5. SOME CRETACEOUS PLANKTONIC FORAMINIFERS (*FAVUSELLA*) OF DSDP SITE 397 (EASTERN NORTH ATLANTIC)

Wolfgang Rösler, Gerhard F. Lutze, and Uwe Pflaumann, Geologisch-Paläontologisches Institut der Universität Kiel, Federal Republic of Germany

ABSTRACT

In the lower section of DSDP Site 397 (Cores 34 to 52) the microfauna, although very rare, contains small amounts of the planktonic foraminiferal genus *Favusella*. The stratigraphic range of *Favusella* species has to be extended down to at least late Hauterivian.

Favusella stiftia n.sp. is described as a new species.

INTRODUCTION

DSDP Site 397 was drilled in the eastern North Atlantic (see Figure 1) on the continental margin between the Canary Islands and northwestern Africa (26°50.7'N, 15°10.8'W, 2900 m water depth). Below 1300 meters of Neogene strata, a 153-meter section (Core 397A-34 to Core 397A-52) of dark gray mudstone was penetrated. The nannofossil age determination of this section is late Hauterivian. According to the shipboard party, the lithology of this section is an alternation of mudstones and thin siderite layers, with numerous varve-like laminations, not disturbed by a few small burrows. In the lower part of this section, small deformation structures (faults and slumps) and isolated clasts were found. The dominant grain size is silt and clay. Fossils are very rare; occasionally some wood debris, fish remains, and (in some cores) abundant nannoplankton are present. Most samples contain only a few, very tiny foraminifers (< 10 specimens/15 cm^3 sediment). Therefore, these samples are unsuitable for a quantitative analyses, such as plankton-benthos ratio. The benthic microfauna consists of some lenticulinas, epistominas, miliolids, and agglutinated foraminifers. They are discribed by Basov, Lopatin, et al. (this volume) and by Butt (this volume).

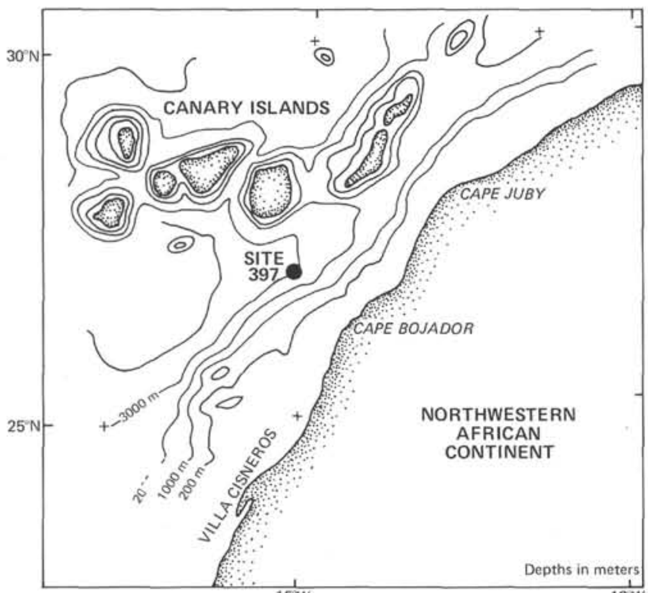

Figure 1. *Location of Site 397.*

PLANKTONIC FORAMINIFERS AND STRATIGRAPHIC POSITION

In general, the planktonic foraminifers are poorly preserved and very small, most of them do not exceed 125 μm in diameter. In contrast to their first appearance under the light microscope, the stereoscan micrographs reveal distinctly reticulated surfaces on most specimens studied. They must be referred to the genus *Favusella* Michael. Their distribution at Site 397 is given in Figure 2. Within their range at this site, the peculiarities of the forms remain constant; evolutionary trends were not recognized.

Besides these favusellas, rare foraminifers are somewhat similar to "*Clavihedbergella simplex* (Morrow)" as figured by Fuchs, 1971 (pl. 10, fig. 4 and 6) from the Drusbergschichten (Barremian) of Vorarlberg (western Austria), but our specimens are preserved too poorly for a definite determination (see Plate 2, Figures 3 to 6).

