RECONSIDERATION OF THE SO-CALLED OLIGOCENE FAUNA IN THE ASPHALTIC DEPOSITS OF BUTON (MALAY ARCHIPELAGO)

2. YOUNG-NEOGENE FORAMINIFERA AND CALCAREOUS ALGAE

BY

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Abstract

Miopliocene marls from the island of Buton yield a large marine foraminiferal fauna and some calcareous algae. Three-hundred and thirthy-three species have been identified. Two genera, twenty-three species and four varieties are described as new.

The existence of mud-volcanoes in young neogene time is advocated.

CONTENTS

I. INTRODUCTION

The island of Buton is situated off the southeastern tip of the island of Celebes in the Indonesian Archipelago. Mollusks and corals from tertiary asphalt marls have been described by various palaeontologists with controversial results. The examination of the foraminiferal fauna is meant to offer a contribution to the solution of this stratigraphical problem.

The study of the foraminifera was started in 1942, when Dr. D. THÖENES sent a number of foraminifera concentrates — obtained from asphalt marls by extraction of the asphalt with carbon bisulfide — to the Geological Institute of the University of Utrecht. The writer is much indebted to the late professor L. M. R. RUTTEN for permission to study these samples. More samples were kindly supplied by professor J. H. F. UMBGROVE and Dr. P. KRUIZINGA of the Delft Polytechnical University. Some additional samples were found in the collections of the Geological Institute at Utrecht, were most of the determination work was done. The manuscript was largely

completed in Cuba, where the late Mrs. DOROTHY K. PALMER and Dr. P. J. BERMÚDEZ kindly offered the writer the use of their respective libraries.

The writer is very grateful to Dr. C. BEETS, who was always ready to offer helpful suggestions and who volunteered to look after the publication of this paper. Dr. C. O. VAN REGTEREN ALTENA kindly undertook the onerous task of proof reading for which valuable help I wish to express my indebtedness.

All slides containing specimens of foraminifera and algae have been deposited in the collections of the Geological Institute at Utrecht.

Guatemala, 7th August, 1949.

II. DISCUSSION OF THE FORAMINIFERAL FAUNA

Most of the identified foraminifera have been listed in Table I. For reasons which will become apparent further on, the samples listes in this table will be discussed in two groups.

A. Age.

1. The group C-1w, C-1b, C-21, C-2d, C-3. (abbreviated as C-1 — C-3).

These samples derive from the Kabungka asphalt field. Dr. THÖENES described the samples as follows:

C-1b (C-1 brown): is a sample from a curved fissure filled with asphalt.
C-1w (C-1 white): is a sample from the surrounding white marl, containing very little asphalt.
C-2d (C-2 dark): is a sample from a layer of 50 centimeters thickness and small horizontal extension, lying below C-1w. The fissure C-1b starts upwards from this layer.
C-21 (C-2 light): is a sample from the marls surrounding the asphalt lens C-2d. It contains but little asphalt.
C-3. is a sample from a layer of asphalt marl some two meters below C-21: it seems to have no connection with C-2d.

The foraminiferal fauna of these samples is fairly uniform and, as judged from the ranges of species cited in the literature on the Japanese, Indopacific and Australian regions, its age must be regarded as Miopliocene. Larger foraminifera are completely absent, probably due to facies conditions. Because of the scant published data on the stratigraphical distribution of smaller foraminifera in the East Indies — at least on those from the faunae of the eastern part of the Indonesian archipelago — it is impossible to arrive at a closer determination of the age.

2. The group 287, A, D, SI.

These samples have been kept apart from the first group because they contain mollusks belonging to a fauna which has been regarded by K. MARTIN — and originally also by C. BEETS — as Oligocene.

287: is a sample from the Utrecht collection, which will be discussed again in chapter IV.
A: is a sample from the mould of *Arca perinusitata* BEETS (lit. 1).
D: is a sample from the Delft collection of the Waisiu field.
Si: is a sample from asphalt in the apex of a *Siphonalia* from the Delft collection.

TABLE I

	287	A	D	SI	C—1w	C—1b	C—2l	C—2d	C—3
1. *Amphycoryne falx* (JONES & PARKER)	vr								
2. *Amphimorphinella butonensis* nov. gen. nov. sp.	r					vc		c	r
3. *A. butonensis* nov. sp. var. *minuta* nov. var.	r								
4. *A. butonensis* nov. sp. var. *compressa* nov. var.	vc	r							c
5. *Amphistegina radiata* (FICHTEL & MOLL)	vc	vc	c			r			
6. *Angulogerina angulosa* (WILLAMSON)	r			x		r			
7. *Anomalina ammonoides* (REUSS)	vr	r							
8. *A. glabrata* CUSHMAN	c								
9. *A. semipunctata* (BAILEY)	vr				vc	r	c	r	r
10. *A. thalmanni* VAN BELLEN					c				
11. *Astacolus crepidulus* (FICHTEL & MOLL)	r								
12. *Astrononion tumidum* (CUSHMAN & EDWARDS)						r			
13. *Bifarina thöenesi* nov. sp.	vr								
14. *Bigenerina nodosaria* D'ORBIGNY	r		r						
15. *Bolivina arta* MACFADYEN	r					r			
16. *B. aspera* CLODIUS	r		r			vc	r	r	c
17. *B. compacta* SIDEBOTTOM	r					vc	c	r	vc
18. *B. crespinae* CUSHMAN			r						
19. *B. decussata* BRADY									r
20. *B. globulosa* CUSHMAN	r								c
21. *B. hantkeniana* BRADY			r						
22. *B. jugosa* (BRADY)	r								
23. *B. ligularia* SCHWAGER	r		r		r				
24. *B. pseudobeyrichi* (CUSHMAN)	vr					r			r
25. *B. pseudopygmaea* CUSHMAN	r								
26. *B. rhomboidalis* (MILLETT)	r		cc					r	vc
27. *B. robusta* BRADY	r								
28. *B. scalprata* SCHWAGER var. *miocenica* MACFADYEN	vr		r		r	r		r	r
29. *B. scalprata* SCHWAGER var. *retiformis* CUSHMAN	r		c		r	vc		r	vc
30. *B. spinea* CUSHMAN			r		r				
31. *B. striatula* CUSHMAN	vr								
32. *B. seranensis* GERMERAAD	c				r			r	r
33. *B. subtenuis* CUSHMAN	vr								
34. *B. tortuosa* BRADY	r		A			vc		r	c
35. *B. victoriana* CUSHMAN	vr								
36. *Bulimina ovata* D'ORBIGNY	vr								
37. *B. ovula* D'ORBIGNY	vr								
38. *B. rostrata* BRADY	r					r			r
39. *B. striata* D'ORBIGNY	vr	r			r	r			r
40. *B.* sp.	vr								r
41. *Buliminella sculpturata nov. sp.*	r					vc		vc	vc
42. *B. septata* nov. sp.			vc			r		vc	r
43. *Cancris auricula* (FICHTEL & MOLL)	vr								
44. *C. indica* (CUSHMAN)	vr								
45. *C. philippinensis* (CUSHMAN)	vr								
46. *Candeina nitida* D'ORBIGNY	c							r	
47. *Cassidulina butonensis* nov. sp.	r								
48. *C. delicata* CUSHMAN	c		c		c	vc	r	vc	vc
49. *C. laevigata* D'ORBIGNY								r	
50. *C. laevigata* D'ORBIGNY var. *carinata* CUSHMAN	r		r			r		r	r
51. *C. minuta* CUSHMAN	r					r		r	r
52. *C. moluccensis* GERMERAAD	r		c			c		r	r
53. *C. multicamerata* nov. sp.	r		r						
54. *C. pacifica* CUSHMAN	vc	r	c		A	A	A	A	A
55. *C. patula* CUSHMAN	r								
56. *C. perumbonata* nov. sp.			r			r		vc	
57. *C. subglobosa* BRADY	c	vc	c					A	vc

TABLE I (continued)

	287	A	D	SI	C—1w	C—1b	C—21	C—2d	C—3
58. *Cassidulinoides bradyi* (NORMAN)	vr								
59. *C. parkerianus* (BRADY)						r			r
60. *Ceratobulimina contraria* (REUSS)	vr	r							
61. *C. pacifica* CUSHMAN & HARRIS	vr								
62. *Chrysalidinella dimorpha* (BRADY)	vr								
63. *Cibicides americanus* (CUSHMAN)	r								r
64. *C. bradyi* TOLMACHOFF	r				c				r
65. *C. lobatulus* (WALKER & JACOB)	r				r				
66. *C. lobatulus* (WALKER & JACOB) var. *grossa* TEN DAM & REINHOLD	r								
67. *C. pseudoungerianus* (CUSHMAN)	vc	r	r	x	A	A	A	vc	vc
68. *C. refulgens* (MONTFORT)	r		r						r
69. *C. victoriensis* CHAPMAN, PARR & COLLINS)	vr								
70. *Clavulina bradyi* CUSHMAN			r						
71. *Clavulinoides indiscretus* (BRADY)	vr		vc						
72. *C. fijiensis* nov. sp.			c					r	r
73. *C. szaboi* (HANTKEN)	r					r			
74. *C.* sp.	vr								
75. ? *Cribrogoësella* sp.	vr								
76. *Cristellaria (R.) calcar* (LINNÉ)	vr					r			r
77. *C. (R.) costata* (FICHTEL & MOLL)	vr								
78. *C. (R.) costata* (FICHTEL & MOLL) var. *subdecorata* CUSHMAN	r								
79. *C. (R.) cultrata* (MONTFORT)	vr	r	r						
80. *C. (L.) dicampyla* FRANZENAU	vr								
81. *C. (R.) foliata* STACHE	r					r			
82. *C. (L.) gibba* (D'ORBIGNY)	r					r			
83. *C. (R.) lucida* CUSHMAN	vr		r						
84. *C. (R.) orbicularis* D'ORBIGNY	vr			x					r
85. *C. (R.) polita* SCHWAGER			r						
86. *C. (L.) reniformis* D'ORBIGNY	vr								
87. *C. (L.) rotulata* (LAMARCK)	r	r	r		r	r	r	c	c
88. *C. (R.) vortex* (FICHTEL & MOLL)	vr	vr							
89. *Cymbalopora bradyi* CUSHMAN	r	c	c						
90. *Cymbaloporetta squamosa* (D'ORBIGNY)	r								
91. *Dentalina atlantica* (CUSHMAN)	r								
92. *D. consobrina* D'ORBIGNY var. *emaciata* REUSS	vr	r				r			
93. *D. cooperensis* CUSHMAN	r								
94. *D. costai* SCHWAGER	vr								
95. *D. mucronata* NEUGEBOREN	vr								
96. *D. neugeboreni* SCHWAGER	r	r							r
97. *D. roemeri* NEUGEBOREN	vr								
98. *D. semilaevis* HANTKEN	vr					r			
99. *D. soluta* REUSS								r	
100. *D. tauricornis* SCHWAGER	vr								
101. *Discorbis mira* CUSHMAN	vr								
102. *D. opima* CUSHMAN	r								r
103. *D. planulinaformis* nov. sp.	r				r	c		c	r
104. *D. procera* (BRADY)	r	r				r			
105. *D. rarescens* (BRADY)	vr								
106. *Dorothia pauperoula* (CUSHMAN)	r		r						
107. *D. robusta* nov. sp.	r	r	r						
108. *Ehrenbergina albatrossi* CUSHMAN						r			
109. *E. hystrix* BRADY	vr					r		vc	
110. *E. pacifica* CUSHMAN	c	r	vc		r	c		r	r
111. *E. rugosa* nov. sp.	r								
112. *E.* sp.	vr								

