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NOTA BREVE - SHORT NOTE

DESCRIPTION OF AN EARLY ONTOGENETIC EVOLUTIONARY STEP IN *LEPIDORBITOIDES*: *LEPIDORBITOIDES BISAMBERGENSIS ASYMMETRICA* SUBSP. N., EARLY MAASTRICHTIAN (CENTRAL TURKEY)

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Riassunto. *Lepidorbitoides bisambergensis* è caratterizzato per avere una camera embrionale quadriseriale senza nessuna cameretta che si origini direttamente dalla deuteroconca. È una specie comune e molto diagnostica nelle successioni flyscioidi del Maastrichtiano inferiore dell'Anatolia. Alcune popolazioni di questa specie presentano una disposizione marcatamente asimmetrica della prima camera, in visione orizzontale, nei primi stadi ontogenetici. Tale asimmetria è causata soprattutto da una marcata differenza nella dimensione delle camerette ausiliarie che si trovano sia nella protoconca che nella deuteroconca e sono anche enfatizzate dallo sviluppo dispari di camerette nella serie che si origina da queste camerette ausiliarie sul lato della protoconca. Queste popolazioni asimmetriche a causa della comparsa di una nuova cameretta ausiliaria si trovano comunemente in orizzonti stratigrafici sottostanti quelli a disposizione simmetrica, che le sostituiscono progressivamente. Gli esemplari asimmetrici "quadriseriali" rappresentano lo stadio filogenetico iniziale de *L. biambergensis* e si trovano negli orizzonti stratigrafici corrispondenti alle zone a *G. havanensis* and *G. aegyptiaca* (?). Si ritiene meritino uno status tassonomico sottospecifico e vengono descritti con il nome di *Lepidorbitoides bisambergensis asymmetrica* subsp. n.

Abstract. *Lepidorbitoides bisambergensis* is characterised by having a 'quadriserial' embryo without any chamberlet directly arising from the deuteroconch and is a very diagnostic and common species in Lower Maastrichtian flysch successions in Anatolia. Some populations of this species present an early ontogenetic morphologic feature which is characterised by distinctly asymmetric early chamber arrangement recognised in the horizontal sections. This asymmetry is mainly caused by the pronounced difference in the size of auxiliary chamberlets which rest on both, protoconch and deuteroconch and also enhanced by the development of unequal number of chamberlets in the series arising from these auxiliary chamberlets on the protoconchal side. These asymmetric specimens are commonly identified in stratigraphic horizons below the symmetric ones after the introduction of a new auxiliary chamberlet and progressively replaced by symmetric ones in the younger populations. Asymmetric 'quadriserial' specimens representing the early phylogenetic stage of *L. bisambergensis* described in the stratigraphic horizons corresponding to *G. havanensis* and *G. aegyptiaca* (?) zones are thought to deserve a particular taxonomic status and are attributed to *Lepidorbitoides bisambergensis asymmetrica* subsp. n.

Introduction.

Lepidorbitoides bisambergensis is an Early Maastrichtian species characterised by a 'quadriserial' nepionic chamber arrangement (specimens having two auxiliary chamberlets of Van Gorsel 1975 and 1978 and without any chamberlets arising directly from deuteroconch). Although Papp (1954, 1956) considered this species late Campanian in age, same horizons which bear *Siderolites calcitrapoides* above *L. campaniensis* populations were dated as early Maastrichtian by Van Gorsel (1975). Caus (1988) and Özcan & Özkan-Altiner (1999a) also considered this species Early Maastrichtian in age. *L. bisambergensis*, which possesses two auxiliary chamberlets, has both symmetric and asymmetric variants as recognised in horizontal sections. Asymmetric *L. bisambergensis* is distinguished from the symmetric ones basically by having an auxiliary chamberlet comparatively smaller than the other. The early ontogenetic asymmetry in some specimens of *L. bisambergensis* and its stratigraphic position below the symmetric ones were first recognised by Van Gorsel (1975, 1978). This author illustrated the embryos with two auxiliary chamberlets; one with the dimensions smaller than the other and from which only few and small subsequent chamberlets are formed. Although these asymmetric specimens were considered as the primitive stages of development of *L. bisambergensis*, the variation in early chamber arrangement, their biometric aspects and stratigraphic position have not been fully discussed.

