PETER DOYLE*, NINO MARIOTTI**

*Nature Conservancy Council, Northminster House, Peterborough PE1 1UA, England.
**Dipartimento di Scienze della Terra, Università "La Sapienza", P.za A. Moro 5, 00185 Roma, Italia.

JURASSIC AND LOWER CRETACEOUS BELEMNITES FROM NORTHWESTERN ANATOLIA (TURKEY)

A new belemnite fauna, ranging in age from Early Pliensbachian (*jamesoni* Zone) to Aptian was collected from a number of stratigraphic sections in north-western Anatolia, Turkey. Abundant *Passaloteuthis*, *Pseudohastites sensu stricto*, *"Pseudohastites" sensu* Lang, *Angeloteuthis* and *Coeloteuthis*, characteristic of the English Belemnite Marls of Dorset, were found with *Nannobelus* and the aulacocerid *Atractites* in the Rosso Ammonitico facies of Bayirkoy-Günören (Bilecik) (BÇT, BGA, BT), Sögüt (SA, SC), Derbent (Iznik). Middle Jurassic *Belemnopsis* (Callovian) and Upper Jurassic *Rhopaloteuthis* (Oxfordian) were recorded from Aktaş (Gerede) (AI, Ag, AC), Akpinar (Halilar) (Akp), Kabalar (Mudurnu) (MK). Species of *Duvalia*, characteristic of the Tethyan Realm, were recorded from Late Jurassic and Early Cretaceous (Tithonian-Aptian) sections at Aktaş (AC), Nallihan (NALLI), Çayirhan (Beypazari) (ÇAY), Dogdu Dag (Çerkes) (CD), Kozluca (Beypazari) (KEL), Kinik (Bilecik) (Bi-K), and Kabalar (Mudurnu) (MK). *Neohibolites* and *Parahibolites*, characteristic of the Aptian, are recorded from Nallihan (NALLI).

The Lower Jurassic fauna is important to biogeography combining more widespread early belemnitid taxa with the more restricted, largely Tethyan *Atractites*. The post-Early Jurassic belemnites have Tethyan affinities alone, except for *Neohibolites* and *Parahibolites* which became widespread in the Aptian prior to the demise of the Tethyan belemnite fauna.

KEY WORDS: Belemnites, Jurassic, Lower Cretaceous, Turkey.

INTRODUCTION

An abundant belemnite fauna was collected during the four years (1984-87) of the joint research project of the East Technical College, Ankara and the Università "La Sapienza", Rome. This fauna was obtained from several stratigraphic sequences located in north-western Anatolia (Turkey), and more exactly within the area east of the line Edremit-Can, south of the Northern Anatolian Fault and west of the line Ankara-Çerkeş (Fig. 1).

Few belemnites have previously been described from Anatolia. Pompeckj (1897) was first with description of two "species" of fragmentary belemnites which he assigned to the Middle Lias of Kessik-tasch. Meister (1913) followed with a description of *Atractites* from Merzifoun, and concluded from the gross fauna that it had a Lower Lias aspect. No other Jurassic or Cretaceous belemnites have previously been described from Anatolia, although Stevens (1973b) does note the presence of the group *Mesohibolites-Parahibolites* in the Aptian.

During the present study a good belemnite fauna of Early Pliensbachian age was collected from Rosso Ammonitico facies near Günören (Fig. 1) and forms the bulk of the belemnite collection. This fauna, although including species of *Atractites* and *Nannobelus*, is close to that of the Belemnite Marls (*jamesoni* Zone) of Dorset, England (Lang, 1928), and collections of ammonites, brachiopods (Ager, this volume) and crinoids (Manni & Nicosia, this volume) also support a *jamesoni* Zone age. Lesser collections of Middle and Late Jurassic, and Early Cretaceous, belemnites were obtained, but good biostratigraphic control is still possible because of the widespread nature of the belemnopsid and duvaliid forms present.

The purpose of this paper is therefore to describe the belemnite fauna in detail and to discuss its implications to biogeography.

STRATIGRAPHY AND LOCATION

The geology, stratigraphy and palaeogeography of the study area has been discussed in detail by Altiner *et al.* (1989) and Kocyigit *et al.* (this volume), and are not dealt with further here. The structural development of the major basins of the study area is given in Fig. 2.

The belemnites were collected from a number of stratigraphic sections in the study area. The following sections yielded belemnites or aulacocerids: Bilecik-Günören (BGA, BT, BÇT), Derbent (Iznik), Sögüt (SA, SC), Aktaş (Gerede) (AC, Ag), Kabalar (Mudurnu) (MK), Akpinar Halilar (Akp), Beypazari (Çayirhan, ÇAY; Kozluca, Koz), Kinik (Bilecik, Bi-K), Nallihan (NALLI).

Belemnites were also collected from other sequences but, due to their fragmentary nature and poor preservation, we could not identify them. Their

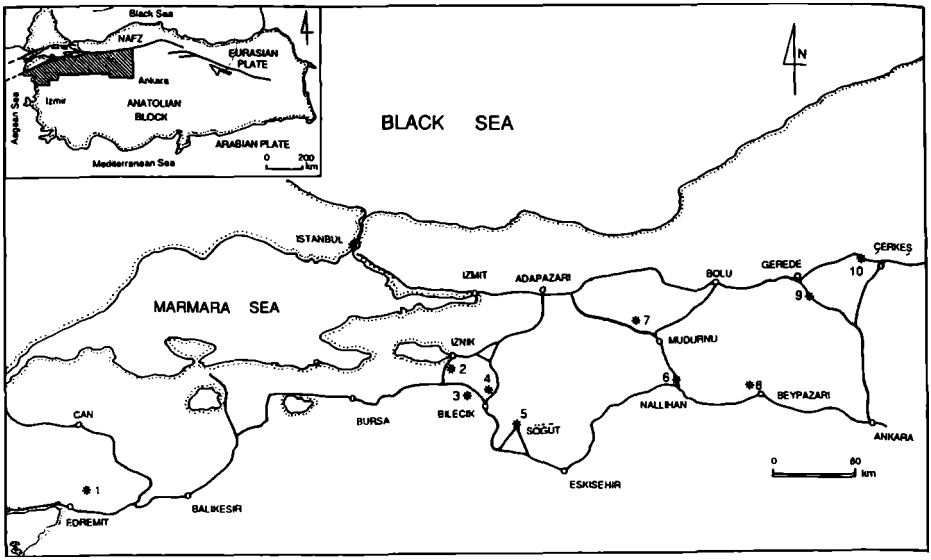


Fig. 1 —Map of the belemnite and aulacocerid localities. 1) Halilar (AKP); 2) Derbent (Iznik) (I-DER); 3) Kinik (Bilecik) (Bi-K); 4) Bayirköy-Günören (Bilecik), in this area several sequences were examined, those with belemnites and aulacocerids are: Bayirköy Günören (BGA), Bayirköy Çaldagi Tepe (BÇT) and Bayirköy Trafo (BT); 5) Sögüt, the belemnites were collected from two of the many sequences studied (SA and SC); 6) Nallihan (NALLI); 7) Kabalar (Mudurnu) (MK); 8) two outcrops at NW of Beypazari: Kozluc (Koz, KEL) and Çayirhan (ÇAY); 9) Aktaş (Gerede), the belemnite bearing exposures were: AI, AÇ (Aktaş Çamtur) and Ag (Aktaş Gölcuk); 10) Dogdu Dag (Çerkeş) (CD).
NAFZ: Northern Anatolian Fault Zone.

presence only is marked in the lithological sequences (Figs. 3, 4).

A stratigraphic section from each locality is given in Figs. 3, 4, with the belemnite-bearing strata indicated.

SYSTEMATICS

The specimens (prefix 20) are housed in the Paleontological Museum of the Earth Sciences Department, Rome; other repositories: BMNH, British Museum (Natural History), London; WM, Whitby Museum, Whitby, North Yorkshire; GPIT, Geologisches und Palaöntologisches Institut, Tübingen.

The classification used below follows that of Jeletzky (1966) in the main. Terms used in the descriptions below are discussed fully in Mattei *et al.* (1987) and Doyle & Kelly (1988). Apical line terminology after Schumann (1974). Relatively few xiphoteutid specimens could be measured. The following dimensions are in Mattei *et al.* (1987):
H: height of camera; Dm: diameter of the camera calculated at the mid point of the height; α: alveolar angle.

The value H/Dm is an average.

Only relatively whole belemnitid specimens have measured. Dimensions cited are as in Doyle and Kelly (1988); L, total preserved length; l, length from apex to tip of alveolus; X, length from apex to Dmax; Dv, dorso-ventral diameter at l; Dl, lateral diameter at l; Dv max, maximum ventral diameter; Dl max, maximum lateral diameter; na, apex not preserved; Ic, Dv max/Dl max; Id,L/Dv max or l/Dv max. Symbol * in synonymy indicates first valid description of a species.

Class Cephalopoda Cuvier, 1794
Subclass Coleoidea Bather, 1888
Order Aulacocerida Stolley, 1919
Family Xiphoteuthididae Naef, 1922

Genus **Atractites** Gümbel, 1861

(= *Xiphoteuthis* Huxley, 1864, p. 16, subj., *Ausseites* Flower, 1944, p. 760, subj., *Choanoteuthis* Fischer, 1951, p. 386, subj.)

Diagnosis: Rostrum (telum) elongate and hastate in profile and outline, becoming narrow waisted near

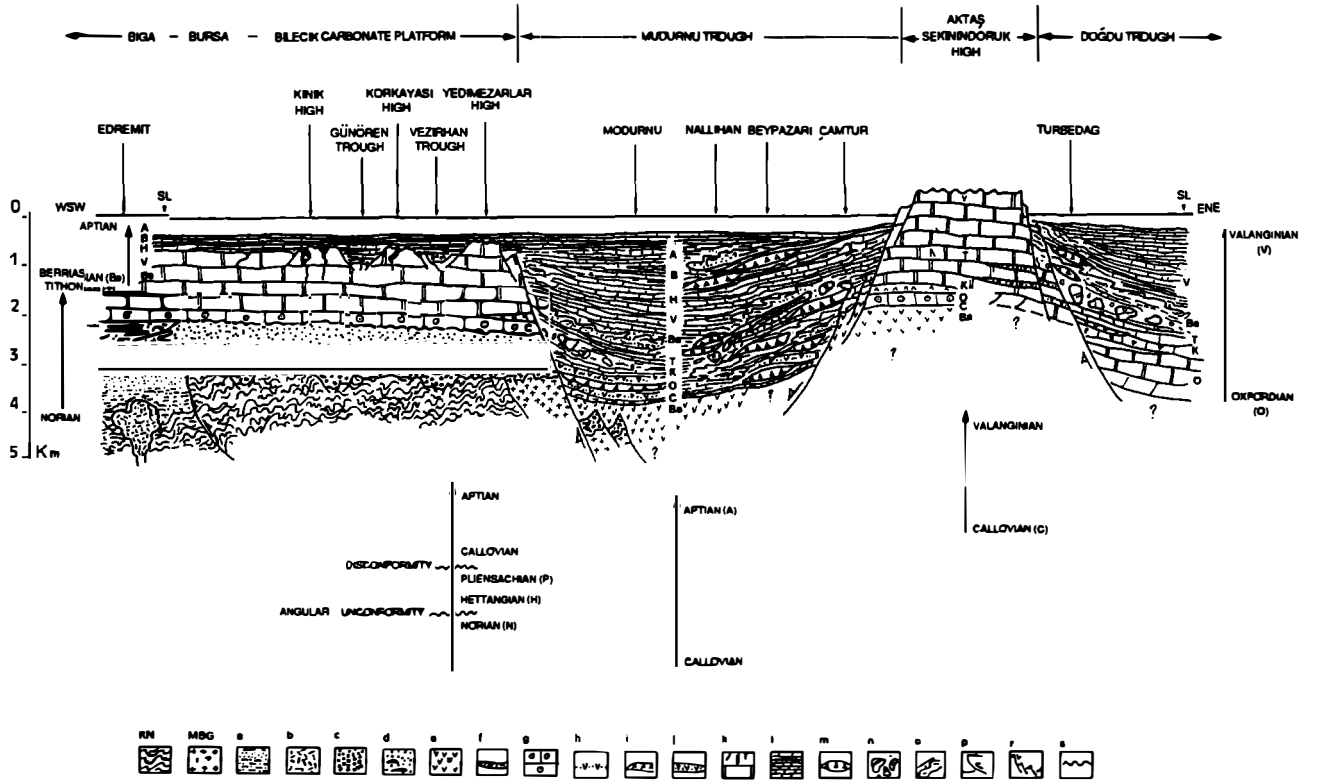


Fig. 2 — Model of structural development of the study area. KN) Karakaya tectonostratigraphic unit (Norian); MSG) Middle Sakarya Granite (pre-Permian); a) black shale, siltstone and yellow arenite alternating with ammonite-bearing, condensed intercalations at its top (Norian-Bathonian); b) granitic to granodioritic intrusion (Hettangian); c) alluvial-braided river conglomerate (Hettangian); d) shallow marine clastics with Rosso Ammonitico facies (Hettangian-Pliensbachian); e) rift volcanics (pre-Callovian); f) jusp and siliceous pelagic limestone (Callovian); g) cherty limestone with pelagic "oolite" (Callovian-Oxfordian); h) spilitic basalt (Callovian-Kimmeridgian); i) ignimbritic tuff; j) spilitic basalt flows (Kimmeridgian); k) shallow marine platform carbonates with iron-oxide, neptunian dykes and travertine in its top levels (Oxfordian-Early Hauterivian); l) pelagic limestone and limestone turbidites alternating with abundant syndepositional features (Callovian-Aptian); m) olistostrome and slope breccias (Callovian-Barremian); n) limestone olistoliths; o) slump folds (Tithonian-Barremian); p) thrust faults in basement (pre-Hettangian); q) growth faults; r) unconformities. (After Altiner *et al.*, 1989, redrawn and simplified).

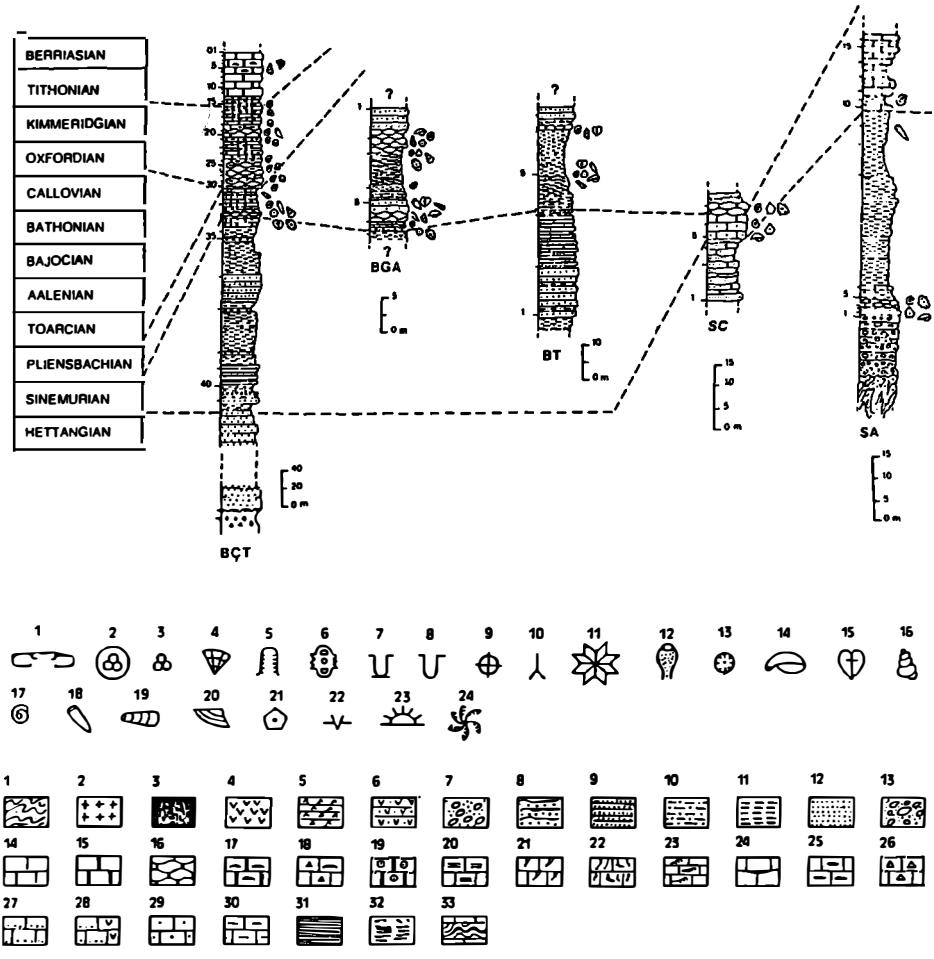


Fig. 3 — The main Lower Jurassic (Lias) outcrops in Rosso Ammonitico facies. BÇT: Bayirköy Çaldagi Tepe; BGA: Bilecik Günören; BT: Bayirköy Trafo; SA, SC: Sögüt. Fossil symbols: 1) *Globotruncana*; 2) Cretaceous planktonic foraminifers; 3) *Protoglobigerina*; 4) agglutinant foraminifers; 5) *Trocholina*; 6) *Involutina liassica*; 7) *Chitinoidella*; 8) Calpionellidae; 9) Radiolaria; 10) spicules; 11) dasycladacean algae; 12) sponges; 13) corals; 14) brachiopods; 15) bivalves; 16) gastropods; 17) ammonites; 18) belemnites; 19) *Atractites*; 20) *Apthycus*; 21) crinoids; 22) *Saccocoma*; 23) echinids; 24) *Zoophycus*.
Lithological symbols: 1) low-grade metamorphics (slate, phyllite etc.); 2) granite or granodiorite; 3) spilitic diabase-basalt; 4) volcanic; 5) tuff or tuffite; 6) volcano-clastic; 7) sand-supported conglomerate; 8) thick-bedded, coarse-grained continental or shallow marine sandstone; 9) thin-bedded or laminated, fine-grained sandstone or siltstone; 10) siltstone or silty shale; 11) shale; 12) flysch; 13) slope breccia or olistostrome; 14) limestone; 15) high-energy limestone; 16) nodular limestone; 17) reefal limestone; 18) fore-reefal limestone; 19) oolitic limestone; 20) laminated limestone; 21) bioturbed limestone; 22) ferrugineous breccioid limestone; 23) limestone with *Microcodium*; 24) silicified limestone; 25) cherty limestone; 26) breccioid limestone; 27) fine-detritic limestone (calciturbidite); 28) detritic limestone (calciturbidite); 29) sandy limestone; 30) argillaceous limestone; 31) laminated argillaceous limestone; 32) nodular marl; 33) slump.
The lithological sequences were taken from Altiner *et al.* (1989).