TABLE I (continued)

	287	A	D	SI	C—1w	C—1b	C—2l	C—2d	C—3
113. *Ellipsoidina ellipsoideo* SEGUENZA								r	
114. *Elphidium advenum* (CUSHMAN) var. *depressula* CUSHMAN	vr								
115. *E. crispum* (LINNÉ)	r		r		r	r			
116. *E. macellum* (FICHTEL & MOLL)	vc	c	r			r	r	r	r
117. *E. macellum* (FICHTEL & MOLL) var. *limbatum* (CHAPMAN)	vr								
118. *E. oceanicum* CUSHMAN	vr		r						r
119. *E. rugosum* (D'ORBIGNY)	r	c	r		r	r	r		r
120. *Epistomina elegans* (D'ORBIGNY)	c	vc	vc			r			r
121. *Epionides haidingeri* (D'ORBIGNY)	vr					r			
122. *E. nanus* (REUSS)	vr								
123. *E. praecinctus* (KARRER)		r	r					r	
124. *E. tubiliferus* (HERON-ALLEN & EARLAND)	r	r		x					
125. *E. umbonatus* (REUSS)	vr	r			c	vc	c	r	c
126. *E. umbonatus* (REUSS) var. *multisepta* KOCH	vr								
127. *Flintia robusta* BRADY	vr								
128. *Gaudryina collinsi* CUSHMAN			r						
129. *G. solida* (SCHWAGER)			r						
130. *Globigerina altispira* CUSHMAN & JARVIS	A	A	A		A	A	A	A	A
131. *G. bulloides* D'ORBIGNY	A	A	A			A		A	A
132. *G. conglomerata* SCHWAGER	A		A						
133. *G. quadripartita* KOCH							A	A	
134. *Globigerinella aequilateralis* (BRADY)	A	A	A		A	A		A	
135. *G. subcretacea* CHAPMAN	A	A	A		A	A		A	A
136. *Globigerinoides helicinus* (D'ORBIGNY)	A		A			A			A
137. *G. sacculiferus* (BRADY)	A	A	A			A	A	A	A
138. *Globorotalia canariensis* (D'ORBIGNY)	A		A						A
139. *G. menardii* (D'ORBIGNY)	A	A	A	A	A	A	A	A	A
140. *G. tumida* (BRADY) var. *flexuosa* KOCH		A	A		A				
141. *Globulina gibba* D'ORBIGNY	vr								
142. *Gümbelina globigera* (SCHWAGER)	vc					r	r		
143. *Guttulina lactea* (WALKER & JACOB)	vr								
144. *G.* sp.	vr								
145. *Gyroidina neosoldanii* BROTZEN	c	r	vc		c	vc		vc	vc
146. *Heronallenia pulvinulinoides* (CUSHMAN)								r	
147. *Karreriella bradyi* (CUSHMAN)			r						
148. *K. chilostoma* (REUSS)							r		
149. *K. novo-zealandica* CUSHMAN							r	r	
150. *K. siphonella* (REUSS)					r				
151. *Lagena acuticosta* REUSS	r					r		r	r
152. *L. caepulla* SCHWAGER	r							r	
153. *L. costata* (WILLIAMSON)	vr								
154. *L. costata* (WILLIAMSON) var. *polygonata* CUSHMAN	vr								
155. *L. feildeniana* BRADY	vr								
156. *L. globosa* MONTAGU	r						r		r
157. *L. gracilis* WILLIAMSON	vr					r		r	r
158. *L. hexagona* WILLIAMSON	vr				r				
159. *L. laevis* (MONTAGU)	vr	r						vr	
160. *L. laevis* (MONTAGU) var. *nebulosa* CUSHMAN	vr	r							
161. *L. marginata* (WALKER & BOYS)	r		r			r		r	r
162. *L. marginatoperforata* SEGUENZA	vr								
163. *L. orbignyana* (SEGUENZA)	vr							c	c
164. *L. orbignyana* (SEGUENZA) var. *clathrata* BRADY	vr								
165. *L. orbignyana* (SEGUENZA) var.	r				r				r
166. *L. plumigera* BRADY									r
167. *L. radiatomarginata* PARKER & JONES	vr								

TABLE I (continued)

	287	A	D	SI	C—1w	C—1b	C—2l	C—2d	C—3
168. *L. spiralis* (BRADY)	vr								
169. *L. striata* D'ORBIGNY	vr					r			
170. *L. sulcata* (WALKER & JACOB)	vr								
171. *L. sulcata* (WALKER & JACOB) var. *apiculata* CUSHMAN	vr								
172. *L. vitrea* nov. sp.		c	r						
173. *Lamarckina erinacea* (KARRER)	vr		r						
174. *L. scabra* (BRADY)	vr	r							
175. *Laticarinina pauperata* (PARKER & JONES)	vr		r						
176. *L. tenuimargo* (BRADY)	vr								
177. *Listerella antillarum* CUSHMAN	vr								
178. *L. milletti* CUSHMAN	vr								
179. *L.* sp.	vr								
180. *Loxostomum hentyanum* (CHAPMAN)	vr								
181. *L. laevigatum* (KARRER)	vr								
182. *L. limbatum* (BRADY)	r	c							
183. *L. limbatum* (BRADY) var. *costulatum* (CUSHMAN)	vr	r			c			r	r
184. *L. lobatum* (BRADY)	r								
185. *L.* sp.	vr								
186. *Marginulina subaculeata* (CUSHMAN) var. *glabrata* (CUSHMAN)	vr								
187. *Massilina arenaria* (BRADY)	vr								
188. *Miliolinella procera* (GOËS)			r						
189. *Nodosaria albatrossi* CUSHMAN	vr				r				
190. *N. arundinea* SCHWAGER	r		c		c	c	r		r
191. *N. brevicula* SCHWAGER	vr								
192. *N. calomorpha* REUSS	vr								
193. *N. catenula* BRADY	vr								
194. *N. hirsuta* D'ORBIGNY	vr							r	
195. *N. milletti* CUSHMAN	r							r	
196. *N. pyrula* D'ORBIGNY							c		r
197. *N. scalaris* (BATSCH)	r	r							r
198. *N. subscalaris* CUSHMAN var. *paucicostata* CUSHMAN	r								
199. *N. vertebralis* (BATSCH)	vr				r				
200. *Nonion galeatum* CUSHMAN	vr								
201. *N. nicobarense* CUSHMAN	vr								
202. *N. pacificum* CUSHMAN	vr								
203. *N. pauperatum* (BALKWILL & WRIGHT)	vr								
204. *N. pompilioides* (FICHTEL & MOLL)	r	e	r		c	c		r	c
205. *N. scapha* (FICHTEL & MOLL)						r			r
206. *N.* sp.									r
207. *Ophtalmidium inconstans* BRADY			r						
208. *Orbulina universa* D'ORBIGNY	A	A	A	A	A	A	A	A	A
209. *Parrella bengalensis* SCHWAGER	r	r	r		vc	r	vc	r	
210. *P. tenuimarginata* CHAPMAN, PARR & COLLINS	r								
211. *Pavonina triformis* PARR	vr		r						
212. *Planorbulina mediterranensis* D'ORBIGNY	r								
213. *Planorbulinella larvata* (PARKER & JONES)	vr		r						
214. *Planularia bermudezi* PALMER	vr								
215. *P. gemmata* BRADY	vr								
216. *Planulina depressa* (D'ORBIGNY)	r								
217. *P. fijiensis* CUSHMAN	vr		r		r			r	
218. *P. wuellerstorffi* (SCHWAGER)	r	r	r		A	vc	A	vc	vc
219. *Plectofrondicularia angusticostata* CUSHMAN	vr								
220. *P. beetsi* nov. sp.	vr								
221. *P. grandis* nov. sp.	r		r			r	r	r	
222. *P. inaequalis* (COSTA)	r	r	r		r				

TABLE I (continued)

	287	A	D	SI	C—1w	C—1b	C—2l	C—2d	C—3
223. *P. interrupta* (KARRER)	r		r			r			
224. *P. spinosa* (VAN DER SLUIS & DE VLETTER)	r	r							
225. *Pleurostomella alternans* SCHWAGER	r	r			r	c	vc	r	r
226. *P. alternans* SCHWAGER var. *telestoma* SCHUBERT	vr						r		
227. *P. brevis* SCHWAGER	vr		r						
228. *P. bolivinoides* SCHUBERT	vr								
229. *P. bolivinoides* SCHUBERT var. *lata* nov. var.	r		r						
230. *P. sapperi* SCHUBERT	vr								
231. *Pseudoglandulina conica* (NEUGEBOREN)	r								
232. *P. radicula* (LINNÉ)	vr								
233. *Pseudoparrella pustulosa* nov. sp.								r	vc
234. *Pullenia quinqueloba* (REUSS)	vr								
235. *P. sphaeroides* (D'ORBIGNY)	vr					r			r
236. *Pulleniatina obliqueloculata* (PARKER & JONES)	A	A	A	A	A	A	A	A	A
237. *Pyrgo anomala* SCHLUMBERGER	r	vc	r						
238. *P. depressa* (D'ORBIGNY)	vr	c	r						r
239. *P. murrhyna* (SCHWAGER)	vr								r
240. *Quinqueloculina asperula* SEGUENZA	r								
241. *Q. amygdaloides* (BRADY)	r								
242. *Q. anguina* TERQUEM var. *agglutinans* WIESNER		c	vc						
243. *Q. auberiana* D'ORBIGNY	r		c						
244. *Q. bicostata* D'ORBIGNY	vr								
245. *Q. berthelotiana* D'ORBIGNY	r		r						
246. *Q. disparilis* D'ORBIGNY			r						
247. *Q. lamarckiana* D'ORBIGNY			r						r
248. *Q. seminulum* (LINNÉ)	vr								
249. *Q. venusta* KARRER	r								
250. *Ramulina globulifera* BRADY	r								
251. *Rectobolivina bifrons* (BRADY)	vr								
252. *Reophax scorpiurus* (MONTFORT)			r						
253. *Reussella decorata* (HERON-ALLEN & EARLAND)	vr								
254. *R. spinulosa* (REUSS)	c		vc			r			c
255. *Robertina bradyi* CUSHMAN & PARKER	vr								
256. *Rotalia beccarii* LINNÉ	r		r						r
257. *R. polygyrata* nov. sp.	r								
258. *Ruttenella butonensis* nov. gen nov. sp.	r	r	c					r	
259. *Saracenaria italica* DEFRANCE	vr								
260. *S. latifrons* (BRADY)	vr								
261. *Seabrookia pellucida* BRADY	vr								
262. *Sigmoilina sigmoidea* (BRADY)			r						
263. *Sigmomorphina semitecta* (REUSS) var. *terquemiana* (FORNASINI)	r								
264. *Siphogenerina dimorpha* (PARKER & JONES) var. *pacifica* (CUSHMAN)	r				c	c		r	vc
265. *S. raphanus* (JONES & PARKER)	vr	r	r						
266. *S. raphanus* (JONES & PARKER) var. *nodosaroides* (SCHUBERT)	r	r	r	x		r			r
267. *S. raphanus* (JONES & PARKER) var. *semistriata* (SCHUBERT)	r	r	r						
268. *S. striata* (SCHWAGER)	r	r			c	c		r	c
269. *S. virgula* (BRADY)	vr								
270. *Siphonina australis* CUSHMAN	c	c						r	r
271. *Siphonodosaria antillea* (CUSHMAN)	r								r
272. *S. challengeriana* THALMANN	r				r			r	r
273. *S. curvatura* (CUSHMAN) var. *spinea* (CUSHMAN)	r								
274. *S. fijiensis* CUSHMAN	vr				r	r			r
275. *S. fijiensis* CUSHMAN var. *butonensis* nov. var.	vr				r	c		r	c

