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# REMARKS ON THE EOCENE/OLIGOCENE BOUNDARY, WITH SOME PRELIMINARY RESULTS OF THE STUDY OF EOCENE/OLIGOCENE PLANKTONIC FORAMINIFERA IN BELGIUM.


par H.J.F. HOOYBERGHS *



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SUMMARY. - Some important results of different authors, considering the problem of the Eocene/Oligocene boundary, are discussed. In Belgium, the association of planktonic foraminifera, recorded from the "Wemmelian" in the Kallo well, confirms its Middle Eocene (Lutetian) age. In the Kallo well and in a new well at Mol (Northern Belgium), the presence of a level with fine micaceous sands containing *Globigerina danvillensis* HOWE & WALLACE 1932, is demonstrated. It is suggested that this level can be correlated with the Lattorfian in Germany. The rich association of planktonic foraminifera, recorded from the Lower Rupelian, indicates the presence of the *Globigerina tapurensis* Zone (P. 18) and the *Globigerina sellii* Zone (P. 19).


Particularly since the "Colloque sur l'Eocène" (Paris, 1968), the Eocene-Oligocene boundary has become a prominent problem.

Some authors (f.i. KRUTSCH & LOTSCH, 1957, THENIUS, 1959 and KOROBKOV, 1961)had already noted that the Lattorfian, introduced in 1893 by MAYER-EYMAR as the lower part of the Oligocene System of BEYRICH, should be Upper Eocene in age.

During the Eocene Colloque in Paris, various conceptions about the Ecocene-Oligocene boundary were defended. Finally, two possibilities were accepted in the resolutions (See fig. 1).

Most specialists agreed to put the Ecocene/Oligocene boundary at the base of the Lattorfian in Germany, at the base of the Lower Tongrian in Belgium, at the base of the Middle Headson beds in England and within the Gypsum of Montmartre in France. In the Mediterranean region, the Priabonian, including the Upper Bryozoa beds (See HARDENBOL, 1968), was accepted as a valid stage for the Upper Eocene.

The second possibility was to include the Lattorfian (Germany), the Lower Tongrian (Belgium), the Middle and Upper Headson Beds and Bembridge Beds (England) and the Gypsum of Montmartre (France) completely in the Eocene.

Translated in terms of worldwide biozonation, the problem is reduced to the question wheter the *Ericsonia subdisticha* nannoplankton Zone, which was observed in the Lattorfian (MARTINI & RITZKOWSKI, 1968 and MARTINI, 1969) and in the Lower Tongrian in Belgium (MARTINI & MOORKENS, 1969) is of Upper Eocene or of Lower Oligocene age.


* Katholieke Universiteit Leuven.

| NANNO-PLANCTON | FORAMINIFERES PLANCTONIQUES | NUMMULITES | ITALIE | U.S.A. | ALLEMAGNE | BELGIQUE | ANGLETERRE | BASSIN DE PARIS | |
|---|---|---|---|---|---|---|---|---|---|
| *Cycloccolithus margaritae* | | | | Red Bluff formation | | Tongrien supérieur (Hoogbutsel) | Lower Hamstead B | Argile verte | OLIGOCENE |
| *Ellipsolithus subdistichus* | *Cassigerinella chipolensi/ Hastigerina micra (= Globigerina sellii)* | *N. intermedius* | | | formation de Latdorf | Tongrien inférieur Grimmertingen) | Bembridge B<br>U. Headon B<br>M. Headon B | Gypse de Montmartre (Ludien) | 2 |
| *Isthmolithus recurvus* | *Globigerina gortanii* | *N. retiatus* | *N. fabianii s.l.* Priabonien s.l. | Yazoo formation | | Sables et argiles d'Asse | L. Headon B<br>Barton Beds | Sables de Marines (Marinésien) | 1 |
| | *Globorotalia cerroazulensis* | *N. fabianii* s.s. | | | | | | Sables d'Auvers (Auversien) | EOCENE |
| | *Globigerapsis semiinvoluta* | *N.* aff. *fabianii* | | | | Sables de Wemmel | | | |
| *Discoaster tani-nodifera* | *Truncorotaloides rohri* | *N. brongniarti*<br>*N. perforatus* | | | | Sables de Lède | | Lutétien supérieur (Biarritzien) | |

