs and finally almost rectiradiate, bipartite with frequent intercalatory external ribs. In the internal whorls, secondary ribs rather prominent on the ventro-lateral shoulder, then more attenuated on the venter crossed by a broad deep spiral sulcus, absent in the external whorl, which exhibits persistent secondary costae, although very weak, also on the venter. Constrictions three and then four per whorl, limited adorally by a high costa similar to a flare. After the final constriction, there is an auricle with weakly undulating lateral surface and 2 strong ventral folds.

DIMENSIONS (in mm):

D	41	
H	11.7	28° ₀
L	10.3	25° ₀
U	20.4	40° ₀
R	30:34; 39:31; 48:31	

REMARKS. The specimen under examination is very well preserved. Its observable features place it in an intermediate position between the subgenera *Otosphinctes* Buckman and *Alligaticeras* Buckman.

It does not however appear to correspond with any species so far described. It probably represents a new species, which is not being denominated because only one specimen is available.

OCCURRENCE. The subgenus *Otosphinctes* occurs in the Plicatilis zone and in the lower part of the Transversarium zone.

Subgenus *Dichotomoceras* Buckman, 1919**Perisphinctes** (*Dichotomoceras*) sp.

Pl. 19, fig. 4

1966 *Divisosphinctes* cf. *grossouvrei* - Fantini Sestini in Assereto, p. 37.**MATERIAL.** (62) IA-M2281a (8 specimens).**LOCALITY.** Tiz Kuh III.

Numerous fragments of various sizes, compressed, with sharp costae, slender, weakly sinuous, slightly concave adorally near the umbilical angle, then straight or weakly convex up to 3/5ths of the height, where they bifurcate into two secondary ribs slightly projecting and always well pronounced. Bifurcations are intercalated in the inner whorls of some specimens.

OCCURRENCE. The subgenus *Dichotomoceras* Buckman is employed here in the sense proposed by Enay (1966, p. 502) and is limited to the upper part of the Transversarium zone (Bifurcatus subzone).

Genus *Orthosphinctes* Schindewolf, 1925Subgenus *Orthosphinctes* Schindewolf, 1925**Orthosphinctes** (*Orthosphinctes*) *fischeri* sp. n.

Pl. 19, fig. 5

HOLOTYPE. (63) IA-1583a.

LOCUS TYPICUS. Assaman Kuh (63) IA-1583: north slope of Assaman Kuh, about 160 metres below the pointed mountain top in an NE direction.

STRATUM TYPICUM. Lar Formation, Upper Oxfordian.

DERIVATIO NOMINIS. The specific name *fischeri* is proposed in honour of E. Fischer, the first to describe a specimen belonging to this species.

LOCATION. Palaeontology Institute of the Milan University. Register Number No. I 1336.

DIAGNOSIS. Shell moderately evolute, with oval whorl section, rounded venter, rather deep umbilicus.

Primary ribs rectiradiate, slightly projected, markedly prorsiradiate and denser in the internal whorls, generally bipartite, but also tripartite with rare intercalatory external ribs or also umbilical ribs. Constrictions present in the internal whorls, strongly prorsiradiate, shallow. Parabolic nodes in the external whorls.

DIMENSIONS (in mm):

	Holotype		Fischer's specimen	
D	61.5		68	
H	21.5	34%	22.4	33%
W	14	22%	15.5	23%
U	26.4	42%	28	42%
PR	55		52	
SR				
$\frac{SR}{PR}$	2.1		2.4	

REMARKS. This new species has been attributed to the subgenus *Orthosphinctes* Schindewolf, even though the shell has a poor evolution and the rather restricted umbilicus is more reminiscent of forms of the subgenus *Progeronia* Arkell. The presence of parabolic nodes is also noted, while the ribs are regularly bipartite or tripartite, never polygyrate. It should however be observed, as already correctly noted by Geyer (1961, p. 29), that it is difficult to distinguish the representatives of these two taxa if the internal whorls only are taken into account; this is so in the present case, in which both of the specimens have rather reduced dimensions.

Although it has dimensions somewhat less than those of the specimen of Fischer, the specimen originating from Assaman Kuh has been chosen as the holotype, because it has been found in association with other species, such as *Orthosphinctes* (*Orthosphinctes*) *virgulatus* (Quenstedt), in a locality the position of which is known with great precision. The specimen of Fischer comes in fact from the Heller Kalk of Diktasch in the Upper Oxfordian, together with a fragment identified as *Perisphinctes* sp. (*ernesti* group).