TABLE I (continued)

	287	A	D	SI	C—1w	C—1b	C—2l	C—2d	C—3
276. *S. lepidula* (SCHWAGER)	c		r		A	A		c	vc
277. *S. modesta* (BERMÚDEZ) var. *prolata* (CUSHMAN & BERMÚDEZ)	vr					r			
278. *S. simplex* nov. sp.	r								
279. *S. spinata* (CUSHMAN)	r		r		r	A	c	r	vc
280. *S. umbgrovei* nov. sp.								r	vc
281. *S. verneuili* (D'ORBIGNY)	c	r	c		c	r	r	r	c
282. *Siphotextularia concava* (KARRER)	vr								
283. *Sphaeroidina bulloides-austriaca* D'ORBIGNY	A		A			A		A	A
284. *Sphaeroidinella dehiscens* (PARKER & JONES)	A	A	A	A	A	A	A	A	A
285. *Spirillina ornata* SIDEBOTTOM			r						
286. *Spiropleotella gracillima* nov. sp.	r		r			c			c
287. *S. milletti* CUSHMAN			r		r	r	c		
288. *S. parallela* CUSHMAN	vr		r			r			
289. *Spiroplectoides bulbosa* (CUSHMAN)	vr							r	r
290. *Textularia abbreviata* D'ORBIGNY			r						
291. *T. foliacea* HERON-ALLEN & EARLAND		r							
292. *T. gramen* D'ORBIGNY			r						
293. *T. horrida* EGGER			r						
294. *T. philippinensis* nov. sp.	vr								
295. *T. sagittula* DEFRANCE var. *fistulosa* BRADY				c					
296. *Textulariella magdalidiformis* (SCHWAGER)			r						
297. *Tretomphalus bulloides* (D'ORBIGNY)	A								
298. *Trifarina bradyi* CUSHMAN	r		r		c	c	r		vc
299. *Tristix carinatum* (SIDEBOTTOM)	vr								
300. *Triloculina circularis* BORNEMANN	vr		c						
301. *T. insignis* (BRADY)	vr								
302. *T. oblonga* (MONTAGU)	vr								
303. *T. tricarinata* D'ORBIGNY			r						r
304. *T. trigonula* (LAMARCK)	vr		r						
305. *Trochammina nitida* BRADY								r	
306. *Tubulogenerina butonensis* nov. sp.	vr								
307. *Uvigerina canariensis* D'ORBIGNY var. *australis* HERON-ALLEN & EARLAND	vr								
308. *U. gemmaeformis* SCHWAGER	r		r		c		c	r	r
309. *U. hispida* SCHWAGER	vr	r	r		vc	r	r	r	r
310. *U. interrupta* BRADY	r								
311. *U. nitidula* SCHWAGER	r					r			
312. *U. peregrina* CUSHMAN var. *bradyana* CUSHMAN	vr								
313. *U. peregrina* CUSHMAN var. *parvula* CUSHMAN			r						
314. *U. proboscidea* SCHWAGER	r	c	r	x		c	r	r	vc
315. *Vaginulina linearis* MONTAGU	vr								
316. *V. perprocera* (SCHWAGER)	vr								
317. *V. (Vaginulinopsis) gradata* THALMANN	vr								
318. *Valvulineria butonensis* nov. sp.	r								
319. *V. inaequalis* (D'ORBIGNY)	vr								
320. *Verneuilina* sp.			r						
321. *Virgulina* sp.								r	
322. *Vulvulina pachyheilus* HADLEY	vr								
323. *V. pennatula* (BATSCH)						r		c	r
324. *V. spinosa* CUSHMAN var. *miocenica* CUSHMAN		r							
325. *V.* sp.			r						

Symbols used in Table I

vr — very rare
r — rare
c — common
vc — very common
A — abundant
x — present (only in sample SI)

The foraminiferal fauna of this second group is quite similar to that of the group C-1—C-3 and it must accordingly be regarded as Miopliocene. The great number of species identified from sample 287 is due to the large amount of material examined. On the other hand, the small fauna recorded from the sample SI is due to the small amount of asphalt recovered from the apex of the *Siphonalia* shell.

An indication that at least part of the series from which the above samples derive belongs to the Miocene, is given by the fauna from the sample W-10 from the Wariti asphalt field. This sample contains the following larger foraminifera:

Cycloclypeus spp. (2 species)
Katacycloclypeus sp.
Miogypsina sp. (microspheric)
Lepidocyclina (Trybliolepidina) rutteni VAN DER VLERK

These forms indicate an Upper Miocene age (Tertiary-f of the East Indian stratigraphical column). The rather badly preserved smaller foraminifera from this sample are:

Amphistegina radiata (FICHTEL & MOLL)	v. c.
Buliminella septata nov. sp.	r
Cassidulina pacifica CUSHMAN	r
Cristellaria javana KOCH	r
Cristellaria vortex (FICHTEL & MOLL)	r
Cristellaria sp.	r
Gyroidina neosoldanii BROTZEN	c
Planorbulinella larvata (PARKER & JONES)	c
Planopulvinulina dispansa (BRADY)	r
Quinqueloculina anguina TERQUEM var. *agglutinans* WIESNER	r
Siphonina australis CUSHMAN	r
Siphonodosaria curvatura (CUSHMAN) var. *spinea* (CUSHMAN)	r
Siphonodosaria verneuili (D'ORBIGNY)	r
Uvigerina gemmaeformis SCHWAGER	r
Vaginulina sp.	

With the exception of *Cristellaria javana* and *Planopulvinoline dispansa,* all these species occur also in the samples of Table I.

B. Facies.

W-10. This sample certainly represents a shallow marine facies. This is indicated by the presence of larger foraminifera, the very common *Amphistegina* and the absence of pelagic forms.

C-1—C-3. An attempt to compile from the literature the depth distribution of the recent species of the fauna yielded very unsatisfactory and widely divergent results for different species. A comparison with NATLAND's and NORTON's publications (Lit. 11, 12) on the ecology of some recent faunae was not more successfull. However, the Buton fauna has definite affinities to that of NATLAND's zones 3 (20—150 fathoms) and 4 (150—1100 fathoms). Much resemblance exists with the fauna described by CUSHMAN (Lit. 5) from Vitilevú, which was regarded as deposited at a depth of 100—250 fathoms (more rather than less). A similar depth of deposition seems a very probable estimate for the Buton fauna. The abundance of pelagic foraminifera, the absence of any clastic material and the great variety of bottom-living species indicate sedimentation in clear water of normal salinity and in open connection with the ocean. The abundance of Cassidulinidae, finally, may point to relatively cold water.

287. **A, D, SI.** The same consideratians apply to this group as to C-1—C-3. The depth of deposition may have been slightly less. This is suggested by the greater abundance of *Amphistegina* and Miliolids. The number of Cassidulinidae is smaller. The depth of deposition may have been between that of W-10 and the group C-1—C-3.

III. DISCUSSION OF THE ALGAL FLORA

Calcareous algae have been found in all samples. Especially fragments of *Halimeda* are common, but never abundant. Dasyclad algae are invariably rare. From sample 287 the following forms could be identified:

Halimeda opuntia LAMARCK
Halimeda sp.
Neomaris (Descaisnella) annulata DICKIE
Neomeris (Descaisnella) ? ignota MORELLET
Amphiroa foliacea LAMOUR

The first species occurs (as *Halimeda opuntia,* forma *triloba*) in the Miocene of Borneo and is known living in the recent seas. *Neomeris annulata* is known from Eocene to recent. *Neomeris ignota* was described from the Miocene of Hungary. *Amphiroa foliacea* is known in a fossil state from the Upper Miocene-Pliocene of the East Indies and still occurs in recent seas. The algae thus tend to confirm a Miopliocene age. On the other hand, they suggest a depth of deposition of less than 50—60 fathoms.' In the recent seas *Halimeda* occurs abundantly down to 40 fathoms, but it may occur as deep as 60 fathoms. Dasyclad algae like *Neomeris* may live as deep as 25 fathoms and perhaps 60 fathoms. Red calcareous algae like *Amphiroa* may occur as deep as 60—110 fathoms. It seems possible, however, that in very clear tropical seas the phototropic zone to which the algae are bound may range down to greater depths.

IV. THE POSSIBLE EXISTENCE OF FOSSIL MUD-VOLCANOES

The stratigraphical table of South Buton following below has been compiled from a summary report on the geology of Buton by HETZEL (Lit. 6, with a list of literature).

Quaternary	Alluvial deposits Terraced and warped coral limestones and marls, often reaching far inland. Asphalt impregnations and fissure fillings.
	—— strong folding ——
Miopliocene	*Globigerina* marls and limestones (provisional determination of mollusks in Middle Buton: Pliocene). Asphalt seepages, impregnations and veins. Oil seepage in Middle Buton
	—— local weak folding or upheavels ——
U. Miocene	Conglomerates, sandstones, with subordinate clays and marls. Larger foraminifera (*Lepidocyclina, Miogypsina,* etc.), corals, badly preserved mollusks. Asphalt impregnations and veins; oil locally in sandstones.
	—— folding ——

Eocene	Sandstones, conglomerates, with pebbles of a. o. serpentine. *Lepidocyclina*, *Asterocyclina*, reworked cretaceous *Globotruncana*.
	strong folding
U. Cretaceous	White and grey dense-textured limestones, chert, grey marls with *Globotruncana*, *Gümbelina*, etc. Asphalt and oil in fissures.
	? folding ?
U. Jurassic	Grey limestones, shales, variegated marly limestones. *Belemnites*, *Aucella*.
L. Jurassic	Grey limestones and marly limestones. *Ammonites*. Asphalt impregnations.
U. Triassic	Conglomerates, sandstones, bituminous limestones, variegated shales ("Flysch" facies). *Halobia*, *Daonella*, *Monotis*, *Myophoria*, *Ammonites*, etc. Dikes of diabase. Oil seepages.
	——— strong folding ———
Pre-Mesozoic	Crystalline schists.

