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306. A NEW MORPHOLOGIC VARIATION
OF THE FORAMINIFER *CIBICIDES LOBATULUS*

SUSAN C. COOPER

University of Washington, Department of Oceanography, Contribution No. 301.

ABSTRACT

Samples taken in the northeast Pacific contained a new form which is a variation of the foraminifer *Cibicides lobatulus* (Walker and Jacob). A diagram of the life cycle of *Cibicides lobatulus* after Nyholm is given and the probable development of the new form is described and illustrated.

INTRODUCTION

In an examination of samples from the Washington, Oregon, British Columbia, and Alaska coasts, an attached foraminifer was noted which appeared to be a new species. Enbysk (1960) figured portions of this form in her unpublished thesis and suggested that it was an anomalinid. In later examination of samples the foraminifer was frequently found attached to pebbles and boulders. After examining several specimens, Miss Ruth Todd, U. S. National Museum, referred the author to an article by Nyholm (1961). This paper described several types of tests which Nyholm believes to be different phases of *Cibicides lobatulus*: a monothalamous test, a chambered test and a planorbulinoid test. All of these were found associated with the new form in the material from the Northeast Pacific, and it became apparent that this form was part of the complex life cycle of *Cibicides lobatulus*.

The illustrations were drawn by Janet Griffin. This study was supported by National Science Foundation Grant GP 337 and contract Nonr 477(10), Project NR 083 012 with the Office of Naval Research. Ten samples collected by the U. S. Bureau of Commercial Fisheries chartered vessel *Tordenskjold* in the Gulf of Alaska were examined in addition to selected samples from collections of the University of Washington's Department of Oceanography.

DESCRIPTION OF VARIANT

Test attached, first few chambers low and coiled. Later chambers uncoiled and expanded rapidly with development of heavy irregular ridges (Figures 1, 3, and 4, Plate 21). The change to the heavy chambers may be gradual or it may be abrupt. Early chambers are tectin and the next few have a thin calcareous layer over the dark reddish-brown tectin (Figure 2, Plate 21). Successive chambers have thicker calcareous walls and the final, heavily ridged chambers have an almost porcellaneous texture. The tectin layer is present under the calcareous layer in the final chambers. The aperture is round, with a

lip of the same texture as the ridges. Under certain bottom conditions—apparently rocks and pebbles subject to influxes of fine sediment—a flexible arenaceous tube protrudes from the aperture. The tube is often broken but when preserved it may be as long as the test (Figure 4, Plate 21). Small specimens with only a few calcareous chambers were 0.4 mm. long and 0.3 mm. wide. Heavily ridged forms which meander across the rock surface were 2.3 mm. long and 1.5 mm. wide.

NOMENCLATURE

The work of Nyholm has raised interesting questions concerning the taxonomy of the Cibicididae and Planorbulinidae. Until these families can be restudied, it is most reasonable to use the parataxonomic category of *forma* as a stop-gap measure, as suggested by Boltovskoy (1961). As he has pointed out, *forma* has no status and does not enlarge our systematic household but still retains all the differences which are important in ecology and life-cycle studies. This new form, with its unusual ridges and aperture, occurs with such frequency that it seemed necessary to utilize some name. The Latin word for "tripe" was used, as it was descriptive, short, and not incumbered by references to any previously named allied genera. The new form is thus named: *Cibicides lobatulus* (Walker and Jacob), *forma omasicus*. This form and rough specimens of *Cibicides lobatulus*, like Figure 1, Plate 21, were probably the forms which Saidova (1964) referred to as *Cibicides cicatricosus* (Schwager), *Cibicides tuberculata* Natland, *Dyocibicides biserialis* Cushman and Valentine, and perhaps even *Anomalina polymorpha* Costa from a station north of the Queen Charlotte Islands. This is quite near station BB110-38, which contained almost all the forms illustrated in this paper.