Fig. 1. - Proposition of the Eocene Colloque (Paris, 1968) on the Eocene/oligocene boundary

In the resolutions of the Eocene Colloque, this *Ericsonia subdisticha* Zone was correlated with the *Cassigerinella chipolensis/Hastigerina micra* planktonic foraminiferal Zone, which can be subdivided in the *Globigerina tapurensis* Zone (P. 18) and the *Globigerina sellii* Zone (P. 19) of BLOW 1969.

In 1971 however, ROTH, BAUMAN & BERTOLINO published an improved correlation of planktonic foraminiferal zonation with the nannoplankton zonation, proposed by ROTH. The results of ROTH (1970), BAUMAN & ROTH (1969) and BAUMAN (1970) have been an important contribution to the establisment of this correlation table.

In this table, the *Globigerina gortanii* Zone of BAUMAN (1970) corresponds to the *Globigerina gortanii/Globorotalia centralis* Zone (P. 18) and to the *Globigerina tapurensis* Zone (P. 19) of BLOW, 1969. The *Ericsonia subdisticha* Zone can be correlated with P. 17 and the lower part of P. 18. Since the *Ericsonia subdisticha* Zone is considered by most specialists as the base of the Oligocene, this means that in the zonation of BLOW, the Eocene/Oligocene boundary is lowered. In the original zonation of BLOW, P. 17 is considered to be the top of the Eocene (Priabonian). BLOW himself noted however that "the boundary between Zone P. 18/Zone P. 17 may be taken as approximating to the Oligocene/Eocene boundary in practice, but the actual positions of these two boundaries may prove not to be coincident".... " and it may prove that the base of Zone P. 18 occurs within the very latest Eocene, geostratigraphically, or conversely, the latest part of Zone P. 17 may prove to be Oligocene" (BLOW, 1969, p. 211).

MARKS & VAN VESSEM (1971) noted that this lowering of the Ecocene/Oligocene boundary is contrary to the propositions of the Eocene Colloque. Indeed, CITA (1969) and CASTELLARIA & CITA (1969) stated that *Globorotalia cerroazulensis* (COLE, 1928) did not occur until the top of the Priabonian. In the upper part of the Priabonian (Bryozoa beds), they found the *Globigerina gortanii* Zone. In the resolutions of the Eocene Colloque, the Priabonian was proposed as a valid Stage for the Upper Ecocene, including the Bryozoa beds. The Eocene age of this level was based also on large foraminifera (*Nummulites*).

MARKS and VAN VESSEM (1971) described the planktonic foraminifera from the Lattorfian in Germany. Their conclusion was that the assemblage of planktonic foraminifera has slightly more affinity with Eocene than with Oligocene fauna. In particular the presence of *Globigerina danvillensis* HOWE & WALLACE 1932, suggest a correlation with the Danville Landing Member of the Jackson Formation, Louisiana, from which it was described, and which is considered to be Upper Eocene in age.

Considering the results of BAUMAN (1970), CAVELIER (1972) concluded that the *Ericsonia subdisticha* Zone is synchronous with the Upper Priabonian and has to be included in the Upper Eocene, since this Zone can be correlated with the *Globigerina gortanii* Zone, occuring in the Priabonian. Further, CAVELIER argued that the presence of *Discocyclina* in the *Globigerina gortanii* Zone of BAUMAN proves the Upper Eocene age of this level. BAUMAN indeed recorded some specimens of this large foraminifera from the lower part of the *Globigerina gortanii* Zone, which he correlated with the *Ericsonia subdisticha* Zone. He concluced that, either this *Discocyclina* must be reworked, or the Eocene/Oligocene boundary based on large foraminifera (extinction of *Discocyclina*) does not coincide with the Eocene/Oligocene boundary based on planktonic foraminifera and nannoplankton. CLARKE & BLOW (1969) indicated the extinction level of *Discocyclina* in the middle of P. 17. It is thus quite possible that *Discocyclina* occurs normally in the section studied by BAUMAN. CLARKE & BLOW suggested putting the Eocene/Oligocene boundary in the middel of P. 17. This coincides with the extinction of *Discocyclina* and *Hantkenina*. Since the presence of *Discocyclina* in the Oligocene hardly seems to be accepted, this suggestion should be considered when defining the Eocene/Oligocene boundary.