The genus *Favusella* seems to have a worldwide distribution (see Loeblich and Tappan, 1961, p. 278; Michael, 1972, p. 216). According to present knowledge, the stratigraphic range of *Favusella* is Aptian (?) to Cenomanian (see Figure 3). The two earliest occur rences were reported from the Aptian of the Scotian Shelf of Atlantic Canada (Ascoli, 1976, sub *Favusella* aff. *washitensis*) and from the upper part of the lower Albian of the Bavarian Limestone Alps (Risch, 1971, sub *Hedbergella washitensis*). As an early occurrence in northwestern Germany, *Favusella* cf. *hiltermanni* and *Favusella* cf. *washitensis* were found southeast of Hanover in the upper part of the middle

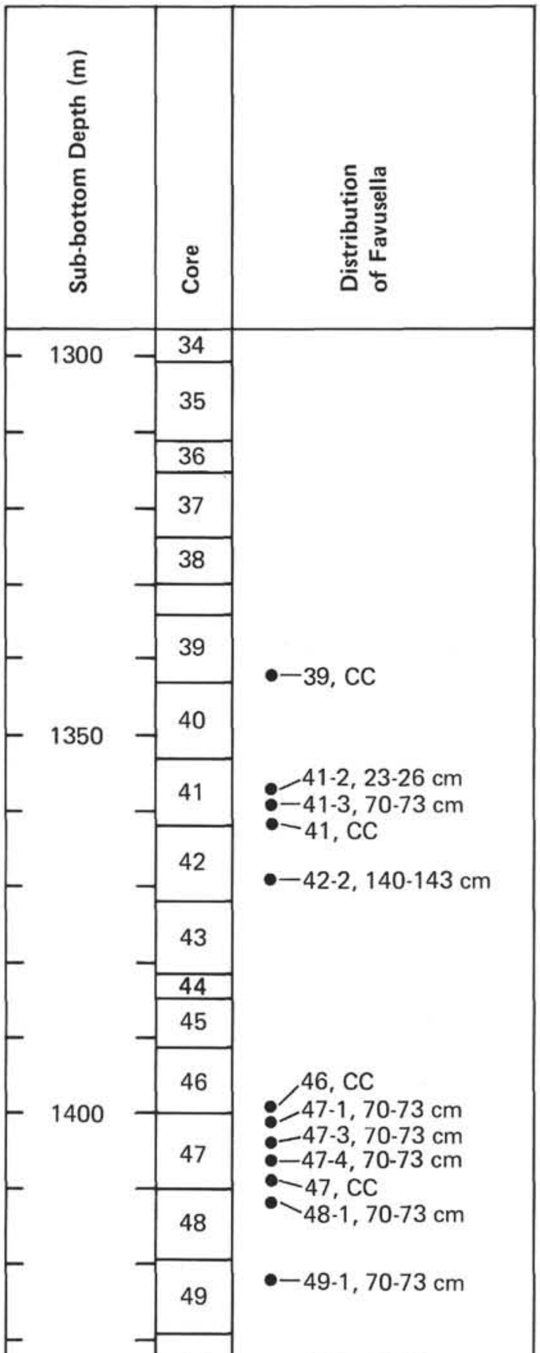

Figure 2. *Distribution of* Favusella *within Hole 397A.*

Albian (unpublished diplom. thesis by Reiter at Kiel, 1978; age determination based on benthic foraminifers, which are correlated to ammonite zones in nearby outcrops). The extinction date of *Favusella* is reported within the early Cenomanian by most authors. Scattered occurrences of *Favusella washitensis* or/and *Favusella hiltermanni* from the middle and upper Cenomanian are mentioned by Koch (1977). From DSDP data, specimens which are now attributed to *Favusella* have been reported (sub *Hedbergella washitensis*) from:

1) Site 97 (in the Florida Strait), Cores 6 to 10, *Rotalipora greenhornensis* Zone, late-early Cenomanian (McNeely, 1973, p. 681).

2) Site 105 (lower continental rise hills, off USA), Core 11, late Albian to early Cenomanian (Luterbacher, 1972, p. 569).

3) Site 144 (flank of Demerara Rise, off Surinam), Samples 5, CC and 6-1, 134-137 cm, Albian to early Cenomanian (Beckmann, 1972, p. 420).

The hitherto known ranges of *Favusella* species are compiled in Figure 3. Up to now, they were believed to separate from the *Hedbergella*-stock in the Albian, according to Longoria and Gamper (1975, fig. 2).