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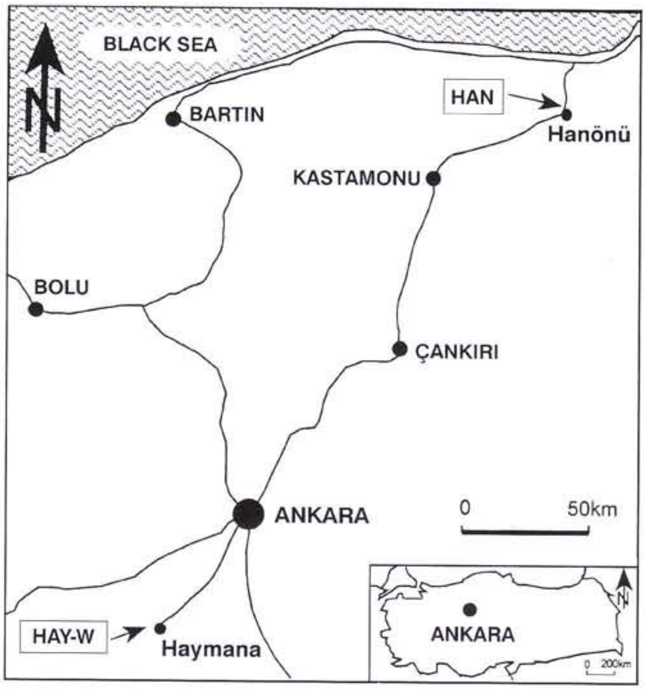
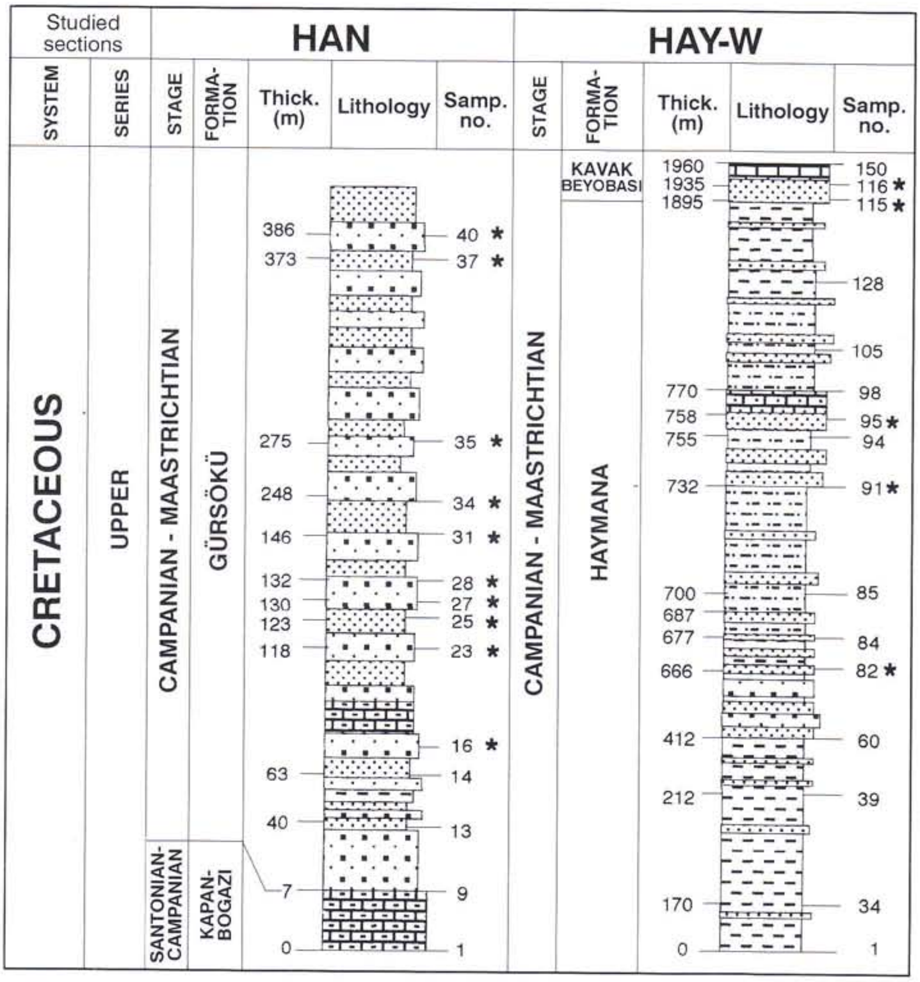


Fig. 1 - Location of the sampling sites (top) and generalized columnar sections of the measured sections Han and Hay-W (below). Stars indicate the *Lepidorbitoides* and other orbitoidal foraminifera bearing horizons.