In Belgium, GULINCK, DROOGER & MARTINI (1969) studied the transition between Eocene and Oligocene deposits in the Kallo well. In this well there is a complete marine complex between the Asse Clay( Eocene) and the Boom Clay (Oligocene). This is composed of clays and silty sands, called the "complex argilo-sableux de Kallo (GULINCK, 1969a).

At - 174 m in the Kallo well, MARTINI noted the presence of the *Ciphragmalithus alatus* Zone. This confirms once more the Middle Eocene (Lutetian) age of the Wemmel Sands, indicated before by ACHUTAN & STRADNER (1969) and by MARTINI (1969), who found this Zone also in the Asse Clay.

At - 124.6 m, MARTINI found *Ericsonia subdisticha* (ROTH & HAY, 1967) still associated with some Upper Eocene species, which he considered to be reworked. He therefore indicated the presence of the *Ericsonia subdisticha* Zone at this level.

In the interval between -124 m and - 131 m, DROOGER found an association of foraminifera and ostracoda with a slight predominance of Upper Eocene elements. From the sample at - 131 m however, he recorded a single specimen of *Cassigerinella chipolensis* (CUSHMAN & PONTON, 1932). The first appearence of this species is considered by different specialists to be a good indication of the Eocene/Oligocene boundary.

At - 85,9 m in the Kallo well, MARTINI suggested the presence of the *Cyclococcolithus margaritae* Zone.

The association of planktonic foraminifera which we recorded from the Lede Sands and from the Wemmel Sands in the Kallo well, is in agreement with the Middle Eocene age of these deposits :

*Globanomalina micra* (COLE 1927)
*Globanomalina wilcoxensis* (CUSHMAN & PONTON 1932)
*Chiloguembelina martini* (PIJPERS 1933)
*Globorotalia spinulosa* (CUSHMAN 1927)
*Acarinina pentacamerata* SUBBOTINA 1947
*Acarinina rotundimarginata* SUBBOTINA 1953
*Globigerinita echinata*(BOLLI 1957).

As DROOGER pointed out, this Middle Eocene position of the Wemmelian is important in relation to the problem of the Eocene/Oligocene boundary in Belgium. Very probably, the considerable gap between the Middle Eocene and the Oligocene deposits can be filled up, not only with the Asse Sands, but also with the glauconiferous silty sands and clays of the Kallo complex. Apart from the importance we can attach to the presence of the single specimen of *Cassigerinella chipolensis* at a depth of - 131 m in the Kallo well, the species has been recorded also from Eocene deposits. BERGGREN (1969) for instance noted its presence in the *Globorotalia cerroazulensis* Zone in Libya. The presence of *Cassigerinella chipolensis* at - 131 m in the Kallo well can hardly be accepted as an indication of the Eocene/Oligocene boundary. In the fine micaceous sands and silty clays between - 92 m and - 110 m in the Kallo well, we have found an interesting association of planktonic foraminifera :

*Globigerina danvillensis* HOWE & WALLACE 1932
*Globigerina officinalis* SUBBOTINA 1953
*Globigerina ouachitaensis* HOWE & WALLACE 1932
*Globigerina praebulloides leroyi* BLOW & BANNER 1962
*Globigerina praebulloides occlusa* BLOW & BANNER 1962
*Chiloguembelina cubensis* (PALMER 1934)
*Pseudohastigerina barbadoensis* BLOW 1969.

This association of planktonic foraminifera has been recorded from the Silberberg Formation (Lattorfian) in Germany by MARKS & VAN VESSEM (1971). Since this association in the Kallo well fits in the interval between the *Cyclococcolithus margaritae* Zone and the level - 131 m, it is probably that the "reworked" species of nannoplankton at - 124.6 m, are in fact not reworked, as suggested by CAVELIER (1972). Lithologically, the fine glauconitic sands at this level link up better with the glauconiferous sands of the Upper Eocene.