Because of the occurrence of *Favusella* in our samples, which are dated by nannofossils as late Hauterivian, the genus range of *Favusella* must be extended back to at least late Hauterivian time.

However, the foraminiferal age, determined by the Russian group (Basov, Lopatin, et al., this volume), as well as the age determination of Butt (this volume) is younger than the age deduced from nannofossils. Their findings support a "Barremian to Aptian" age. Three ammonite fragments considered by Wiedmann (this volume) to be of Hauterivian to Barremian age are not too useful because the author ascribed long ranges to all of them. Up to now, the conflict between the foraminiferal ages Barremian-Aptian (Butt, Basov), and the nannofossil age late Hauterivian (Čepek, Wind) is not resolved.

Other paleontologists (Butt, this volume, and Koch, personal communication) have found *Hedbergella hoterivica* in samples of this section. Therefore, a connection between our favusellas and the so-called *Hedbergella hoterivica* was considered. As knowledge is incomplete about planktonic foraminifers of the Lower Cretaceous, different species might have been placed in *Hedbergella hoterivica.*

Ascoli (1976) has figured one specimen with surface ornamentation as *Caucasella hoterivica* (pl. 1, fig. 3). Dailey (1973) mentioned and figured sub *Globigerina hoterivica* specimens, which "are somewhat more coarsely perforate" than specimens from the original type material, "but otherwise appear to be typical."

Therefore, we believe that several specimens with surface ornamentations, which should have been attributed to *Favusella*, have been placed in *Hedbergella hoterivica.*

However, our favusellas are not identical with *Hedbergella hoterivica* (Subbotina) (sensu strictu), as this species is clearly defined by Subbotina (1953) to have a smooth wall with fine pores. Subbotina would have noted rough surface structures because of her high standard of careful observation.

However, Gorbatchik (personal communication at the International Symposium "Deutsche Kreide," April of 1978, Münster) observed similar surface ultrastruc-