COMPARISONS. Fischer had referred his specimen to *Perisphinctes mogosensis* Choffat, but this identification was not accepted by Spath (1948). In the species of Choffat (1893, pl. 12, fig. 5: lectotype designated by Enay, 1966) the umbilicus is in fact broader and the height of the whorls grows more slowly; also the ribs are less dense, as Fischer had already observed.

Another closely allied species is *Orthosphinctes* (*Orthosphinctes*) *virgulatus* (Quenstedt), which however has ribs slightly concave adorally, slightly sinuous and much more robust and distanced in the external whorls compared with the internal ones. In our species, on the other hand, the ribs in the internal whorls are also straight and relatively robust.

Orthosphinctes (Orthosphinctes) cf. laufenensis (Siemiradzki, 1898)

Pl. 20, fig. 1

cf. 1898 *Perisphinctes laufenensis* Siemiradzki, p. 188, pl. 26, fig. 46.cf. 1940 *Perisphinctes laufenensis* - Dieterich, p. 36, pl. 2, fig. 9 (not fig. 8).cf. 1963 *Perisphinctes (Orthosphinctes) laufenensis* - Koerner, p. 359, pl. 25, fig. 2; pl. 29, fig. 2; pl. 30, fig. 1; text-figs. 56, 57.

MATERIAL. (61) IA-L396 (1 specimen).

LOCALITY. Tiz Kuh III.

One specimen only, of small dimensions, slightly flattened.

Shell evolute, whorl section oval. Widely spaced, ribs prorsiradiate, rather irregular, bipartite or occasionally tripartite, with intercalatory external ribs.

DIMENSIONS (in mm):

D	54.2	
H	18	33%
W	7.8	14%
U	24.4	45%
PR	40	
SR		
PR	2.1	

OCCURRENCE. *O. (Orthosphinctes) laufenensis* (Siemiradzki) has been found in the Upper Oxfordian of Germany and France. In Swabia it occurs at α/β White Jura boundary.

Orthosphinctes (Orthosphinctes) polygyratus (Reinecke, 1818)

Pl. 20, fig. 3

1818 *Nautilus polygyratus* Reinecke, p. 73, pl. 5, fig. 45.1873 *Perisphinctes subpunctatus* Neumayr, p. 181, pl. 34, fig. 4.1877 *Ammonites (Perisphinctes) polygyratus* - de Loriol, p. 61, pl. 7, fig. 1.1879 *Perisphinctes colubrinus* - Fontannes, p. 62, pl. 9, fig. 4.1881 *Ammonites (Perisphinctes) polygyratus* - de Loriol, p. 20, pl. 6, fig. 4 (not fig. 5).1895 *Perisphinctes polygyratus* - de Riaz, p. 382.1929 *Perisphinctes polygyratus* - Wegele, p. 47, pl. 1, fig. 6.1929 *Perisphinctes* n. sp. aff. *triplex* - Wegele, p. 48, pl. 2, fig. 2.1935 *Planites polygyratus* - Arkell, p. 35, pl. 100, fig. 5.1943 *Planites polygyratus* - Buttiaz, p. 19, pl. 4, fig. 1.1953 *Planites polygyratus* - Pelletier, p. 349.1961 *Perisphinctes (Orthosphinctes) polygyratus* - Geyer, p. 21, pl. 1, fig. 4.1963 *Perisphinctes (Orthosphinctes) polygyratus* - Enay, p. 30.1963 *Perisphinctes (Orthosphinctes) polygyratus* - Koerner, p. 351, text-figs. 46, 47.1966 *Orthosphinctes (Orthosphinctes) polygyratus* - Enay, p. 516.1966 *Perisphinctes (Orthosphinctes) polygyratus* - Fantini Sestini in Assereto, p. 37.

MATERIAL. (61) IA-V153a (1 specimen).

LOCALITY. Katumbargah.

One specimen only, of medium dimensions, slightly deformed by compression.

Shell evolute, whorls with elliptical section, venter narrow and convex; umbilicus large, shallow; umbilical angle rounded.

Primary ribs prominent, slightly prorsiradiate, bipartite or more rarely tripartite. Intercalatory ribs present. Secondary ribs rounded, with ratio $\frac{SR}{PR} = 2.7$. The bifurcations and trifurcations of the primary costae are not visible in the umbilicus.