The Eocene/Oligocene transitional strata in Belgium could now be studied in a new important well at Mol (Northern Belgium). In this well, the top of the Asse Clay is at about - 300 m. Between - 300 and - 274,5 m, fine glauconiferous sands and silty clays are developed. From a depth of - 274,5 m; we again observed the clayey micaceous sands with the same association of planktonic foraminifera :

*Globigerina danvillensis* HOWE & WALLACE, 1932
*Globigerina officinalis* SUBBOTINA 1953
*Globigerina ouachitaensis* HOWE & WALLACE 1932
*Globigerina praebulloides leroyi* BLOW & BANNER 1932
*Globigerina praebulloides occlusa* BLOW & BANNER 1962
*Chiloguembelina cubensis* (PALMER 1934)
*Pseudohastigerina barbadoensis* BLOW 1969.

In the lower part of the Boom Clay we found :

*Globigerina ampliapertura* BOLLI 1957
*Globigerina cryptomphala* GLAESSNER 1937
*Globigerina eocaena* GUMBEL 1868
*Globigerina galavisi* BERMUDEZ 1961
*Globigerina gortanii* BORSETTI 1959
*Globigerina officinalis* SUBBOTINA 1953
*Globigerina ouachitaensis* HOWE & WALLACE 1932
*Globigerina praebulloides leroyi* BLOW & BANNER 1962
*Globigerina praebulloides occlusa* BLOW & BANNER 1962

*Globigerina praebulloides praebulloides* BLOW & BANNER 1962
*Globigerina tapurensis* BLOW & BANNER 1962
*Globorotalia clemenciae* BERMUDEZ 1961
*Globorotalia increbescens* (BANDY 1949)
*Globorotalia gemma* JENKINS 1965
*Globorotalia permicra* BLOW & BANNER 1962
*Globorotalia opima nana* BOLLI 1957
*Globigerinita martini martini* BLOW & BANNER 1962.
*Globigerinita pera* (TODD 1957)
*Globigerinita unicava primitiva* BLOW & BANNER 1962
*Pseudohastigerina barbadoensis* BLOW 1969
*Chiloguembelina cubensis* (PALMER 1932)
*Globorotaloides suteri* BOLLI 1957
*Cassigerinella chipolensis* (CUSHMAN & PONTON 1932).

This is without doubt the *Globigerina tapurensis* Zone (P. 18) of BLOW 1969. At a depth of - 227,5 m in this new well, we observed *Globigerina sellii* BORSETTI 1959 (= *Globigerina sellii* Zone - P. 19 - of BLOW), associated with :

*Globigerina ampliapertura* BOLLI 1957
*Globigerina angiporoides* HORNIBROOK 1965
*Globigerina angulifficinalis* BLOW 1969
*Globigerina labiacrassata* JENKINS 1966
*Globigerina officinalis* SUBBOTINA 1953
*Globigerina ouachitaensis ouachitaensis* HOWE & WALLACE 1932
*Globigerina ouachitaensis gnaucki* BLOW & BANNER 1962
*Globigerina praebulloides leroyi* BLOW & BANNER 1962
*Globigerina praebulloides occlusa* BLOW & BANNER 1962
*Globigerina praebulloides praebulloides* BLOW 1959
*Globigerina tapurensis* BLOW & BANNER 1962
*Globigerina winkleri* BERMUDEZ 1961
*Globorotalia clemenciae* BERMUDEZ 1961
*Globorotalia gemma* JENKINS 1965
*Globorotalia opima nana* BOLLI 1957
*Globigerinita martini scandretti* BLOW & BANNER 1962
*Globigerinita unicava primitiva* BLOW & BANNER 1962
*Pseudohastigerina barbadoensis* BLOW 1969
*Chiloguembelina cubensis* (PALMER 1932)
*Globorotaloides suteri* BOLLI 1957
*Cassigerinella chipolensis* (CUSHMAN & PONTON 1932)

A more detailed study of planktonic foraminifera and nannoplankton in this new well in Mol is in progress.