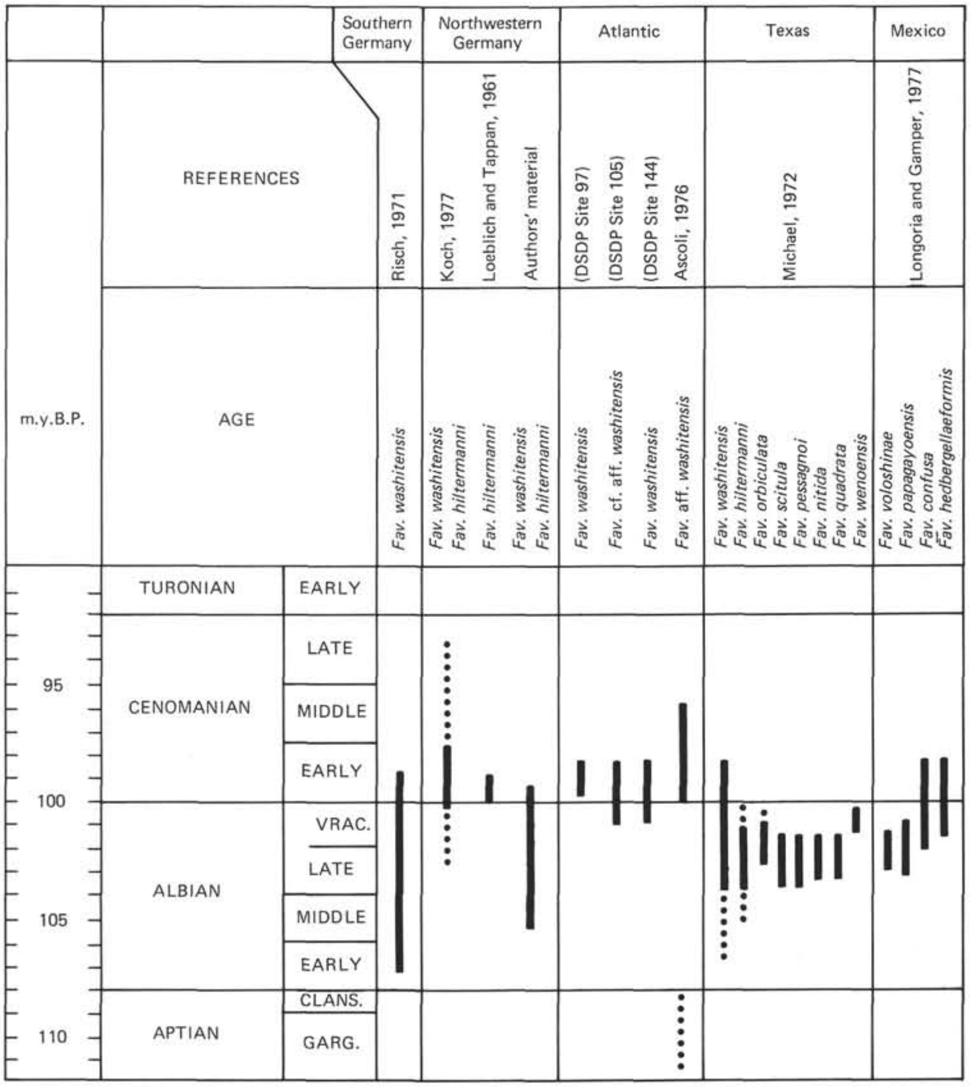

Figure 3. *Stratigraphic range of* Favusella.

tures by SEM investigations on upper Jurassic and Lower Cretaceous planktonic foraminifers of Russian material.

Further investigations on type samples with Subbotina's "*Globigerina*" *hoterivica* are in progress to solve the generic position of this species.

Longoria (1974) interpreted the surface ornamentation of *Favusella* as an environmental adaptation and stated: "the Favusellidae are restricted to shallow neritic environments (inner neritic depth zone)." Michael (1972) reported, that *Favusella* has not been found in bathyal and abyssal deposits. He suggested that the distribution of *Favusella* is influenced by certain environmental parameters, such as salinity. In northern Germany, *Favusella* occurs in beds deposites in water depths estimated at some hundred meters. However, further investigations are needed to ascertain if this paleoecological aspect is also applicable to the pre-Albian precursors.

Paleontological

After Michael (1972, p. 213), the "most diagnostic feature of *Favusella*, n. genus, is its striking pattern of ornamentation composed of coarsely polygonal pattern to the test." This is its main difference from the genus *Hedbergella*. *Favusella* differs from *Globigerina* in having numerous pores in the polygonal areas (see Plate 1, Figures 1d and 4), whereas *Globigerina* has only one large pore per polygonal area. These two characteristics were found in all the specimens designated as *Favusella* found in Cretaceous samples from DSDP Site 397.

Our specimens are generally smaller (100 to 150 μm) than those previously figured; all have four chambers in the last whorl. Their small size is believed the reason for the genus not being recognized by light microscope inspection. A striking characteristic of some of our specimens is the presence of a size-reduced ultimate chamber instead of a normal final chamber. In addition to the description of Michael (1972), Longoria (1974) noticed the following: ". . . The forms included in *Favusella* often show a bulla-like rudimentary ultimate chamber, which covers partly or completely the umbilical area." He also stated (in describing *Favusella washitensis* [Carsey], p. 75) the small last chamber is always devoid of ornamentation. Longoria and Gamper (1975, p. 65) named this size-reduced final chamber "pseudobulla," and added that this pseudobulla seems to have an imperforate structure. In contrast to these observations, the small ultimate chambers of our specimens show at least an indication of ornamentation and have pores in some cases. Ornamentation often changes within the last whorl. The polygonal structures of the ultimate and penultimate chambers are smaller than those of older chambers.

We found more than 30 specimens which can be attributed to the genus *Favusella.* Of these, eight specimens belong to *Favusella stiftia* n. sp.

TAXONOMY

Family FAVUSELLIDAE Longoria, 1974
Genus FAVUSELLA Michael, 1972
***Favusella stiftia* n. sp.**
(Plate 1, Figures 2-4)

Derivatio nominis: The species is named in memory of the former site of our laboratory in Altenholz-Stift near Kiel.

Holotype: 1 complete test, maximum diameter 125μm.

Type locality: DSDP Site 397, eastern North Atlantic between the Canary Islands and northwestern Africa. Sample 47A-397A-47-1, 5-8 cm.

Stratigraphic range: *Favusella stiftia* n. sp. occurs in Samples 397A-47-1, 5-8 cm, to 397A-47-4, 14-17 cm. Based on nannofossils, its age determination is late Hauterivian.

Paratypes: 7 specimens, diameter: 100 to 125 μm.