DIMENSIONS (in mm):

D	123.7
H	36.2
W	19.7
H	51.1
PR	44
$\frac{SR}{PR}$	2.7

OCCURRENCE. *O. (Orthosphinctes) polygyratus* (Reinecke) has been found in the Bimammatum and Planula zones (Enay et al., 1967) and in the Planula and Platynota zones (Geyer, 1961) of France, Switzerland and Germany.

***Orthosphinctes (Orthosphinctes) virgulatus* (Quenstedt, 1858)**

Pl. 20, fig. 2

- 1858 *Ammonites virgulatus* Quenstedt, p. 593, pl. 74, fig. 4.
 1887 *Ammonites virgulatus* - Quenstedt, p. 923, pl. 100, fig. 5.
 1887 *Ammonites* cf. *virgulatus* - Quenstedt, p. 926, pl. 100, figs. 12, 13.
 1893 *Perisphinctes virgulatus* - Choffat, p. 41, pl. 5, fig. 1.
 1898 *Perisphinctes virgulatus* - de Riaz, p. 20, pl. 10, figs. 3, 4.
 1903 *Perisphinctes virgulatus* - de Loriol, p. 80, pl. 15, fig. 2.
 1929 *Perisphinctes virgulatus* - Wegele, p. 53, pl. 2, fig. 6.
 1963 *Perisphinctes (Orthosphinctes) virgulatus* - Koerner, p. 358, pl. 24, fig. 2; text-figs. 54, 55.

MATERIAL. (63) IA-1583b (1 specimen).

LOCALITY. Assaman Kuh.

One specimen of small dimensions, slightly deformed.

Shell slightly evolute, whorl section elliptical. Ribs prorsiradiate, slender and dense in the inner whorls, more widely spaced and robust in the outer whorls, bipartite with external intercalatory ribs.

DIMENSIONS (in mm):

D	48	
H	16.4	35%
W	9.5	20%
U	21.1	43%
PR	48	

OCCURRENCE. *O. (Orthosphinctes) virgulatus* (Quenstedt) has been found in the Upper Oxfordian of Germany, Portugal and France. In Swabia it occurs in the α and β White Jura.

Genus *Lithacoceras* Hyatt, 1900

Subgenus *Larcheria* Tintant, 1961

Lithacoceras (Larcheria) sp.

Pl. 20, fig. 4

MATERIAL. (62) IA-M2281e (1 specimen).

LOCALITY. Tiz Kuh III.

One incomplete specimen, of small dimensions corresponding to a nucleus. Shell weakly involute with long straight primary ribs, slightly prorsiradiate, tripartite or more rarely bipartite, secondary ribs very slender.

OCCURRENCE. The subgenus *Larcheria* Tintant occurs in the Transversarium and Bimammatum zones of Europe and Madagascar.

Subgenus *Discosphinctes* Dacqu , 1914

Lithacoceras (Discosphinctes) sp.

Pl. 20, fig. 5

MATERIAL. (62) IA-M2281b (3 specimens).

LOCALITY. Tiz Kuh III.

Several fragments, of various sizes, compressed, with numerous ribs, slender, dense, slightly sinuous, prorsiradiate, bipartite, very occasionally simple with intercalatory external ribs.

OCCURRENCE. The subgenus *Discosphinctes* Dacqu , occurs in the Upper Oxfordian.

Subgenus *Progeronia* Arkell, 1953**Lithacoceras** (*Progeronia*) cf. **triplex** (Quenstedt, 1887)

Pl. 21, fig. 2

1887 *Ammonites triplex* Quenstedt, p. 925, pl. 100, figs. 9, 10.1961 *Lithacoceras (Progeronia) triplex* - Geyer, p. 32, pl. 9, figs. 2, 3.**MATERIAL.** (62) IA-M2282a (1 specimen).**LOCALITY.** Tiz Kuh III.

One very incomplete specimen, about 130 mm in diameter, slightly deformed.

Whorl section elliptical, more high than broad, with rounded umbilical angle and rather high umbilical walls. Primary ribs dense, more distanced at the end of the final preserved whorl, slightly prorsiradiate, bipartite with external intercalatory ribs, more rarely polygyrate, with ratio $\frac{PR}{SE} = 22$.

OCCURRENCE. *L. (Progeronia) triplex* (Quenstedt) has been found from the Platynota to the Hypselocyclum zone of Franconia and Swabia and in the Wangener and Badener Beds of Switzerland.