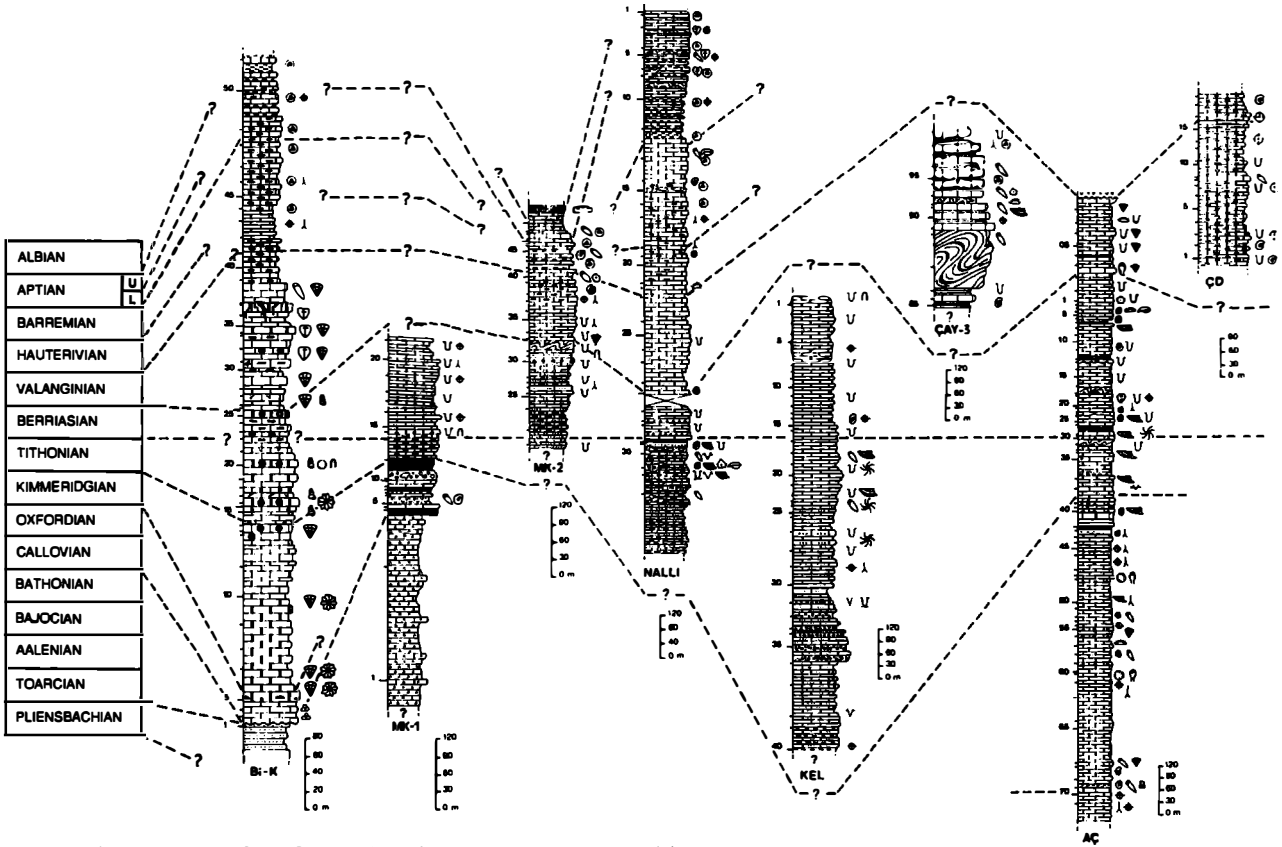


Fig. 4 — The main Jurassic and Lower Cretaceous belemnite bearing sequences. Bi-K: Kinik (Bilecik); MK: Kabalar (Mudurnu); NALLI: Nallihan; AÇ: Aktaş Çamtur; KEL: Kozluca (Beypazari); ÇAY: Çayirhan (Beypazari); CD: Dogdu Dag (Çerkeş). The lithological sections are taken from Altiner *et al.* (1989).

the apex of the shallow alveolus. Transverse sections are either approximately equidimensional and rounded or laterally compressed and elliptical. Surface of rostrum smooth, with one longitudinal furrow present on each flank. Phragmocone more commonly found than rostrum, often with acute apical angle (4°-6°). Camerae usually widely spaced, phragmocone elongate.

Type species: *Atractites alpinus* Gümbel, 1861 by monotypy.

Remarks: *Xiphoteuthis* Huxley and *Ausseites* Flower are junior subjective synonimus of *Atractites* as they possess rostra (tela) identical to this genus (Jeletzky, 1966; Doyle, 1990). Jeletzky (1966) also considered *Choanoteuthis* Fischer a synonym of *Atractites* as he felt there was little to distinguish it from this genus.

Often, only fragments of *Atractites* phragmocones are found. This is the case in the Turkish material where several tens of phragmocones ascribable to this genus were collected. However, although their overall morphology distinguishes from co-occurring Belemnitida, we feel that without rostra (tela) it is impossible to assign them specific names. We do recognize two distinct groups which illustrate very clear differences based on the ratio of height to maximum width of the camerae and on the alveolar angle value.

Many species have been instituted by past authors, based solely on specimens with few camerae in connection. It is probable that this represents "oversplitting" of the genus and that many are conspecific.

Range: Lower Middle Triassic (Anisian)-lower Upper Jurassic (Oxfordian). Extremely rare in Middle Jurassic and lower Upper Jurassic. Certainly *Atractites* is the dominant xiphoteutid genus already from middle Upper Trias in the alpine regions and the Americas. In the Lower Jurassic (Pliensbachian-Toarcian) it continued to be the xiphoteuthid form most common in the Mediterranean Tethys, the Americas and possibly also in New Zealand (Doyle, 1990).

Atractites sp. A
(Pl. 1, figs. 1, 2, 5)

Material: Many tens of phragmocone fragments, from Bilecik Günören (BG-A), Bayrkoi-Trafo (BT) and Bayirkoy Çaldagi Tepe (BÇT).

Description: Phragmocone typically very long and slender. The camerae are relatively high. Alveolar angle small (5°-7°). The transverse section is circular or very slightly elliptical with the greatest diameter in the dorso-ventral position. The ventral siphuncle, visible in many specimens, comprises tubular segments, straight with constant transverse section and diameter. The septal necks are long. The sutural line is simple. There is no trace of the shell (conotheca).

Dimensions:

Atractites sp. A

N.	Number of camerae	H/Dm	α
NS 20 315	4	0.54	6°
NS 20 324	3	0.57	5°
NS 20 346	4	0.72	6°
NS 20 347	3	0.62	7°
NS 20 348	4	0.62	7°
NS 20 363	2	0.66	—
NS 20 370	2	0.54	—
NS 20 389	2	0.74	—

Remarks: The material constitutes many phragmocone fragments, with very few camerae in connection (maximum 4). Some are in a good state of preservation so that the siphuncle is seen. Specimens of this group differ from those of *Atractites* sp. B in having a greater cameral height and a smaller alveolar angle. The ratio between the height of the camerae and their maximum diameter is between 0.50 and 0.75. These forms are much more common than those of *Atractites* sp. B. *Atractites* sp. A is quite similar to specimens described and figured by Mattei *et al.* (1987) as *Atractites indunense* from the French Late Carixian-Domerian, and by Meneghini (1867-1881) as *Aulacoceras indunense* from the Domerian of Medolo and the Upper Lias of Bicicolla and Erba (Northern Italy). Meneghini (1867-1881) distinguishes an *Aulacoceras inflatum* with a slightly compressed phragmocone which is also similar to our specimens. This form is closest of the two to Meister's (1913) *Atractites* cf. *orthoceropsis* from the Lias of Merzifoun, but his figured specimen is not sufficient for close comparison.

Occurrence: Lower Pliensbachian, *jamesoni* Zone, based on the presence of brachiopods of this age (Ager, this volume) and its association with *Passaloteuthis*, *Angeloteuthis*, *?Coeloteuthis* and *Nannobelus*.

Atractites sp. B
(Pl. 1, figs. 3, 4)

Material: A few poorly preserved phragmocone fragments. Provenance of the material is the same as *Atractites* sp. A.

Description: The phragmocone is relatively long with an alveolar angle of 9°-12°. The transverse section is circular. The ventral siphuncle is not easily discerned. The camerae are thickened and relatively low.

Dimensions:

Atractites sp. B

N.	Number of camerae	H/Dm	α
NS 20 302	3	0.38	—
NS 20 316	4	0.27	—
NS 20 352	9	0.34	9°
NS 20 353	5	0.33	12°
NS 20 354	4	0.28	11°
NS 20 365	4	0.40	—

Remarks: Among the specimens collected, the most complete example shows 9 camerae in connection with an anterior diameter of 15.8 mm and a posterior diameter of 7 mm. All the specimens are partially eroded on the ventral side so it is not possible to observe the siphuncle. Some forms have an elliptical transverse section but this is due to erosion. This form differs from *Atractites* sp. A in having lower camerae, a probably shorter cone and a less acute alveolar angle. The ratio between the height of the camerae and their maximum diameter varies between 0.23 and 0.40. These forms are less common than those here ascribed to *Atractites* sp. A; they are similar to those described and figured by Meneghini (1867-1881) as *Aulacoceras orsinii* (pl. 26, fig. 10-11). As with Meneghini's specimens these fragments can be easily confused, when poor preserved, with true belemnitid phragmocones. However, the small alveolar angle of the Turkish specimens distinguishes them from belemnitid phragmocones.

Occurrence: As for *Atractites* sp. A.

Order Belemnitida Zittel, 1895
Suborder Belemnitina Zittel, 1895
Family Belemnitidae d'orbigny, 1842
Subfamily Belemnitinae d'orbigny, 1842

Remarks: Doyle & Riegraf (1986,1987) have applied to the ICZN to request usuage of their plenary powers to suppress the genus *Belemnites* Lamarck, 1799 for cogent reasons, and to designate *Passaloteuthis* Lissajous, 1915 type genus of the Belemnitidae d'Orbigny, 1842. This usage is employed below.

Genus **Passaloteuthis** Lissajous, 1915

Type species: *Belemnites bruguierianus* d'Orbigny, 1842, by original designation.

Diagnosis: Medium to large sized, cylindrical or weakly subhastate Belemnitinae. Outline symmetrical, cylindrical to cylindriconical, becoming weakly subhastate in some forms. Profile generally similar to outline, but usually more inflated, and asymmetrical to symmetrical. Transverse sections are generally subquadrate to circular. There are two dorso-lateral grooves confined to the apex; there is no ventral groove. Apical striations are common. The apical line is goniolineate, and the phragmocone penetrates one third to one quarter of the rostrum.

Range: Lower Pliensbachian to Toarcian of Europe, the Soviet Union, ?South America, North America, East Greenland and Spitsbergen.

Passaloteuthis aff. **ima** Lang, 1928
(Pl. 1, figs. 6-12)

aff. v.* 1928 *Passaloteuthis ima* Lang, p. 199, pl. XIII, fig. 5.

Material: 14 almost complete specimens (NS 20 633, 5, 57, 8, 60-62, 5, 7-9, 464, 9, 70), 3 possible specimens (NS 20 459-61) and some tens of fragments from the Rosso Ammonitico facies, one complete (NS 20 525) and many fragmentary specimens from sandy facies, of Bilecik-Günören (BG-A); 2 fragments (NS 20 671, 5) from Iznik (I-DER); one juvenile form (NS 20 595) and 3 fragments (NS 20 435-7) from Sögüt (more exactly the first one from SA 9 and the other ones from SC).

Description: Medium sized, elongate *Passaloteuthis* with a total length of approximately five times Dv. The outline is symmetrical and cylindrical, with weakly diverging flanks in the apical region, which become parallel in the stem and alveolar regions. The profile is symmetrical and cylindriconical to elongate conical. The apex is uninflated to weakly inflated in profile, the venter and dorsum diverging gradually towards the alveolar region. The transverse sections are compressed (Dv:Dl 1.1) and elliptical, with venter and dorsum having a similar breadth.

It is difficult to observe surface features on the rostra studied. However, some of the specimens have two short, dorso-lateral apical grooves. In general the apices are strongly striated, but this may be the result of diagenetic effects. Lateral lines are present as three indistinct but parallel longitudinal depressions, separated by a strongly developed ventro-lateral ridge, and a weaker dorso-lateral one. The alveolus penetrates approximately one quarter of the rostrum, and the apical line is goniolineate. Juveniles are more acutely conical than the adults, but are distinguished from co-occuring *Nannobelus* by their compressed elliptical section.

Dimensions:

Passaloteuthis aff. *ima*

N.	L	l	Dv	Dl
NS 20 657	77.7 na	54.0	14.7	12.9
NS 20 658	96.5	69.0	16.8	14.1
NS 20 660	69.2 na	55.9	13.5	12.1
NS 20 661	79.3	75.9	15.8	14.3
NS 20 662	61.3 na	58.2	13.5	12.1
NS 20 665	57.3 juv.	46.8	10.6	9.8
NS 20 667	48.4 juv.	43.9	11.1	9.6
NS 20 668	43.6 juv.	41.6	11.4	9.5
NS 20 669	41.6 juv.	38.9	2.5	6.9

Remarks: *Passaloteuthis* aff. *ima* LANG from Turkey resembles several other *Passaloteuthis* species from the Lower Pliensbachian Belemnite Marls of Charmouth in Dorset (Lang, 1928). However, the Turkish forms are closest to the holotype of *Passaloteuthis ima* LANG (BMNH C. 28989), which is squat with a similar apex and groove form. Unfortunately, the relatively poor preservation of the specimens under consideration, along with their less compressed transverse section, does not allow more definite assignment to this species. *P. apicicurvata* as interpreted by Lang (1928) (rather than by Schumann 1974, whose interpretation is wide) is similar in the form of its cross section, but differs in being larger, more elongate, and having an attenuated apex. Pompeckj (1897) described fragments of rostra which may represent pieces of this species from the Middle Lias of North Anatolia.

Occurrence: These specimens, from Bilecik-Günören (BG-A), were collected in association with brachiopods suggestive of an Early Pliensbachian, *jamesoni* Zone age (Ager, this volume). The association of *Passaloteuthis*, *Angeloteuthis*, ? *Coeloteuthis* and *Nannobelus* in these beds is also consistent with this age, as all these genera are known from the basal Pliensbachian in Europe (Lang, 1928; Jeletzky pers. comm. 1987). For these reasons it is possible to ascribe the same age to the specimens from Sögüt.

Passaloteuthis aff. **auricipitis**
(Pl. 2, figs. 1, 2)

aff. v.* 1928 *Passaloteuthis auricipitis* Lang, p. 204, pl. XIV, fig. 2.

Material: Four fragmentary apical regions (NS 20 686,7, 90, 91) from the sandy facies, and one possible alveolar fragment (NS 20 458) from the Rosso Ammonitico facies, of Bilecik-Günören (BG-A).

Description: The four apical regions are tentatively compared with the species *Passaloteuthis auricipitis* Lang by virtue of their overall robust form, and by their attenuated, incurved apices. Attenuated and incurved apices are common in species of *Pseudohastites sensu stricto*, but the robust cylindriconical form and relatively uncompressed transverse sections of these fragments ally them with *Passaloteuthis* and particularly with *P. auricipitis*. The alveolar fragment is robust with Dv 20.8 and Dl 19.3. This fragment also resembles *P. ridgensis* Lang, 1928 but is too fragmentary to be certain.

Occurrence: As for *Passaloteuthis* aff. *ima*.

Genus **Pseudohastites** Naef, 1922 *sensu stricto*
(= *Catateuthis* Nal'nyaeva, 1967, subj.,
Propassaloteuthis Riegraf, 1980, subj.,
non **Pseudohastites** *sensu* Lang, 1928)

Type species: *Belemnites scabrosus* Simpson, 1866, by original designation.

Diagnosis: Medium sized, elongate subcylindrical, cylindrical or subhastate Belemnitinae. Outline symmetrical, cylindrical to cylindriconical. Profile asymmetrical to symmetrical, subhastate to cylindrical. Apex attenuated. Transverse section subquadrate to elliptical with flattened flanks. Two short dorsolateral grooves are restricted to the apical region. Apical striations common. Apical line ortholineate to goniolineate.

Range: Lower Pliensbachian to lowermost Toarcian of northwest Europe and the Soviet Union.

Pseudohastites cf. **westhaiensis** (Lang, 1928)
(Pl. 2, figs. 3, 4)

cf. v.* 1928 *Passaloteuthis westhaiensis* Lang, p. 202, pl. XIII, fig. 9.

Material: Two loose specimens (NS 20 703, 6) from the Rosso Ammonitico facies, one partly complete specimen (NS 20 685) and five apical fragments (NS 20 689, 92-5) from the sandy facies, of Bilecik-Günören (BG-A); two specimens (NS 20 438, 9) from Sögüt (SC).

Description: None of the specimens are preserved whole, but they probably represent medium sized, to elongate *Pseudohastites sensu stricto*. The outline and profile are cylindrical with parallel dorsum, venter and flanks, and a short, weakly adorally divergent apical region. The loose Günören specimen is more cylindriconical, with a longer divergent apical region.

The apex is acute in profile and outline. The transverse sections are notably compressed (Dv:Dl 1.2) in all specimens, and elliptical with flattened flanks.

In common with all the Turkish Lower Jurassic belemnites, surface features are not well preserved. However, two very short dorso-lateral apical grooves are present in the largest specimen. Lateral lines on this specimen are represented by three indistinct longitudinal depressions, comprising a narrow dorso-lateral depression, separated from two weaker, more ventro-lateral examples by a dorso-lateral ridge. A weak ventro-lateral ridge separates the last named depressions.

Dimensions:

Pseudohastites cf. *westhaiensis*

N.	L	Dv	Dl
NS 20 685	63.6	11.0	9.5*
NS 20 703	65.4	13.5	12.0+

* At fractured end.
\+ At protoconch.

Remarks: The best preserved specimen closely resembles the holotype of *Passaloteuthis westhaiensis* Lang (BMNH C.28894) from the Belemnite Marls of Charmouth in Dorset (Lang, 1928). Both specimens share compressed, cylindrical rostra with short apical regions and acute apices. However, as nonc of the specimens from Turkey are complete, they cannot be definitely assigned to this species. In addition, although included in the description, the largest and loose specimen from Günören is slightly more robust and might be more properly assigned to *Pseudohastites elongata* (Miller) (see Lang, 1928, p. 201).