Anatolian *L. bisambergensis* mainly represented by symmetric specimens have been identified in numerous horizontal sections and its early ontogenetic biometric aspects were previously described by Özcan (1995), Özcan & Özkan-Altiner (1997) and Özcan & Özkan-Altiner (1999a, b). The analysis of early ontogenetic features of *Lepidorbitoides* specimens from sections Han and Hay-W measured in northwest central Anatolia has revealed the different developmental stages of asymmetric and symmetric *L. bisambergensis*. All the specimens in the lower part of the section Han have invariably asymmetric nepionts. These specimens have been attributed to *L. bisambergensis asymmetrica* subsp. n. (Özcan & Özkan-Altiner, 1999a). However, the complete description of the new taxon is here presented for the first time. *Lepidorbitoides* specimens sectioned in the stratigraphically lowermost orbitoidal foraminifera bearing horizon below the asymmetric ones have only one auxiliary chamberlet ('biserial' nepionts of Van Gorsel 1975, 1978) and were attributed to *L. campaniensis*. Asymmetric specimens which are replaced by symmetric ones in the younger horizons seem to represent an important evolutionary step after the introduction of a second auxiliary chamberlet during Early Maastrichtian and thought to deserve an independent subspecific status. Asymmetric and symmetric *L. bisambergensis* populations are diagnostic for *Gl. havanensis* and *G. aegyptiaca* zones. Chamberlets which arises directly from deuteroconch (adauxiliary chambers of Van Gorsel, 1975 and 1978) are first observed in the populations consisting of asymmetric *L. bisambergensis*.

Material and age of the samples.

Asymmetric *L. bisambergensis* specimens have been identified in sections Han and Hay-W measured in the vicinity of town of Hanönü (Kastamonu) near the Black Sea coast and near the town of Haymana (Ankara) in northwest Central Anatolia respectively (Fig. 1).

Section Han which commences with condensed, planktonic foraminiferal clayey limestone or shale lithologies at the base consists of thick, coarsely turbiditic horizons of mainly sandstone, pebbly sandstone and olistostromal conglomerate horizons (Gürsökü Formation). Except for the lower part, this section is almost devoid of fine siliciclastic and carbonate levels. Ten horizons (Han-16, 23, 25, 27, 28, 31, 34, 35, 37, 40) with orbitoidal foraminifera have been sampled. Asymmetric *L. bisambergensis* populations have been identified in samples Han-23, 25, 27, 28 and 31. Although sporadic, asymmetric specimens may also be encountered in Han-34, 35 and 37. Three successive clayey limestone horizon, Han-17, 18, 19, below asymmetric *L. bisambergensis* and above *L. campaniensis* bearing levels (Han-16) yielded planktonic foraminifera in three meters interval. Han-17 bears *Contusotruncana plummerae*, *Globotruncana arca*, *Globotruncana bulloides*, *Globotruncana linneiana* and *Globotruncana orientalis*. Han-18 yielded *Globotruncanita elevata*, *Globotruncanita stuartiformis*, *Globotruncana arca*, *Globotruncana linneiana* and *Globotruncana rosetta*. Han-19 contains *Globotruncana aegyptiaca* (?), *Globotruncana arca* and *Globotruncana linneiana*. Han-16 with *L. campaniensis* and *Pseudosiderolites vidali* just three meters below Han-18 is of possibly *R. calcarata* zone age. In the absence of planktonic foraminifera in the upper part of the succession, Han-23, 25, 27, 28 and 31 containing asymmetric 'quadriserial' specimens and the overlying Han-34, 35, 37 and 40 containing mostly symmetric 'quadriserial' specimens are possibly of *G. havanensis* (?)- *G. aegyptiaca* (?) zone age.

Section Hay-W consists of deep- marine planktonic foraminiferal clayey limestone, marl/shale and turbiditic sandstone and olistostromal horizons (Özcan and Özkan-Altiner, 1997). Lower part of the section which is mainly composed of siliciclastic levels is almost devoid of orbitoidal foraminifera. Higher up in the section, coarse turbiditic horizons intercalated with fine siliciclastic levels dominate in the succession. In this part of flysch succession, three horizons (Hay-W-82, 91 and 95) have been analysed. Asymmetric *Lepidorbitoides* has been identified only in Hay-W-91 and sporadically in Hay-W-95. Hay-W-82 bears invariably the specimens with one auxiliary chamber ('biserial') (*L. campaniensis*) and Hay-W-95 bears mostly symmetric *L. bisambergensis* specimens. Hay-W-91 with *L. bisambergensis asymmetrica* and primitive stage of development of *Orbitoides megaloformis* is of *G. havanensis* zone age. Hay-W-82 with *L. campaniensis* specimens 34 meters below *G. ventricosa*/ *R. calcarata*- *G. havanensis* zonal boundary is possibly of *R. calcarata* zone age (Özcan & Özkan-Altiner 1999a).