Diagnosis: A species of the genus *Favusella* Michael, 1972 with the following significant characteristics: 4 chambers in the last whorl, size-reduced final chamber with ornamentation, primary aperture umbilical to slightly extraumbilical with a distinct apertural lip.

Description: Test small with a moderate trochospire. The last whorl is formed by four chambers, increasing gradually in size as added. The final chamber is reduced in size. Chambers of the last whorl are globular. Sutures are depressed, straight, radial. Primary aperture is interiomarginal, umbilical to slightly extraumbilical with a distinct apertural lip. Surface ornamentation formed by irregular polygonal areas, which contain several pores. Size-reduced final chamber with an indication of ornamentation. Umbilical area often covered by the last chamber, small and deep.

Variation of species: Within the small number of specimens, *Favusella stiftia* n.sp. shows variation in size of the final chamber, but it always remains smaller than the penultimate chamber. The apertural lip also changes in dimension, but never becomes a rim.

Remarks: *Favusella stiftia* n. sp. differs from *Favusella hedbergellaeformis* Longoria and Gamper, *Favusella hiltermanni* (Loeblich and Tappan), *Favusella nitida* Michael, *Favusella orbiculata* Michael, *Favusella pessagnoi* Michael, *Favusella quadrata* Michael, and *Favusella scitula* Michael in being much smaller in size and having less chambers in the last whorl. It differs from *Favusella confusa* Longoria and Gamper, and *Favusella wenoensis* Michael in having a size-reduced final chamber. From *Favusella voloshinae* Longoria and Gamper, it can be distinguished in having a more umbilically situated primary aperture. From *Favusella washitensis* (Carsey), it can be distinguished in having a smaller umbilical area and a small final chamber with polygonal ornamentation.

Favusella stiftia n. sp. differs from *Globigerina kugleri* Bolli in being much smaller (less than half as large) and having a reticulated surface ornamentation. The aperture is not a high, but mostly a small and low arch. Additionally, *Favusella stiftia* n. sp. has a distinct apertural lip instead of a small rim.

Besides the surface ornamentation, *Favusella stiftia* n. sp. can be distinguished from *Hedbergella hoterivica* (Subbotina) in having a large and distinct apertural lip instead of a small lip in the form of a narrow border.

Deposition of holotype: The holotype, as well as negatives of scanning electron micrographs, are deposited in the collection of the Geol.-Paleontological Institute and Museum, Kiel University, FRG.

ACKNOWLEDGMENTS

We want to thank Dr. A. Butt, P. Čepek, T. Gorbatchik, W. Koch, H.P. Luterbacher, U. von Rad, M. Sarnthein, and J. Wiedmann for many interesting discussions and helpful information. The scanning electron micrographs were made with the assistance of Mr. W. Reimann.

This contribution was supported by the Deutsche Forschungsgemeinschaft (German research society).

REFERENCES

Ascoli, P., 1976. Foraminiferal and ostracod biostratigraphy of the Mesozoic-Cenozoic, Scotian-Shelf, Atlantic Canada. 1st. Int. Symp. on benthic foraminifera of continental margins, Part B: Paleoecology and biostratigraphy, *Maritime Sediments,* Spec. Pub. 1, p. 653-771.

Beckmann, J. P., 1972. The foraminifera and some associated microfossils of Sites 135 to 144. *In* Hayes, D. E., Pimm, A. C., et al., *Initial Reports of the Deep Sea Drilling Project*, v. 14: Washington (U.S. Government Printing Office), p. 389-420.

Dailey, D., 1973. Early Cretaceous foraminifera from the Budden Canyon Formation, Northwestern Sacramento Valley, California, *University of California Publications in Geol. Sciences*, v. 106.

Fuchs, W., 1971. Eine alpine Foraminiferenfauna des tieferen Mittelbarreme aus den Drusbergschichten vom Ranzenberg bei Hohenems in Vorarlberg, *Abh. Geol. Bundesanstalt Wien*, v. 27.

Koch, W., 1977. Biostratigraphie in der Oberkreide und Taxonomie von Foraminiferen, *Geol. Jb.*, Reihe A., v. 38, p. 11-123.

Loeblich, A.R, Jr., and Tappan, H., 1961. Cretaceous planktonic foraminifera: Part 1—Cenomanian, *Micropaleontology,* v. 7, p. 257-304.