Pseudohastites cf. *westhaiensis* Lang is distinguished from *Passaloteuthis* aff. *ima* Lang by its more cylindrical, elongate rostrum and compressed transverse section. It is distinguished from the fragments of "*Pseudohastites*" Naef *sensu* Lang which have a quadrate transverse section and are representative of the slender "spicular" belemnites characteristic of this genus (e.g. *Belemnites junceus* Phillips, 1867).

Occurrence: As for *Passaloteuthis* aff. *ima*.

Genus "**Pseudohastites**" *sensu* Lang, 1928 non Naef, 1922 gen. nov.

Remarks: Lang (1928, p. 211) employed the nominal genus *Pseudohastites* Naef for elongate slender, subhastate to cylindrical belemnites of the group of *Belemnites junceus* Phillips. These belemnites are broadly devoid of apical grooves but possess well developed lateral lines. The type species of *Pseudohastites* is *Belemnites scabrosus* (see above), the type specimen of which (WM. 976) is closely allied to *Passaloteuthis*, possessing clear apical grooves (Doyle, in press). In view of this, the late Jeletzky had planned rename this taxon in a major revision of the belemnites of the English Lower Pliensbachian. (See also Schwegler 1962b, p. 155). However, because of the fragmentary nature of the present material, a new name is not introduced here.

Range: Pliensbachian-lowermost Toarcian of Europe.

"**Pseudohastites**" *sensu* Lang ? sp. ind.
(Pl. 2, figs. 5-7)

Material: Seven fragments (two alveolar, NS 20 590, 2; four stems, NS 20 445, 86, 91, 93 and one apical, NS 20 485) from the Rosso Ammonitico facies of Bilecik-Günören (BG-A); one fragment (NS 20 674) from Iznik (I-DER).

Description: The specimens are very poorly preserved, but all bear points of resemblance to "*Pseudohastites*" *sensu* Lang. Although lacking most of their length, the fragments are considered to be from elongate cylindrical or cylindriconical rostra, with acute apices and inflated alveolar regions. Profile and outline of fragments are similar, being cylindrical in form and symmetrical. Their transverse sections are compressed (Dv:Dl 1.2) and elliptical (in the alveolar region), becoming subquadrate with flat, parallel flanks. The apex is missing from all the fragments. Lateral lines are present, and these correspond to Lang's "*Pseudohastites*" in having three closely parallel and narrow depresssions separated by corresponding ridges.

Dimensions:

? *Pseudohastites sensu* Lang sp. ind.

N.	L	l	Dv	Dl
NS 20 590	—	—	7.5	6.5
NS 20 592	—	—	7.8	6.6
NS 20 593	—	—	7.7	6.1

Remarks: The specimens are all too poorly preserved to allow specific comparison, but the features that are preserved indicate their generic affinity.

Occurrence: As for *Passaloteuthis* aff. *ima* Lang.

Genus **Angeloteuthis** Lang, 1928

Type species: *Angeloteuthis gabriel* Lang, 1928, by original designation.

Diagnosis: Small, cylindrical to weakly cylindriconical Belemnitinae. Outline symmetrical, cylindrical to cylindriconical in more inflated forms. Apex obtuse. Transverse sections compressed to very compressed, generally with very flat, parallel flanks producing a quadrate form.

There are two dorso-lateral grooves confined to the apex. The apical line is goniolineate. The phragmocone penetrates one half to a quarter to the rostrum.

Range: Lower Pliensbachian of Europe.

Remarks: This genus is in need of revision, and no further remarks can be made about it at this time.

Angeloteuthis cf. **raphael** Lang, 1928
(Pl. 2, figs. 8-10)

cf. v.* 1928 *Angeloteuthis raphael* Lang, p. 208, pl. XV, fig. 9-10.

Material: Three specimens (NS 20 428-30) from the Rosso Ammonitico facies of Bilecik-Günören (BG-A).

Description: Small, stout, cylindrical *Angeloteuthis*, with a total length of approximately four and a half times Dv. The outline is symmetrical and cylindrical, the flanks only weakly to moderately diverging from the apex, becoming parallel in the stem. The apex is acute in both views. The profile is symmetrical to asymmetrical with an uninflated venter, and is cylindrical. Venter and dorsum diverge adorally only in the apical region, becoming parallel in the stem and alveolar part. The transverse sections are quadrate with flattened flanks (Dv:Dl 1.2), venter, and dorsum. However, the venter is slightly broader than the dorsum.

These specimens have little surface detail preserved, and show little sign of apical grooves. However, a single specimen has faint indications of lateral lines on its flanks, comprising two sub-parallel narrow depressions separated by a weak ridge or "weal". The alveolus penetrates a quarter of the rostrum. The single juvenile specimen is essentially similar to the adult, although it has an abnormally inflated apex.

Dimensions:

Angeloteuthis cf. *raphael*

N.	L	l	Dv	Dl
NS 20 428	50.2	36.5	10.8	8.7
NS 20 429	27.5	21.2	8.1	6.7
NS 20 430	43.8	34.5	10.3	8.4

Remarks: These specimens display the compressed cylindrical form typical of *Angeloteuthis* Lang. The specimens most closely resemble the elongate *A. raphael* Lang, rather than squat, inflated forms such *A. michael* Lang and *A. uriel* Lang.

Age: As for *Passaloteuthis* aff. *ima* Lang.

Genus **Coeloteuthis** Lissajous, 1906
(= **Clastoteuthis** Lang, 1928, subj.)

Type species: *Belemnites excavata* Phillips, 1866, by original designation.

Diagnosis: Small, robust, conical to cylindriconical Belemnitinae. Outline and profile symmetrical, conical to cylindriconical. Apex acute to obtuse, sometimes recurved. Transverse sections robust, subcircular to subquadrate. Apical grooves absent, although dorso-lateral line may extend to apex. Lateral lines consist of a deep dorso-lateral line and a more shallow ventro-lateral line. Apical line cyrtolineate. Phragmocone penetrates three quarters to fourth fifths of the rostrum.

Range: Sinemurian and Lower Pliensbachian of Europe. The genus *Clastoteuthis* Lang has also been extensively recorded from the Upper Pliensbachian and Toarcian of the Soviet Union (Saks & Nal'nyaeva, 1970), but it is probable that these Russian species represent a new, endemic, genus (Jeletzky pers. comm., 1987).

Remarks: The nominal genus *Clastoteuthis* Lang, 1928 (type species *Clastoteuthis abrupta* Lang 1928, by original designation) is here treated as a junior subjective synonym of *Coeloteuthis* Lissajous following Bairstrow (1950).

Coeloteuthis ? sp. ind.
(Pl. 2, figs. 11-12)

Material: One juvenile (NS 20 455), one pathological specimen (NS 20 456) and one apical fragment (NS 20 457) from the Rosso Ammonitico facies, and one apical fragment (NS 20 721) from the sandy facies of Bilecik-Günören (BG-A).

Description: The specimens are small (L 23-28 mm), and are probably juvenile. The outline of the non-pathological specimen is bullet-like, symmetrical and conical with curving flanks. The apex is moderately acute. Its profile is symmetrical and conical, but with a slightly recurved appearence. The transverse section of this specimen is only weakly compressed, and rounded subquadrate, with rounded venter and dorsum.

The apex bears no true grooves, although the dorso-lateral line on each flank is reasonably incised and extends almost to the apex. A second, shallow lateral line is situated in a ventro-lateral position. The phragmocone penetrates one half of the rostrum.

Dimensions:

? *Clastoteuthis* sp. ind.

N.	L	l	Dv	Dl
NS 20 455	28.2	19.6	8.8	8.6
NS 20 456*	23.2	21.3	8.1	8.7

* Pathological juvenile.

Remarks: Although possessing a robust conical form, these specimens are only very tentatively assigned to *Coeloteuthis* because of their juvenile, and distorted, nature. Adult *Coeloteuthis* are more robust and conical with a greater penetration of the phragmocone (Lang, 1928).

Occurrence: As for *Passaloteuthis* aff. *ima* Lang.

Genus **Nannobelus** Pavlow, 1913
(= **Prototeuthis** Lemoine, 1915, obj.)

Type species: *Belemnites acutus* Miller, 1826, by subseguent designation of Stolley (1919).

Diagnosis: Small, conical Belemnitinae. Outline (and profile generally), symmetrical and conical to cylindrical in some cases. Apex acute. Transverse sections subquadrate to pyriform. Apex generally smooth, although apical striae are sometimes present. Apical line ortholineate. Phragmocone penetrates one quarter to one third of the rostrum. Lateral lines consist of two subparallel faint depressions on each flank.

Range: Lower Sinemurian to Lower Pliensbachian of Europe, East Greenland, and Toarcian of the U.S.S.R.; these forms are endemic to Siberia and probably represent a new genus.

Remarks: This genus is characterized by its small conical form and featureless apex. However, species of this genus can be confused with juvenile members of other belemnitid genera (e. g. *Passaloteuthis*), although the absence of grooves in *Nannobelus* belies its true affinity.

Nannobelus acutus (Miller, 1826)
(Pl. 2, figs. 13-15; Pl. 3, figs. 1, 2)

*1826 *Belemnites acutus* Miller, p. 60, pl. VIII, fig. 9.
1842 *Belemnites acutus* Miller; d'Orbigny, p. 94, pl. IX, fig. 8-12.
1866 *Belemnites acutus* Miller; Phillips, p. 33, pl. 1, fig. 1.
1912 *Belemnites acutus* Miller; Werner, p. 108, pl. X, fig. 1 [full synonymy].
1962 *Belemnites acutus* Miller; Schwegler, p. 11, text-fig. 8.
?1977 *Nannobelus* cx gr. *acutus* (Miller); Stoyanova-Vergilova, p. 179, pl. 1, fig. 1.
1980 *Nannobelus acutus* (Miller); Riegraf, p. 142.

Type specimen: The original of Miller (1826) pl. VIII, fig. 9, (no locality strata given). This specimen was reported lost by Phillips (1866), and a neotype should necessarily be selected.

Material: Nine almost complete (NS 20 451-4, 526, 47, 682-4) and thirteen fragmentary specimens (NS 20 446, 7, 488, 501-8, 12, 13) from the Rosso Ammonitico facies, and three specimens (NS 20 515-7) from the sandy facies, of Bilecik-Günören (BG-A).

Description: Small, conical *Nannobelus* with a total length of approximately 4-4.5 times Dv. The profile is symmetrical to almost symmetrical, and cylindriconical to conical. The outline is similar but always symmetrical. The transverse sections are subquadrate (Dv:Dl 1.1) in the stem, becoming more inflated and rounded in the alveolar region.

The apex lacks grooves, although there are striae that resemble incipient grooves. All the specimens are too poorly preserved to allow lateral lines to be distinguished. The phragmocone penetrates one third to a half of the rostrum.

Dimensions:

Nannobelus acutus

N.	L	l	Dv	Dl
NS 20 451	49.3	28.2	9.4	8.7
NS 20 452*	33.0	23.3	8.5	7.8
NS 20 453	37.7	26.3	9.3	8.9
NS 20 454	39.5	30.8	9.4	8.8
NS 20 516	34.0	25.2	9.1	8.2
NS 20 604	31.0	21.2	8.0	7.5
NS 20 682	53.5	31.4	10.2	9.6
NS 20 683	45.8	30.0	9.4	9.1

* Pathological.

Remarks: These specimens are typical of *N. acutus* (Miller), and are distinguished from juveniles of *Passaloteuthis* aff. *ima* Lang which are slightly more elongated and more compressed. Some specimens may only be tentatively assigned to this species, however, as although conical, they possess distinct apical grooves. Such specimens may actually represent a species of *Passaloteuthis*.

Occurrence: *Nannobelus* is not known to occur with *Coeloteuthis*, *Angeloteuthis* and "*Pseudohastites*" in Dorset, but examples of Early Pliensbachian age have been recorded elsewhere in Europe (Stoyanova-Vergilova, 1977), although *Nannobelus acutus* is known to have a range of Hettangian-topmost Sinemurian Riegraf, 1980).

Suborder Belemnopseina Jeletzky, 1965
Family Belemnopseidae Naef, 1922
Genus **Belemnopsis** Bayle, 1878

Type species: *Belemnites sulcatus* Miller, 1826, by subsequent designation of Douville (1879).

Diagnosis: Small to large sized, hastate, cylindrical to cylindriconical Belemnopseidae. Outline hastate to cylindriconical and symmetrical. Apex acute. Profile symmetrical to asymmetrical cylindrical or cylindriconical to hastate. Venter generally uninflated. Transverse sections are commonly depressed and elliptical (mainly in Middle Jurassic forms), to circular or elliptical (in later forms). A broad, ventral groove is developed, usually extending from the alveolar region to the apical region, often as far as the apex itself. Lateral lines consist of Doppellinien with adoral flattening to a greater or lesser degree. Apical line ortholineate. The phragmocone penetrates generally one fifth of the rostrum.

Range: Bajocian to Oxfordian of European Tethys; Bajocian to Hauterivian of Tethyan regions, including the Southern Hemisphere (see Stevens, 1965).

Belemnopsis depressa (Quenstedt, 1848)
(Pl. 3, figs. 5-6)

*1848 *Belemnites semihastatus depressus* Quenstedt, p. 439, pl. 29, fig. 12-19.
1858 *Belemnites calloviensis* Oppel, p. 546.
1875 *Belemnites calloviensis* Oppel; Waagen, p. 14, pl. 2, fig. 4.
1980 *Belemnopsis* (*Belemnopsis*) *depressa* (Quenstedt); Riegraf p. 199, pl. 3, fig. 27, 28, text-fig. 184, 185 [Full synonymy list].

Type specimen: Neotype (GPIT 1532/ 27), Ornatenthon, Middle Callovian, Wurtemberg (Riegraf 1980).

Material: Three almost complete specimens (NS 20 530-2), and numerous fragments from the volcaniclastic sediments of Kabalar (Mudurnu) (MK 5-6). Several fragments from Aktaş-Golçuk (Agl).

Description: Medium sized, moderately slender *Belemnopsis* with a total length of approximately six times Dv max. The outline is symmetrical and hastate with Dl max at the midpoint of the rostrum. The apex is acute. The profile is symmetrical or almost symmetrical and weakly subhastate to almost cylindrical, with Dv max at the mid-point of the rostrum. Venter and dorsum are uninflated, the apex being acute in profile. The transverse sections are depressed (Dv:Dl 0.8), and elliptical in the stem region, becoming more compressed and subquadrate in the alveolar part.

The preservation of these specimens is such that the form of the ventral alveolar groove is difficult to determine. However, it is basically incised in the alveolar region, shallowing adapically, stopping short of the apex by approximately 10 mm. The surface of the rostra is too poorly preserved to be able to discern lateral lines. Although the alveolar region is missing in these specimens, the phragmocone penetrates an estimated one fifth of the rostrum.

Dimensions:

Belemnopsis depressa

N.	l.	Dvmax	Dlmax
NS 20 530	68.6 na	10.1	11.7
NS 20 531	58.8 na	9.9	10.8
NS 20 532	—	9.0	12.0

Remarks. These specimens approach closely the species *Belemnopsis depressa* (= *calloviensis* of authors) in the elongate and slender form of their rostra. Although the position of maximum inflation (Dv max) in the Turkish specimens is somewhat anterior of those seen in other specimens (see Riegraf, 1980), its hastate form corresponds well with this species. *Belemnopsis beyrichi* (Oppel) and *B. bessina* (d'Orbigny) are more depressed and cylindrical in outline than *B. depressa*.

Occurrence. Swabian Jura (SW Germany); Callovian (*calloviense* Zone to, at most, *coronatum* Zone). By influence the Turkish specimens are considered to be Callovian in age.

Belemnopsis aff. **subhastata informis** Riegraf, 1980
(Pl. 3, figs. 3, 4)

1980 *Belemnopsis* (*Belemnopsis*) *subhastata informis* Riegraf, p. 197, pl. 3, fig. 26, text-fig. 183

Material: One almost complete specimen (NS 20 463), and three fragments (NS 20 536, 7, 754) from the volcanoclastic deposits of Kabalar (Mudurnu) (MK 5-6). One specimen (NS 20 423) from Aktaş Golçuk (Ag1).

Description: The specimens are mostly fragmentary, but the one almost complete specimen is a large, robust *Belemnopsis* with a total length of approximately four times Dv max. The outline is symmetrical and subhastate, with Dl max in the apical third of the rostrum. The apex is moderate acute. The profile is weakly subhastate to cylindrical, with the dorsum being slightly inflated at Dv max. The transverse sections are depressed throughout (Dv:Dl 0.9), although elliptical in the stem and apex, becoming quadrate in the alveolar region. The ventral groove is broad and relatively shallow, although incised towards the alveolar end. The groove stops short of the apex by an estimated 20-30 mm. Surface erosion does not allow investigation of lateral lines. Neither the apex nor the alveolar region are preserved.

Dimensions:

Belemnopsis aff. *subhastatus informis*

N.	L	Dvmax	Dlmax
NS 20 463	82.8 na	19.5	22.2

Remarks: These specimens are similar in form to the preceding specimens of *Belemnopsis depressa* (Quenstedt), in possessing similar transverse sections and outline/profile. However, the large size of the specimen, considered with its broader groove, that it is distinct from *B. depressa*. This specimen does approach in form and dimensions Riegraf's *Belemnopsis subhastata informis*, but because of its fragmentary nature, it cannot be assigned with certainty to this subspecies.

Age: Riegraf (1980) has recorded *B. subhastata informis* only from the Lower Callovian (*macrocephalus* Zone) of the Swabian Alps of Germany. The Turkish specimens are therefore considered to be of Callovian age.

Belemnopsis sp. nov.?
(Pl. 3, fig. 7)

Material: Two almost complete specimens (NS 20 542, 3) from Actaş-Çamtur (AÇ 69).

Description: A (probably) juvenile specimen of a small, elongate slender *Belemnopsis* with a total length of approximately ten times Dv max. In outline it is symmetrical (although distorted) and very weakly subhastate, with only slight inflation of the flanks in the stem region of the rostrum. In profile, it has a similar form, and the apices of both views are acute. Transverse sections are weakly depressed (Dv:Dl 0.95) and subquadrate for the length of the rostrum. The ventral groove is wide in proportion to the width of the rostrum, and is present for most of the length of the rostrum. The groove is only faintly present in the posterior 10 mm of the apical region. Lateral lines are barely discernible and appear as relatively incised Doppellinien.

Dimensions:

Belemnopsis sp. nov?