Description.

Lepidorbitoides bisambergensis asymmetrica

subsp. n.

Pl. 1

1954 *Lepidorbitoides bisambergensis* (Jaeger, 1914), Papp, pl.. 1, figs. 7, 8.

1975 *Lepidorbitoides bisambergensis* (Jaeger, 1914), Van Gorsel, Pl. VII, figs. a and b; Pl. VIII, figs. b and c.

1978 *Lepidorbitoides bisambergensis* (Jaeger, 1914), Van Gorsel, Fig. 16-d.

1997 *Lepidorbitoides bisambergensis* (Jaeger, 1914), Özcan and Özkan-Altiner, Pl. 1, figs. 11-14; Pl. 2, fig.1.

1999a *Lepidorbitoides bisambergensis asymmetrica* subsp. n., Özcan and Özkan-Altiner, Pl. 2, figs. 13, 15-22.

1999b Asymmetric *L. bisambergensis* (Jaeger, 1914), Özcan and Özkan-Altiner, Fig. 3, 9-13.

Özcan and Özkan-Altiner in 1999a illustrated the new taxon (pl. 2, figs. 15-22), but did'nt described it. According to ICZN, art. 13 the name is not valid. A full description is provided only here.

Etimology. Named considering the asymmtric peri-embryonic chamber arrangement (having auxiliary chamberlets of unequal size) as recognised in horizontal sections.

Holotype. Specimen Han-27-21, illustrated on Plate 1, figure 17 is designated as type specimen. The asymmetric specimens figured on Plate 1 (Figures 6-16 and 18-24, 27) are designated as paratypes. All material has been filed in the collection of Department of Geological Engineering, Akdeniz University, Antalya.

Type locality. Northeast of Kastamonu, located about 4 km north of town of Hanönü (Fig. 1).

Type horizon. *G. havanensis zone* and also possibly a part of *G. aegyptiaca* zone.

Associated fauna. Different developmental stages of *Orbitoides megaloformis* and primitive *Orbitoides gruenbachensis* populations have been identified based on the biometric species definition of *Orbitoides* proposed by Van Gorsel (1978). *Orbitoides* specimens in Han-25 have a range of embryo size (Li+li) between 410 and 1025 microns with an average of 703.4 microns. The number of epi-embryonic chambers (E) varies between 4 and 12 with an average of 7.09. This population is attributed to *O. megaloformis*. The *Orbitoides* population in sample Han-27 has a range of Li+li between 515 and 915 microns with an average of 755 microns, and is attributed to "advanced" *O. megaloformis*/ "primitive" *O. gruenbachensis*. *Orbitoides* specimens in Han-31 have a range of Li+li between 525 and 875 microns with an average of 711.1 microns, and E varies between 5 and 9 with an average of 7.16. This population is attributed to advanced *O. megaloformis*.

External and internal features. The well preserved specimens are lenticular, discoidal and circular in outline, having usually slightly undulating periphery. Test diameter is up to 4.5 mm, but usually less than 4mm. At the surface of the test pillars with the diameter up to 150 microns are observed at the central part. These pillars are smaller near the peripheral part of the test and are usually 35-75 microns in diameter as measured in vertical sections. Internal features are described mainly considering the peri-embryonic chamber arrangement which is the most diagnostic morphological element of the new taxon. The values of size of the protoconch (P) and deuteroconch (D) and deuteroconch/ protoconch ratio (D/P) of the asymmetric *Lepidorbitoides* populations are presented in Table 1.

The equatorial layer consists of a bilocular embryo (protoconch and deuteroconch) and surrounding rings of almost arcuate equatorial chamberlets. The almost

Samples	LEPIDORBITOIDES									ORBITOIDES				
	N	P (μ)		D (μ)		D/P	Ad	ps	ds	N	Li+li (μ)		E	
		Range	Mean	Range	Mean	Mean	Mean	Mean	Mean		Range	Mean	Range	Mean
HAY.W.82	26	70-110	88.0	95-150	118.2	1.34	0.00	7.09	6.18	32	440-1025	662.1	4-9	6.20
HAY.W.91	2	110-120	115.0	150-175	162.5	1.40	0.00			26	430-775	604.4	4-8	4.86
HAY.W.95	53	85-155	108.9	120-210	161.8	1.48	0.02			34	375-1065	692.3	4-12	7.51
HAN.16	3	65-75	71.7	70-110	93.3	1.30	0.00	8.50	6.00					
HAN.23	11	90-120	100.9	120-165	139.0	1.37	0.00							
HAN.25	30	75-140	108.3	85-180	145.3	1.34	0.06			19	410-1025	703.4	4-12	7.09
HAN.27	24	85-140	113.3	105-205	151.7	1.34	0.00			8	515-915	755.0	7-11	9.66
HAN-28	2	100-105	102.5	145-170	157.5	1.54	0.00							
HAN.31	16	105-160	123.4	120-190	160.0	1.29	0.00			9	525-875	711.1	5-9	7.16
HAN.34	28	90-145	112.3	125-220	165.7	1.47	0.11			16	540-1210	786.9	5-14	9.00
HAN.35	24	85-175	125.2	125-275	179.4	1.43	0.00			15	660-1155	914.0	6-11	9.25
HAN.37	27	90-155	118.3	140-205	169.8	1.44	0.00							
HAN.40	17	75-200	132.9	105-250	187.6	1.41	0.12			10	545-1155	898.0	6-11	9.50