Lithacoceras (*Progeronia*) sp.**MATERIAL.** (61) IA-V153c (1 specimen).**LOCALITY.** Katumbargah.

One specimen of small size, deformed.

Shell slightly evolute, whorl section oval with maximum thickness near the umbilical suture; umbilicus of medium dimensions with rounded umbilical angle and moderately developed umbilical walls.

Primary ribs slightly prorsiradiate, acute, 38 in the final whorl, a smaller number in the internal whorls, generally bipartite, more rarely tripartite, with intercalatory external ribs. Rare constrictions, 1 or 2 per whorl, limited adorally by an intercalatory umbilical costa.

REMARKS. The specimen is very deformed, and it is therefore not possible to give its dimensions. Its maximum diameter is about 50 mm. It could be allied to *L. (Progeronia) uresheimensis* (Wegele) on the basis of the frequency of the primary and secondary costae. The state of preservation and the reduced size make this identification uncertain.

OCCURRENCE. The subgenus *Progeronia* occurs from the Upper Oxfordian (Bimammatum zone) to the Middle Kimmeridgian (Geyer, 1961; Enay, 1966).

Lithacoceras (Progeronia) sp.

Pl. 21, fig. 1

1966 *Progeronia* sp. ex gr. *progeron* - Fantini Sestini in Assereto, p. 38.

MATERIAL. (62) IA-M2282c (1 specimen).

LOCALITY. Tiz Kuh III.

One specimen about 150 mm in diameter, incomplete.

Shell slightly involute, with shallow umbilicus, whorl section elliptical with almost flat flanks; venter narrow, convex; umbilical angle sub-right; umbilical wall rather high.

Ribs slightly prorsiradiate, dense, bipartite or polygyrate with intercalatory external ribs.

REMARKS. The specimen could be allied to *L. (Progeronia) progeron* (Ammon) in Geyer (1961, p. 31, pl. 7, fig. 2), as regards the general shape of the shell and the course of the ribs. The costae however are much denser than in the species of Ammon, both in the inner whorl and in the outer ones. The figured side of this specimen (Pl. 21, fig. 1) may also resemble to the forms of the subgenus *Larcheria* Tintant. This is mainly due to the erosion of the ornament. On the other side where the ornaments are well preserved, these are more prominent and broader.

OCCURRENCE. See above.

Genus *Katroliceras* Spath, 1924Subgenus *Torquatisphinctes* Spath, 1924**Katroliceras (Torquatisphinctes) sp.**

MATERIAL. (62) IA-M2282b (1 specimen).

LOCALITY. Tiz Kuh III.

One specimen, very incomplete, about 140 mm in diameter.

Shell very evolute, with slow growth, whorl section oval with flattened flanks. Primary ribs prorsiradiate, denser in the inner whorls, straight but with weak adoral concavity near the umbilical angle which should be very prominent above the suture. On the final whorl preserved the ribs are bipartite with rare intercalatory external ribs. Secondary ribs very prominent, robust, tending to cluster in pairs on the venter.

OCCURRENCE. According to Geyer (1961), *Torquatisphinctes* Spath is a

subgenus of *Katroliceras* Spath and occurs in the Lower and Middle Kimmeridgian.

Genus *Ataxioceras* Fontannes, 1879
Subgenus *Parataxioceras* Schindewolf, 1925

Ataxioceras (*Parataxioceras*) sp.

Pl. 21, fig. 3

MATERIAL. (63) IA-1494a (1 specimen).

LOCALITY. Tiz Kuh I.

Shell slightly evolute; whorl section elliptical; umbilicus moderate, shallow; umbilical angle rounded.

Primary ribs rursiradiate, irregular, bipartite with intercalatory umbilical ribs and rare polyplacoid ribs, 32 in the last whorl preserved, which is about 38 mm in diameter. Rare constrictions, strongly sinuous.

REMARKS. The specimen under examination is small and fairly well preserved, but unfortunately it was not possible to completely free the last whorl. It appears to belong to the group of *A. (Parataxioceras) balnearium* (Loriol), but this identification is rendered uncertain by the impossibility of confirming the dimensions.

OCCURRENCE. The subgenus *Parataxioceras* Schindewolf is limited, according to Geyer (1961), to the lower and middle parts of the White Jura (*Sutneria platynota* and *Ataxioceras hypselocyclum* zones).

