

## CRETACEOUS MICROFOSSILS IN THE PALEOGENE AND MIOCENE OF THE ROUMANIAN CARPATHIANS

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**I**N 1918, Lapparent put forward the idea that the fossil foraminifera *Globotruncana* (at that time known under the name of



*Rosalina*) is characteristic of the upper Cretaceous. This opinion, reiterated in 1930 by Viennot, has been afterwards confirmed by all the investigators who dealt with the study of the Cretaceous. In the Paris basin (Marie P. 1936), in the Central Appenins (Renz, O. 1936), in Sweden (Brotzen F. 1936), in the Caucasus (Glaessner M. 1937), at Emba (Morozova V. G., 1939), in Greece (Kiskyras D. 1941), etc., the *Globotruncanae* have been found only in the upper part of the Cretaceous, from the Cenomanian up to the Maestrichtian inclusively. After having appeared during the phase of the austrian foldings, they seem to attain their highest degree of development and distribution during the subhercynic foldings, and disappear simultaneously with the Laramic orogenesis (Kiskyras), at the same time as Ammonites, Rudists and *Inoceramus* (Majson).

The variety of the *Globotruncanae*, the quick appearance and disappearance of their forms, made it possible to make a rather accurate differentiation of the upper Cretaceous in the above-mentioned regions, and lately such a differentiation was made also in the Flysch deposits of the upper Cretaceous

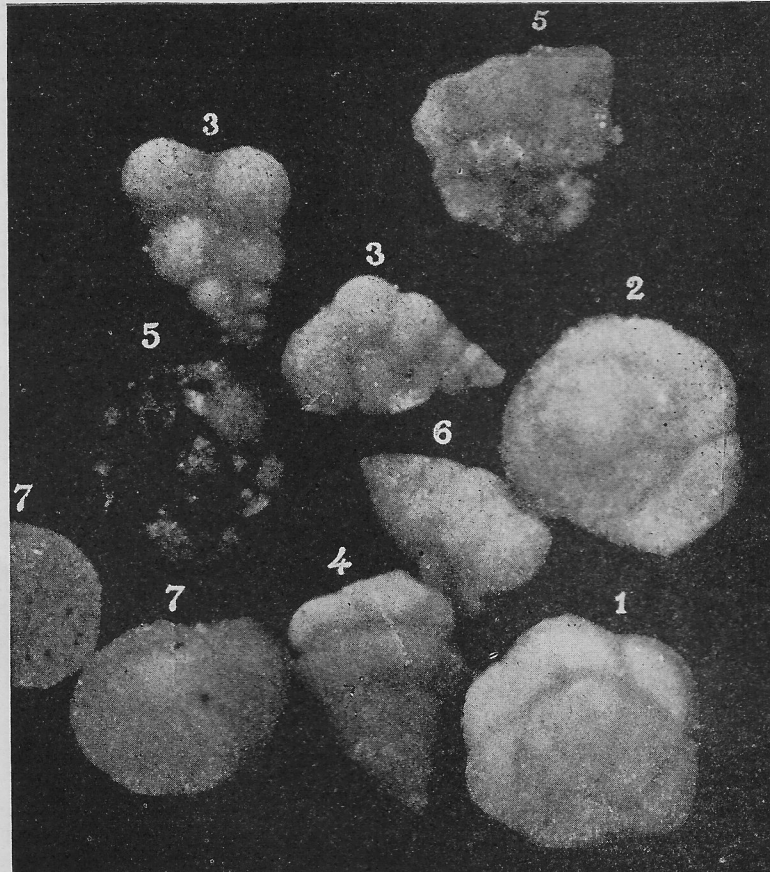
in Roumania (Tocorjescu, 1954). But in the Flysch of the Roumanian Carpathians<sup>1</sup> the studies of the microfauna did not confirm the idea that the *Globotruncanae* are strictly localized in the Cretaceous.

In 1943, Noth and Patrut, describing for the first time a Senonian fauna of the Roumanian Carpathians, a very characteristic one, differing essentially from other Flysch formations, did not include among the characteristic forms of the Senonian either the *Globotruncana*, or the *Gumbelina*, or the *Pseudotextularia*, as was done in other parts of the world. This position was justified by the fact that all these forms, in a state of preservation which suggested their presence "in situ", had been found by them also in younger formations, especially in the Miocene.