Tab. 1 - Values of size of the protoconh (P) and deuteroconch (D) and deuteroconch/protoconch ratio (D/P) of the asymmetric *Lepidorbitoides* (Hay-W-91, Han-23-31), symmetric *Lepidorbitoides* (Hay-W-95, Han-34-40) and *Lepidorbitoides campaniensis* (Hay-W-82, Han-16) populations.

globular protoconch is followed by slightly larger deuteroconch which is invariably the progressive chamber in 'quadriserial' *Lepidorbitoides*. It was observed in the vertical sections that protoconch- deuteroconch axis (P/D axis) is not necessarily aligned in accordance with the equatorial plane and may show a small deviation. Two auxiliary chamberlets of unequal dimensions, which are very diagnostic for this taxon, arise from the protoconch and deuteroconch. Considering the size of auxiliary chamberlets along P/D axis, one of them is invariably very small and may be as small as one-third of the size of the larger auxiliary chamberlet.

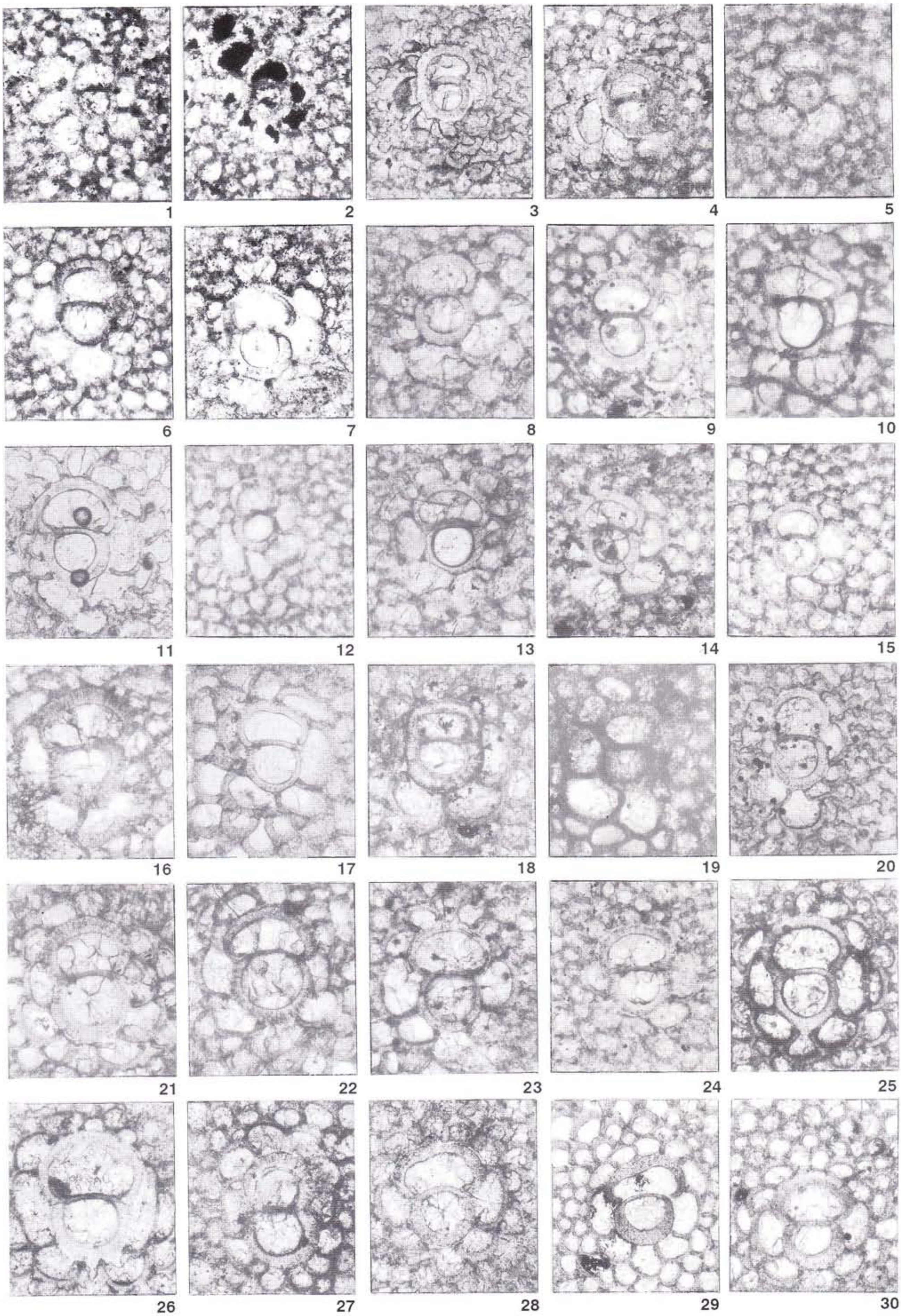
Chamberlets developing from each of the auxiliary chamberlets close on the protoconchal and deuteroconchal wall. The position of the closing chamberlet on the deuteroconchal wall (dc) is usually symmetric with respect to protoconch- deuteroconch (P-D) axis. However, a slightly pronounced asymmetry of the deuteroconchal closing chamber in some specimens is also observed. The number of the chamberlets arising from the auxiliary chamberlets on the deuteroconchal side may be equal in number and in size, if not, it is observed that larger chamberlets arise from the larger auxiliary chamberlet. In some of the specimens, the number of the chamberlets arising from each of the auxiliary chamberlets before the closing chamberlet (pc) on the protoconchal side are not equal (Fig. 2, Han-25-15, 28, 5; Han-27-1, 21, 8, 13; Han-31-15, 3, 12; Han-35-24) and chamberlets usually close at 5th budding stage. However, in the lower part of section Han, the closing chamberlet on the protoconchal side (pc) may even rest on the smaller auxiliary chamberlet and the last chamberlet arising from the larger auxiliary chamberlet (Fig. 2, Han-25-15, Han-27-1, 21, 8). This indicates the retardation of the development of chamberlets from the small second auxiliary chamberlet on the protoconchal side. Thus, the position of protoconchal closing chamberlet is strongly asymmetric with respect to the P/D axis. The sizes of the chamberlets on the protoconchal side are not also equal. Larger chamberlets arise from the larger and smaller ones from the smaller auxiliary chamberlets. This also enhances the asymmetry of the peri-embryonic chamber