OCCURRENCE

This form was found along the Washington, Oregon, British Columbia and Alaska coasts at depths of 17 to 139 fathoms. It may occur shallower, but no samples were available. An attached form, it occurs on pebbles, rocks or hard bottom. All the available samples of this sediment type examined from the Washington, Oregon, and British Columbia coasts contained the above described variant. However, it was found in only five of the eleven

samples examined from the Alaskan coast, although the involute *Cibicides lobatulus* was present. No limiting factor could be detected, as the sediment type, depth, temperature and latitude were similar to other localities where the form did occur. Table 1 lists the locations and depths of the stations where *Cibicides lobatulus* forma *omasicus* was found. Samples from Cobb Seamount, which rises to 18.5 fathoms, contained many involute *Cibicides lobatulus* but none of the new form.

TABLE 1
LOCATION OF STATIONS CONTAINING
THE NEW FORM

Station No.	Latitude (north)	Longitude (west)	Depth (fathoms)
BB108-34	43°13.1'	124°36.0'	57
BB108-28	44°15.6'	124°35.8'	59
BB291-31	44°25.8'	124°39.4'	74
BB108-25	44°43.1'	124°23.6'	58
BB108-20	45°43.3'	124°19.3'	81
BB291-56	45°55.2'	124°33.0'	65
BB291-11	47°22.9'	124°25.7'	17
BB312-12	48°06.3'	125°13.5'	90
BB322-4	48°26.9'	124°36.0'	130
BB322-2	48°17.6'	123°58.8'	102
BB322-1	48°14.5'	123°39.1'	95
BB110-43	54°30.0'	133°25.0'	139
BB110-38	54°33.3'	133°17.0'	91
Tord 2-21	58°14.7'	137°10.5'	64
Tord 2-3	58°37.1'	137°56.5'	52
Tord 2-14	58°47.9'	139°02.7'	124
Tord 2-8	58°49.2'	138°31.2'	59
BB110-7	59°53.7'	147°56.8'	85

LIFE CYCLE

Text figure 1 diagrams the life cycle of *Cibicides lobatulus* as described by Nyholm (1961). The involute *Cibicides lobatulus* (Figure 1, Plate 22) is the microspheric form, or schizont. By asexual reproduction, four-chambered schizozoites with calcareous tests are produced, which, after adding chambers, become evolute megalospheric gamonts (Figure 2, Plate 22). However, some of the schizozoites do not develop into the gamont stage but act as schizonts and asexually produce more four-chambered schizozoites. These are identical with the other calcareous schizozoites and may develop into the thin-walled gamont stage. The gamont disintegrates to produce gametes. Two gametes pre-

sumably unite to form a zygote. This uninucleate mass apparently develops an agglutinated coniform test. Under the coniform test a four-chambered tectin test develops which adds calcareous chambers. As the calcareous test grows the agglutinated outer test breaks down, exposing the top of the involute calcareous test. In the mature involute *Cibicides lobatulus* schizont, only a fringe of the agglutinated material remains.

Nyholm found that the involute *Cibicides lobatulus* at certain times of the year decalcified its test walls and presumably transformed to a flat crust with irregular chambers (Figure 8, Plate 22). This form, previously considered to belong to the genus *Planorbulina*, is a resting schizont of *Cibicides lobatulus*. The cytoplasm is concentrated in the center, but when the resting schizont starts to emit schizozoites the protoplasm migrates, little by little, to the outer chambers, which become quite porous (Figure 7, Plate 22). The schizozoites are flat, four-chambered, tectin forms which later develop calcareous chambers. Some of the schizozoites develop into forms like the planorbulinoidal resting stage but are differentiated from the resting stages formed from the involute *Cibicides lobatulus* by their tectin centers. The same generation of schizozoites may, depending on the conditions of growth, develop into forms which have been called *Cyclocibicides*, *Annulocibicides* and *Rectocibicides*. The new form, with the early tectin coiled portion, is most likely also of this generation. All these *Cibicides*-related forms produce schizozoites which are identical with the schizozoites produced by the planorbulinoidal resting schizont. Another variation these schizozoites may take is to become an evolute form like a gamont. Nyholm did not observe laboratory specimens of these forms emitting gametes, but identical forms collected from the field did produce them.