N.	L	Dvmax	Dlmax
NS 20 542	71.2	—	—
NS 20 543	57.5	6.4	6.7

Remarks: The slender, almost needle-like form of this species is unlike any European *Belemnopsis*. Some juveniles of *Belemnopsis bessina* and its allies have a similar width and slender form, but are much more depressed than this specimen. These specimens might conceivably represent a new species, but it is too poorly preserved for further comment.

Age: In Europe *Belemnopsis* ranges from the Bajocian to the Oxfordian. A probable Callovian age is ascribed to the Turkish specimens given its occurrence with *B.* aff. *subhastata informis* and *B. depressa*.

? **Belemnopsis** sp. ind.
(Pl. 3, fig. 8)

Material: One almost complete specimen (NS 20 529) from Nallihan (NALLI 30).

Description: Middle sized, slender guard with an estimated total length of about nine times the Dv max. Although distorted the outline is symmetrical and hastate with the maximum transverse inflation slightly posterior. Anterior of the position of Dv max the flanks slightly converge. Posterior to Dv max the flanks converge towards a probably acute apex. The profile is symmetrical and very slightly hastate, not so marked as in the outline. The transverse sections of stem and apical region are depressed; that of the alveolar region is almost circular. A median ventral groove extends from the alveolus to the apical re-

gion. It is relatively broad and shallows towards the posterior end. The preservation of this specimen is poor and it is impossible to see lateral lines.

Remarks: The preservation of this species does not allow detailed comparison, and although it is somewhat similar in outline to *B. bessina* (d'Orbigny) from the Bathonian-Callovian of Europe, it is distinguished by "its" transverse sections.

Occurrence: This specimen was collected from levels in which were found other fossils, such as *Saccocoma* sp., of Tithonian age.

Genus **Hibolithes** Montfort, 1808
(= **Pseudohibolites** Blüthgen, 1936, subj.)

Diagnosis: See Swinnerton 1954, p. xxxix; Stevens 1965, p. 59; Doyle & Kelly 1988, p. 19.

Type species: *Hibolithes hastatus* Montfort, 1808, by monotypy.

Hibolithes jaculoides Swinnerton, 1937
(Pl. 4, figs. 1, 2)

1892 *Belemnites jaculum* Swinnerton; Pavlow, p. 257-260, pl. VII, fig. 2-3.
*1937 *Hibolites jaculoides* Swinnerton, p. XXV.
v.1952 *Hibolites jaculoides* Swinnerton, p. 54, pl. 14, fig. 17, 18.
1978 *Hibolites jaculoides* Swinnerton; Mutterlose, p. 99, pl. 4, fig. 1-3; pl. 5, fig. 4; pl. 6, fig. 1. [Full synonymy].
v.1988 *Hibolithes jaculoides* Swinnerton, Doyle & Kelly, p.19, pl. 1, fig. 11-15; pl. 2, fig. 8, 9.

Type specimen: Holotype (BMNH C.42313) bed C7, Hauterivian, Speeton Clay, Yorkshire.

Material: One almost complete specimen (NS 20 718), partially enclosed in the matrix and many fragments from Kinik (Bilecik) (Bi-K 39), two almost complete (NS 20 715, 6) and one fragmentary (NS 20 697) specimens from Kabalar (Mudurnu) (MK 39-40, MK 50). All specimens lack the alveolar region.

Description: Medium sized rostrum with a total length of 7.5-8.5 times the maximum diameter (Dv max). The profile is symmetrical and hastate. The outline is symmetrical and hastate with its maximum diameter (Dv max) about 25 mm from the apex. In transverse section, the stem and apical region are slightly depressed, being subcircular in the apical region and slightly elliptical in the stem. Double lateral lines (Doppellinien) are present on the flanks. The alveolar region is missing in all the specimens.

Dimensions:

Hibolithes jaculoides

N.	L	X	Dvmax	Dlmax
NS 20 715	71.2	26.0	8.2	8.7
NS 20 716	74.8 na	21.0	10.1	10.7
NS 20 718	73.8	25.0	—	—

Remarks: Swinnerton (1952) suggested that this species has a wide variability. The most variable characters are the position of the maximum inflation and the degree of inflation, resulting in a greater or less degree of hastation. Swinnerton (1952, p. 56) in consequence erected several varieties of *H. jaculoides*, e.g. var. *stylirostris* for slim spindle-shaped forms with very acute apices and var. *torpedinus* for stout clavate forms with obtuse apices. In addition, transverse sections of the rostra range from subcircular to clearly depressed. For the latter Swinnerton (1952) gave the name var. *depressirostris*. However, although slightly depressed, most Turkish specimens here described do not fall within this extreme. However, the specimen coming from MK 50 does exhibit an overall depressed rostrum.

Occurrence: This species is recorded from the Valanginian-?Barremian of northwest Europe, European Russia and South America (Stevens, 1965; Mutterlose, 1978, 1990) and in the Valanginian-Hauterivian of Kongsoya (Kong Karls Land, Svalbard; Doyle & Kelly, 1988). The present specimens were collected immediately above (about 10 m) the F Zone (*Tintinnopsella* Zone) of the Valanginian, that is well below the *Globurigerina hoterivica* Zone of the Upper Hauterivian (Altiner & Ozkan, this volume). This is consistent with the known stratigraphic range of this species.

Hibolithes cf. **savornini** Nicolai, 1950
(Pl. 4, fig. 3)

cf. * 1950 *Hibolites savornini* Nicolai, p. 36, pl. VI, fig. 7,8.

Material: One incomplete specimen (NS 20 696) coming from Kinik (Bilecik) (Bi-K 54). Only the apical region is preserved.

Description: Medium sized, moderately slender rostrum. The outline and profile of the specimen are symmetrical and conical. The venter is a little more flattened than the dorsum, and thus the transverse section is depressed (Dv/Dl 0.8). The ventral groove is weak, but we can see only its distal part. The apex

seems to be mucronate. The poor preservation does not permit study of the lateral lines.

Remarks: This specimen can be compared with that described and figured by Nicolai (1950) as *Hibolites savornini* from Madagascar. Our specimen has the same general aspect and transverse sections, although it lacks the stem and the alveolar region. It is also similar to the incomplete specimen figured, by Nicolai (1950) in Pl. VI, fig. 6, and named *Hibolites* cf. *flemingi* Spath. However the description is poor and the figure shows only one side of the rostrum; thus it is not possible to directly compare the two specimens.

Occurrence: *Hibolithes savornini* is recorded in the Kimmeridgian-Tithonian from NW of Ankilizato and W of Antsakamahale (Madagascar) (Nicolai, 1950).

Genus Neohibolites Stolley, 1911

Type species. *Belemnites ewaldi* v. Strombeck, 1861, by subsequent designation of Gorn (1968, p. 383).

Diagnosis: See Stolley (1911, p. 174), Swinnerton (1955, p. XXIX), Spaeth (1971, P. 56).

Neohibolites ewaldi (v. Strombeck, 1861) (Pl. 4, figs. 4, 5)

1847 *Belemnites semicanaliculatus* Blainville; d'Orbigny, p. 23, pl. IX, fig. 7-8.
*1861 *Belemnites Ewaldi* v. Strombeck, p. 34.
1911 *Neohibolites clava* Stolley, p. 37, pl. I, fig. 21; pl. II, fig. 1-12.
1911 *Neohibolites inflexus* Stolley, p. 42, pl. I, fig. 30; pl. II, fig. 13-26.
v.1955 *Neohibolites ewaldi* (v. Strombeck); Swinnerton, p. 64, pl. XVI, fig. 8-26, pl. XVII, fig. 1-14.
v.1987 *Neohibolites ewaldi* (v. Strombeck); Doyle, p. 312, pl. 43, fig. 1-5.

Type specimen: Lectotype (designated by Swinnerton 1955, p. 65), the original of d'Orbigny (1847, pl. IX, fig. 7), Aptian, southern France.

Material: One fragmentary (NS 20 601) and two well preserved (NS 20 714, 546) specimens from Nallihan (NALLI 7, 13); one rostrum partially enclosed in the matrix (NS 20 599) collected at Kabalar (Mudurnu) (Mk 45).

Description: Medium sized rostrum with a total length of 8-9 times the maximum diameter. The maximum inflation is situated at the adoral most part of the apical region (about 2/3 of the total length). Outline and profile are similar, symmetrical, hastate or subhastate. The apex is characterized by an acute angle of 20°-26°. The transverse sections of the stem and apical regions are circular, that of the alveolar region is subquadrate. Two lateral lines (Doppellinien) are visible along the total length of the rostrum in the young forms. A short and clear ventral alveolar groove is visible. The apical line is central and ortholineate.

Neohibolites ewaldi

N.	L	X	Dvmax	Dlmax
NS 20 546	46.8	16.0	6.4	6.8
NS 20 599	47.0	16.4	—	—
NS 20 714	46.3	17.0	6.7	7.3

Remarks: These Turkish forms are closest to the lectotype of *Neohibolites ewaldi* designated by Swinnerton (1955). The two well preserved specimens, as almost all the forms of this group, lack the alveolar region. The only other form similar to this species is *N. minimus* (Miller) from which it differs by its larger dimensions and in being more hastate.

Occurrence: This species is recorded from Southern France (Aptian), Germany (Aptian), Southern Mozambique (Rio Maputo section near Catuane; Upper Aptian); Speeton Clay (Speeton, Yorkshire, Lower Aptian), Sutterby Marl (Lincolnshire, Lower Aptian) and Hythe Beds (Kent, Aptian) (Swinnerton, 1936-1955; Doyle, 1987a).

Neohibolites sp. ind. (Pl. 4, fig. 6)

Material: Two incomplete specimens (NS 20 301, 598) from Nallihan (NALLI 18, 6).

Description: Elongate rostrum, its length 8 times the maximum diameter. The outline is symmetrical and slightly hastate; after a slight narrowing at the alveolar region the flanks enlarge slowly till the point of the maximum inflation (adoral most part of the apical region) and then converge quickly to the apex. The profile is slightly asymmetrical because the venter is weakly curved for its total length while the dorsum is straight. The transverse sections of the stem and apical regions are circular. Very weak lateral lines in the form of Doppellinien are visible on the flanks.

Remarks: Unfortunately the poor preservation of this specimen does not allow us to go beyond generic

attribution. However, this form does possess some characteristics, such as dimensions and general morphology, which are close to the species *N. spicatus* Swinnerton.

Occurrence: Probably Lower Aptian. *N. spicatus* is known from the Lower Aptian Sutterby Marl, Sutterby, Lincolnshire.

Genus **Parahibolites** Stolley, 1919

Type species. Neohibolites duvalaeformis Stolley, 1911, by original designation.

Diagnosis: See Doyle 1985, p. 24.

Parahibolites sp. nov. ?
(Pl. 4, Fig. 7)

Material: One rostrum (NS 20 700) and one fragment (NS 20 701) from Nallihan (NALLI 13).

Description: The complete specimen consists of an elongate slender *Parahibolites*. The outline is cylindrical to weakly subhastate with weak divergence of the flanks, and the profile is broadly similar. The apex is acute. Transverse sections are weakly compressed (Dv:Dl 1.08) and elliptical. The small fragment displays a well developed ventral alveolar groove which is poorly preserved in the complete specimen but which extends adapically for approximately one third of the rostrum. Flattened areas on the flanks correspond to lateral lines, which are otherwise poorly preserved.

Dimensions:

Parahibolites sp. nov. ?

N.	L	I	Dv	Dl
NS 20 700	58.0	47.0*	6.7*	6.2

* Estimated.

Remarks: These specimens are assigned to *Parahibolites* because of their short alveolar groove, coupled with their shape, small size and compressed section. The type species *P. duvalaeformis* is more hastate in outline, but the present specimens resemble *P. blanfordi* (Spengler) and *P. fibula* (Forbes) in the general form of the rostrum. However, they are more slender and concievably represent a new species of this genus.

Occurrence: *Parahibolites* is known from the Albian-Cenomanian of southern Europe and Gondwana. Stevens (1973b) does note the presence of the group *Mesohibolites-Parahibolites* in the Aptian of Turkey, but no further data are available.

Family Duvaliidae Pavlow, 1913
Genus **Duvalia** Bayle, 1878

Type species: *Belemnites dilatatus* Blainville, 1827 by subsequent designation (Douville, 1879). Naef (1922) and Combémorel (1973) suggested that *Belemnites latus* Blainville, 1827 was more typical, but this is invalid as discussed by Stoyanova-Vergilova (1965).

Diagnosis: More or less compressed, medium to large sized rostra with a dorsal alveolar groove. The outline is asymmetrical; the ventral surface is more convex than the dorsal surface. The profile is symmetrical and hastate. Two elongate lateral lines (Doppellinien) are present on each lateral surfaces.

Range: Very common in the Tithonian-Aptian. Very rare in the Middle Jurassic; the only recorded forms are *D. disputabilis* from the Lower Callovian-Bathonian of Poland (Pugaczewska, 1961) and *D. rhopaliformis* from the Bathonian of Madagascar (Combémorel, 1989). Rare in the Oxfordian-Kimmeridgian.

Duvalia lata (Blainville, 1827)
(Pl. 4, fig. 8)

	*1827	*Belemnites latus* Blainville, p. 121, pl. 5, fig. 10.
	1829	*Belemnites convexus* Raspail, p. 42, pl. 7, fig. 57.
pars	1840-41	*Belemnites latus* Blainville; d'Orbigny, p. 48, pl. 4, fig. 4-8, *non* fig. 1-3.
pars	1841	*Belemnites latus* Blainville; Duval-Jouve, p. 61, pl. 6, fig. 2, 3, 5, 6 *non* fig. 1, 4, 7-11.
	1878	*Duvalia lata* (Blainville); Bayle, pl. XXXI, fig. 3-8.
	1902	*Duvalia lata* var. *constricta* Uhlig, p. 19, pl. I, fig. 4.
	1907	*Duvalia lata* var. *zeugitana* Pervinquiere, p. 405, fig. 157.
	1965	*Duvalia lata* (Blainville); Stoyanova-Vergilova, p. 184, pl. I, fig. 1-3.
	1965	*Duvalia lata constricta* Uhlig, 1902; Stoyanova-Vergilova, p. 185, pl. VIII, fig. 3-4.
	1970	*Duvalia lata lata* (Blainville); Stoyanova-Vergilova p. 51, pl. XXVI, fig. 1-3, pl. XXXII, fig. 19.
	1970	*Duvalia lata constricta* Uhlig, 1902; Stoyanova-Vergilova, p. 52, pl. XXVI, fig. 4-5.

Type specimen: Combémorel (1973) pointed out that the type-specimen of *Belemnites latus* Blainville (1827, pl. 5 fig. 10) is a deformed guard in which the groove is abnormally short. He considers that this species is much better defined by Duval-Jouve (1841, pl. 6, fig. 2, 3, 5, 6).

Material: One well-preserved guard (NS 20 300) from Aktaş Çamtur (AÇ 02).

Description: Medium sized, weakly compressed rostrum (Dv max: Dl max 1.14) with a total length of 4.2 times the Dv max. The profile is asymmetrical, with the dorsum almost straight for its length while the venter is strongly convex. The outline is symmetrical and hastate. Dorsum and venter are parallel in the alveolar region. The alveolar region in this specimen is attenuated with the minimum diameter 57 mm from the apex, diverging adorally from this point. The transverse section is elliptical in the alveolar region, its dorso-ventral diameter increasing adapically. A long, deep groove is present on the dorsum extending adapically from the alveolar region and ending 15 mm from the apex. It is delimited by two slight but clear depressions corresponding to lateral lines. The alveolus penetrates up to one third of the rostrum and is excentric towards the dorsum.

Dimensions:

Duvalia lata

N.	L	Dvmax	Dlmax	Ic	Id	X
NS 20 300	83.0	20.1	17.7	1.14	4.12	26.0

Remarks: This specimen, because of its characteristic alveolar constriction, can be favourably compared with the subspecies *Duvalia lata constricta* (Uhlig, 1902). Stoyanova-Vergilova (1965) affirmed the necessity to maintain this subspecies together with the other ones including *D. lata lata* (ventral and dorsal sides almost parallel) and *D. lata zeugitana* (intermediate form with a regular curvature of the venter for the total length of rostrum). However, Combémorel (1973) recognized a continuous morphological range from a single outcrop, which started with forms having dorsal and ventral surfaces parallel (as in *D. lata lata*), passing through intermediate forms (*D. lata zeugitana*) and ending with *D. lata constricta*. So we prefer to consider the three subspecies as forms fulling in the normal specific variability of *D. lata*.

Occurrence: This species is common in the Berriasian-lower Upper Valanginian of south eastern France. It is also recorded in the Tithonian, Berriasian and Valanginian of the Swiss Alps, Algeria, Tunisia, Silesia, Madagascar and in the Valanginian of Bulgaria (Stoyanova-Vergilova, 1965; Combémorel, 1973). In Turkey the *Duvalia lata* bearing bed has been ascribed to the Zone D (*Calpionellopsis* Zone) and in particular to the Subzone D3. The lower and upper limits of this subzone are respectively characterized by the first *Lorenziella hungarica* and *Calpionellites darderi*. The Subzone D3 has a latest Barremian-earliest Valanginian range (Altiner and Ozkan, this volume).

Duvalia tithonica (Oppel, 1865)

*1865 *Belemnites tithonicus* Oppel, p. 545.
v. non 1868 *Belemnites tithonicus* Oppel; Zittel, p. 37, pl. 1, fig. 12, 13.
v. non 1870 *Belemnites tithonicus* Oppel; Zittel, p. 29, pl. 25, fig. 7.
v. 1870 *Belemnites tithonicus* Oppel; Zittel, pl. 25, fig. 6.
v. non 1875 *Belemnites tithonicus* Oppel; Pillet and Frommentel, p. 124, pl. 14, fig. 1, 2.
1868-76 *Belemnites tithonicus* Oppel; Gemmellaro, p. 20, pl. 3, fig. 6, 7.
1880 *Belemnites tithonicus* Oppel; Favre, p. 19, pl. 1, fig. 18, 19.
non 1885 *Belemnites tithonicus* Oppel; Nicolis and Parona, p. 64, pl. 4, fig. 5.
v. non 1897 *Duvalia tithonica* (Oppel); Roman, p. 280, pl. 1, fig. 2.
1931 *Duvalia tithonica* (Oppel); Krimholz, p. 43, pl. 2, fig. 45-48.
v. 1986 *Duvalia tithonica* (Oppel); Combémorel and Mariotti, p. 36, text-fig. 2.

Type specimen: Lectotype, original of Oppel figured by Zittel (1868, pl. 1, fig. 13), Tithonian of Stramberg, preserved in Munich Museum (Combémorel and Mariotti, 1986b, p. 38).