Ataxioceras (*Parataxioceras*) sp.

Pl. 21, fig. 4

1966 *Ataxioceras* (*Ataxioceras*) sp. ex gr. *guentheri* - Fantini Sestini in Assereto, p. 37.

MATERIAL. (61) IA-V153b (4 specimens).

LOCALITY. Katumbargah.

Several small specimens, slightly deformed.

Shell evolute, whorl section elliptical; shallow umbilicus.

Primary ribs very irregular, prominent, prorsiradiate, bipartite and also polygyrate, with intercalatory umbilical ribs. Parabolic nodes not well preserved. Rare constrictions limited by intercalatory umbilical ribs and by polygyrate ribs.

REMARKS. All of the specimens are compressed and extensively

deformed; their diameter ranges from 24 to 40 mm. It is not therefore possible to arrive at a confident specific identification (Geyer, 1961, p. 81).

In particular, the specimens under examination can be related to those illustrated by Choffat (1893, pl. 14, fig. 2) as *Perisphinctes inconditus* Fontannes, but belonging according to Geyer (1961, p. 81) to a new species not denominated by him. The largest specimen, with the best preserved ornamentation, exhibits 41 primary ribs at 40 mm diameter and a ratio $\frac{SR}{PR} = 2$, factors which agree well with those reported by Geyer (p. 81).

OCCURRENCE. See above.

Family *Aspidoceratidae*

Genus *Euaspidoceras* Spath, 1931

Euaspidoceras sp.

MATERIAL. (63) IA-1583e (1 specimen).

LOCALITY. Assaman Kuh.

External cast of a whorl fragment, of small dimensions.

There are visible 7 periumbilical tubercules, connected by simple ribs (very weak) with the same number of ventro-lateral tubercules. Ventro-lateral tubercules with larger and more prominent bases. Venter broad, convex and smooth.

OCCURRENCE. The genus *Euaspidoceras* Spath occurs from the Upper Callovian to the Upper Oxfordian.

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PLATE 19.

- Fig. 1 - *Trimarginites arolicus* (Oppel). Tiz Kuh I, (63) IA-1493 b; \times 1.
- Fig. 2 - *Perisphinctes* (*Otosphinctes*) sp. Tiz Kuh I, (63) IA-1493 ad; \times 1.
- Fig. 3 - *Ochetoceras canaliculatum* (v. Buch). Tiz Kuh I, (63) IA-1493 a; \times 1.
- Fig. 4 - *Perisphinctes* (*Dichotomoceras*) sp. Tiz Kuh III, (62) IA-M2281 d; \times 1.
- Fig. 5 - *Orthosphinctes* (*Orthosphinctes*) *fischeri* sp. n. Holotype. Assaman Kuh, (63) IA-1583 a; \times 1.

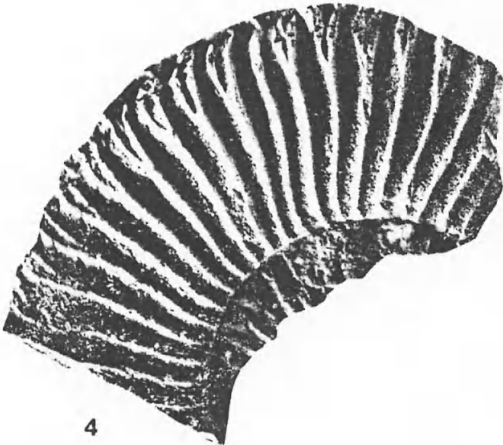
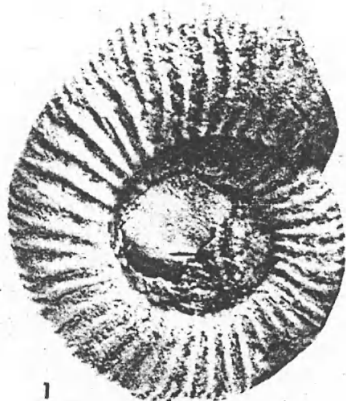


PLATE 20.

- Fig. 1 - *Orthosphinctes* (*Orthosphinctes*) cf. *laufencensis* (Siemiradzki). Tiz Kuh III, (61) IA-L396; \times 1.
- Fig. 2 - *Orthosphinctes* (*Orthosphinctes*) *virgulatus* (Quenstedt). Assaman Kuh, (63) IA-1583 b; \times 1.
- Fig. 3 - *Orthosphinctes* (*Orthosphinctes*) *polygyratus* (Reinecke). Katumbargah, (61) IA-V153 a; \times 0.75.
- Fig. 4 - *Lithacoceras* (*Larcheria*) sp. Tiz Kuh III, (62) IA-M2281 e; \times 1.
- Fig. 5 - *Lithacoceras* (*Discosphinctes*) sp. Tiz Kuh III, (62) IA-M2281 ba; \times 1.