ACCESSORY STRUCTURES

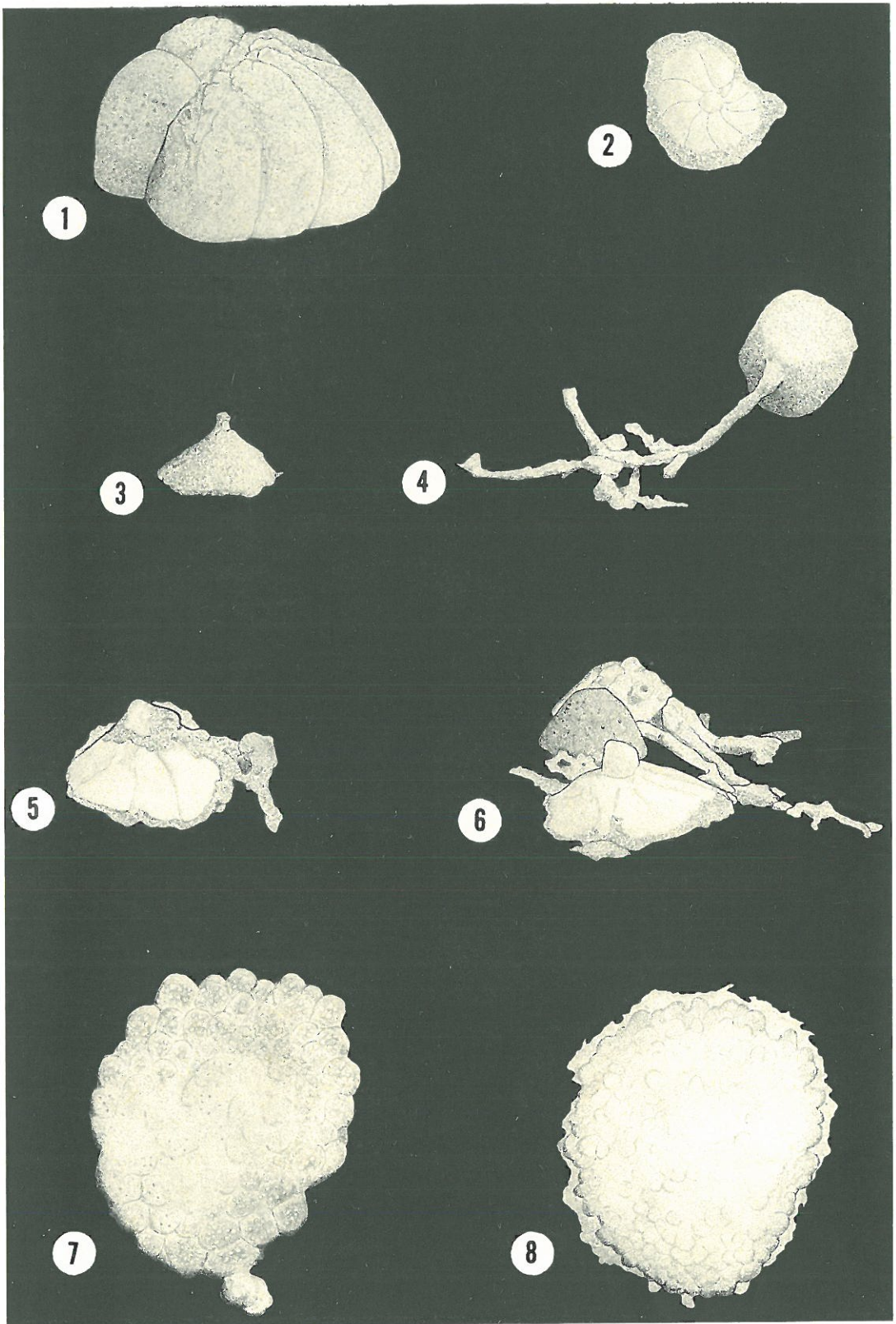
In well preserved specimens, flexible arenaceous tubes were found extending from the tests. The coniform stage often had a tube extending from the top (Figure 3, Plate 22), or, in later stages, from the apertural area. Usually one tube extended from the apertural area, but it was not uncommon to find it coming from another area, several tubes coming from one test, or branching tubes (Figure 4, Plate 22). The new ridged form also had an arenaceous tube coming from the aperture, but it was not ob-