Longoria, J.F., 1974. Stratigraphic, morphologic and taxonomic studies of Aptian planktonic foraminifera, *Rev. Esp. Micropaleont.*, num. extra-ord. 1974.

Longoria, J.F., and Gamper. M.A., 1975. The classification and evolution of Cretaceous planktonic foraminifera. Part 1: The superfamily Hedbergelloidea, *Rev. Esp. Micropaleont.*, num. especial 1975, p. 61-96.

_______, 1977. Albian planktonic foraminifera from the Sabinas Basin of northern Mexico, *J. Foram. Res.*, v. 7, p. 196-215.

Luterbacher, H., 1972. Foraminifera from the Lower Cretaceous and Upper Jurassic of the Northwestern Atlantic. *In* Hollister, C. D., Ewing, J. I., et al., *Initial Reports of the Deep Sea Drilling Project*, v. 11: Washington (U. S. Government Printing Office), p. 562-593.

McNeely, B. W., 1973. Biostratigraphy of the Mesozoic and Paleogene pelagic sediments of the Campeche Embankment Area. *In* Worzel, J. L., Bryant, W., et al., *Initial Reports of the Deep Sea Drilling Project*, v. 10: Washington (U. S. Government Printing Office), p. 679-686.

Michael, F. Y., 1972. Planktonic foraminifera from the Comanchean Series (Cretaceous) of Texas, *J. Foram. Res.*, v. 2, p. 200-220.

Risch, H., 1971. Stratigraphie der höheren Unterkreide der bayrischen Kalkalpen mit Hilfe von Mikrofossilien, *Palaeontographica,* Abt. A, v. 137, p. 1-80.

Subbotina, N.N., 1953. Fossil Foraminifera of the USSR. Globigerinidae, Hantkeninidae and Globorotaliidae, *Trudy VNIGRI*, v. 76, p. 1.

PLATE 1

Figure 1	*Favusella stiftia* n. sp. Holotype. Sample 397A-47-1, 5-8 cm. 1a. Umbilical view, 500×, 10 kV, neg. no. 1769/29. 1b. Peripheral view, 500×, 10 kV, neg. no. 1769/28. 1c. Spiral view, 500×, 10 kV, neg. no. 1769/32.
Figure 2	*Favusella stiftia* n. sp. Paratype. Sample 397A-47-1, 5-8 cm. 2a. Umbilical view, 500×, 10 kV. 2b. Peripheral view, 500×, 10 kV.
Figure 3	*Favusella stiftia* n. sp. Paratype. Sample 397A-47-4, 14-17 cm. Ultrastructure of the last chamber, 2500×, 10 kV. Note the numerous pores within the polygonal areas.
Figure 4	*Favusella stiftia* n. sp. Paratype. Sample 397A-46, CC. 4a. Umbilical view, 500×, 10 kV. 4b. Ultrastructure (antepenultimate chamber), 2500×, 10 kV. 4c. Ultrastructure (lip), 2500×, 10 kV.
Figure 5	*Favusella* sp. Sample 397A-49-1, 70-73 cm. 5a. Umbilical view, 500×, 10 kV. 5b. Peripheral view, 500×, 10 kV. 5c. Spiral view, 500×, 10 kV. One small specimen without a size-reduced last chamber. This specimen has a large apertural lip and depressed sutures.