PLATE 1

Fig. 1-5 - *Lepidorbitoides campaniensis* van Gorsel, 1973, All X75. (1 - Han-16-1; 2 - Han-16-2; 3 - Hay-W-82-17; 4 - Hay-W-82-9; 5 - Hay-W-82-7).

Fig. 6-24, 27 - *Lepidorbitoides bisambergensis asymmetrica* subsp. n. All X75. (6 - Han-23-3; 7 - Han-23-11; 8 - Han-25-29; 9 - Han-25-28; 10 - Han-25-9; 11 - Han-25-5; 12 - Han-25-15; 13 - Han-25-18; 14 - Han-25-12; 15 - Han-27-1; 16 - Han-27-22; 17 - Han-27-21; 18 - Han-27-14; 19 - Han-27-18; 20 - Han-31-9; 21 - Han-31-15; 22 - Han-31-10; 23 - Han-31-7; 24 - Han-31-2; 27- Hay-W-91-16).

Fig. 25-26, 28-30 - *Lepidorbitoides bisambergensis* (Jaeger, 1914) (Symmetric *L. bisambergensis*), All X75. (25 - Han-34-21; 26 - Han-34-5; 28 - Han-37-21; 29 - Hay-W-95-8; 30 - Hay-W-95-21).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arrangement and asymmetric position of protoconchal closing chamberlet. Specimens with auxiliary chamberlets, almost equal in size, replace the asymmetric ones in the younger stratigraphic horizons. Asymmetric specimens are very rare in Han-35 and 37. In Han-40, the specimens which are unquestionably asymmetric were not identified. In section Han, although the majority of the specimens are without adauxiliary chamberlets, two specimens having one adauxiliary chamberlet in Han-25, one specimen with one and one specimen with two adauxiliary chamberlets in Han-34 and one specimen with two adauxiliary chamberlets in Han-40 were also sectioned (Fig. 2, Han-34-5, Han-40-9). One "biserial" specimen having only one auxiliary chamber (*Lepidorbitoides campaniensis* type) was also encountered in Han-35 (Fig. 2, Han-35-10). These 'biserial' specimens have been mainly identified in the lower stratigraphic horizons (Hay-W-82 and Han-16). The embryo and peri-embryonic biometric aspects of asymmetric *Lepidorbitoides* populations are given as follows:

Han-23: The diameter of the protoconch varies from 90 to 120 microns, with a sample average of 100.9; that of the deuteroconch from 120 to 165 microns, with a sample average of 139.0. All specimens are invariably asymmetric 'quadriserial' without any chamberlets directly arising from deuteroconch.