Material: One rostrum (NS 20 717) from NW of Beypazari (Kozluca, KEL 18).

Description: Medium sized, clearly compressed rostrum (Dv max: Dl max 1.50). The dorsum and venter show the characteristic morphology of this species: an excavation delimited by prominent rounded edges. The outline is symmetrical with the lateral surfaces a little convex, with very slight but clearly developed depressions (lateral lines) in the central part. The profile is asymmetrical, with an inflated venter. Towards the anterior, after narrowing, the alveolar region begins; the alveolus is not deep and from it a long phragmocone starts. The transverse section at the beginning of the alveolar region is ellipsoid, while posteriorly it is rectangular. Alveolar angle of 15°.

Dimensions:

Duvalia tithonica

N.	L	Dvmax	Dlmax	Ic	Id	X
NS 20 717	—	14.6	9.7	1.51	—	—

Remarks: Only the anterior part of a single rostrum was collected. However, it shows all the morphological characters useful for the identification of this species. A phragmocone is partially preserved, although poorly, within the alveolus. Its length is 87 mm. It is possible to recognize the septa at intervals of 5.8 mm.

Occurrence: This species is recorded from the Tithonian of Italy, Poland, Czechoslovakia, Hungary, Switzerland, Spain, Tunisia, France, Crimea (Combèmorel and Mariotti, 1986b). In Central Italy it occurs in levels ascribed to *durangites* Zone equivalent to A2 Zone of calpionellid stratigraphy and to *euxinus* Zone, *jacobi* Subzone (Lower Berriasian) equivalent to B Zone of calpionellid stratigraphy (Combèmorel and Mariotti, 1990). Memmi and Salaj (1975) recorded this species from the *jacobi* Zone equivalent to the *Calpionella alpina* Zone, *Crassicollaria brevis* Subzone, of Northern Tunisia. It was also recorded from the *jacobi* Zone in the Cordoba district (Spain) (Combèmorel and Mariotti, 1986b). The belemnite bearing level (KEL 18) is in the lower part of the Zone B representing the latest Tithonian and the earliest Berriasian (Altiner and Ozkan, this volume).

Duvalia binervia (Raspail, 1829)
(Pl. 4, fig. 9-11)

*1829	*Belemnites binervius* Raspail, p. 304, pl. 6 fig. 6.
1829	*Belemnites acinaciformis* Raspail, p. 35, pl. 6, fig.8.
1829	*Belemnites distans* Raspail, p. 35, pl. 6, fig. 7.
1829	*Belemnites truncatus* Raspail, p. 35, pl. 6, fig. 9.
v. 1840-41	*Belemnites dilatatus* Blainville; d'Orbigny, p. 39, pl. 2, fig. 9-19.
pars 1841	*Belemnites hybridus* Duval-Jouve, p. 51, pl. 3, fig. 1, 5, 6, 9-14, non fig. 2-4, 7-8, 15-16.
1878	*Duvalia hybrida* (Duval-Jouve); Bayle, pl. XXXII, fig. 8-13.
1965	*Duvalia binervius* (Raspail); Stoyanova-Vergilova, p. 187, pl., fig. 1-9. (Cum syn.)
1970	*Duvalia binervia* (Raspail); Stoyanova-Vergilova, p.53, pl. XXVII, fig. 1-3; pl. XXXIII, fig. 10-11.
1973	*Duvalia binervia* (Raspail); Combèmorel, p. 147, pl. 4, fig. 1.

Type specimen: See Paleont. Universalis, ser. I, fasc. 2, N. 16, 1904.

Material: Two specimens (NS 20 426, 33) from NW of Beypazari (Kozluca: ÇAY 3) and two (NS 20 698, 9) from W of Çerkes (Dogdu Dag: CD 9).

Description: Small, strongly compressed rostrum (Dv max : Dl max 1.78) with an asymmetrical profile, and a symmetrical, hastate outline. The asymmetry is caused by a greater inflation of the venter than of the dorsum. A slight depression, corresponding to lateral lines, is visible on the lateral surfaces. The dorsum and venter are flat in the anterior, separated from the laterals by sharp edges giving the section a quadrate form. These edges extend adapically to the maximum dorso-ventral diameter when they become rounded, with an elliptical section.

Dimensions:

Duvalia binervia

N.	L	Dvmax	Dlmax	Ic	Id	X
NS 20 426	32.0	13.9	7.4	1.88	2.3	15.6
NS 20 698	40.6	11.8	6.8	1.73		
NS 20 699	31.2	12.4	7.0	1.78	2.5	13.5

Remarks: Two incomplete specimens were collected, but unfortunately lack the alveolar region. They also resemble *D. dilatata binervoides* Stoyanova-Vergilova, 1965, but are closer to *D. binervia* which has larger dorsal and ventral surfaces, a smaller compression index (Dv max:Dl max 1.5-2.3 for *D. binervia* and 2.5-3.0 for *D. dilatata binervoides*) and well-marked edges between the lateral surfaces and the dorsum and venter.

Occurrence: This species is recorded from Switzerland (Upper Valanginian and Hauterivian), Bulgaria (Hauterivian-Lower Barremian), Georgia, Abkhasie (Hauterivian-Barremian), south eastern France (Lower Valanginian-Hauterivian), south eastern Caucasus (Hauterivian and Barremian), Gruzija (Lower Barremian), Crimea (Hauterivian), (Stoyanova-Vergilova, 1965; Combémorel, 1989). All the Turkish specimens come from levels ascribed to Zone F (*Tintinopsella* Zone), be placed in the Valanginian (Altiner and Ozkan, this volume).

Duvalia cf. **grasiana** (Duval-Jouve, 1841)

Material: One incomplete specimen (NS 20 586) from Nallihan (NALLI 16).

Description: This specimen represents only the alveolar region of a probably medium sized rostrum. The profile and the outline are symmetrical. Lateral compression is very evident (Dv:Dl 1.3). A clear dorsal alveolar groove, straight and with well-marked edges, is visible. Probably the alveolus is deep. Characteristic swellings, tending to form a "keel", are present on the lateral surfaces, giving the transverse section a lozenge form.

Remarks: Although only one incomplete specimen is available, it possesses the following features: keel-like swellings on the lateral surfaces determining

the characteristic lozenge-shaped transverse section, and a straight dorsal groove delimited by marked edges. In particular the typical transverse section allows us to compare this specimen tentatively with *Duvalia grasiana*.

Occurrence: Stoyanova-Vergilova (1965) recorded this species in the Barremian-Aptian of Bulgaria, France, northern Germany, Silesia, Tunisia, Gruzija and in the Aptian of the Crimea, Caucasus and in the Upper Aptian of Azerbaidjan. Combémorel (1973) recorded *D. grasiana* in the Upper Barremian and Aptian of southern eastern France. He affirmed that this species disappeared at the end of the Aptian from the Mesogean realm, while it was found in the North, near Hannover. This form is the last *Duvalia* known and the commonest of the duvaliid forms to penetrate into the Boreal Realm (Mutterlose, 1979).

The foraminifers present at the same level give an Aptian age. A further fragmentary belemnite rostrum was collected from the same level; it might be compared, tentatively, to the genus *Mesohibolites* with an Albian-Cenomanian range.

Duvalia sp. ind. A

Material: One incomplete specimen (NS 20 600) collected at Nallihan (NALLI 17).

Description: Only a portion of the stem (L= 26 mm), from the adapical part of the alveolar region to the adoral part of the apical region, was collected. Both partial outline and profile are cylindrical. The transverse section nearest the apical region is ellipsoid (Dv:Dl 1.24; the measurements were taken on a fragment of the guard), while the section nearest the alveolar region has slight swellings determining a lozenge shape. On the lateral surface it is possible to observe a slight depression corresponding to the lateral lines (the same depression is visible in the growth lines in the transverse section).

Remarks: The clear compression of the rostrum and the shape of the transverse section near the alveolar region are typical of a duvaliid form close to *Duvalia grasiana*.

Occurrence: This rostrum was found together with specimens ascribable to the genus *Neohibolites*, with a possible Aptian age.

Duvalia sp. ind. B

Material: One incomplete specimen (NS 20 528) from NW of Beypazari (Kozluca: Koz 26).

Description: Only the alveolar region and a small part of the stem are preserved. The profile and the outline are symmetrical and cylindrical. A dorsal, relatively shallow, groove is present in the alveolar region. The rostrum is clearly compressed (Dv:Dl 1.4); the transverse section is subrectangular.

Remarks: The position of the groove and the characteristic compression allow us to ascribe this specimen to the genus *Duvalia*. The transverse section and the weakly expressed groove are similar to those of the Tithonian species *Duvalia ensifer*, but the poor preservation does not permit a definite attribution.

Genus **Rhopaloteuthis** Lissajous, 1915
(= *Pachyduvalia* Riegraf, 1981, subj.)

Type species: *Belemnites sauvanausus* d'Orbigny, 1842 by original designation.

Diagnosis: Medium sized hastate rostrum. Symmetrical and hastate outline. Symmetrical to very slightly asymmetrical and hastate profile. Circular to subquadrangular transverse section. Dorsal alveolar groove present. Apical line slightly excentric, alveolus penetrating 1/4 to 1/2 of the total length.

Remarks: Lissajous (1915) instituted this genus for belemnites that are inflated in the posterior similar to *Hibolithes*, but which possess a dorsal alveolar groove. The dorsal groove of this taxon clearly indicates its affinity with the Duvaliidae, even though it lacks the compression typical of these forms. This phenomenon occurs also in duvaliid forms such as *Castellanibelus* and some variants of *Duvalia lata*.

Despite this, Riegraf (1981) considered that the type species *Belemnites sauvanaui* d'Orbigny, 1842 possessed a ventral groove (d'Orbigny, 1842, Pl. 2, fig. 1-2), and consequently employed *Rhopaloteuthis* as a subgenus of *Hibolithes*. This is at variance with most authors (Pugaczewska, 1957, 1961; Stoyanova-Vergilova, 1969; Combémorel and Mariotti, 1986 a) who consider this form a duvaliid with a dorsal alveolar groove. Combémorel (personal comunication) has confirmed the dorsal position of the groove trough the study of specimens complete with phragmocones.

The nominal subgenus *Pachyduvalia* Riegraf (type species *Produvalia* (*Pachyduvalia*) *pinguis* Riegraf, 1981), erected for inflated duvaliid forms from the Jurassic, is here considered a junior synonym of *Rhopaloteuthis* Lissajous.

Range: Bathonian-Tithonian of Mediterranean and southern Europe.

Rhopaloteuthis sauvanausus (d'Orbigny, 1842)
(Pl. 4, fig. 12)

*1842	*Belemnites sauvanausus* d'Orbigny, p. 128, pl. 21, fig. 1-10.
1875	*Belemnites sauvanausus* d'Orbigny; Waagen, p. 8, pl. II, fig. 6.
non 1876	*Belemnites sauvanausus* d'Orbigny; Favre, p. 19, pl. I, fig. 4-6.
1900	*Belemnites sauvanausus* d'Orbigny; de Loriol, p. 6, pl. II, fig. 2.
1902	*Belemnites sauvanausus* d'Orbigny; de Loriol, p. 19, pl. I, fig. 12.
v. 1925	*Rhopaloteuthis sauvanausus* (d'Orbigny); Lissajous, p. 41-43, p. 131, text-fig. 23.
1961	*Rhopaloteuthis sauvanausus* (d'Orbigny); Pugaczewska, p. 194, pl. vi, fig. 7-9.
1969	*Rhopaloteuthis sauvanaui* (d'Orbigny); Stoyanova-Vergilova, p. 98, pl. 1, fig. 1a, b, 2a, b.
v 1989	*Rhopaloteuthis sauvanausus* (d'Orbigny); Combémorel, p. 140, pl. 23, fig. 12.

Type specimen: *Belemnites sauvanausus* d'Orbigny, 1842, p. 128-130, pl. 21, fig. 1-3. Lissajous (1925) regards as type-figure d'Orbigny's (1842) text-fig. 23.

Material: One poorly preserved specimen (NS 20 424), collected from Akpinar (Halilar) (Akpl).

Description: Medium sized rostrum with a total length of 5.7 times the maximum dorso-ventral diameter. Profile and outline symmetrical to weakly asymmetrical. In profile and outline the apex diverges rapidly to the maximum diameter close to the apex, then converges gradually to the minimum diameter, from which point it expands gradually again. The transverse section is subquadrate. A dorsal alveolar groove extends to just short of half of the rostrum.

Dimensions:

Rhopaloteuthis sauvanausus

N.	L	Dvmax	Dlmax	Ic	Id	X
NS 20 424	48.6	8.5	8.5	1.0	6.0	13.0

Remarks: Even if poorly preserved this specimen shows the hastate, subquadrate rostrum with a sharp apex that is typical of this species. It differs from the other species (*R. gillieroni*, *R. bzoviensis*, *R. spissus*) in having a less stout general morphology and an apex more continuous with the rostrum.

Occurrence: Lower Oxfordian of Germany, France, Switzerland, Portugal, Algeria, India, Madagascar and Upper Callovian-Lower Oxfordian of Poland (Pugaczewska, 1961).

Combémorel (1989) found this species in Early Oxfordian levels at Andranomiolaka (Madagascar) with *Putealiceras*, corresponding to the Early Oxfordian *mariae* Zone, of Tethyan Europe.

Rhopaloteuthis sp.

Material: Three incomplete specimens (NS 20 585, 96, 7) from south of Gerede (Aktaş: Al).

Description: Incomplete,medium sized rostrum with the outline and the profile symmetrical. Transverse section subcircular with the position of the dorsal groove indicated by the growth lines. The alveolus was relatively deep because it is present in transverse sections up to 12 mm from the apex.

Remarks: Because of the more or less cylyndrical rostrum shape, the presumed deep alveolus and the presence of a dorsal groove we ascribe this specimen to the genus *Rhopaloteuthis*, but owing to the lack of an apical region it was indeterminate at specific level.

PALAEOBIOGEOGRAPHICAL DISCUSSION

Due to the variable abundances of the Turkish belemnites, only those of wider significance are discussed below.

Lower Jurassic belemnites

Very little is known about the distribution of belemnites in the Lower Jurassic. Belemnites have a limited record prior to the Toarcian (Stevens, 1965, 1973a; Saks and Nal'nyaeva, 1970, 1975; Stoyanova-Vergilova, 1982; Doyle, 1987a) that makes the Turkish early Pliensbachian record especially important. The belemnites first appeared in the Hettangian, although anomalous records exist for Carboniferous (Flower, 1945) and Triassic (Zhu and Bian, 1984) belemnites, and they were apparently restricted to the European shelf seas (e.g. Schwegler, 1962a; Riegraf, 1980). Sinemurian belemnites are similarly restricted, although Doyle (1987b) has discussed scattered records from Antarctica, Pakistan and Tibet. A record of indeterminate belemnite fragments from Canada (Frebold and Little, 1962), refers in fact to fragmentary aulacoceratid phragmocones (Jeletzky personal comunication, 1987). There are rather more early Pliensbachian belemnite records (Phillips, 1865-71; Dumortier, 1869; Simpson, 1884; Lissajous, 1927; Schwegler, 1962; Schumann, 1974; Riegraf, 1980; StoyanovaVergilova, 1982) and it is clear that belemnites were relatively abundant in Europe at this time.

The Turkish early Pliensbachian belemnites have greatest affinity to the fauna discussed by Lang

(1928) from the Belemnite Marls of Dorset, England. Both faunae share the genera *Passaloteuthis*, *Pseudohastites sensu stricto*, "*Pseudohastites*" *sensu* Lang, *Angeloteuthis*, *Coeloteuthis*, but the Turkish fauna also contains the genus *Nannobelus*. A similar fauna has been recorded from rocks of the same age in Bulgaria (Stoyanova-Vergilova, 1982). Of these genera, *Passaloteuthis* is the most widespread, and continued to be the most abundant genus in Europe up into the Toarcian, when it reached into the Americas and Siberia (Saks and Nal'nyacva, 1970; Stevens, 1973a; Doyle, 1987a). *Nannobelus* is similarly well distributed in Europe, especially in the Sinemurian, with records from Britain (Phillips, 1865-71), France (Dumortier, 1869), Germany (e.g. Riegraf, 1980), East Greenland (Rosenkrantz, 1934; specimens in the Geologisk Museum, Copenhagen), Bulgaria (Stoyanova-Vergilova, 1977) and possibly Algeria (Coquand, 1862). *N. acutus* (Miller) has a wide range (Hettangian-topmost Sinemurian; Riegraf, 1980, p. 146) but appears to be less common in the early Pliensbachian. In the *jamesoni* Zone the species *N. alveolata* and its allied forms are apparently more common (Werner, 1912; Troedsson, 1951 (in Sweden); Riegraf, 1980). Similar forms are known from the Belemnite Marls (Jeletzky personal comunication, 1987). *Nannobelus*-like forms have been recorded from Siberia (Saks and Nal'nyaeva, 1970), but in reality these probably represent members of a new genus endemic to the Siberian basin. "*Pseudohastites*" *sensu* Lang is relatively common in the Sinemurian to early Pliensbachian sediments of Britain and north-west Europe. Species related to *Belemnites junceus* and *Belemnites charmouthensis*, typical of this genus, are recorded from Britain (Lang, 1928), France (Dumortier, 1869), Germany (Schwegler, 1962b), and possibly Sweden (Troedsson, 1951). *Coeloteuthis* and *Angeloteuthis* are more restricted in their distribution. *Coeloteuthis* (= *Clastoteuthis*) is only known from Sinemurian to Pliensbachian sediments in England (Schwegler, 1962a; Schumann, 1975), although similar forms (e.g. *Belemnites palliatus* Dumortier) are also known from France (Dumortier, 1869). "*Coeloteuthis*" species recorded from the Toarcian of Siberia (Saks and Nal'nyaeva, 1970) are probably species of a new genus endemic to Siberia. *Angeloteuthis* is so far recorded only from Britain. However, Jeletzky (personal comunication, 1987) has noted this genus in mainland Europe. Troedsson (1951) has figured a belemnite (pl. XXIV, fig. 2) that resembles species of *Angeloteuthis* from Sweden.

Aulacocerida (Xiphoteuthididae) are relatively abundant in the Upper Trias of alpine Tethys, and lasted into the Lower Jurassic. *Atractites* and the Aulacocerida were largely replaced by the belemnitids by the Toarcian (Doyle, 1990) but in many areas *Atractites* coexisted with Belemnitida in the Tethys (e.g. in Bulgaria; Stoyanova-Vergilova, 1982). This is indicated by the presence of *Atractites* with an otherwise typical English belemnite fauna in Turkey. Migration of *Atractites* westwards in the Upper Pliensbachian is indicated by the presence of *A. indunense* (Stoppani) in the Carixian-Domerian of the Causses basin (south of the Massif Central, France) (Mattei *et al.*, 1987) and by the species *A. elongata* (De La Beche) in Germany and England (Doyle, 1990). This occurs at the same time as the mixing of northern (amaltheid) and southern (paleohildoceratid) ammonite families in the Causses Basin for the first time.