Outcrops of pre-Eocene serpentines are always bordered by faults.

The often considerable amount of asphalt in the Miopliocene beds has led to exploitation. The origin of the asphalt is generally believed to be Upper Triassic oil which, migrating along fissures, impregnated the porous *Globigerina* marls, although THÖENES (Lit. 14) — on the basis of a physico-chemical study — regarded at least part of the asphalt as indigenous to the formation.

A problem in the palaeontology of the Tertiary of Buton was posed by the determination of mollusks collected from the *Globigerina* marls of the asphalt fields. The age determination of molluscan faunae in the East Indies is based partly on the percentage method: the greater the percentage of recent forms, the younger the fauna. Consequently, when K. MARTIN (Lit. 8, 9) did not find a single recent species in a fauna from the asphalt fields, he determined its age as Oligocene or lowermost Miocene. HETZEL (op. cit.) rejected this determination on stratigraphical grounds, pointing out, moreover, that a mollusk fauna provisionally determined as Pliocene had been collected from the same formation in Middle Buton. He concluded that the aberrant character of the fauna might be due to special facies conditions. MARTIN (Lit. 10) then suggested that mollusks of oligocene age might have been ejected by mud-volcanoes in latest-tertiary to quaternary times.

UMBGROVE (Lit. 15), studying corals — some actually from one and the same piece of rock as the mollusks — found seven species of shoal-water colony-forming reef corals and two species of solitary corals from deeper (?) water. He determined the age as Pliocene or younger. The reef corals were found to be strongly damaged, sometimes very large fragments ($60 \times 50 \times 45$ cm), surrounded by an asphalt matrix. A mould of a probably subrecent coconut was also figured by UMBGROVE, who adhered to MARTIN's theory of mud-volcanoes.

BEETS (Lit. 1—4), studying a much larger fauna of mollusks than MARTIN, and revising the entire fauna, finally arrived at a younger-miocene-pliocene age for the fauna. He regards the fauna to represent sediments from the deepest part of the neritic zone (about 100 fathoms or even a greater depth but at least cold water) thus explaining the small affinities to other young-neogene faunae of the East Indies, most of which are of a shallow-water facies. The low percentage of recent species in the Buton fauna is regarded by him to be due to our little familiarity with the recent fauna from deeper water in the Indopacific region.

REINHOLD (Lit. 13), after a study of the Diatomeae concluded to a probable Upper Miocene age of samples from Waisiu and Kabungka and to deposition in cold water.

The foraminifera and calcareous algae, discussed in chapters II and III, indicate a miopliocene age and deposition in clear, cold water at a probable depth of between 50 and 100 fathoms. This is thus quite in accordance with the opinions expressed by BEETS and REINHOLD.

With the determination of all the different groups of fossils from the asphalt beds as Miopliocene, the need for the mud-volcano theory seems to have disappeared. However, the presence of definitely very shallow-water corals in a facies of deep cold water as recorded by UMBGROVE, still goes unexplained and so does the subrecent coconut mould. The Waisiu asphalt field where the first mollusks and the corals were collected, lies closely below the pleistocene cover of reef limestones. It seems possible that fragments of the younger reef limestones — undercut by erosion — have rolled far away from their original position. When exposed on steep slopes, the asphalt beds are subjected to flow and this might explain the apparent interbedding of the corals and, incidentally, also the occurrence of the coconut mould. A mud-volcanic origin of the corals implies the existence of a formation of — otherwise unexposed — reef limestones below the *Globigerina* marls. Moreover, to eject limestone blocks of 60 × 50 × 45 centimeters, it would have to be a very big "volcano" indeed!

However, one as yet unmentioned phenomenon is very much suggestive of mud-volcano activity. The sample 287, instead of being a uniformly fine-grained *Globigerina* marl like all other samples, is composed of badly sorted, sharply angular fragments of white and grey chert and limestone, up to 2 cm in diameter, embedded in a marly matrix impregnated with asphalt. The rock fragments resemble in every respect the cretaceous *Globotruncana* limestones from Buton as represented in the collections of the Geological Institute at Utrecht. The sample does not have the habit of a normal sedimentary breccia, none of the components is water-worn or even slightly rounded. Dr. J. DUFOUR, palaeontologist of the "Bataafsche Petroleum Maatschappij", told the author that he had seen quite similar rocks in Venezuela, where they are regarded as products of mud-volcano activity. It is much to be regretted that the exact locality where this sample was collected is not known. It was presented to the Geological Institute by Mr. MATHYSEN, at the time manager of the company which was engaged in exploitation of the asphalt fields of Southern Buton.

The miopliocene foraminiferal fauna from the matrix of the breccia contains many upper cretaceous smaller foraminifera, which differ markedly from the beautifully preserved neogene specimens by their dull grey color. A list of the cretaceous foraminifera was given by the present author in an earlier paper (lit. 7).

The presence of fragments of cretaceous rocks removes one of the objections which might be raised against the existence of fossil mud-volcanoes, i. e. the absence of material from formations lying between the supposed upper triassic oil source beds and the miopliocene asphalt marls. The author therefore regards the existence of miopliocene mud-volcanoes as a distinct possibility, although the volcanoes need not necessarily be responsible for the occurrence of the reef corals in a deep water facies.

V. SYSTEMATICAL DESCRIPTIONS OF FORAMINIFERA

286. *Spiroplectella gracillima* nov. sp. (Plate I, fig. 1, 2).

Test very finely arenaceous, smoothly finished, moderately compressed, very slender, straight or slightly curved, slowly increasing in width from the initial end, narrowing again in the adult stage. Up to 30 pairs of biserially arranged chambers follow a coiled initial stage. Aperture textularian in the biserial chambers, last chambers in adult specimens tending to become uniserial with the aperture terminal. Sutures oblique, slightly limbate. The species differs from described forms by its very slender shape and the very large number of chambers.

Length: up to 1.4 mm.

294. *Textularia philippinensis* nov. sp.

Gaudryina pupoides D'ORBIGNY var. *chilostoma* BRADY (*non* REUSS).
Rept. Voy. Challenger, vol. 9, Zoöl., p. 379, pl. XLVI, f. 5 (1884).
Gaudryina baccata CUSHMAN (*non* SCHWAGER).
U. S. Nat. Mus. Bull. 104—105, p. 150, pl. 29, f. 6 (1921).

BRADY's fig. 5 certainly represents a biserial form. His figure 6 is rather unintelligable; it may be the same species. CUSHMAN's figure appears to be fully identical with BRADY's figure 5. The specimens from Buton are certainly completely biserial.

72. *Clavulinoides fijiensis* nov. sp. (Plate I, fig. 18, 19).

Clavulina angularis D'ORBIGNY (?) CUSHMAN.
Bern. P. Bishop Mus. Bull. 119, p. 107, pl. 10, f. 10 (1934).

Test arenaceous, triangular in transverse section with very prominent carinate edges. Earlier chamber arrangement obscure because of indistinct sutures, but very probably triserial. Last three or four chambers uniserial. Aperture large, round, surrounded by a ring formed by the fusion of the three carinae. Sutures between uniserial chambers non-limbate and depressed.

The species is not identical with *Clavulina angularis* d'ORBIGNY because it lacks an apertural tooth, and the growth is not terminated by inflated and rounded chambers (Cushm. Lab. For. Res., Spec. Publ. 8, p. 19, pl. 2, f. 29—33 (1937)). It differs from *Clavulinoides trilatera* (CUSHMAN) var. *concava* (CUSHMAN) in the more indistinct sutures and the smaller number of chambers (Cushm. Lab. For. Res. Spec. Publ. 7, p. 121, pl. 16, f. 19—25 (1937)).

The species was originally described from the Miocene of Vitilevú.

Length: up to 1.7 mm.

74. *Clavulinoides* sp. (Plate I, fig. 3—6).

A single specimen of this peculiar, smoothly finished arenaceous form was found. It is triserial and triangular with rather sharp edges in the early portion of the test, with slightly depressed sutures between the chambers. The growth is terminated by two uniserial chambers which are elliptical in cross section. The aperture in this stage is slightly elliptical and somewhat produced. The specimen may be a monstruosity. Other species of *Clavulinoides* with a laterally compressed uniserial portion are *C. parri* CUSHMAN (Cushm. Lab. For. Res. Spec. Publ. 7, p. 126, pl. 18, f. 6 (1937)) and *C. compressa* (CUSHMAN) (ibid. p. 123, pl. 17, f. 7—13), both from the Cretaceous, but these forms differ in quite a number of characters.

Length: 1.55 mm.

179. *Listerella* sp. (Pl. I, fig. 7, 8).

Two specimens were found of a form resembling *Listerella rhumbleri* CUSHMAN (Cushm. Lab. For. Res. Spec. Publ. 8, p. 141, pl. 6, f. 22 (1937)), but the Buton form is bigger. Without additional material it seems imprudent to identify this species with the form from the Middle Oligocene of Germany.

Length: 1.5 mm.

107. *Dorothia robusta* nov. sp. (Pl. I, fig. 9—11)

Test robustly fusiform, arenaceous with a coarse outer layer typically enclosing fragments of small Globigerinidae. Upon a large thin-walled embryonic chamber follow four chambers in the first whorl, followed by three chambers in the second whorl. The growth is terminated by five biserial chambers. The sutures are indistinct and slightly depressed. The aperture is a vertical slit in a re-entrant of the somewhat flattened front of the last chamber.

The high narrow aperture serves to distinguish this form from other species of *Dorothia*, with the exception of *Dorothia* (?) *subrotundata* (SCHWAGER) (refigured in Cushm. Lab. For. Res. Spec. Publ. 8, pl. 10, f. 15) which, however is proportionately much longer. *Dorothia* (?) *lacerata* (SCHWAGER) (Novara Exped. Geol. Theil, vol. 2, p. 194, pl. 4, f. 3 (1866)) has the same type of aperture, but differs by the shape of the test and the more distinct and depressed sutures. It may be remarked here that SCHWAGER's *Ataxophragmium laceratum* is mentioned by CUSMAN (Bern. P. Bishop Mus. Bull. 119, p. 106, pl. 10, f. 9 (1934)) as a *Gaudryina*, which it is probably not (the species is not mentioned any more in the Monograph of the Verneuilinidae (Cushm. Lab. For. Res. Spec. Publ. 7). It is mentioned, however, in the Monograph of the Valvulinidae (Cushm. Lab. For. Res. Spec. Publ. 8, p. 179 (1937)) as ? *Eggerella*, which it is neither, being biserial in the adult. *Dorothia robusta* also resembles *Dorothia rotundata* BOOMGAART (Smaller Foraminifera from Bodjonegoro. Acad. thesis Univ. Utrecht, 1949, p. 60, pl. V, f. 4), which differs, however, by its lower uniserial chambers, more constricted sutures and apparently lower aperture.