Han-25: The diameter of the protoconch varies from 75 to 140 microns, with a sample average of 108.3; that of the deuteroconch from 85 to 180 microns, with a sample average of 145.3. All specimens are invariably asymmetric 'quadriserial'. Only two 'quadriserial' specimens, out of 30, with one chamberlet, which arises from the deuteroconch, were also sectioned.

Han-27: The diameter of the protoconch varies from 85 to 140 microns, with a sample average of 113.3; that of deuteroconch from 105 to 205 microns, with a sample average of 151.7. All specimens are invariably asymmetric, 'quadriserial' without adauxiliary chamberlets.

Han-28: The diameter of the protoconch varies from 100 to 105 microns, with a sample average of 102.5; that of deuteroconch from 145 to 170 microns, with a sample average of 157.5. Specimens are invariably asymmetric 'quadriserial' without any chamberlets directly arising from deuteroconch.

Han-31: The diameter of the protoconch varies from 105 to 160 microns, with a sample average of 123.4; that of deuteroconch from 120 and 190 microns, with a sample average of 160.0. The majority of the specimens are asymmetric 'quadriserial' without any chamberlets arising directly from deuteroconch.

Hay-W-91: The diameter of the protoconch varies from 110 to 120 microns, with a sample average of 115.0; that of deuteroconch from 150 to 175 microns, with a sample average of 162.5. Specimens are asymmetric 'quadriserial' without any chamberlets arising directly from deuteroconch.

Stratigraphic remarks and Conclusions.

The study of early ontogenesis of Anatolian *Lepidorbitoides bisambergensis* characterized by having 'quadriserial' nepionts without any chamberlet arising from deuteroconch has revealed two distinct types with different peri-embryonic configurations. These arrangements differentiated mainly on the basis of the difference in size of auxiliary chamberlets and consequent difference in size and the number of the chamberlets surrounding the embryo have been categorized into two groups as stratigraphically older 'asymmetric' and younger 'symmetric' ones. Asymmetric *Lepidorbitoides* forms a transitional stage between 'biserial' *L. campaniensis* with only one auxiliary chamber and symmetric *Lepidorbitoides bisambergensis* with two auxiliary chamberlets of equal sizes. Asymmetric and symmetric variants were previously recognised by Van Gorsel (1975 and 1978) and stratigraphic position of asymmetric ones was tentatively mentioned as Early Maastrichtian. In this study, transitional stages from 'biserial' *Lepidorbitoides campaniensis* to asymmetric and symmetric *Lepidorbitoides bisambergensis* nepionts have been documented and described by their biometric characteristics. *L. bisambergensis asymmetrica* was erected on the following arguments. 1) The specimens are distinctly asymmetric by having two auxiliary chamberlets of unequal size. All specimens in samples Han-23, 25, 27, 28, Hay-W-91 and majority of the specimens in Han-31 are invariably asymmetric, representing distinct populations as recognised in horizontal sections. The size of auxiliary chamberlets progressively becomes equal in successive populations. 2) In most of the asymmetric specimens, the number of chamberlets arising from two of the auxiliary chamberlets on the protoconchal side are not equal. This also enhances the asymmetry of peri-embryonic chamber arrangement. 3) Asymmetric specimens are identified in the lower stratigraphic horizons below the symmetric ones with the introduction of a second auxiliary chamberlet during phylogeny. This indicates the stratigraphic importance of asymmetric *Lepidorbitoides* specimens. Planktonic foraminifera identified in some levels of studied sections indicate that these populations are of *Gl. havanensis* and possibly *G. aegyptiaca* zone age (Özcan & Özkan-Altiner 1999a and b). Van Gorsel (1975) introduced asymmetric *L. bisambergensis* in three populations from Pemberger of Austria and indicated that asymmetric forms are older than the symmetric ones. These populations, 1961AW, 1961AG and 1961V2 have the mean D and D/P values of 145.6 microns, 1.36; 162.2 microns, 1.43; 159.0 microns,