More recent investigations, owed to Voicu (1953) and Iorgulescu (1953), have shown that, in fact, the form *Globotruncana linnei* d' Orb<sup>2</sup>, two forms of *Gumbelina* (*G. Globosa* Ehrenb. and *G. Striata* Ehrenb.-and the *Pseudotextularia*<sup>3</sup>) pass over the borders of the upper Cretaceous in which they are well represented, and climb into the stratigraphical succession reaching the base of the Pliocene.

Considering the absoluteness of the conclusions set in literature as to the strict camping of these forms in the Cretaceous, Iorgulescu, contrary to Noth and Patrut, and although he is aware of their state of perfect preservation, their constant appear-

- (1) In the Flysch of the Roumanian Carpathians' massif are included formations of various ages, beginning with the lower Cretaceous up to the Pliocene inclusively.
- (2) In the present trinary wording *G. linnei* d' Orb is denominated *G. lapparenti lapparenti* Vogler.
- (3) In the literature of specialty all these forms are considered as strictly Cretaceous.



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rance in time and their concentration in certain horizons of the Miocene, is nevertheless of the opinion that they are washed forms of the Cretaceous.

The possibility that microfossils may be washed cannot be questioned, just as the washing of the rocks cannot be denied. When the rock which constitutes a formation in the form of blocks of various sizes pass into another formation constituting conglomerates or sedimentary breccia, they carry within themselves the whole microfauna of the respective formation as well. In such cases, the integrity of the microfossils is perfect, and the frequency of their appearance is the same as in the formation to which they had belonged.

In sands and fine-grained formations only shells of the microfossils can be washed. But such a washing secures neither the integrity of the forms nor the same frequency as in the original formation.

Bearing in mind these two possibilities, concerning the washing of microfossils, Voicu reaches a different conclusion to Iorgulescu's or that derived from the literature. He is of the opinion, like Noth and Patrut, that the above-mentioned microfossils are neither strictly characteristic for the Cretaceous, nor washed in younger formations, but that wherever they appear, they are "in situ".

If one follows the spread of the *Globotruncana linnei* form along the vertical line in the Flysch formations of the Roumanian Carpathians<sup>1</sup>, the following remarks can be made:

(1) In the Cretaceous, and in the Senonian respectively, *G. linnei* as number of specimens is well represented, both in comparison with the other forms of *Globotruncana* and with other foraminifera.

(2) In the lower Eocene, which follows above the Senonian in continuity of sedimentation, and which has a similar lithological constitution, *G. linnei* appears with the same frequency as in the Senonian. It is associated as well with forms which are common to both stages as with forms characteristic to the Eocene, so that it is not possible to believe in a washing from the Senonian.

(3) In the middle and upper Eocene, the frequency of the form *Globotruncana linnei* decreases as compared with its frequency in the inferior sediments, but nevertheless it is found very often. The state of preservation in which the shells are found, the association with forms that are specific to these deposits, and the large regional distribution suggest the idea that here too they are "in situ".

(4) In the Oligocene, a formation of a generally lagoony or semilagoony character, the *Globotruncanae* appear only sporadically and in a reduced number of specimens. Exceptionally, however, thin strata of sandstones with a rich content of microfauna have also been met, almost exclusively represented by forms of *G. linnei*. The multitude of specimens<sup>2</sup>, the lack of any other cretaceous forms and the perfect preservation of the shells, all this leads to the

## EXPLANATIONS OF PLATE 42

FIG. 1—	<i>Globotruncana linnaeana</i> (d'Orb.)	80.
	(dorsal view).	
2—	" <i>stuarti</i> (de Lapp.)	80.
	(dorsal view).	
3—	<i>Gumbelina globulosa</i> (Ehrenberg)	80.
	(side view).	
4—	" <i>striata</i> (Ehrenberg)	80.
	(side view).	
5—	<i>Ventilabrella eggeri</i> Cushm.	80.
	(side view).	
6—	<i>Pseudolextularia fruticosa</i> (Egger)	80.
	(side view).	
7—	<i>Stensioina</i> aff. <i>exculpta</i> (Reuss)	80.
	a. (dorsal view). b. (ventral view).	

- (1) These remarks refer for the time being only to the Flysch contained in the bend of the Carpathians which is oriented East-West.
- (2) The possibility of a selective washing with preference for *G. linnei* or of a concentration through washing cannot be conceived.

conclusion that in these strata *Globotruncana linnei* is in its right place, just as in the Senonian.