PLATE 1

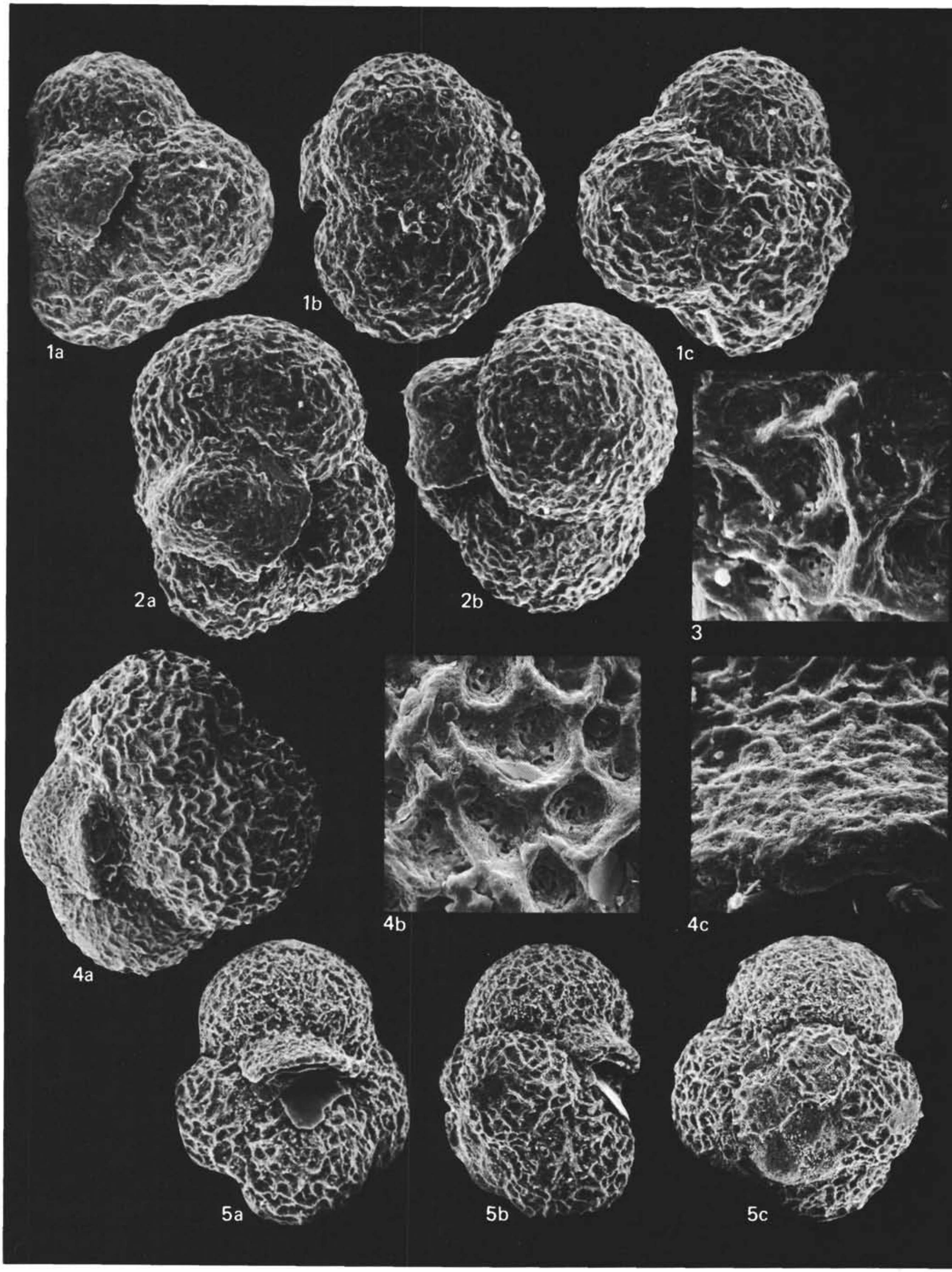

PLATE 2

Figure 1 *Favusella* sp. Sample 397A-50-3, 24-27 cm.
1a. Umbilical view, 500×, 10 kV.
1b. Peripheral view, 500×, 20 kV.
1c. Umbilical view, 500×, 20 kV.
One small specimen with less depressed sutures, which give the test a globular appearance. It differs from *Favusella stiftia* n. sp. and *Favusella* sp. on Plate 1, Figure 5 in having no apertural lip.

Figure 2 *Favusella* sp. Sample 397A-46, CC.
2a. Umbilical view, 500×, 10 kV.
2b. Peripheral view, 500×, 10 kV.
2c. Ultrastructure, 2500×, 10 kV.

Figures 3-6 *Hedbergella?* sp., somewhat similar to "*Clavihedbergella simplex,*" as figured by Fuchs, 1971.
3. Sample 387A-46, CC, spiral view, 500×, 10 kV.
4. Sample 397A-46, CC, umbilical view, 500×, 10 kV.
5. Sample 397A-47, CC, spiral view, 500×, 10 kV.
6a. Sample 397A-46, CC, umbilical view, 500×, 10 kV.
6b. Sample 397A-46, CC, peripheral view, 500×, 10 kV.
6c. Sample 397A-46, CC, spiral view, 500×, 10 kV.
6d. Sample 397A-46, CC, ultrastructure, 2500×, 10 kV.

PLATE 2