In summary, it is clear that the belemnites were restricted to the shelf seas of northwest Europe, in the Sinemurian and early Pliensbachian, periodically reaching as far north as Sweden and East Greenland, and more rarely as far south as the Tethyan borders (Turkey and possibly Algeria). The Xiphoteuthididae coexisted with the belemnites in the Tethys, migrating northwards in the Late Pliensbachian. The Belemnitidae only became widespread in the Toarcian, when it replaced the aulacoceratid family Xiphoteuthididae in the Tethys and in the Americas (Doyle, 1990).

Cretaceous Duvaliidae forms and *Hibolithes*

The Turkish belemnite fauna of the Lower Cretaceous comprises the genera *Duvalia*, *Hibolithes*, *Neohibolites* and *Parahibolites*. The Duvaliidae first occur in the Middle Jurassic, with only *Duvalia disputabilis* from the Bathonian-Lower Callovian of Poland (Pugaczewska, 1961) and *D. rhopaliformis* from the Bathonian of Madagascar (Combémorel, 1989) are known. The Duvaliidae first appeared in Turkey in the Oxfordian with *Rhopaloteuthis sauvanausus*. It was during the Tithonian that the belemnopseid genus *Hibolithes* (in the Lower and Upper Tithonian) and the genus *Duvalia* (in the Upper Tithonian) spread over the Mediterranean area and reached the Indo-Pacific region (Stevens 1965). In the Upper Jurassic *Hibolithes* was confined to more southerly areas but during Berriasian-Hauterivian it migrated into the Northern Hemisphere (Stevens, 1973b). *Hibolithes* finally declined in the Barremian. The genera *Hibolithes* and *Duvalia* continued their diffusion from Europe during the Berriasian-Barremian interval, following the same pattern as occurred in the Kimmeridgian and Tithonian, moving along routes characterized by shallow waters.

Two characteristic duvaliid species of the lowermost Cretaceous are recorded from Turkey: *Duvalia tithonica* and *D. lata*. The former was already common in the Upper Tithonian of Italy, Poland, Czechoslovakia, Hungary, Switzerland, Spain, France and the Crimea being a wide spread form. In the Lower Cretaceous (Berriasian) it is known out-

side Turkey in Sicily, Central Italy and Tunisia. *D. lata* is very rare in the Tithonian, but it is a wide spread species in the Berriasian-Valanginian interval (south eastern France, Swiss Alps, Tunisia, Algeria, Silesia, Madagascar). It is recorded in Bulgaria only in the Valanginian (Stoyanova-Vergilova, 1965; Combémorel, 1973; Combémorel and Mariotti, 1986b). This shows that in the Hauterivian the southern European region was still the evolutionary centre of the Tethyan belemnites which migrated through the Tethys. (Stevens, 1973 a,b).

To confirm the Tethyan affinity of the Turkish belemnites in the Valanginian-Barremian interval there is the occurrence of the species *Duvalia binervia* and *Hibolithes jaculoies*. The former is recorded in Switzerland, south eastern France (Valanginian-Hauterivian), Bulgaria (Hauterivian-Lower Barremian), Georgia, Abkhasia (Lower Barremian), South East Caucasus (Hauterivian-Berriasian), Gruzjia (Lower Barremian) and the Crimea (Hauterivian); the latter in the Valanginian-Barremian of north western Europe, European Russia and South America (Stoyanova-Vergilova, 1965; Combémorel, 1973; Doyle and Kelly, 1988).

A north-westernwards migration of *H. jaculoides*, coming from Tethyan area, is documented, since the Early Valanginian, in north-western Germany; but only from the Early Hauterivian this form was markedly present reaching the Hauterivian/Barremian boundary and replacing, in northwestern Europe, *Acroteuthis s.s.*; it desappeared in the Late Barremian (Mutterlose, 1990).

In the Barremian the Tethyan belemnites of the Mediterranean region were til characterized by the presence of the genera *Hibolithes* and *Duvalia*. From the Aptian the last forms of *Duvalia* are known. In the Turkish sequences the species *D.* cf. *grasiana* occurs, a characteristic form of the Barremian-Aptian of Bulgaria, France, northern Germany, Silesia, Tunisia and Gruzjia (Stoyanova-Vergilova, 1970; Combèmorel, 1973, 1989). This species is also recorded from the Aptian in the Crimea and Caucasus and from the Upper Aptian in Adzerbaidjan. At the end of Aptian it disappeared in the Mesogean Realm and it is the only duvaliid form to penetrate into the Boreal Realm (Mutterlose, 1979).

Neohibolites - Parahibolites

Stevens (1973b) had recognized that *Neohibolites* and *Parahibolites*, along with *Mesohibolites*, were characteristic of the Tethyan Realm in the Aptian and Albian. *Neohibolites* was the most widespread genus, extending into northwest Europe (Mutterlose, *et al.*, 1983) and throughout the Tethys and Gondwana (Stevens, 1973b; Doyle 1987a; Combèmorel, 1989) in the Aptian. *Neohibolites ewaldi* (Strombeck) in particular is found in northern Europe (Swinnerton, 1955), Turkey and as far south as Mozambique (Doyle, 1987b). *Parahibolites* is rarer in northern Europe (Mutterlose *et al.*, 1983) but is equally widespread in Tethys and Gondwana, recorded from Turkey, the Caucasus, Crimea, southern India, Patagonia and New Guinea (Stevens, 1973b; Doyle, 1985).

Mesohibolites is absent from Turkey although a single doubtful specimen is known and is restricted only to southern Europe (Stevens, 1973a).

The widespread distribution of *Neohibolites* in northern Europe in the Aptian is mirrored by the migration of *Duvalia grasiana* into Germany and England (Mutterlose, 1979). After the Cenomanian and the demise of the *Neohibolites-Parahibolites* stock, no true Tethyan belemnite can be recognized being replaced by distinct Boreal and Austral faunas in the north and south respectively.

ACKONWLEDGEMENTS

Dr. M.K. Howarth (B.M.N.H.) is thanked for allowing access to specimens in his care and M. R. Combémorel, of the Claude-Bernard University of Lyon, for the critical discussion about duvaliid forms. We thank also Mr. E. Dominici for the drawings and the photos.

RIASSUNTO

Una nuova fauna a belemniti, di età compresa tra il Pliensbachiano inferiore (Zona a *jamesoni*) e l'Aptiano è stata raccolta in numerose sezioni stratigrafiche affioranti nell'Anatolia nord occidentale, Turchia. In particolare sono state riconosciute forme appartenenti ai generi *Passaloteuthis*, *Angeloteuthis*, *Coeloteuthis*, *Pseudohastites*, "*Pseudohastites*" *sensu* LANG e *Nannobelus*, tutte provenienti da numerosi affioramenti (Iznik, Bilecik-Günören, Bayirkoy Trafo, Bayirkoy Caldagi Tepe, Sögüt) in facies di Rosso Ammonitico. In particolare sono state riosciute le seguenti forme: *Passaliteuthis* aff. *ima*, *P.* aff. *auricipitis*, *Angeloteuthis* cf. *raphael*, *Coeloteuthis* ? sp. ind., *Pseudohastites* cf. *westhaiensis*. "*Pseudohastites*" NAEF *sensu* LANG? sp. ind., *Nannobelus acutus*. Negli stessi livelli è stata anche raccolta una rilevante quantità di frammenti di fragmoconi appartenenti al genere *Atractites*. Da terreni del Giurassico medio (Calloviano) affioranti ad Aktaş (AÇ, Ag) e Kabalar (Mudurnu) provengono alcuni rappresentanti del genere *Belemnopsis* (*B. depressa*, *B.* aff. *subhastata informis*, *B.* sp. nov., *B.* sp. ind.), mentre dal Giurassicco superiore (Aktaş, AG) sono state raccolte alcune forme attribuite al genere *Rhopaloteuthis* (Oxfordiano) (*R. sauvanausus*) e al genere *Hibolithes* (Titonico) (*H.* cf. *savornini*).

Rappresentanti del genere *Duvalia* (*D. lata*, *D. tithonica*, *D. binervia*, *D.* cf. *grasiana*, *D.* sp. ind. A, *D.* sp. ind. B), caratteristico del dominio tetisiano, provengono da livelli del Cretacico inferiore affioranti a Nallihan, Kabalar (Mudurnu), Aktas (AC) e Beypazari; sempre dal Cretacico inferiore (Kinik, Kabalar) sono

stati segnalati alcuni individui appartenenti alla specie *Hibolithes jaculoides*.

Neohibolites e *Parahibolites*, generi caratteristici dell'Aptiano, sono stati rinvenuti a Nallihan (*N. ewaldi*, *N.* sp. ind., *P.* sp. nov.?).

Le belemniti del Pliensbachiano inferiore presentano una forte affinità con le forme contenute nelle "Belemnite Marls" del Dorset, Inghilterra. Infatti nella fauna turca sono presenti tutti i generi ritrovati nella suddetta formazione inglese a cui si aggiunge il genere *Nannobelus*. Fra tutti i generi riconosciuti *Passaloteuthis* è quello che ha avuto una maggiore diffusione geografica in Europa fino al Toarciano. Anche *Nannobelus* è ugualmente ben distribuito in Europa, soprattutto nel Sinemuriano. Il genere *Pseudohastites* è relativamente comune in Gran Bretagna ed Europa occidentale. I generi *Coeloteuthis* e *Angeloteuthis* hanno una distribuzione più limitata, essendo noti solo in Gran Bretagna. Si può quindi ritenere che tutte queste forme nel Sinemuriano e Pliensbachiano inferiore erano ristrette a "shelf seas" dell'Europa nord occidentale e solo sporadicamente si spostavano sia verso nord, fino a raggiungere Svezia e Groenlandia orientale, sia più raramente verso sud sino ai confini tetisiani (Turchia e probabilmente Algeria). Insieme a questa fauna, caratterizzata da una chiara affinità europea, coesisteva il genere tipicamente tetisiano *Atractites* (Xiphoteuthididae). Anche quest'ultimo nel Carixiano-Domeriano migrò verso nord sino al Massiccio centrale francese.

Dal Giurassico medio al Cretacico inferiore sono presenti in Turchia generi tipicamente tetisiani. Infatti il genere *Belemnopsis*, caratteristico in tutta la Tetide sud orientale, è stato rinvenuto in sedimenti calloviani così come nei sedimenti Oxfordiani è presente il genere *Rhopaloteuthis*. Quest'ultimo, insieme al genere *Duvalia*, caratterizza i sedimenti titonici della Turchia e di tutta la Tetide. Manca soltanto nel Malm, a differenza di quanto avviene nel resto del dominio tetisiano, l'alta percentuale di forme appartenenti al genere *Hibolithes*, infatti ne è stato ritrovato un solo frammento in sedimenti titonici. Questi ultimi due generi, caratterizzanti nel Barremiano la maggior parte della Tetide, sono stati segnalati anche in sedimenti del Cretacico inferiore.

Nell'Aptiano la presenza di forme attribute ai generi *Parahibolites*, *Neohibolites*, *Duvalia* e *Hibolithes* confermano un'affinità faunistica con il dominio tetisiano.

REFERENCES

ALTINER D., KOCIGIYT A., FARINACCI A., CONTI M.A. & NICOSIA U. (1989) — Kuzeybati Anadoly'nun kuzey Anadolu fay zonu guneyindeki Rosso Ammonitiko'lu Jura-alt Kretase stratigrafisi, Bolgenin paleocografik ve tektonik evrimi. TUBITAK, project report: 1-270, 39 figs. Ankara.

ALTINER D. & OZKAN S. (1990) — Calpionellid zonation in northwestern Anatolia (Turkey) and calibration of the stratigraphic ranges of some benthic foraminifera at Jurassic-Cretaceous boundary. (this volume)

AGER D. (this volume) — Mesozoic brachiopod faunas from the western Pontides, Turkey; their stratigraphical, palaeogeographical and palaeoecological significance. **27**: 5 pp, 2 figs, 1 pl., Roma.

BAIRSTOW L. (1950) — *Coeloteuthis* and synonymous homonymy at generic level. Geol. Mag., **87**: 226-227.

BAYLE E. (1878) - Explication de la carte géologique de France. IV, 1ª partie. Fossiles principaux des terrains. Paris.

BLAINVILLE H.M.D. de (1827) - Mémoires surles Bélemnites considérées zoologiquement et géologiquement. Ed. F. G. Levrault: 1-136, 5 pl., Paris.

BLÜTHGEN J. (1936) - Die Fauna und Stratigraphie des Oberjura und der Unterkreide von König Karl Land.: 1-91, Grimmen. Pommen.

COMBÉMOREL R. (1973) - Les Duvaliidae PAVLOW (BELEMNITIDA) du Crétacé inférieur francais. Docum. Lab. Géol. Fac. Sci. Lyon, **57**: 131-185, 5 pls, Lyon.

COMBÉMOREL R. (1989) - Les Bélemnites du Madagascar. Docum. Lab. Géol. Lyon, **104**: 1-239, 23 pl., Lyon.

COMBÉMOREL R. & MARIOTTI N. (1986a) - Les bélemnites de la carrière de Serra San Quirico (Province d'Ancona, Apennin central, Italie) et la paléobiogéographie des bélemnites de la Téthys méditerranéenne au Tithonique inférieur. Geobios, **19** (13): 299-321, 4 figs, 2 pls, Lyon.

COMBÉMOREL R. & MARIOTTI N. (1986b) - First record of *Duvalia tithonica*, a marker of Upper Tithonian, in Central Apennines. Boll. Soc. Pal. It., **25** (1): 35-39, 2 figs, Modena.

COMBÉMOREL R. & MARIOTTI N. (1990) - Taxonomic and biostratigraphic remarks on Tithonian belemnites from Sicily. Atti II Convegno Piccinini: 195-205, 2 pls, Pergola.

COQUAND H. (1862) - Géologie et Paléontologie de la région sud de la province de Constantine. Appendix: Catalogue des fossiles receuillis dans l'Afrique française, Mém. Soc. d'Emulation de la Provence, **2**: 275-318, Marseille.

DOUVILLÉ M. (1879) - (Bayle's Explication de la Carte Géologique de la France. Vol. 4, Atlas.) Bull. Soc. géol. France, **7** (3): 91-92, Paris.

DOYLE P. (1985) - "Indian" belemnites from the Albian (Lower Cretaceous) of James Ross Island, Antarctica. Br. Antarct. Surv. Bull., **69**: 23-24.

DOYLE P. (1987a) - The Cretaceous Dimitobelidae (Belemnitida) of the Antarctic Peninsula region. Palaeontology, **30** (1): 147-177, pls 21-23. London.

DOYLE P. (1987b) - Early Cretaceous belemnites from Southern Mozambique. Palaeontology, **30** (2): 311-317, pl. 43, London.

DOYLE P. (1990) - The biogeography of the Aulacocerida (Coleoidea). Atti II Conv. Intern. "Fossili, Evoluzione, Ambiente", Pergola 1987: 263-271.

DOYLE P. (1990) - The British Toarcian (Lower Jurassic) belemnites. Palaeontogr. Soc. (Monogr.), **144**: 1-49, 17 pl., London.

DOYLE P. & KELLY S.R.A. (1988) - The Jurassic and Cretaceous belemnites of Kong Karls Land, Svalbard. Norsk Polarinstitut, Skr. **189**: 1-77, 13 pls, 14 figs., Oslo.

DOYLE P. & RIEGRAF W. (1986) - *Belemnites paxillosa* Lamarck, 1801 (Mollusca, Coleoidea): Proposed suppression of both generic and specific names. Bull. Zool. Nomen. **43**: 355-357, London.

DOYLE P. & RIEGRAF W. (1987) - (Reply to C.W. Wright.) Bull. Zool. Nomen. **44**: 48, London.

DUMORTIER E. (1869) - Etudes paléontologiques sur les dépôts jurassiques du bassin du Rhône. Lias moyen.: 1-348, Paris.

DUVAL-JOUVE J. (1841) - Bélemnites des terrains crétacés inférieurs des environs de Castellane (Basses-Alpes) considérées géologiquement et zoologiquement, avec la description de ces terrains. Ed.: Fortin, Masson & Cie: 1-80, 12 pls, Paris.

FAVRE E. (1876) - Description des fossiles du terrain oxfordien des Alpes Fribourgoises. Mém. Soc. paléont. Suisse, **8**: 1-75, Genève.

FAVRE E. (1880) - Description des fossiles des couches Tithoniques des Alpes Fribourgoises. Mém. Soc. paléont. Suisse, **6**: 1-74, Genève.

FISCHER A.G. (1951) - A new belemnoid from the Triassic of Nevada. Am, J. Sci., **249**: 385-393, New Haven.

FLOWER R.H. (1944) - *Atractites* and related coleoid cephalopods. Am. Midl. Nat., **32** (3): 756-770, Notre Dame.

FORBES E. (1845) - Report on the Cretaceous fossil invertebrates

from South India, collected by Mr Kaye and Mr Cunliffe. Transactions of the Geological Society, 7: 97-174, London.

FREBOLD H. & LITTLE H. (1962) - Paleontology, stratigraphy and structure of the Jurassic rocks in Salmo map area, British Columbia. Bull. Geol. Serv. Can., 81: 1-31. Ottawa.

GEMMELLARO G.G. (1868-76) - Studi paleontologici sulla fauna del Calcare a *Terebratula janitor* del Nord di Sicilia. Parte I.: 1-95, 2 pls, Palermo.

GORN N.K. (1968) - Systematics of Early Cretaceous Belemnopsinae. Paleont. J., 2: 383-384, Moscou.

GÜMBEL C.W. von (1861) - Geognostische Beschreibung des bayrischen Alpengebirges und seines Vorlandes.: 1-950, 42 pls, Gotha.

HUXLEY T.H. (1864) - On the structure of the Belemnitidae; with a description of a more complete specimen of Belemnites than any hitherto known, and an account of a new genus of Belemnitidae, *Xiphoteuthis*. Geol. Survey. United Kingdom, Mem., Figures & Descr. British Organic Remains, Mon. 2: 1-22, 3 pls, London.

JELETZKY J.A. (1946) - Zur Kenntnis der oberkretazischen Belemniten I. Geol. Fören. Stockholm, Förhandl., 68 (1): 87-105, 4 figs, Stockholm.