Length: up to 1.7 mm.

75. ? *Cribrogoësella* sp. (Pl. 1, fig. 12, 13).

A single broken specimen has been found. The finely arenaceous test is round in cross-section. The sutures are rather indistinct in the earlier portion, but development seems to start with four or five chambers in a whorl, gradually reducing to two in a whorl. Because the test is broken, it is not known whether the growth ended with a uniserial stage, but this is suggested by the position of the double aperture which is situated slightly above the base of the face of the last chamber.

The specimen differs from *Cribrogoësella bradyi* CUSHMAN (Cushm. Lab. For. Res. Spec. Publ. 8, p. 120, pl. 14, f. 4, 5 (1937)) in the proportions of the multi- and bi-serial stages and in the much more indistinct sutures.

Length of fragment: 0.9 mm.

299. *Tristix carinatum* (SIDEBOTTOM) (Pl. II, fig. 19, 20).

Rhabdogonium carinatum SIDEBOTTOM.
Journ. Roy. Micr. Soc. London, p. 138, pl. 4, f. 20—25 (1918).

Chrysalogonium pyramidatum ACOSTA.
Torreia no. 5, p. 4, pl. 2, f. 4, 5 (1940).
? *Trifarina* sp. BOOMGAART.
Smaller Foraminifera from Bodjonegoro, Acad. thesis Univ. Utrecht 1949, p. 122, pl. IX, f. 14.

A single specimen of this species has been found.
Length: 0.5 mm.

172. *Lagena vitrea* nov. sp. (Pl. I, fig. 16, 17).

Test translucent, inflated, slightly compressed, unichambered. A deep sulcus runs along the base and the sides of the test, flanked by conspicuous carinae, each of which bears a large spine, sticking out sideways and obliquely downwards from the base of the test. The flat sides are ornamented with a kind of shield with about 8 conspicuous, curved longitudinal striae. The simple, round aperture is surrounded by a low collar at the end of a sturdy neck. The large size and the conspicuous spines are characteristic for the species.

Length: 1 mm.

144. *Guttulina* sp. (Pl. I, fig. 23—25).

One small specimen of a typical form is pictured for future reference.

206. *Nonion* sp. (Pl. I, fig. 14, 15).

Only one specimen of a very small species was found. It is figured here for future reference.

142. *Gümbelina globigera* (SCHWAGER) (Pl. II, fig. 16—18).

Textilaria globigera SCHWAGER)
Novara Exped. Geol. Theil, vol. 2, p. 252, pl. VII, f. 100 (1866).
Pseudotextularia cf. *glogulosa* EHRENBERG (SCHUBERT) ?
Abh. k. k. geol. Reichsanst. vol. XX, heft 4, p. 104.

Test calcareous, small, fragile, biserial throughout, composed of 5—7 pairs of globose chambers, tapering from the initial end, with the sides becoming more parallel in the adult. Sutures non-limbate, much depressed. Aperture a high opening at the base of the front of the last-formed chamber, with a lip on one side. The structure of the shell is definitely not arenaceous.

In the shape of the aperture the species resembles *Gümbelina goodwini* CUSHMAN & JARVIS (Cushm. Lab. For. Res. Contrib. 9, pt. 3, p. 69, pl. VII, f. 15, 16 (1933)), but the chambers are less inflated in that species. In the shape of the chambers it resembles *Gümbelina globulosa* (EHRENBERG) (as pictured in Cushm. Lab. For. Res. Contrib. 14, pt. 1, p. 6, pl. 1, f. 28—33 (1938)), but it differs in the apertural characters.

This may be the same form as mentioned by SCHUBERT from the Pliocene of the Bismarck Archipelago. CUSHMAN apparently found it in the Miocene of Vitilevú (Bern. P. Bishop Mus. Bull. 119 (1934)). It thus appears that *Gümbelina* has survived in the Indopacific region as late as the Pliocene and it would not be surprising if it were still living there. It may be remarked here that ? *Gümbelitria vivans* CUSHMAN (Cushm. Lab. For. Res. Contrib. 10, pt. 4, p. 105, pl. 13, f. 9, 10 (1934)), another cretaceous relic in the recent Indopacific, is probably identical with *Verneuilina pygmaea* MILLETT (*non* REUSS) (Journ. Roy. Microsc. Soc. London, p. 31, pl. 1, f. 13 (1900)).

Length: up to 0.35 mm.

220. *Plectofrondicularia beetsi* nov. sp. (Pl. II, fig. 25—27).

Test flat, broad, calcareous, translucent. The initial part consists of five biserially arranged chambers, following upon a globular embryonic chamber. The last four chambers are uniserial, low and curved. The sutures are limbate and flush with the surface; the aperture is a narrow slit. The ornamentation consists of a thin flange around the bluntly rounded edges of the test, splitting into two low carinae separated by a shallow trough along the upper part of the last chamber. Low carinae on the flat sides of the test run obliquely inwards and upwards from the junction of the sutures with the peripheral flange.

The typical ornamentation serves to distinguish this form from other *Plectofrondicularia* species.

221. *Plectofrondicularia grandis* nov. sp. (Pl. II, fig. 31—34)

Test large, much compressed, gradually tapering from a blunt point, with a sharp peripheral carina. The ornamentation consists of a varying number (three to seven) of low sharp striae and costae on the flattened sides, continuous over the chambers. Striae are added by intercalation rather than by bifurcation. Chambers uniserial, strongly curved; sutures indistinct, non-limbate. The megalospheric form is uniserial throughout; the microspheric form has slight indications of a biserial arrangement of the first few chambers. The aperture could only be observed in broken specimens, where it consists of an oval opening with irregular, inward-projecting teeth. The large size serves to distinguish this form from similarly ornamented species.

Length: up to 4 mm (broken specimens).

224. *Plectofrondicularia spinosa* (VAN DER SLUIS & DE VLETTER) (Pl. II, fig. 21—24).

? *Frondicularia spinosa* VAN DER SLUIS & DE VLETTER.
Proc. Kon. Akad. Wetensch., Amsterdam, vol. XLV, no. 10, p. 1010, f. 2 (1942).

The specimens from Buton show that this species is truly biserial in the microspheric form, a character which places it in the genus *Plectofrondicularia*. The aperture is a narrow slit (only observed in broken specimens) with irregular inwardly projecting teeth.

Amphimorphinella nov. gen.

Genotype: *Amphimorphinella butonensis* nov. sp.

Test calcareous, finely perforate, elongate. Megalospheric form uniserial throughout. Initial part compressed and biserial in the microspheric form; later portion of the test with the chambers uniserial, at first compressed, but becoming round in cross-section in adult specimens. Aperture pseudo-radiate, consisting of teeth of irregular length closing over an apertural chamberlet which is connected with the main chamber via a rounded opening, divided by radial spokes which are not always fully developed. The genus differs from *Amphimorphina* NEUGEBOREN in the apertural characters.

Some difficulty arose in the assignation of a type species for *Amphimorphinella*. Three different forms, alike in size, ornamentation and in the shape of the latter chambers, have been found. One type is biserial and much compressed in the beginning (Pl. III, f. 8, 13—15, 17, 18) but becoming round in the adult (Pl. III, f. 11, 12). A second type is biserial in the beginning, but only slightly compressed (Pl. III, f. 6, 7); most of its chambers are round in cross section. A third form is unserial and round throughout

(Pl. III, f. 1—4, 7). Unless this uniserial type is regarded as belonging to another genus, it is in all probability the megalospheric form of a species of which one of the initially biserial forms is the microspheric. The uniserial form has a small variety (Pl. II, f. 29), which is accompanied by a small, initially biserial form which is in turn completely like the large slightly compressed biserial form discussed above (Pl. II, f. 30). The two small forms are evidently a megalo- and microspheric pair. Consequently, it may be assumed that the large uniserial form and the large slightly compressed initially biserial form also form a pair. However, this leaves the much compressed initially biserial form without a megalospheric partner. It is quite well possible that the megalospheric forms of both initially biserial forms are completely isomorphous, unless there is a slight difference in the height of the later uniserial chambers. Specimens with the later chambers slightly higher than broad (e.g., Pl. III, f. 6) might represent the megalospheric form of the much compressed initially biserial form, which shows similar proportions in its later uniserial chambers. Specimens with the later chambers about as high as broad might belong to the non-compressed initially biserial form. Because of this difficulty the diverse forms have been regarded as varieties rather than as separate species.

Broken specimens show only the aperture in the floor of the apertural chamberlet. The roof of the chamberlet was apparently resorbed as soon as another chamber was added. This makes one suspect that at least two of the *Plectofrondicularias* of the Buton fauna (*P. grandis*, Pl. II, f. 31—34; *P. spinosa*, Pl. II, f. 21—24) may posses a very similar aperture. Only broken specimens have been found of both species. These show a slit-like or oval aperture with small, irregular, inward-projecting teeth. It seems not impossible that this is the bottom opening of an apertural chamberlet. Both *Amphimorphinella* and *Plectofrondicularia* thus show a tendency to develop a radial aperture. It is quite possible that species exist in which this process has advanced so far, that the apertural characters appear perfectly isomorphous with those of the family Lagenidae. *Parafrondicularia* ASANO might be worth studying in this respect. It is also suggested that another line of evolution may have led to cribrate apertures as in *Chrysalogonium* SCHUBERT (see, e.g., *C. breviloculata* CUSHMAN & JARVIS (Cushm. Lab. For. Res. Contrib. 10, p. 74—75, pl. 10, f. 13), which is perfectly isomorphous with *Amphimorphinella butonensis*, except for the aperture).

2. *Amphimorphinella butonensis* nov. sp. (Pl. III, fig. 1—6).

Test elongate, uniserial with up to 10 chambers, round in cross-section, except for the microspheric form which has two to three pairs of biserial chambers in the slightly compressed initial part. Sutures in the megalospheric form constricted, slightly limbate between the first few chambers. Chambers inflated, growing gradually in height as added, but which the height not exceeding the width in the final chamber. Sutures in the microspheric form slightly limbate and flush in the biserial portion and between the first few uniserial chambers, gradually becoming more constricted; the chambers become more inflated as added and increase gradually in height. The aperture consists of radial teeth, closing over an apertural chamberlet at the top of the last-formed chamber. The chamberlet is connected with the main chamber by a round opening bordered by a slightly elevated rim, and partly closed by six to nine radial spokes. The spokes are not always fully developed, and in that case form small inward-projecting spines. The

ornamentation consists of twelve to fifteen longitudinal costae, continuous over the chambers, but bending along with the curvature near the sutures.
Length: up to 2 mm.

3. *Amphimorphinella butonensis* nov. sp. var. *minuta* nov. var. (Pl. II, fig. 28—30).

The variety resembles the species in all respects, except for its much smaller size.
Length: up to 0.8 mm.