It seems that in Belgium, as in Germany, the level with fine micaceous sands, containing *Globigerina danvillensis* HOWE & WALLACE 1932 (probably *Ericsonia subdisticha* Zone) is well developed. It overlies the more glauconiferous silty sands and clays of Eocene age. In the lower part of the Rupelian, the presence of *Globigerina tapurensis* Zone (P. 18) and of *Globigerina sellii* Zone (P. 19) is demonstrated.

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Plate I.

Fig. 1 - *Globanomalina wilcoxensis* (CUSHMAN & PONTON 1932).
Kallo. Lede Sands (184 m) x 110.

Fig. 2 - *Globigerina angiporoides* HORNIBROOK 1965.
Mol. Boom Clay. Zone P.19 (227,5 m) x 100.

Fig. 3 - *Globigerina ouachitaensis gnaucki* BLOW & BANNER 1962.
Mol. Boom Clay. Zone P.19 (227,5 m) x 110.

Fig. 4 - *Globigerina cryptomphala* GLAESNER 1937.
Mol. Boom Clay. Zone P.18 (251,8 m) x 110.

Fig. 5 - *Globigerina eocaena* GÜMBEL 1868.
Mol. Boom Clay. Zone P.18 (251,8 m) x 105.

Fig. 6 - *Globigerina gortanii gortanii* BORSETTI 1959.
Mol. Boom Clay. Zone P.18 (251,8 m) x 205.

Fig. 7 - *Globigerina ouachitaensis ouachitaensis* HOWE & WALLACE 1932.
Mol. Boom Clay. Zone P.18 (251,8 m) x 100.

Fig. 8 - *Globigerina labiacrassata* JENKINS, 1966.
Mol. Boom Clay. Zone P.19 (227,5 m) x 100.

Fig. 9 - *Globigerina tapurensis* BLOW & BANNER 1962.
Mol. Boom Clay. Zone P.18 (251,8 m) x 110.

Fig.10 - *Globigerina senilis* BANDY 1949.
Mol. Boom Clay. Zone P.19 (227,5 m) x 110.

Fig.11 - *Globigerina winkleri* BERMUDEZ 1961.
Mol. Boom Clay. Zone P.19 (227,5 m) x 100.

Fig.12 - *Globigerinita martini martini* BLOW & BANNER 1962.
Mol. Boom Clay. Zone P.18 (251,8 m) x 110.

Fig.13 - *Globigerinita martini scandretti* BLOW & BANNER 1962.
Mol. Boom Clay. Zone P.19 (227,5 m) x 110.

Fig.14 - *Globigerinita pera* (TODD 1957).
Mol. Boom Clay. Zone P.18 (251,8 m) x 110.

Fig.15 - *Acarinina pentacamerata* SUBBOTINA 1947.
Kallo. Lede Sands. (184 m).