JELETZKY J.A. (1966) - Comparative morphology, phylogeny, and classification of fossil *Coleoidea*. Univ. Kansas paleontol. Contrib. Mollusca, Art. 7: 1-162, 15 figs, 25 pls, Lawrence.

KOCYIGIT A., ALTINER D., FARINACCI A., NICOSIA U. & CONTI M.A. (this volume) - Late Triassic-Aptian evolution of the Sakarya divergent margin: implications for the opening history of the northern neo-Tethys, in northwestern Anatolia, Turkey. 27: 19 pp, 19 figs, 1 tab., Roma.

KRIMHOLZ G. (1931) - Jurassic belemnites of the Crimea and Caucasus. Trans. Geol. Prospect. Serv. U.S.S.R., 76: 1-52, 2 pls, Moscou.

LANG W.D. (1928) - The belemnite marls of Charmouth. Pt. 2, IV, The belemnites. Geol. Soc. London, Quart. Jour., 84: 179-222, figs 1-3, pls 13-15, London.

LISSAJOUS M. (1906) - Toarcian des environs de Mâcon. Mâcon.

LISSAJOUS M. (1915) - Quelques remarques sur les Bélemnites jurassiques. Bull. Soc. Hist. nat.: 1-32, 1 pl., 3 figs, Mâcon.

LISSAJOUS M. (1925) - Répertoire alphabétique des Bélemnites jurassiques précédé d'un essai de classification. Trav. Lab. Géol. Fac. Sci. Lyon, fasc. 8, mém. 7: 1-175, 23 figs, Lyon.

LISSAJOUS M. (1927) - Description de quelques nouvelles espèces de Bélemnites jurassiques. Trav. Lab. Géol. Fac. Sci., Lyon, fasc. 10, mém. 7 (supplement): 1-42, 4 pls, Lyon.

de LORIOL P. (1900) - Etudes sur les mollusques et les brachiopodes de l'oxfordien inférieur ou zone à *Ammonites renggeri* du Jura Lédonien. 1ª Partie Mém. Soc. paléont. Suisse, 27: 1-196, Genève.

de LORIOL P. (1902) - Etudes sur les Mollusques et brachiopodes de l'oxford supérieur et moyen du Jura Lédonien. 1ª Partie Mém. Soc. paléont. Suisse, 29: 1-103, Genève.

MALECKI J. (1984) - Belemnites of the genus *Rhopaloteuthis* Lissajous 1925 from the Lower and Middle Oxfordian in the vicinities of Cracow. Bull. Pal. Acad. Sc. Earth Sciences, 32(14), Cracow.

MATTEI J., COMBÉMOREL R. & ENAY R. (1987) - Sur la présence du genre *Atractites* (Aulacocerida) dans le Lias moyen des Causses du Sud du Massif Central Français. Geobios, 20 (1): 133-139, 1 pl., Lyon.

MEISTER E. (1913) - Über den Lias in Nordanatolien nebst Bemerkungen über das gleichzeitig vorkommende Rotliegende und die Gosaukreide. In: Beiträge zur geologischen Kenntnis von Anatolien II, 1. N. Jahrb. f. Min. Geol. Paläont. Beilage-Band. XXV: 499-548, Stuttgart.

MEMMI L. & SALAJ J. (1975) - Le Berriasien de Tunisie. Succession de faunes d'Ammonites, de Foraminifères et de Tintinnoidiens. Colloquie sur la limite Jurassique-Crétacé, Lyon, Neuchâtel, B.R.G.M., Mém. 86: 58-67, Paris.

MENEGHINI J. (1867-81) - Monographie des fossiles du Calcaire Rouge Ammonitique (Lias supérieur) de Lombardie et de l'Apennin Central. In: "Paléontologie lombarde ou Description des fossiles de Lombardie" A. Stoppani (4ª ser.): 1-242, 31 pl., + Append.: 1-56, Milano.

MILLER J.S. (1826) - Observations on belemnites. Trans. Geol. Soc., ser. 2, II: 45-62, London.

MUTTERLOSE J. (1979) - Representatives of the subfamily Duvaliinae Pavlow (Belemnitida) from The Hauterivian (Lower Cretaceous) of NW Europe. Aspekte der Kreide Europas. IUGS, Stuttgart, ser. A, 6: 121-127, 1 fig., 1 pl., Stuttgart.

MUTTERLOSE J. (1990) - A belemnite scale for the Lower Cretaceous. Cretaceous Research, 11: 1-15, 8 fig.

MUTTERLOSE J. SCHMID F. & SPAETH C. (1983) - Zur Palaobiogeographie von Belemniten der Unter-Kreide in NW Europa. Zitteliana, 10: 293-307, München.

NAEF A. (1922) - Die fossilen Tintenfische; eine palaozoologische Monographie. Ed.: Fischer, Jena.: 1-322, 101 figs, Jena.

NAL'NYAEVA T.I. IN SAKS V.N. & NAL'NYAEVA T.I. (1967) - The systematics of Jurassic and Cretaceous belemnites. In: SAKS V.N. (Ed.), Problems of paleontologie substantation of detailed Mesozoic stratigraphy of Siberia and the far East of USSR.: 6-27, Navka, Leningrad.

NICOLAI M. (1950) - Paléontologie de Madagascar. XXIX - Etude de quelques gisements fossilifères du sud-ouest de Madagascar. Annales de Paléontologie, 36: 1-74, VI Pl., Paris.

NICOLIS E.& PARONA C.F. (1885) - Note stratigrafiche e paleontologiche sul Giura superiore della Provincia di Verona. Boll. Soc. Pal. It., 18 (2): 320-326, 3 figs, Modena.

NICOSIA U. (this volume) - Mesozoic crinoids from north western Turkey. 27: 48 pp, 48 figs, 2 tabs, Roma.

OPPEL A. (1858) - Die Juraformation Englands, Frankreichs und des südwestlichen Deutschlands nach einzelnen gliedern eingeteilt und verglichen. Jahreshefte d. Ver. f. vaterl. Naturkunde in Württemberg, 14, Stuttgart.

OPPEL A. (1865) - Die tithonische Etage. Zeit. d. d. geol. Gesell. Jahrg. 1865, 17 (3): 535-558, Berlin.

d'ORBIGNY A. (1840-41) - Paléontologie française. Description zoologique et géologique et tous les animaux mollusques et rayonnés fossiles de France. t. I: Terrains crétacées.: 1-662, and Atlas, 1840-42, t. I, 148 pls, Paris.

d'ORBIGNY A. (1842-50) - Paléontologie française. Description zoologique et géologique de tous les animaux mollusques et rayonnés fossiles en France. Terrains oolitiques ou jurassiques. t. I. Ed.: V. MASSON, Paris: 1-642, Atlas, t. I, 234 pls, Paris.

d'ORBIGNY A. (1847) - Paléontologie française. Description zoologique et géologique de tous les animaux mollusques et rayonnés fossiles de France. Terrains crétacés, supplement. Ed.: A. Bertrand: 1-28, 9 pls, Paris.

PALEONTOLOGIA UNIVERSALIS - sèr. I, fasc. II, 1904.

PAVLOW A.P. (1892) - Bélemnites de Speeton et leurs rapports avec les Bélemnites des autres pays. Bull. de la Soc. impériale des Naturalistes de Moscou. Moscou.

PAVLOW A.P. (1913) - Les Céphalopodes du jura et du crétacé inférieur de la Sibérie septentrionale. Mém. Acad. imp. sci. St. Pétersbourg. Ser. 8, 21 (4): 1-68, St. Petersbourg.

PERVINQUIERE L. (1907) - Etudes de paléontologie tunésienne. N. 1. Céphalopodes des terrains sécondaires. Bélemnites. Carte géol. de la Tunésie,: 403-410, Paris.

PHILLIPS J. (1865-71) - A monograph of British Belemnitidae. Palaeontographical Soc.,: 1-128, 26 pls, London.

PILLET L. & FROMMENTEL E. (1875) - Description géologique et paléontologique de la colline de Lémenc sur Chambéry.

POMPECKEJ J.F. (1897) - Palaeontologische und stratigraphische Notizen aus Anatolien. Zeit. d. d. geol. ges., **49**: 713-820, Berlin.

PUGACZEWSKA H. (1957) - O dwoch gatunkach belemnitow rodzaju *Rhopaloteuthis* jury Polski. Acta Paleont. Polonica, **2** (4): 384-403, 5 figs, 5 pls, Warszawa.

PUGACZEWSKA H. (1961) - Belemnoids from the Jurassic of Poland. Acta Paleont. Polonica, **6** (2): 105-236, 26 pls, Warsawza.

QUENSTEDT F.A. (1846-49) - Petrefactenkunde Deutschlands. v. 1. Die Cephalopoden: 1-581, atlas with 36 pl., Fues (Tübingen).

RASPAIL F.V. (1829) - Histoire naturelle, accompagnée de la description et de la classification des espèces que M. Emeric de Castellane a recueillies dans les Basses-Alpes de Provence. Ann. Sci. Obs., 1: 271-331, pls 6-8, Paris.

RIEGRAF W. (1980) - Revision der Belemniten des Schwäbischen Jura, Teil 7. Palaeontographica A, **169**: 128-208, 4 pls, figs 130-187, Stuttgart.

RIEGRAF W. (1981) - Revision der Belemniten des Schwäbischen Jura, teil 8. Palaeontographica A, **173**, 1-4: 64-139, pls 5-9, figs 188-254, Stuttgart.

ROMAN F. (1897) - Recherches stratigraphiques et paléontologiques dans le Bas-Languedoc. Ann. Univ. Lyon, **32**: 1-345, Paris.

ROSENKRANTZ A. (1934) - The Lower Cretaceous Rocks of East Greenland. Pt 1. Meddelelser om Gronland, **110** (1): 1-122, Copenhagen.

SAKS V.N. & NAL'NYAEVA T.I. (1970) - Upper and Middle Jurassic belemnites of the northern U.S.S.R., Nannobelinae, Passaloteuthinae, Hastitidae. Acad. Sci. U.R.S.S., Nauka Press: 1-228, 22 pls, 61 figs, Leningrad (in Russian).

SAKS V.N. & NAL'NYAEVA T.I. (1975) - Lower and Middle Jurassic belemnites of the Northern U.R.S.S. Acad. Sci. U.R.S.S., Instit. Geol. Geophys., Nauka ed., **239**: 1-191, 19 pl., Moscow. (in Russian).

SCHUMANN H. (1974) - Die Belemniten des norddeutschen Lias gamma. Geol. Jb., A **12**: 1-85. Hannover.

SCHWEGLER E. (1962a) - Revision der Belemniten des Schwäbischen Jura. Teil 2. Palaeontographica. A **118** (1-3): 1-22, 12 figs, Stuttgart.

SCHWEGLER E. (1962b) - Revision der Belemniten des Schwäbischen Jura. Teil 3. Palaeontographica, A **120** (4-6): 121-164, 30 figs, Stuttgart.

SIMPSON M. (1866) - Inferior Oolite - Lias belemnites of the Yorkshire Coast. Geology and Natural History Repertory: 215-216, London.

SIMPSON M. (1884) - The fossils of the Yorkshire Lias. Second Edition.: 1-256, Whitby.

SPAETH C. (1971) - Untersuchungen an Belemniten des Formenkreises um *Neohibolites minimus* (Miller 1826) aus dem Mittel- und Ober-Alb, Nord westdeutschlands. Beih. geol. Jb., **100**: 1-127, Wien.

SPENGLER E. (1910) - Die Nautiliden und Belemnitiden des Trichinopolydistrikts. Beitr. Paläont. Geol. öst. Ung., **23**: 125-157.

STEVENS G.R. (1965) - The Jurassic and Cretaceous belemnites of New Zealand and a review of the Jurassic and Cretaceous belemnites of the Indo-Pacific region. Pal. Bull. geol. Surv. N.Z., **36**: 1-283, Wellington.

STEVENS G.R. (1973a) - Jurassic belemnites. In Hallam A. (ed.) Atlas of Palaeobiogeography: 259-274, 4 fig., 1 pl., Elsevier, Amsterdam.

STEVENS G.R. (1973b) - Cretaceous belemnites. In HALLAM A. (ed.) Atlas of Palaebiogeography: 385-401, 5 fig., 1 pl., Elsevier, Amsterdam.

STOLLEY E. (1911) - Beiträge zur Kenntnis der Cephalopoden der norddeutschen unteren Kreide 1: Die Belemnitiden der norddeutschen unteren Kreide. Geol. paläont. Abh. N.F., **10** (3): 201-272, 8 pl., Jena.

STOLLEY E. (1919) - Die Systematik der Belemniten. Jah. Niedersachs. geol. Ver., **11**: 1-59, Hannover.

STOYANOVA-VERGILOVA M. (1965) - Représentants de la sousfamille Duvaliinae PAVLOW (Belemnitida) du crétacé inférieur en Bulagarie. Acad. bulg. Sci., Trav. Geol. Bulg., ser. Paleont., **7**: 179-223, 8 pl., Sofia.

STOYANOVA-VERGILOVA M. (1969) - Representatives of the Jurassic genus *Rhopaloteuthis* in Bulgaria. Bull. Geol. Inst. ser. Paleont., **18**: 97-105, 1 pl., Sofia. (In Bulgarian).

STOYANOVA-VERGILOVA M. (1970) - Les fossiles de Bulgarie. Crétacé inférieur. Acad. Sci. Bulg., 68 p., 23 pl., Sofia.

STOYANOVA-VERGILOVA M. (1977) - An attempt for belemnite zonal subdivision of the Lower Jurassic sediments in Bulgaria. Ann. Univ. Sofia, **70**: 161-192, Sofia.(In Bulgarian with English summary).

STOYANOVA-VERGILOVA M. (1982) - On the paleobiogeographical importance of the Early and Middle Jurassic belemnites, distributed in Bulgaria. Geologica Balc., **12**: 37-50, Sofia.

STROMBECK A. von (1861) - Ueber den Gault und insbesondere die Gargas-Mergel im nordwestlichen Deutschland. Z. dt. geol. Ges., **13**: 20-60. Berlin.

SWINNERTON H.H. (1936-1955) - A Monograph of British Lower Cretaceous belemnites. Palaeontogr. Soc. (Monogr.): 1-86, 18 pl., London.

TROEDSSON G.T. (1951) - On the Höganäs Series of Sweden (Rhaeto-Lias) Skrifter Min. Pal. Geol. Inst. Lund, **7**: 1-269, Lund.

UHLIG V. (1902) - Über die Cephalopodenfauna der Teschener und Grödischter Schichten. Denkschr. math.-nat. Classe Akad. Wiss., **62**: 1-87, Wien.

WAAGEN W. (1875) - The Jurassic fauna of Cutch. Vol. 1. The Cephalopoda. Palaeontologia Indica, ser. 9, Calcutta.

WERNER E. (1912) - Über die Belemniten des schwäbischen Lias und die mit ihnen verwandten Formen des braunen Jura (Acoeli). Palaeontographica, **59**: 103-146, Cassel.

ZITTEL K.A. (1868) - Paläontologische Studien über die Grenzschichten der Jura-und Kreideformation im Gebiete der Karpaten, Alpen und Appenninen. 1. Die Cephalopoden der Stramberger Schichten. Paläontolog. Mitt. aus dem Museum des kgl. bayr. Staates. Bd. II. 1. Abtlg., 118 p., Stuttgart.

ZITTEL K.A. (1870) - Die Fauna der älteren Cephalopoden führenden Tithonbildungen. Palaeontographica, suppl.,: I-VII + 1-192, 15 pl., Cassel.

PLATE 1

Figs 1, 2, 5 — *Atractites* sp. A, ventral view, Bilecik-Günören, *jamesoni* Zone, x 1. 1) NS 20 346; 2) NS 20 347; 5) NS 20 348.

Figs 3, 4 — *Atractites* sp. B, ventral view, Bilecik-Günören, *jamesoni* Zone, x 1. 3) NS 20 353; 4) NS 20 354.

Figs 6, 12 — *Passaloteuthis* aff. *ima*, Bilecik-Günören, *jamesoni* Zone, x 1. 6) NS 20 663, a) dorsal outline, b) left profile, c) right profile; 7) NS 20 658, a) dorsal outline, b) right profile; 8) NS 20 666, a) ventral outline, b) dorsal outline, c) right profile; 9) NS 20 664, a) dorsal outline, b) left profile, c) right profile; 10) NS 20 657, a) ventral outline, b) left profile, c) right profile; 11) NS 20 525, a) ventral outline, b) left profile, c) right profile; 12) NS 20 669, a) ventral outline, b) dorsal outline, c) left profile .