4. *Amphimorphinella butonensis* nov. sp. var. *compressa* nov. var. (Pl. III, fig. 7 (?), 8, 10—18).

Variety differing from the typical form in the much more compressed initial part which consists of two pairs of biserial chambers followed by seven to ten slightly chevron-shaped chambers which become gradually more inflated. The last few chambers are practically round and slightly higher than broad. The aperture of the last uniserial chambers is identical with that of the typical species. It evolves from a terminal slit with inward-projecting teeth covering an apertural chamberlet with a slit-like opening in the floor to a gradually more rounded, radial form. The ornamentation is identical with that of the species, but the costae may leave the last chamber bare.

Broken or immature specimens, lacking the inflated uniserial chambers, resemble some species of *Plectofrondicularia* from tertiary formations (e. g. *P. californica* CUSHMAN & STEWART, *P. trinitatensis* CUSHMAN & JARVIS, *P. floridana* CUSHMAN). In such cases, however, the typical aperture is the distinguishing character.
Length: up to 2.3 mm.

41. *Buliminella sculpturata* nov. sp. (Pl. I, fig. 20—22).

Test small, subspherical, consisting of few whorls. Early arrangement of chambers not descernible, later with four in a whorl. Aperture semicircular, situated in a depression of the last chamber, surrounded by a narrow lip and with faint furrows radiating from it. There is no internal tube connecting the apertures. Chambers internally septate, just as in *Buliminella septata* n. sp., the septa showing faintly as depressions on the exterior of the chamber walls. Sutures scalloped, early chambers obscured by high plate-like costae which fuse into a polygonal mesh.

The species may be identical with *Sphaeroidina ornata* BRADY (Quart. Journ. Geol. Soc. 1888, p. 6, pl. 1, f. 4) from the Miocene of Fiji. It differs from the picture given by BRADY in the small last chamber, different angles of intersection between the sutures and different character of ornamentation. However, the present author could not escape the impression that the structure of *Sphaeroidina ornata* was not completely understood by the illustrator.
Diameter: up to 0.5 mm.

42. *Buliminella septata* nov. sp. (Pl. I, fig. 26—29).

Test short and inflated, bluntly pointed at the initial end. Early arrangement of chambers not discernible, later with four in a whorl. Aperture semicircular in a depression of the last chamber and surrounded by a thin lip. Faint furrows radiate from the aperture. The apertures are not connected by an internal siphonal tube. The chambers are subdivided internally by radiate septa which show as shallow depressions on the outside where they give a scalloped effect to the depressed sutures between the inflated chambers. The septate character serves to distinguish this form from other species of the genus. The same type of scalloped sutures — though less strongly — occurs in *Bulimella grata* PARKER & BERMÚDEZ and its variety *spinosa* (Journ. Pal. vol. 11, pl. 59, f. 6, 7 (1937)) which may prove to have also a septate division of the interior of the chambers. *Buliminella grata*, however, is much smaller than *B. septata*, and the septa — if present at all — are less evident on the exterior. Otherwise both species are closely alike.

Length: up to 1 mm.

40. *Bulimina* sp. (Pl. II, fig. 1, 2).

Two specimens have been found resembling *Bulimina pagoda* CUSHMAN, var. *denudata* CUSHMAN & PARKER (Cushm. Lab. For. Res. Contrib. 14, p. 57, pl. 10, f. 1, 2). The main difference lies in the sharply projecting points of the chambers, which give the test a triangular aspect in top view, thus approaching the genus *Angulogerina*.

Length: 0.3 mm.

185. *Loxostomum* sp. (Pl. II, fig. 3, 4).

The single specimen found resembles *Loxostomum rostrum* CUSHMAN (Cushm. Lab. For. Res. Spec. Publ. 9, p. 195, pl. 195, pl. 22, f. 34) but it differs in the outline of the test and in the shape of the chambers.

Length: 0.5 mm.

13. *Bifarina thoënesi* nov. sp. (Pl. II, fig. 5—7).

Rectobolivina sp. BOOMGAART.
Foraminifera from Bodjonegoro. Acad. thesis Univ. Utrecht. 1949, p. 116, pl. IX, f. 6.

Test in the young biserial, compressed, with bluntly rounded edges, gradually tapering from the initial chamber and then narrowing again, composed of six to seven pairs of chambers separated by slightly curved oblique sutures, flush with the surface and somewhat limbate. Biserial portion with a few faint longitudinal striae. Last five chambers uniserial of uniform size, slightly inflated, elliptical to circular in cross-section, separated by limbate, slightly depressed sutures, non-ornamented. Aperture oval or circular, surrounded by a hyaline collar.

The species differs so clearly from the other described species that it cannot possibly be confused with any of these.

Length: up to 1.4 mm.

306. *Tubulogenerina butonensis* nov. sp. (Pl. II, fig. 8—13).

Only a single specimen has been found, but it differs so conspicuously from any described form that it may safely be regarded as new. The initial end of the specimen is lacking and no biserial stage is visible; the oblique first uniserial chamber suggests that such a stage was once present. The uniserial portion consists of nine low chambers, circular to slightly oval in cross-section, ornamented by a single, slightly irregular row of blunt spinose projections around each chamber. The smooth, polished, slightly convex face of the last chamber bears a ring of eleven semi- to sub-circular apertures, each lying in a very slight depression. A few similar apertures are situated near the centre of the face of the chamber (Pl. II, f. 9). The oldest chamber broke off during the examination of the specimen. It shows only two crescentshaped apertures in its convex roof (Pl. II, f. 8). The number of apertures increases to three in the next-younger chamber (Pl. II, f. 10). The apertures are connected with the floor of the chamber by curious, forked, very fragile structures (Pl. II, f. 9, 10, 12, 13).

Length: 0.75 mm (probably 0.9 mm for entire specimen).

Diameter: 0.5 mm at last chamber.

Genus *Siphonodosaria* SILVESTRI 1924.

The present writer agrees with GALLOWAY (A manual of Foraminifera, 1933) that *Nodogenerina* CUSHMAN 1927 should be placed in the synonymy of *Siphonodosaria*. In view of the fact that there are no practical means of distinction between the theoretical uniserial nodosarid derivatives of the Heterohelicidae and the Buliminidae, the determination of a given species as belonging to one or the other genus is completely arbitrary. *Siphonodosaria* has priority over *Nodogenerina* and the former genus has been accepted as valid by both GALLOWAY (op. cit.) and CUSHMAN (Foram., their Classif. and econ. Use, 4th ed., 1948). Therefore all uniserial forms agreeing with the generic characters of *Siphonodosaria* and *Nodogenerina* have been assigned to *Siphonodosaria*. BOOMGAART (Foraminifera from Bodjonegoro, Acad. thesis Univ. Utrecht 1949, p. 121), doubting the validity of *Siphonodosaria*, preferred to use *Nodogenerina* instead.

Curiously enough, the genus *Sagrinnodosaria* JEDLITSCHKA 1931 (ref. THALMANN, Journ. Pal. vol. 7, p. 347, 354 (1933)) — which according to the title of the article and THALMANN's notes on the Challenger foraminifera (Ecl. geol. Helv. vol. 25, p. 304 (1932)) embraces also *Nodosaria abyssorum* BRADY, the genotype of *Siphonodosaria* — is not mentioned at all by GALLOWAY nor by CUSHMAN, although it is listed in the literature in the Contributions from the CUSHMAN Laboratory. The original article was not available to the present author.

275. *Siphonodosaria fijiensis* CUSHMAN var. *butonensis* nov. var. (Pl. III, fig. 19, 20).

Several specimens were found of a slender, simple *Siphonodosaria*, resembling *Siphonodosaria fijiensis* CUSHMAN (Cushm. Lab. For. Res. vol. 7, p. 30, pl. 4, f. 10 (1931)), but differing in the more inflated chambers, larger size and more flaring collar at the end of the apertural neck.

Length: up to 2 mm.

277. *Siphonodosaria modesta* (BERMÚDEZ) var. *prolata* (CUSHMAN & BERMÚDEZ) (Pl. III, fig. 24).

Ellipsonodosaris modesta BERMÚDEZ, var. *prolata* CUSHMAN & BERMÚDEZ.
Cushm. Lab. For. Res. Contrib. no. 13, p. 109, pl. 16, f. 1, 7 (1937).

The Buton form agrees very well with the original figures and description. It is pictured here because it was originally described from the Eocene of Cuba.

Length: 1.9 mm.

278. *Siphonodosaria simplex* nov. sp. (Plate III, fig. 23).

Test calcareous, perforate, smoothly finished, perfectly straight, gradually tapering. Chambers uniserial throughout, up to twelve in number, gradually increasing in size as added. Sutures distinct, flush between the first few chambers, becoming increasingly depressed. Aperture round, simple, surrounded by a thick collar.

Similar but smaller species, differing in details, have been described from the Oligocene of Cuba (?? *Ellipsonodosaria adelinensis* PALMER & BERMÚDEZ, Mem. Soc. Cub. Hist. Nat. vol. X, p. 299, pl. 18, f. 13 (1936); ? *Ellipsonodosaria matanzana* PALMER & BERMÚDEZ, ibid. p. 298, pl. 18, f. 12).

Length: up to 1.6 mm.

280. *Siphonodosaria umbgrovei* nov. sp. (Pl. III, fig. 21, 22).

Test small, calcareous, finely perforate, composed of five to six subglobular chambers arranged in a straight line. Sutures non-limbate and depressed. Aperture simple, round, at the end of a short neck with phialine lip and with a collar around the base of the neck. Ornamentation consisting of fine striae, not continuous over the sutures. The striae terminate in a very small spine at the base of the chambers.

The species differs from described forms in the typical ornamentation and in its very small size.

Length: op to 0.45 mm.

229. *Pleurostomella bolivinoides* SCUUBERT var. *lata* nov. var. (Pl. II, fig. 14—15).

The variety differs from the typical form (Abh. k. k. geol. Reichsanst. vol. XX, heft 4, p. 57, f. 4 (1911)) in the relatively broader and more compressed shape.

Length: up to 0.8 mm.

103. *Discorbis planulinaformis* nov. sp. (Pl. IV, fig. 26—28).

Test small, much compressed, nearly planparallel with a rounded border. Ventral side showing eight to ten chambers of the last whorl, separated by strongly curved, very heavily limbate and raised sutures, merging with the rounded limbate border. Aperture small, ventral, placed at the distal end of the chambers, opening into a very shallow umbilicus. Dorsal side showing two whorls in a rapidly opening spiral. Sutures on that side also strongly curved and even more limbate and raised than on the ventral side.

The species is very conspicuous by its strongly curved and limbate raised sutures which may even be broader than the chambers. It resembles in general shape some species of *Planulina* (e. g., *P. ariminensis* D'ORBIGNY (CUSHMAN, Foram., their Class. and Econ. Use, Key Pl. 36, f. 3 (1948)), but it differs from that genus in the apertural characters. It differs from other species of *Discorbis* in the characters stressed above.