Plate I

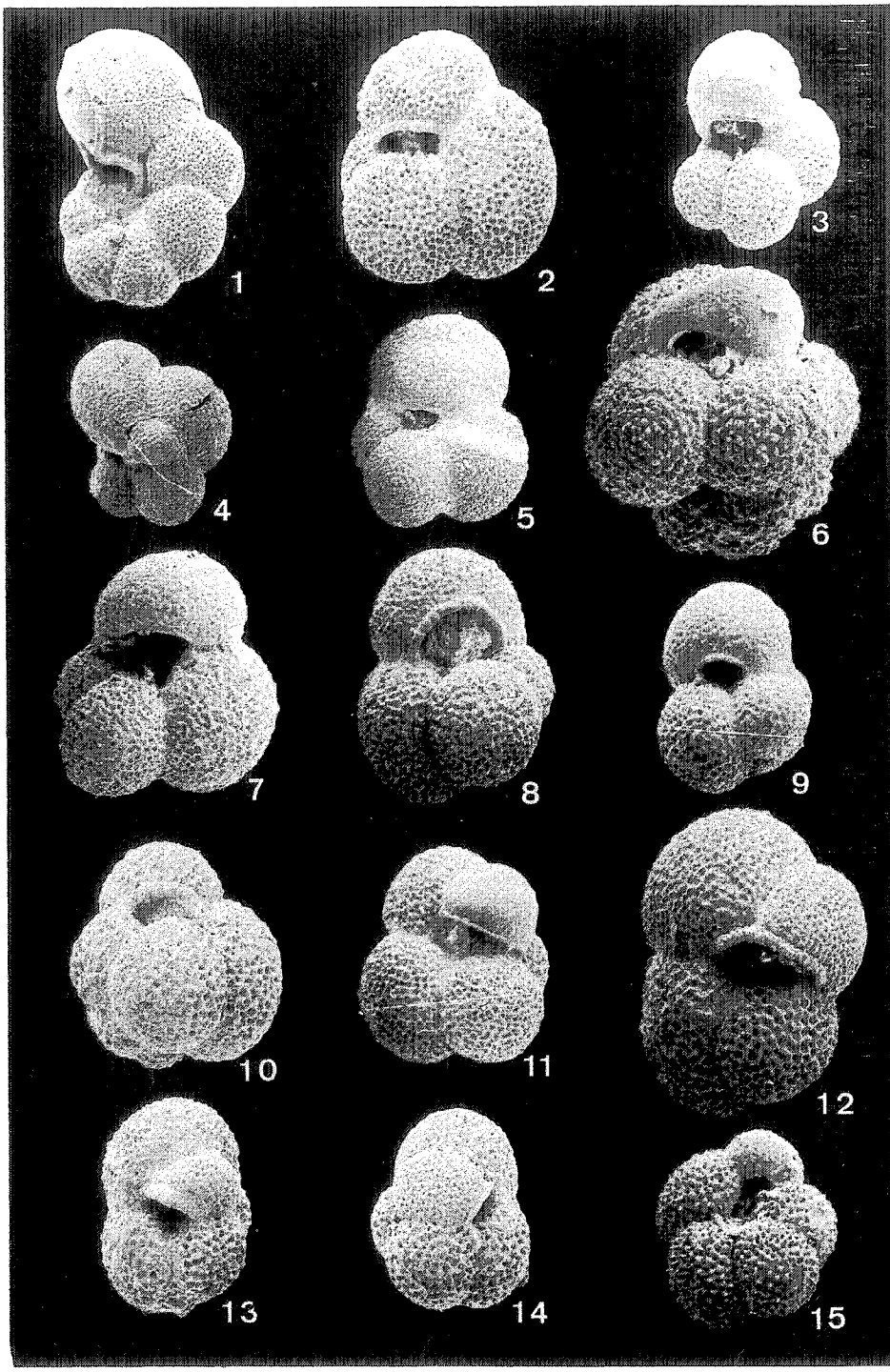


Plate II.

Fig. 1 - *Globorotalia gemma* JENKINS 1965.
Mol. Boom Clay. Zone P.18 (251,8 m) x 200.

Fig. 2 - *Globorotalia clemenciae* BERMUDEZ 1961.
Mol. Boom Clay. Zone P.18 (251,8 m) x 210.

Fig. 3 - *Globigerina denvillensis* HOWE & WALLACE 1932.
Mol. (273,2 m) x 220.

Fig. 4 - *Globigerina officinalis* SUBBOTINA 1953.
Mol. Boom Clay. Zone P.18 (251,8 m) x 200.

Fig. 5 - *Globigerina praebulloides leroyi* BLOW & BANNER 1962.
Mol. Boom Clay. Zone P.18 (251,8 m) x 210.

Fig. 6 - *Globigerina praebulloides occlusa* BLOW & BANNER 1962.
Mol. Boom Clay. Zone P.18 (251,8 m) x 200.

