

**Zeitschrift:** Eclogae Geologicae Helvetiae  
**Herausgeber:** Schweizerische Geologische Gesellschaft  
**Band:** 53 (1960)  
**Heft:** 2

**Artikel:** Bireophax, a new genus of the foraminiferal family Reophacidae  
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**DOI:** <https://doi.org/10.5169/seals-162714>

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# **Bireophax, a New Genus of the Foraminiferal Family Reophacidae**

By **Hans M. Bolli** (Caracas)

With one Plate (I)

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## INTRODUCTION

When the author first saw the specimens that are described here under the new genus *Bireophax*, he believed them to be bifurcating aberrant or gerontic forms of the genus *Reophax*. However, closer study showed that *Bireophax* displays characteristics other than bifurcation that separate it from *Reophax*. In the La Cruz formation of the Cretaceous Temblador Group from Central Venezuela in which the new genus was found, the accompanying *Reophax* specimens remain uniserial with well inflated chambers throughout. The specimens of *Bireophax guari-coensis*, n. gen., n. sp., on the other hand, show quite a different ontogeny. After an initial *Reophax*-like stage of one or two inflated chambers, later chambers become increasingly more depressed and also arched. The maximum depression and the most pronounced arched shape is reached in the chamber from which the bifurcation begins. The chambers of the two separate branches are no longer arched; they become more inflated again and their growth rate is less pronounced than is the case in the early chambers. *Bireophax* can probably be regarded as a short lived evolutionary development from *Reophax*.

There is a tendency amongst some smaller Foraminifera for the chamber arrangement to become simpler during development either by a change from a coiled to an uncoiled form or by a change from a multiserial to a uniserial condition. Examples of the latter group include *Clavulina*, *Bigenerina* and *Gaudryinella* amongst arenaceous genera and *Nodosarella* and *Rectoquembelina* amongst calcareous genera.

A change from simple to more complex chamber arrangement, such as is found in *Bireophax*, is much less common. It occurs in some genera of the family Heterohelicidae (*Ventilabrella*, *Pseudotextularia*) which develop multiple chambers in their later stage and also in the rotaloid genus *Biglobigerinella* which has paired chambers in its final stage. Specimens of the variable calcareous genus *Manorella* can show bifurcation similar to that in *Bireophax*. The arenaceous *Polychasmina paupawensis* as a rule is uniserial but occasional specimens may show the tendency towards bifurcation.

Changes from simple to more complex test forms among the smaller Foraminifera seem to have taken place predominantly during the Cretaceous; all were rather short lived.

The specimens of the described *Bireophax guaricoensis* originate from Phillips Petroleum Company well G.D.4 in Guarico, Venezuela. The company has kindly given permission to publish this paper. The plate illustrations are camera lucida drawings by the author.

#### SYSTEMATIC DESCRIPTION

Family Reophacidae

Subfamily Reophacinae

Genus *Bireophax*, new genus

Type species: *Bireophax guaricoensis*, new species.

Diagnosis. – Test free, uniserial in early part, later divided by bifurcation into two separate uniserial branches. Chamber shape globular or depressed in uniserial early part; later chambers of this part may be fairly strongly depressed and arched. Chambers of the two separate branches may be depressed or globular. As a rule, chambers increase in size more rapidly in the uniserial early part before bifurcation than do the chambers of the two separate branches. Wall arenaceous; a probable chitinous base, with agglutinated material such as grains of quartz, glauconite, etc. forming the outer wall. Sutures depressed, sometimes arched especially in the later chambers of the uniserial part before bifurcation. Aperture terminal, rounded or elongate or somewhat irregular. The last chamber of the uniserial early part possesses two apertures from which the two separate uniserial branches appear.

Three distinct growth stages can be distinguished in *Bireophax*:

1. A uniserial, *Reophax*-like early stage; chambers with terminal aperture.
2. One chamber with two apertures at its upper end, connecting stages 1 and 3.
3. A final stage with two separate uniserial branches springing from the two apertures present in the chamber of stage 2.

Remarks. – *Bireophax*, n. gen., is apparently related to *Reophax* but differs from this genus by becoming bifurcated and partly depressed. *Bireophax* is probably also related to *Polychasmina*. These two genera have in common a uniserial series of the chambers that become depressed and somewhat arched. However, while *Bireophax* bifurcates after the initial 3–5 chambers, *Polychasmina* as a rule remains uniserial throughout, consisting of up to ten chambers. When bifurcation does occur in *Polychasmina* it is apparently of a more irregular and unpredictable nature than in *Bireophax*. Furthermore, the aperture in *Bireophax* is terminal, single, (except in the last chamber of the early uniserial part where there are two terminal apertures) while in *Polychasmina* it is terminal, consisting of a series of about four to six elongate slits in a single row. There is also no indication in *Bireophax* of a labyrinthic interior as is claimed to exist in *Polychasmina*.