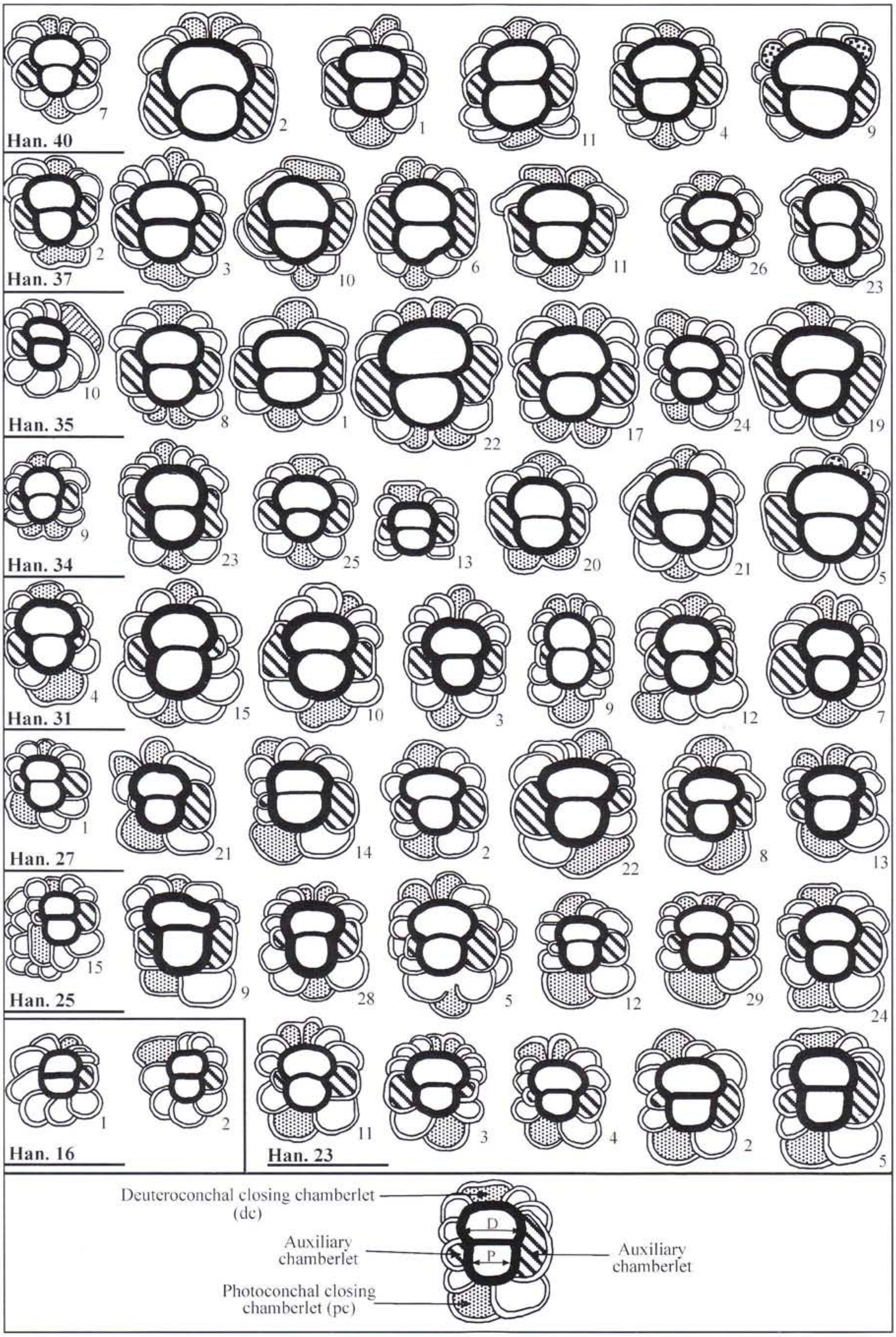

Fig. 2 - Initial chamber arrangement of symmetric and asymmetric (*L. bisambergensis asymmetrica*) *Lepidorbitoides* and *L. campaniensis* in section Han. Numbers refer to the specimen numbers. Auxiliary chamberlets are hatched. Protoconchal and deuteroconchal closing chamberlets in 'quadriserial' specimens and closing chamberlet in *L campaniensis* are finely stippled. Chamberlets directly arising from the deuteroconch are coarsely stippled. All X65.

1.45 respectively. *L. bisambergensis asymmetrica* populations in Han-23, Han-25, Han-27, Han-31 have mean D/P values varying between 1.29 and 1.37 which all are in the biometric limits of *L. campaniensis* proposed by Van Gorsel (1978). According to the mean D and D/P data presented in Table 1, *L bisambergensis asymmetrica* can be tentatively defined as 140 microns <D< 160 microns and 1.3 <D/P< 1.4.

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