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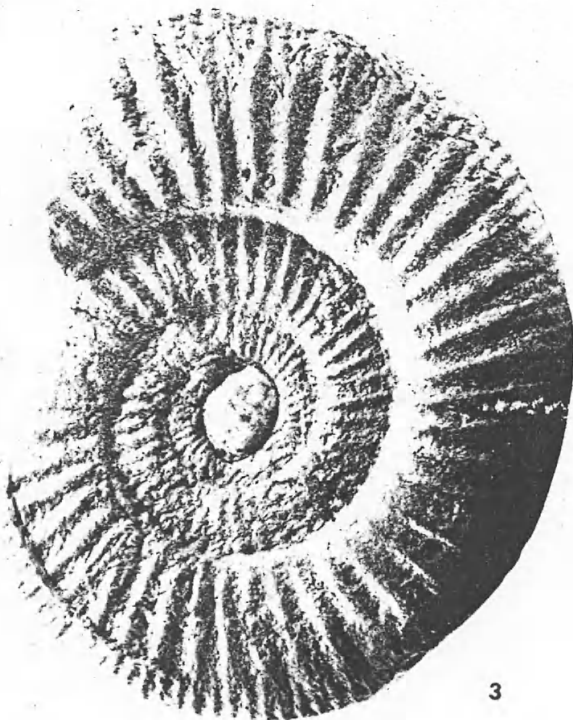
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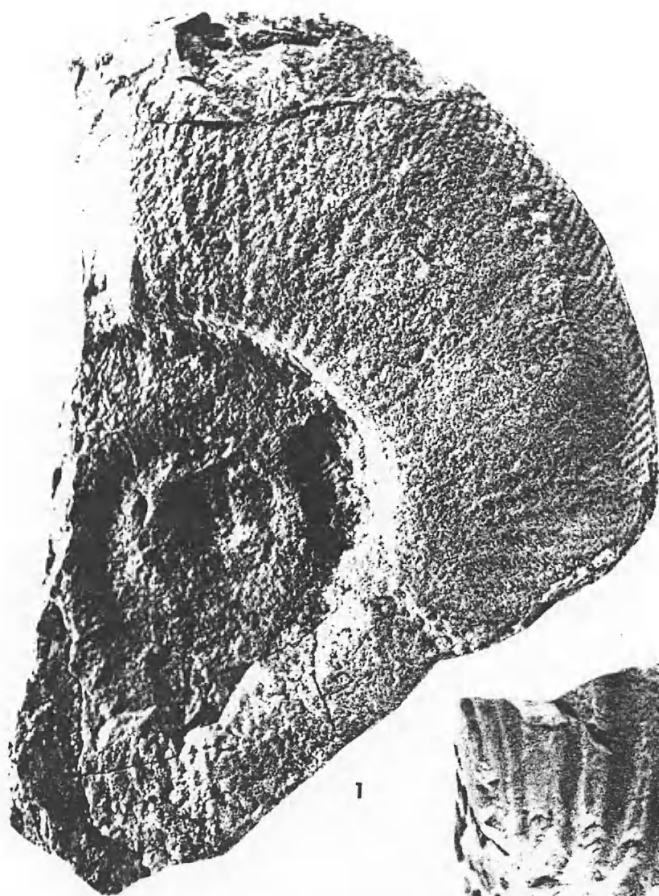
PLATE 21.

Fig. 1 - *Lithacoceras* (*Progeronia*) sp. Tiz Kuh III, (62) IA-M2282 c; \times 0.75.

Fig. 2 - *Lithacoceras* (*Progeronia*) cf. *triplex* (Quenstedt). Tiz Kuh III, (62) IA-M2282 a;
 \times 0.75.

Fig. 3 - *Ataxioceras* (*Parataxioceras*) sp. Tiz Kuh I, (63) IA-1494 a; \times 1.

Fig. 4 - *Ataxioceras* (*Parataxioceras*) sp. Katumbargah, (61) IA-V153 ba; \times 1.



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2



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