Diameter: up to 0.5 mm.

Genus *Ruttenella* nov. gen.

Genotype: *Ruttenella butonensis* n. sp.

Test trochoid, calcareous, perforate, dorsal side flat or concave, ventral side convex. Only the chambers of the last whorl visible on both sides. Aperture on the flat (ventral) side along the base of the last chamber, covered by a slight lip and opening into an umbilicus.

The general characters place the genus in the subfamily Discorbinae of the family Rotaliidae of CUSHMAN's classification (Foram., their Class. and Econ. Use, 4th ed. 1948). It closely resembles *Discorbis* and *Lamarckina* in the ventral characters, but differs from both genera in being completely involute on the dorsal side.

Another species of *Ruttenella* may be *Discorbis rarescens* BRADY (Rept. Voy. Challonger, Zoöl. vol. IX, pl. XC, f. 2) although that species shows something of the previous whorl on the ventral side, thereby reversing the structure of typical species of *Discorbis* which show all the whorls on the dorsal side and only the chambers of the last whorl on the ventral side.

258. *Ruttenella butonensis* nov. sp. (Pl. IV, fig. 11—16).

Test trochoid, ventrally concave with a deep open umbilicus, which is surrounded by a slightly elevated rim. Five chambers of the last whorl are visible on the ventral side. The aperture lies along the base of the chamber between the peripheral margin and the umbilicus and is covered by a narrow lip which has a small flap projecting towards the umbilicus. The ventral sutures are non-limbate, radial and flush with the surface. The periphery is bordered by a blunt carina and is very slightly lobulate. Five chambers of the last whorl are visible on the very convex dorsal side. They are rapidly increasing in size and become increasingly inflated and overlapping. The dorsal sutures are non-limbate, depressed and nearly radial.

Diameter: up to 0.7 mm.
Height: up to 0.05 mm.

318. *Valvulineria butonensis* nov. sp. (Pl. IV, fig. 23—25).

Test calcareous, trochoid, finely perforate, unequally biconvex. Dorsal side slightly umbilicate, showing the chambers of all whorls, which are however partly obscured by a small central boss of shell material. Six to seven chambers are visible on the dorsal side, separated by depressed, non-limbate, curved sutures. Periphery blunt, lobulate. Ventral side more convex than dorsal side, showing only the chambers of the last whorl, separated by nearly radial, slightly curved, depressed sutures. Aperture along the base of the last chamber, covered by a narrow lip. Chambers centrally slightly produced and nearly covering a narrow umbilicus.

The species resembles some *Valvulineria* species from the Tertiary of California, but it differs in the combination of characteristics.

Diameter: up to 0.65 mm.
Height: up to 0.3 mm.

257. *Rotalia polygyrata* nov. sp. (Pl. IV, fig. 8—10).

Test very trochoid, nearly flat on the ventral side, showing ventrally the chambers of the last whorl around a slightly depressed umbilical area. The narrow umbilicus is partly filled by a small plug of clear shell material. The ventral sutures are slightly limbate and radial. The central points of the chambers around the umbilicus generally bear a small blunt spine. The aperture is near the periphery at the base of the last chamber. The dorsal side is high-conical and shows four to five whorls with eight to nine chambers per whorl. The dorsal sutures between the chambers are non-limbate and flush with the surface; the spiral suture is slightly depressed.

The species is readily distinguished by its large number of whorls and its typical plano-conical shape. In the last respect it approaches the genus *Conorbina* Brotzen, but it is distinguished by the presence of an umbilical plug and the near-peripheral position of the aperture.

Diameter: up to 0.5 mm.
Height: up to 0.35 mm.

233. *Pseudoparrella pustulosa* nov. sp. (Pl. IV, fig. 17—19).

Test small, trochoid, equally biconvex, close-coiled, all chambers visible on the dorsal side, only those of the last coil on the ventral side. Sutures strongly oblique dorsally, non-limbate and gently curved. Ventral sutures limbate, near-radial, very slightly curved and joining centrally in a small non-protruding boss of clear shell material. Aperture and elongate opening on the ventral side, close to the periphery and nearly parallel to the plane of coiling. Ventral side smooth, dorsal side ornamented with small pustulose projections.

The species may be easily distinguished by the typical ornamentation of the dorsal side.

Diameter: up to 0.5 mm.
Height: 0.25 mm.

47. *Cassidulina butonensis* nov. sp. (Pl. III, fig. 30—32).

Test small, lenticular, umbonate on both sides. Periphery bluntly rounded. Four pairs of chambers of the last whorl visible in cassiduline arrangement. Sutures strongly curved, non-limbate, slightly depressed. Aperture elongate with a semicircular flat tooth projecting into the apertural opening from the outer side and toothlike plate(s) on the inner side (see Pl. III, f. 30).

The species differs from *Cassidulina tortuosa* CUSHMAN & HUGHES (Cushm. Lab. For. Res. Contrib. vol. 1, pl. 2, f. 4 (1925); Bull. Scripps Instit. Oceanogr. Techn. Ser. vol. 1, pl. 6, f. 2 (1927)) in the smaller number of chambers. It differs from *Cassidulina subtumida* CUSHMAN (Cushm. Lab. For. Res. Contrib. vol. 9, pl. 10, f. 5 (1933)) in the less lobate outline, different curvature of the sutures, less pronounced margin and greater number of chambers.

Diameter: up to 0.45 mm.

53. *Cassidulina multicamerata* nov. sp. (Pl. III, fig. 25, 26).

Test small, lenticular with eight to ten pairs of cassiduline chambers in the last whorl. Sutures sinuously curved, slightly limbate and depressed, radiating on each side from a non-prominent small area of clear shell material. The oblique aperture is situated in a depression in the septal face of the last chamber.

The species resembles *Cassidulina tortuosa* CUSHMAN & HUGHES (see discussion of *C. butonensis*), but it has more chambers per whorl and it differs in edge view. The large number of chambers also serves to distinguish it from other species.

Diameter: up to 0.3 mm.

56. *Cassidulina perumbonata* nov. sp. (Pl. III, fig. 27—29).

Test fusiform, spirally coiled with alternating chambers in cassiduline arrangement, far extending and overlapping laterally. The last coil of adult specimens has about six pairs of chambers. The sutures are limbate, obscure in the beginning of the last coil, later more distinct and slightly depressed. The aperture is an oblique slit at the base of the last chamber in a depression with faint radial grooves running from it.

It differs from other species in the peculiar, axially elongated, shape of the test.

Axial diameter: up to 1 mm.

111. *Ehrenbergina rugosa* nov. sp. (Pl. IV, fig. 1—4).

Test coiled in the early stages, becoming rapidly uncoiling, compressed at right angles to the plane of coiling. Arrangement of chambers in early stage obscured by the finely spinose ornamentation, later chambers biserially alternating. Dorsal and ventral walls of chambers concave and finally rugose. Margins of chambers overhanging and provided with small spines. Aperture a curved slit in the roof of the last chamber.

The small size and the finely spinulose ornamentation are characteristic of the species.

Length: up to 0.45 mm.
Width: slightly less than length.

112. *Ehrenbergina* sp. (Pl. IV, fig. 5, 6).

A single small specimen which was found is figured here for future reference.

Length: 1.2 mm.

66. *Cibicides lobatulus* (WALKER & JACOB) var. *grossa* TEN DAM & REINHOLD. (Pl. IV, fig. 20—22).

Meded. Geol. Stichting, Ser. C—V, no. 2, p. 62, pl. V, f. 5, pl. VI, f. 1 (1941).

The small variety of *Cibicides lobatulus* is known from the Pliocene of the Netherlands.

VI. SYSTEMATICAL DESCRIPTIONS OF ALGAE

(with separate list of references).

Halimeda opuntia LAMARCK

The species could be compared with the fossils and recent specimens of *Halimeda opuntia* forma *triloba* described by L. RUTTEN from the East Indies (ref. 1).

Occurrence: sample 287. Age: Miopliocene.

Halimeda sp.

Small fragments occur in many samples. Fragments of a form with coarser structure than *H. opuntia* were found in sample 287.

Neomeris (Descaisnella) annulata DICKIE

Good figures of this species may be found in ref. 2. One segment of a ring was found, agreeing well with MORELLET's figures (ref. 2, pl. II, f. 1—9, especially f. 6). The species is known from Eocene to Recent.

Occurrence: sample 287. Age: Miopliocene.

Neomeris (Descaisnella) ? ignota MORELLET

What appears to be this species is represented by a few fragments, resembling very well the figures given by MORELLET (ref. 3, pl. XIV, f. 36, 37). However, the material was too scanty for a reliable determination. The species is only known from the Miocene of Hungary.

Occurrence: sample 287. Age: Miopliocene.

Amphiroa foliacea LAMOUR

One joint, agreeing well with the figure and dimensions as given in ref. 4, p. 93, pl. II, f. 9. The species is known as a fossil from the Upper Miocene-Pliocene of the East Indies and still occurs in recent seas.

Occurrence: sample 287. Age: Miopliocene.

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APPENDIX

Foraminifera from Bawean

In order to arrive at a closer determination of the age of the Buton fauna, the author had started on a study of additional faunae from the East Indies. Lack of time prevented the termination of the work. As a part of this study a small fauna from the island of Bawean was rewashed. The following faunal list is given here as a substitute for the original one [1]).

Lepidocyclina (Nephrolepidina) sumatrensis BRADY var. *inornata* RUTTEN, A- and B-form
Miogypsina primitiva TAN SIN HOK, B-form
Gypsina howchini CHAPMAN
Gypsina globulus REUSS
Textularia gramen D'ORBIGNY
Clavulinoides sp.
Valvulina italiana CUSHMAN
Clavulina difformis BRADY
Quinqueloculina sp.
Nonion grateloupi (D'ORBIGNY)
Elphidium craticulatum (FICHTEL & MOLL)
Elphidium macellum (FICHTEL & MOLL)
Elphidium sp.
Reussella spinulosa (REUSS)
Loxostomum limbatum (BRADY) var. *costulatum* (CUSHMAN)
Discorbis mira? CUSHMAN
Amphistegina radiata (FICHTEL & MOLL)
Anomalina sp.
Cibicides lobatulus (WALKER & JACOB)
Planorbulina mediterranensis D'ORBIGNY.

The age of the fauna is Upper Miocene (Tertiary-f).

[1]) F. KEYZER. A Contribution to the Geology of Bawean. Proc. Kon. Akad. Wetensch. Amsterdam, vol. 43, no. 5, p. 620—629 (1940).