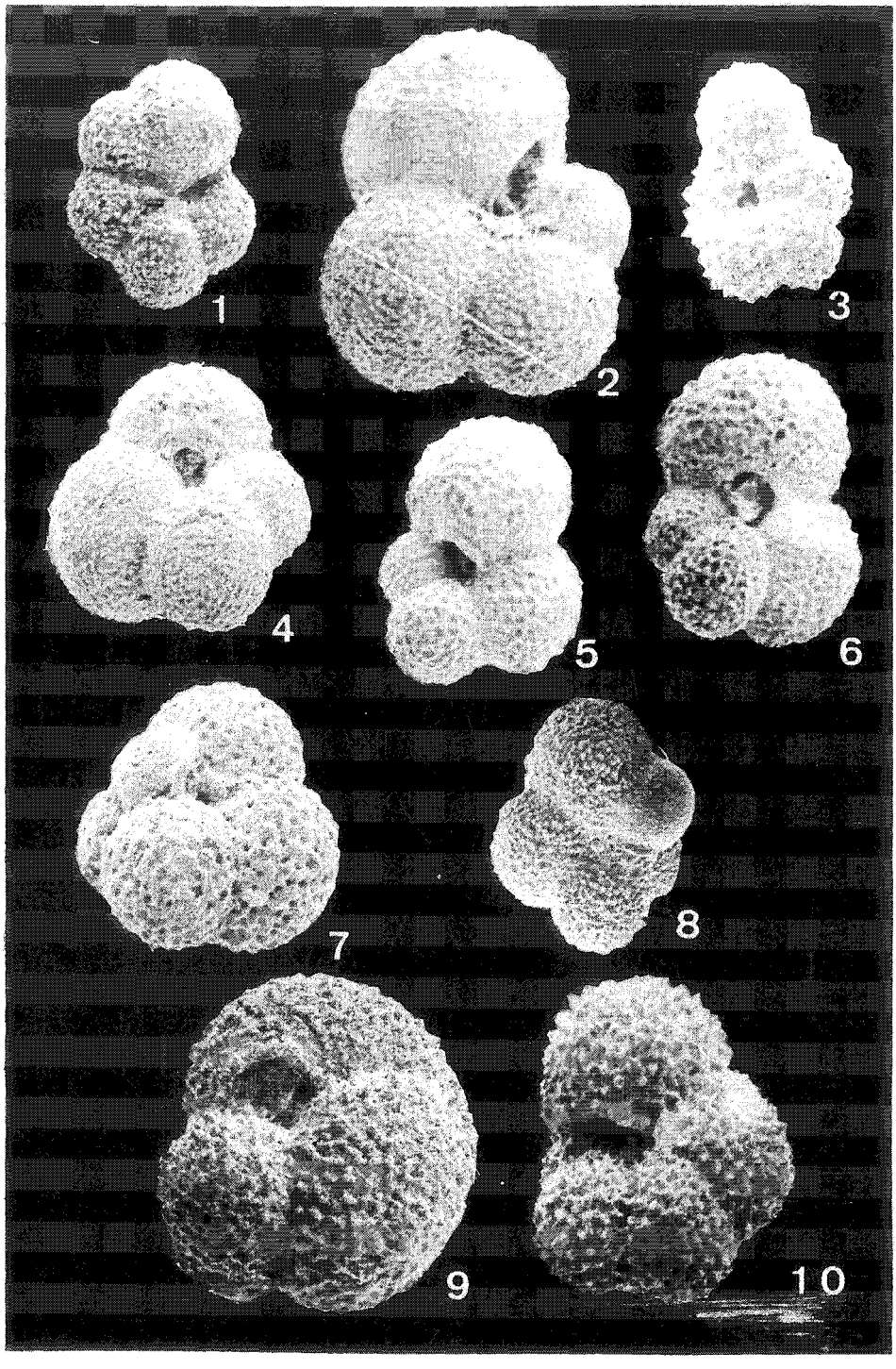
Fig. 7 - *Globigerinita unicava primitiva* BLOW & BANNER 1962.
Mol. Boom Clay. Zone P.19 (227,5 m) x 220.

Fig. 8 - *Globorotaloides suteri* BOLLI 1957.
Mol. Boom Clay. Zone P.19 (227,5 m) x 200.

Fig. 9 - *Globigerina sellii* BORSETTI 1959.
Mol. Boom Clay. Zone P.19 (227,5 m) x 100.

Fig.10 - *Acarinina rotundimarginata* SUBBOTINA 1953.
Kallo. Lede Sands (184 m) x 205.

Plate II



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