(5) With the beginning of the Miocene the frequency of the Globotruncanæ increases again. In the Burdigalian and the lower Helvetian they attain such a development that as far as the number of specimens is concerned they are much better represented than in the Cretaceous. In these two geological series, a series of microfossils, which in other parts of the world are considered strictly Cretaceous, i. e. *Globotruncana linnei* d'Orb., *G. stuarti* de Lapp., *Gumbelina globosa* Ehrenb., *G. striata* Ehrenb., *Pseudotextularia fruticosa* Egger, *Ventilabrella eggeri* Cushman, and *Stensioina aff. exculpta* Reuss, present such a frequency, such a constancy of appearance and association, and are distributed over such a large area, that everyone could be inclined to believe that the respective formation represent the Senonian. The red colour of the Helvetian marls, the same as that of the Senonian marls, could still increase the confusion, were there not other microfossils and stratigraphical criteria to define with precision and without any possible doubt their Miocene age.

The Roumanian micropalaeontologists, even those who admit washing on a large scale, agree that an association of microfossils which includes forms of: *Cibicides*, *Globorotalia*, *Globotruncana*, *Gumbelina*, etc., and in which the last two are predominating, is characteristic for the Burdigalian and the Helvetian. Gh. Voicu, who studied closely the microfauna of these two stages, reaches the conclusion that truly some Senonian and Eocene forms are also included, showing up evident characters of washing, but these forms appear only in a very limited number (1-5 specimens in each sample) and over limited areas. At the same time, however, *G. linnei* appears with an average frequency of 20 specimens per sample and over very large areas (hundreds of square kilometres). More than 100 specimens have been found in many samples, and in some more than 1000 could be counted, a number of specimens which has never been encountered in the Senonian.

(6) In the upper part of the Helvetian, *Globotruncana* is scarcer, and it is to be found

with the same frequency again in the basin of the Tortonian. The explanation for its scarcity in this series should be looked for in the progressive evolution of the purely marine regime from the beginning of the Miocene towards the lagoony facies which culminates in the lower Tortonian, when the salt massifs are formed. The deposits contained in the basis of the Tortonian, the support of the salt massifs, are represented by a thick packet of Dacitic cinerites of a white-greenish colour, which alternate with white-coloured pelitic rocks that are almost exclusively constituted by shells of Globigerinae joined together by a matrix consisting of Dacian volcanic ashes. As such deposits, which contain also beautiful forms of *G. linnei*, cannot derive from the washing of preexistent rocks, it is easy to see why it has been admitted that these forms exist there "in situ".

(7) The frequency of the Globotruncanæ increases with the marine invasion coming from the middle Tortonian, but they begin to appear more frequently with the beginning of the Sarmatian. In this last mentioned series *G. linnei* is again accompanied by the two forms of *Gumbelina*, *G. striata* and *G. globosa*, and sometimes even by *Pseudotextularia*. Towards the upper part of the Sarmatian, in the group of rocks which represent the transition to the Pliocene, the forms of *Gumbelina* seem to predominate those of *Globotruncana*, but both these species belong to the microfaunistic association which Iorgulescu and Voicu have mentioned to be characteristic of these deposits.

(8) In the basis of the Pliocene, respectively in the basis of the Meotian, no more *Gumbelinae* are to be found. Nevertheless, *Globotruncana linnei* continues to persist, although less frequently, and in a limited distribution.

(9) From the middle Meotian to the end of the Pliocene, *G. linnei* and the other forms which have been mentioned, were no longer found, although the microfauna was studied rather thoroughly. Their disappearance can be related to the moment when the waters of the Sarmatic sea begin to get fresh. As a matter of fact, at the same time, the last forms of *Cerithium* also disappear,

In conclusion it can be stated that in the Flysch zone of the Eastern Carpathians in the Roumanian People's Republic, *Globotruncana linnei*, *G. stuarti*, *Gumbelina globosa*, *G. striata* and *Pseudotextularia* are forms which are not strictly characteristic to the cretaceous sediments, as they are in other parts of the world. Here, too, they appear in the Cretaceous, but go forth into the Paleogene, attain their highest degree of development and distribution in the lower Miocene and disappear after the beginning of the Pliocene.

This fact confirms Leon Moret's (1930) assertion that the *Globotruncanae* could develop whenever surrounding conditions had been favourable, and he brings forth a new argument to support Thalman's (1935) opinion that this species is living also to-day. Unfavourable conditions of development seem to be related to waters which have a tendency to get either fresh or excessively salty.

The presence of one or the other of the above-mentioned forms, or of all of them, in the Roumanian Eastern Carpathians cannot offer elements for the precise establishment of a formation's age, except to the degree in which the microfossils with which they associate are also known; and with regard to their appearance in masses as far as the number of specimens is concerned, it can be considered rather as a characteristic of the lower Miocene than one of the Cretaceous.

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