EXPLANATION OF PLATE 21

Figs.		PAGE
1.	<i>Cibicides lobatulus</i> forma <i>omasicus</i> . Typical specimen. Station BB 312-12	137
2.	Young <i>C. lobatulus</i> forma <i>omasicus</i> with arenaceous tube. Station BB 110-38	137
3.	<i>C. lobatulus</i> forma <i>omasicus</i> . Three specimens intergrown. Station BB 312-12	137
4.	<i>C. lobatulus</i> forma <i>omasicus</i> with long arenaceous tube. Station BB 322-1	137



Cooper: A Variant of *Cibicides lobatulus*



Cooper: A Variant of *Cibicides lobatulus*

served to branch. Some of the rocks that were examined had a layer of sediment adhering to the surface. Almost all the specimens on these rocks had arenaceous tubes and the surface was a mass of branching and intertwining tubes. Many planorbulooidal resting stages were found on this type of rock, but they had no tubes. This substantiates Nyholm's findings that they are resting schizonts and do not feed.

A variation of the involute *Cibicides lobatulus* was found which has a clear calcareous knob filling the umbilicus (Figure 5, Plate 22). A form with sinuous sutures, it is often covered with arenaceous material, as is the involute *Cibicides lobatulus*.

Foraminifera with tubes and calcareous knobs are illustrated in Figure 6, Plate 22. The three specimens were clustered in an area 1.5 mm. long and 1.2 mm. wide. The foremost has a knob and remnants of the arenaceous test, the middle is an involute *Cibicides lobatulus* with a circular test; the farthest form is completely covered with agglutinated material and has several tubes, some broken and others branching.

SUMMARY

In the complex life cycle of *Cibicides lobatulus*, Nyholm found that the different Cibicidinae genera, *Planorbulina*, and a form with an arenaceous coniform test are all related. The new form described in this paper apparently is a schizozoite of the planorbulooidal resting schizont. The early tectin cham-

bers, and the development of arenaceous tubes are indicative of this. The recurrent association of *Cibicides lobatulus*, the planorbulooidal stage, and the ridged form is also significant. To add another generic or specific name to this group would be adding more confusion to the existing taxonomic disorder made apparent by Nyholm's work.