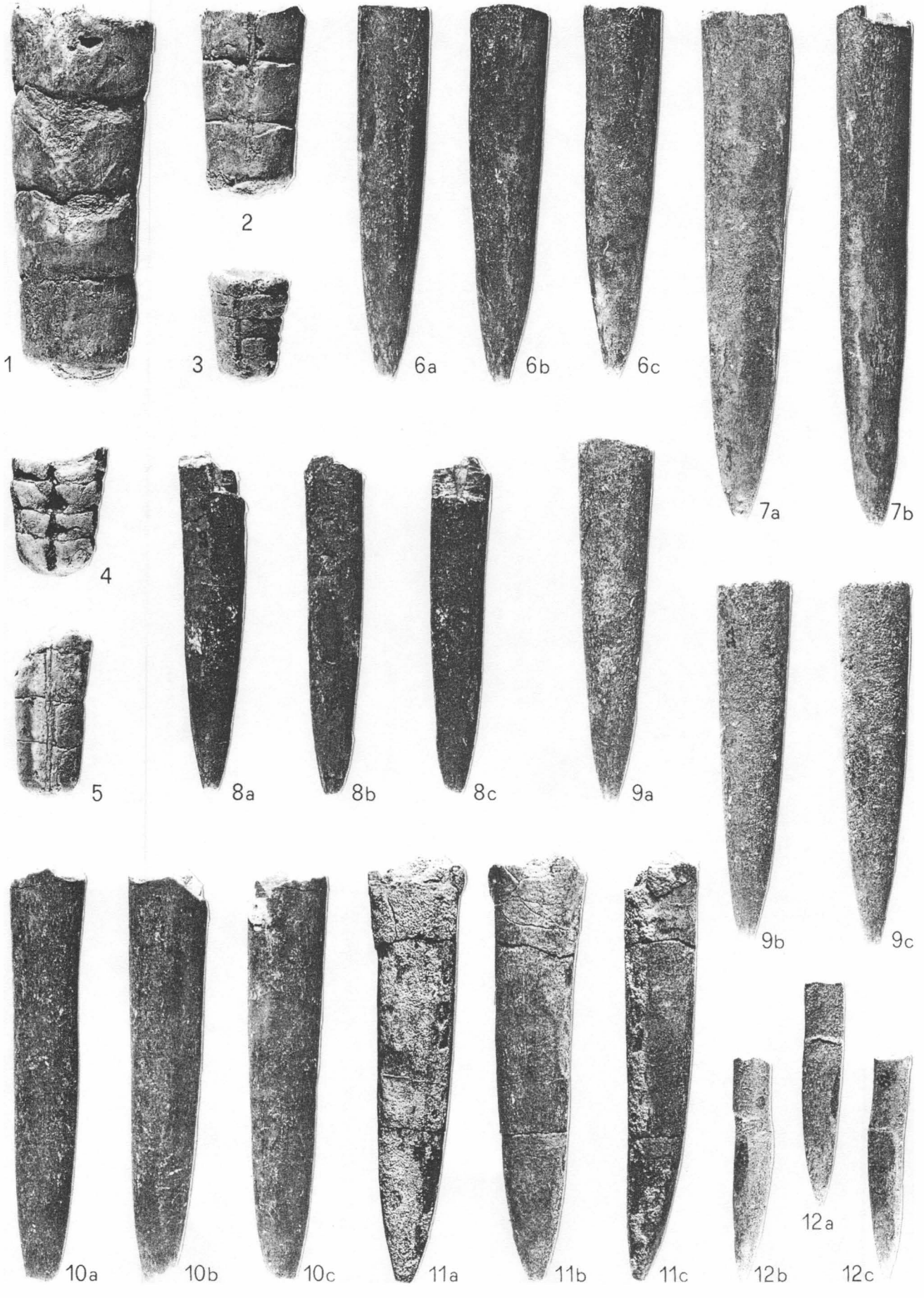

1
2
3
6a
6b
6c
7a
7b
4
5
8a
8b
8c
9a
9b
9c
10a
10b
10c
11a
11b
11c
12a
12b
12c

PLATE 2

Figs 1, 2 — *Passaloteuthis* aff. *auricipitis*, Bilecik-Günören, *jamesoni* Zone, x 1. 1) NS 20 686, a) ventral outline, b) dorsal outline, c) right profile; 2) NS 20 687, a) ventral outline, b) dorsal outline, c) right profile.

Figs 3, 4 — *Pseudohastites* cf. *westhaiensis*; Bilecik-Günören, *jamesoni* Zone. 3) NS 20 685, a) ventral outline, b) right profile , c) left profile; 4) NS 20 703, a) ventral outline, b) right profile, c) left profile.

Figs 5, 7 — "*Pseudohastites*" Naef *sensu* Lang ? sp. indet., Bilecik-Günören, *jamesoni* Zone, x 1. 5) NS 20 590, a) ventral outline, b) lateral view; 6) NS 20 593, a) ventral outline, b) right profile; 7) NS 20 592, a) ventral outline, b) left profile.

Figs 8-10 — *Angeloteuthis* cf. *raphael*, Bilecik-Günören, *jamesoni* Zone, x 1. 8) NS 20 428, a) dorsal outline, b) right profile; 9) NS 20 430, a) ventral outline, b) right profile; 10) NS 20 429, a) ventral outline, b) right profile.

Figs 11, 12 — *Coeloteuthis* ? sp. indet., Bilecik-Günören, *jamesoni* Zone, x 1. 11) NS 20 455, a) left profile, b) right profile; 12) NS 20 456, a) ventral outline, b) left profile.

Figs 13-15 — *Nannobelus acutus*, Bilecik-Günören, *jamesoni* Zone, x 1. 13) NS 20 524, a) dorsal outline, b) left profile, c) right profile; 14) NS 20 454, a) ventral outline, b) dorsal outline, c) left profile; 15) NS 20 451, a) ventral outline, b) right profile c) left profile.

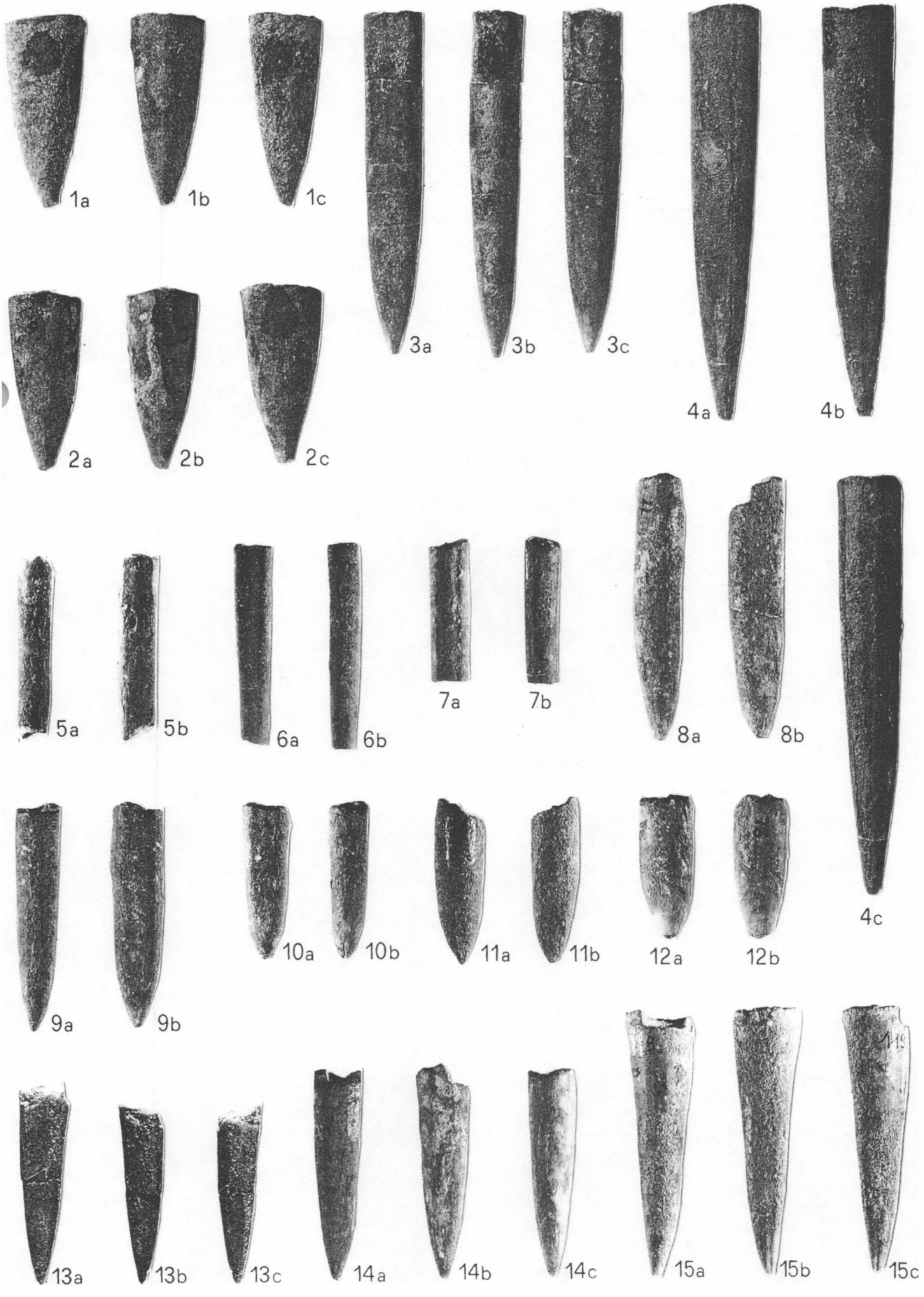

1a
1b
1c
3a
3b
3c
4a
4b
2a
2b
2c
5a
5b
6a
6b
7a
7b
8a
8b
4c
9a
9b
10a
10b
11a
11b
12a
12b
13a
13b
13c
14a
14b
14c
15a
15b
15c

PLATE 3

Figs 1, 2 — *Nannobelus acutus*, Bilecik-Günören, *jamesoni* Zone, x 1. 1) NS 20 682, a) ventral outline, b) dorsal outline, c) left profile; 2) NS 20 526, a) dorsal outline, b) left profile.

Figs 3, 4 — *Belemnopsis* aff. *subhastatus informis*, x 1. 3) NS 20 463, Kabalar (Mudurnu), Lower Callovian, a) ventral outline, b) dorsal outline, c) left profile; 4) NS 20 423, Aktaş (Ag), Lower Callovian, a) ventral outline, b) dorsal outline, c) right profile.

Figs 5, 6 — *Belemnopsis depressa*, Kabalar (Mudurnu), Callovian, x 1. 5) NS 20 531, a) ventral outline, b) dorsal outline, c) left profile; 6) NS 20 530, a) ventral outline, b) dorsal outline, c) left profile.

Fig. 7 — *Belemnopsis* sp. nov. ?, Aktaş (AÇ), Bajocian-Callovian, NS 20 542, x 1; a) ventral outline, b) dorsal outline, c) left profile.

Fig. 8 — *Belemnopsis* sp. ind., Nallihan, Tithonian, NS 20 529, x 1. a) ventral outline, b) dorsal outline, c) left profile.

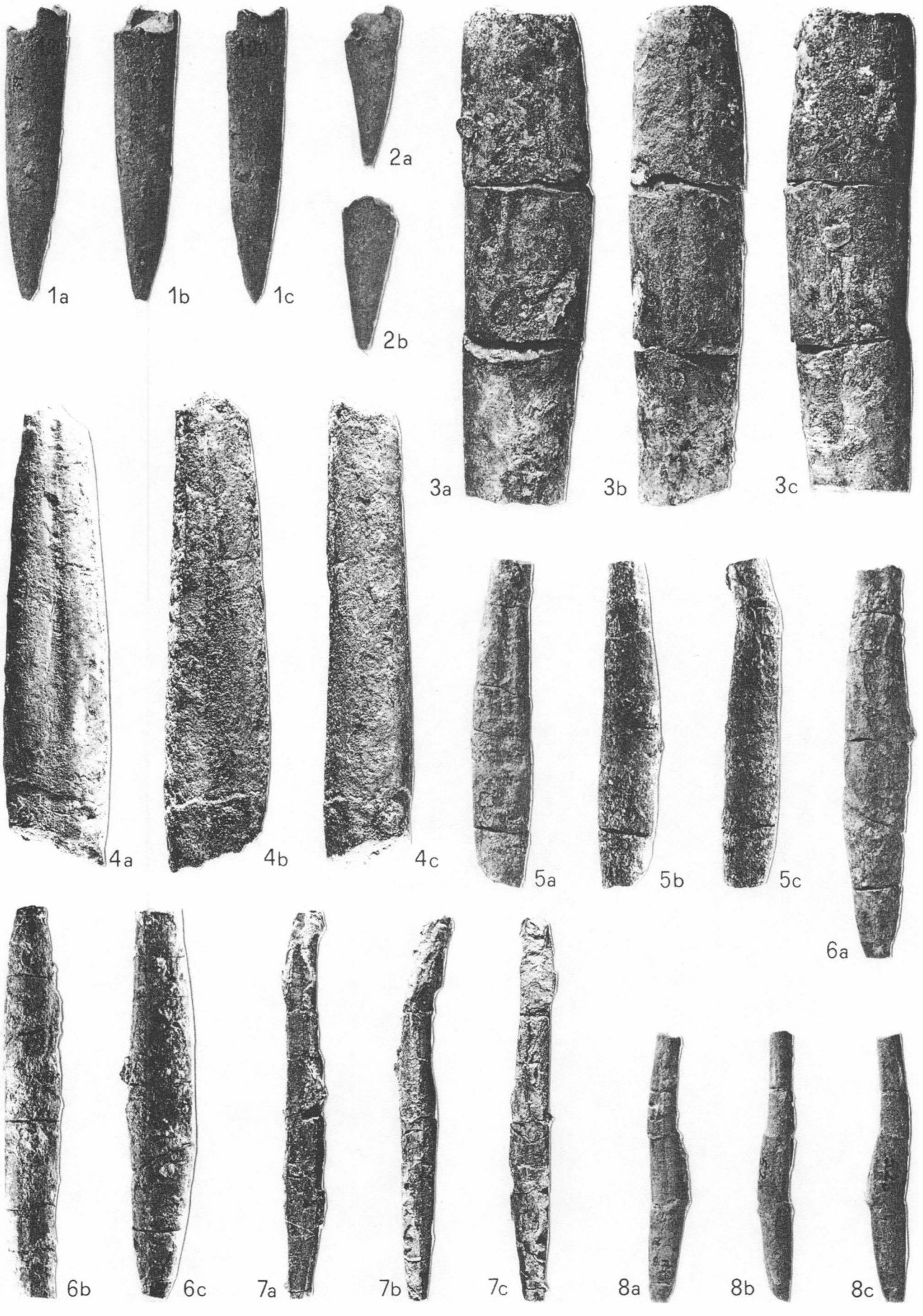

1a
1b
1c
2a
2b
3a
3b
3c
4a
4b
4c
5a
5b
5c
6a
6b
6c
7a
7b
7c
8a
8b
8c

PLATE 4

Figs 1, 2 — *Hibolithes jaculoides*; Kabalar (Mudurnu), Upper Valanginian-Lower Hauterivian, x 1. 1) NS 20 715, a) ventral outline, b) dorsal outline, c) right profile; 2) NS 20 716, a) left profile, b) dorsal outline, c) ventral outline.

Fig. 3 — *Hibolithes* cf. *savornini*; NS 20 696, Kinik (Bilecik), Kimmeridgian-Tithonian, x 1. a) ventral outline, b) left profile, c) right profile.

Figs 4, 5 — *Neohibolites ewaldi*; Nallihan, Aptian, x 1. 4) NS 20 546, a) dorsal outline, b) left profile, c) right profile; 5) NS 20 714, a) ventral outline, b) left profile, c) right profile.

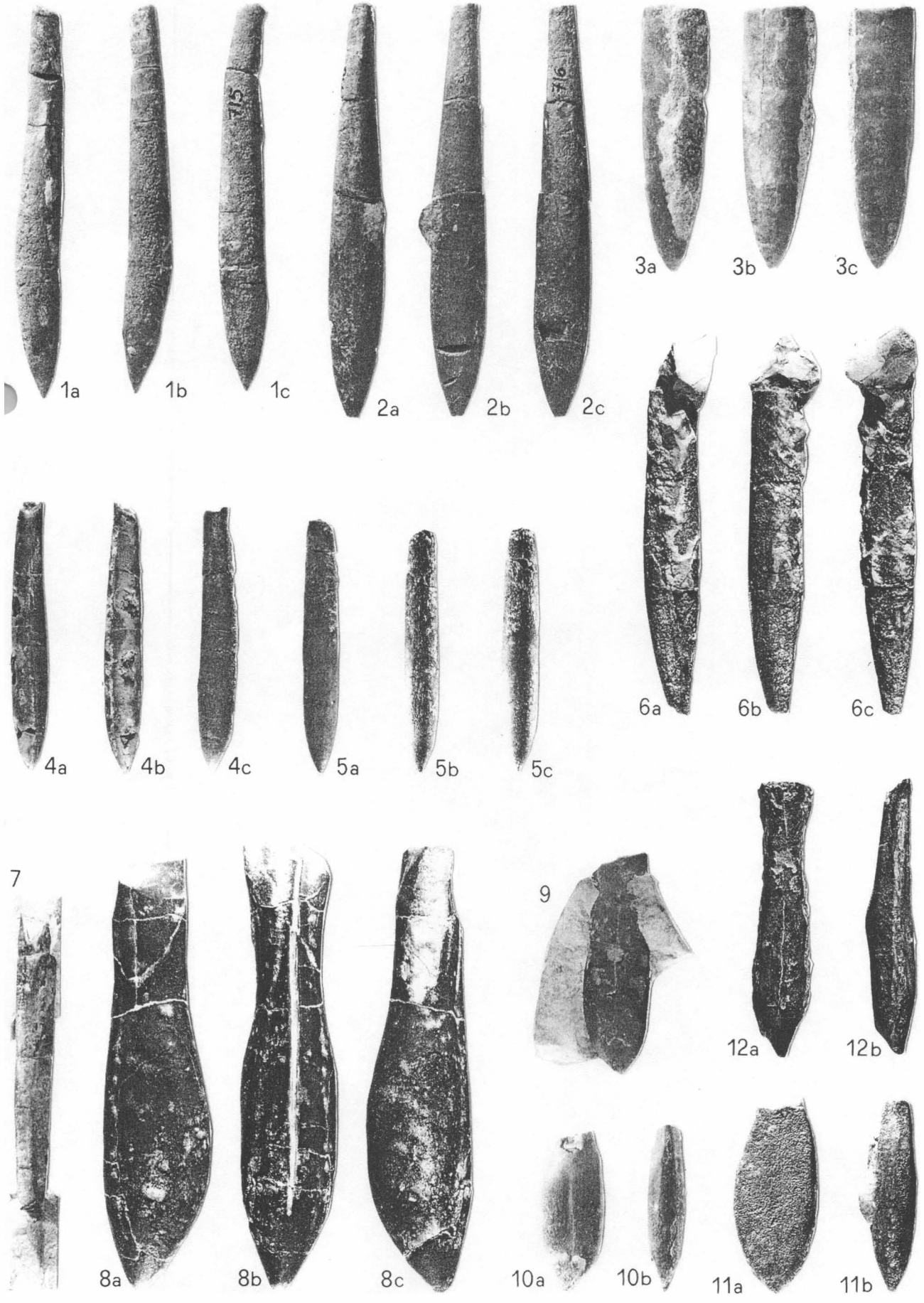
Fig. 6 — *Neohibolites* sp. ind.; NS 20 301, Nallihan, Aptian, x 1. a) ventral outline, b) dorsal outline c) lateral view.

Fig. 7 — *Parahibolites* sp. nov. ?; NS 20 700, Nallihan, Aptian-Cenomanian, ventral outline.

Fig. 8 — *Duvalia lata*; NS 20 300, Aktaş (AÇ), latest Barremian-earliest Valanginian, x 1. a) dorsal outline, b) right profile, c) left profile.

Figs 9, 10, 11 — *Duvalia binervia*, Valanginian, x 1. 9) NS 20 698, Dogdu Dag (Çerkes), left profile. 10) NS 20 699, Dogdu Dag (Çerkes), a) ventral outline, b) right profile; 11) NS 20 426, Çayirhan (Beypazari); a) ventral outline, b) left profile.

Fig. 12 — *Rhopaloteuthis sauvanausus*; NS 20 424, Akpinar (Halilar), Lower Oxfordian, x 1. a) ventral outline, b) left profile.


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