*Bireophax guaricoensis*, new species

Plate I, Figures 1–10

Diagnosis. – Test free, in early stage chambers arranged uniserially, later becoming divided into two separate branches. The early uniserial stage that

includes growth stages 1 and 2 as defined in the genus description consists usually of three to five chambers. The initial one to two chambers are rather spherical in shape, the following ones become more and more depressed and arched. Two separate uniserial stages branch out from the last chamber of this early uniserial part at an angle that may vary between approximately  $90^\circ$  and almost  $180^\circ$ . The chamber size of the two separate branches increases somewhat less rapidly than it does in the earlier part. The branches may consist of one to several chambers. From the limited number of reasonably well preserved specimens it appears that they are at first still rather depressed but become more and more globular as added. The wall consists almost exclusively of small quartz grains with a calcareous cement. Occasional other mineral grains are glauconite, pyrite, etc. The sutures are depressed throughout and arched in the last chambers of the early uniserial part, especially in the last chamber. The aperture is terminal, single, rounded in the spherically shaped chambers and somewhat elongate in the depressed chambers. The last chamber of the early uniserial part possesses two elongate apertures at its upper end from which branch out the two separate uniserial stages. Length of Holotype: 1.9 mm. Variation in size is considerable. Other specimens of the studied material measure from approximately 1.5–3.5 mm.

Observed stratigraphic range. – Part of the La Cruz formation (Temblador Group), which probably ranges from Albian to lower Senonian.

Locality. – Holotype (pl. I, figs. 4a, 4b) and figured paratypes (pl. I, figs. 1–3, 5–10) from Phillips Petroleum Company well G.D.4, ca. 40 kilometers SSW of El Sombrero, Estado Guarico, Venezuela. Ditch samples 2900–3015' (Holotype 2910') in the La Cruz formation of the Temblador Group (shale, sandy and glauconitic). Figured specimens deposited in the Museum of Natural History, Basle (holotype N° C 2716, figured paratypes N° C 2713–C 2715 and C 2717– C 2722).

Remarks. – *Bireophax guaricoensis*, n. gen., n. sp., is associated at the type locality with *Reophax* of the *R. texana*/*R. woodbinensis* group, *Ammobaculites* sp., numerous Ostracod species and fish bone fragments. This faunal association points to a rather shallow, probably somewhat brackish water environment. Of other wells drilled in the same general area a similar but less well developed fauna exists only in well GD 7 situated about 11 km to the north of GD 4. This would indicate that the above mentioned faunal association, including *Bireophax guaricoensis*, was restricted to a very narrow belt. To the east it was replaced by a more marine environment and to the west by increasingly brackish and even fresh water conditions. Furthermore, the formations of the Temblador Group become rapidly reduced westwards, this is another reason why beds containing *Reophax guaricoensis* are so restricted in their geographical distribution. Most of the available specimens are broken. This is explained by their shape and large size which makes them rather fragile and the fact that all the specimens except one were obtained from ditch samples. In contrast to *Bireophax guaricoensis* the walls of the accompanying *Reophax* of the *R. texana*/*R. woodbinensis* group often are made up of larger mineral grains, with glauconite often fairly dominant and with the cement either none calcareous or only slightly calcareous.

The species is named after the state of Guarico, Venezuela, where it was first found.

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Manuscript received May 16, 1960

### Explanation of Plate I

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1, 2, Side views of paratypes. Small specimens showing growth stages 1 and 2. Two apertures on last chamber (growth stage 2) visible; final growth stage with two separate uniserial branches not yet developed or broken off (Mus. of Nat. Hist. Basle, Nos. C 2713 and C 2714.)	
3a, 3b, Side view and edge view of paratype. Initial chambers broken off; edge view showing one of the two elongate apertures of the chamber of growth stage 2. Final growth stage with two separate uniserial branches not yet developed or broken off (Mus. of Nat. Hist. Basle, No. C 2715).	
4a, 4b, Side view and edge view of holotype. Side view showing the three growth stages; edge view showing terminal aperture of one of the two separate uniserial branches (Mus. of Nat. Hist. Basle, No. C 2716).	
5, Side view of paratype (Mus. of Nat. Hist. Basle, No. C 2717).	
6, Side view of paratype. Initial chambers broken off; final growth stage of two separate uniserial branches with one chamber each (Mus. of Nat. Hist. Basle, No. C 2718).	
7, Side view of paratype. Initial chamber broken off; final growth stage of two separate uniserial branches with one and two chambers respectively (Mus. of Nat. Hist. Basle No. C 2719).	
8, Side view of paratype. Large specimen with initial chambers broken off; final growth stage of two separate uniserial branches with two and one chamber respectively (Mus. of Nat. Hist. Basle, No. C 2720).	
9, Side view of paratype. Largest specimen encountered, length 3.5 mm (Mus. of Nat. Hist. Basle, No. 2721).	
10, Side view of paratype. Large specimen with initial chambers broken off; final growth stage of two separate uniserial branches with one and four chambers respectively (Mus. of Nat. Hist. Basle, No. C 2722).	