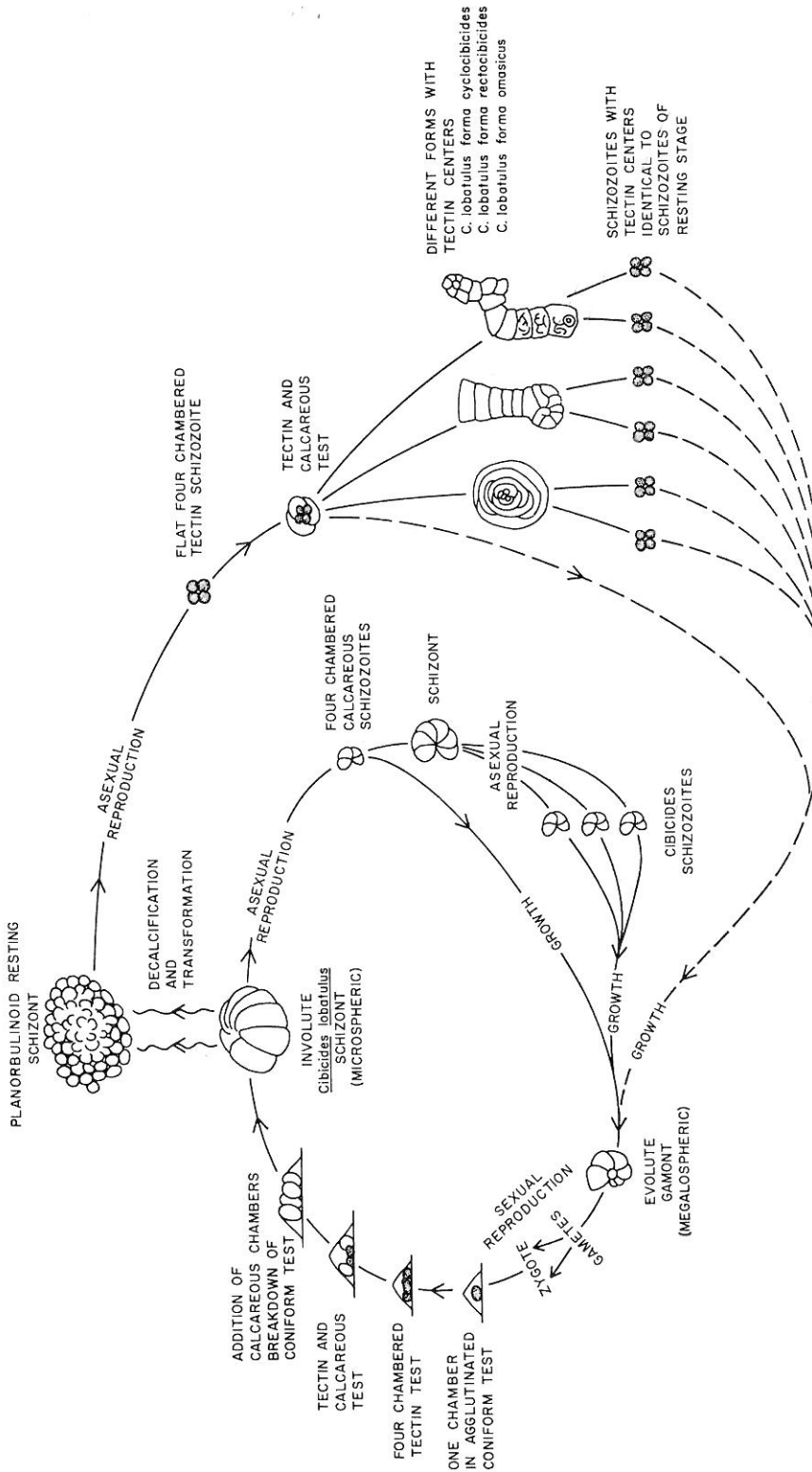
The use of *forma* is suggested as a stop-gap measure and the new form is called *Cibicides lobatulus* (Walker and Jacob), *forma omasicus*.

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EXPLANATION OF PLATE 22

FIGS.	PAGE
1. <i>Cibicides lobatulus</i> (Walker and Jacob). Typical microspheric form. Station T. 204	138
2. Gamont. Megalospheric form. Station BB 110-38	138
3. Coniform stage with short arenaceous tube. Station BB 110-38	138
4. Test covered with agglutinated material showing branching tubes. Station BB 110-38	138
5. <i>Cibicides lobatulus</i> with knob and remnants of agglutinated test and tube. Station BB 110-38	139
6. <i>Cibicides</i> group. Foremost: with knob and fringe of agglutinated material; middle: involute <i>Cibicides lobatulus</i> with a dark porous test; farthest: agglutinated test with branching tubes, some broken. Station BB 110-38	139
7. Planorbulooidal stage. Thick specimen showing dense center and porous outer chambers. Station BB 322-2	138
8. Planorbulooidal stage. Crust-like specimen showing some porous chambers. Station BB 322-2	138



TEXT FIGURE 1
Diagram of the life cycle of *Cibicides lobatulus* (Walker and Jacob) after Nyholm.