PLATE I

1, 2.	*Spiroplectella gracilima* nov. sp.	
	1. Holotype; 2. paratype	p. 271
3—6.	*Clavulinoides* sp.	p. 271
7, 8.	*Listerella* sp.	p. 272
9—11.	*Dorothia robusta* nov. sp.	p. 272
12, 13.	? *Cribrogoësella* sp.	p. 272
14, 15.	*Nonion* sp. (× 105)	p. 273
16, 17.	*Lagena vitrea* nov. sp.	p. 273
18, 19.	*Clavulinoides fijiensis* nov. sp.	p. 271
20—22.	*Buliminella sculpturata* nov. sp.	p. 276
23—25.	*Guttulina* sp.	p. 273
26—29.	*Buliminella septata* nov. sp.	p. 276

All figures (except 14, 15) .... × 35

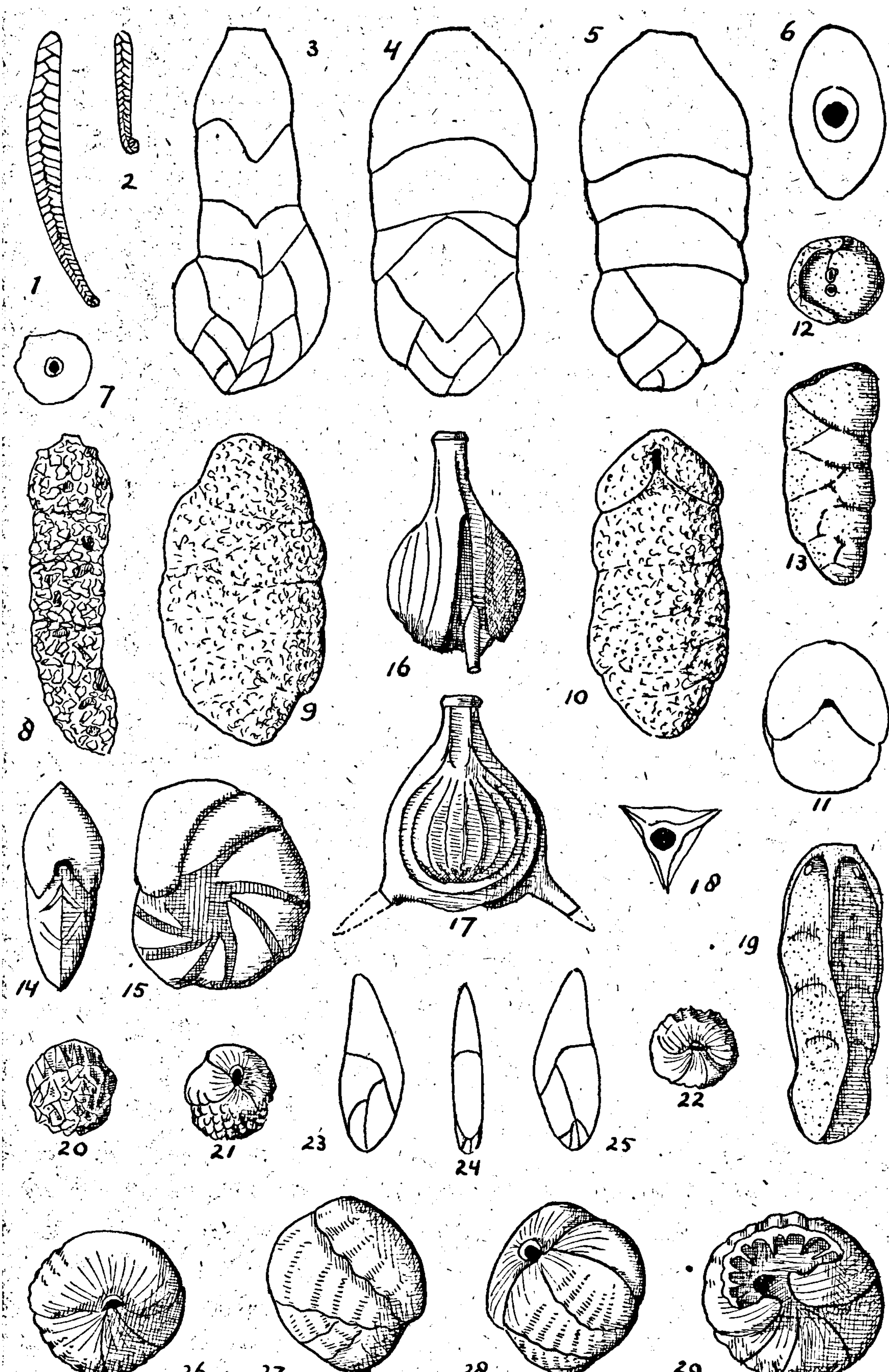
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PLATE II

1, 2.	*Bulimina* sp. (× 105)	p.	277
3, 4.	*Loxostomum* sp. (× 105)	p.	277
5—7.	*Bifarina thoënesi* nov. sp.	p.	277
8—13.	*Tubulogenerina butonensis* nov. sp.	p.	277
	9. side view; 11. top view; 8. lowermost chamber seen from above (× 105; 10. lowermost chamber seen from below (× 105); 12. schematic drawing of connecting structure between roof and floor of chamber; 13. schematic drawing of relation between apertures and connecting structures.		
14—15.	*Pleurostomella bolivinoides* SCHUBERT var. *lata* nov. var.	p.	279
16—18.	*Gümbelina globigera* (SCHWAGER) (× 105)	p.	273
19, 20.	*Tristix carinatum* (SIDEBOTTOM) (× 105)	p.	272
21—24.	*Plectofrondicularia spinosa* (VAN DER SLUIS & DE VLETTER)	p.	274
	21, 24. megalospheric form; 23. microspheric form; 22. aperture of broken specimen (× 105).		
25—27.	*Plectofrondicularia beetsi* nov. sp.	p.	274
28—30.	*Amphimorphinella butonensis* nov. sp. var. *minuta* nov. var.	p.	276
	28, 29. megalospheric form; 30. microspheric form.		
31—34.	*Plectofrondicularia grandis* nov. sp.	p.	274
	31. megalospheric form; 32. microspheric form; 34. top view of broken specimen.		

If not indicated otherwise, all figures .... × 35

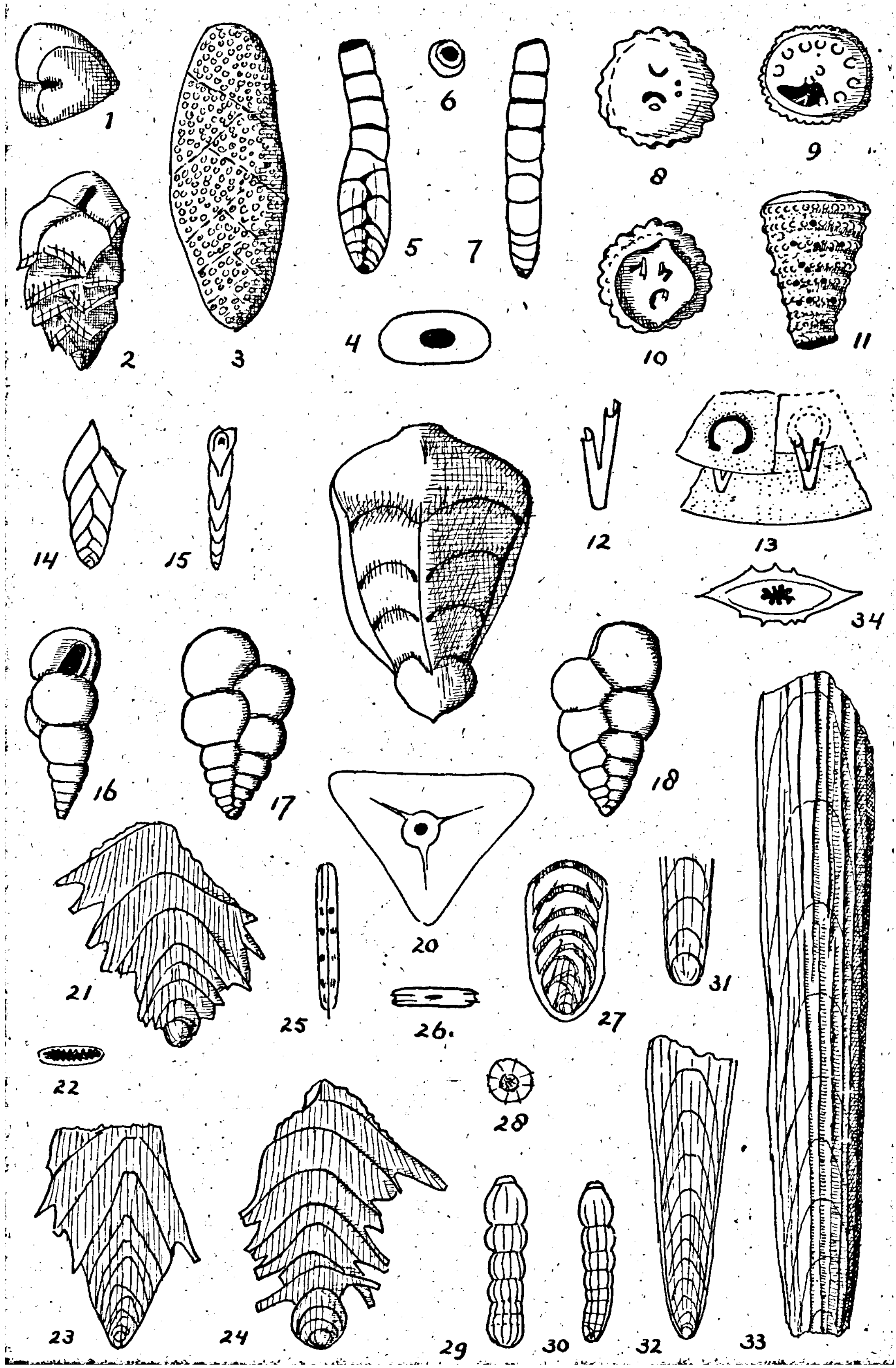
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PLATE III

1—6.	*Amphimorphinella butonensis* nov. sp. 1, 2. megalospheric form (holotype); 3, 4. megalospheric form (broken) (paratype); 5, 6. microspheric form (holotype).	p.	274
7—18.	*Amphimorphinella butonensis* nov. sp. var. *compressa* nov. var. 7. megalospheric form?; 13, 14, 15, 17, 18 microspheric forms (15 holotype); 8. apertural view of 17, 18; 10. apertural view of 15; 11. apertural view of 13; 12. apertural view of 16 (all apertural views × 105). 9. Scheme of apertural characters of *Amphimorphinella*.	p.	276
19, 20.	*Siphonodosaria fijinensis* CUSHMAN var. *butonensis* nov. var. 19. ? microspheric form; 20. megalospheric form.	p.	278
21, 22.	*Siphonodosaria umbgrovei* nov. sp. (× 105) 21. holotype; 22. paratype.	p.	279
23.	*Siphonodosaria simplex* nov. sp.	p.	278
24.	*Siphonodosaria modesta* (CUSHMAN) var. *prolata* (CUSHMAN & BERMÚDEZ)	p.	278
25, 26.	*Cassidulina multicamerata* nov. sp.	p.	281
27—29.	*Cassidulina perumbonata* nov. sp.	p.	281
30—32.	*Cassidulina butonensis* nov. sp. 30. showing details of aperture.	p.	281

If not indicated otherwise, all figures .... × 35

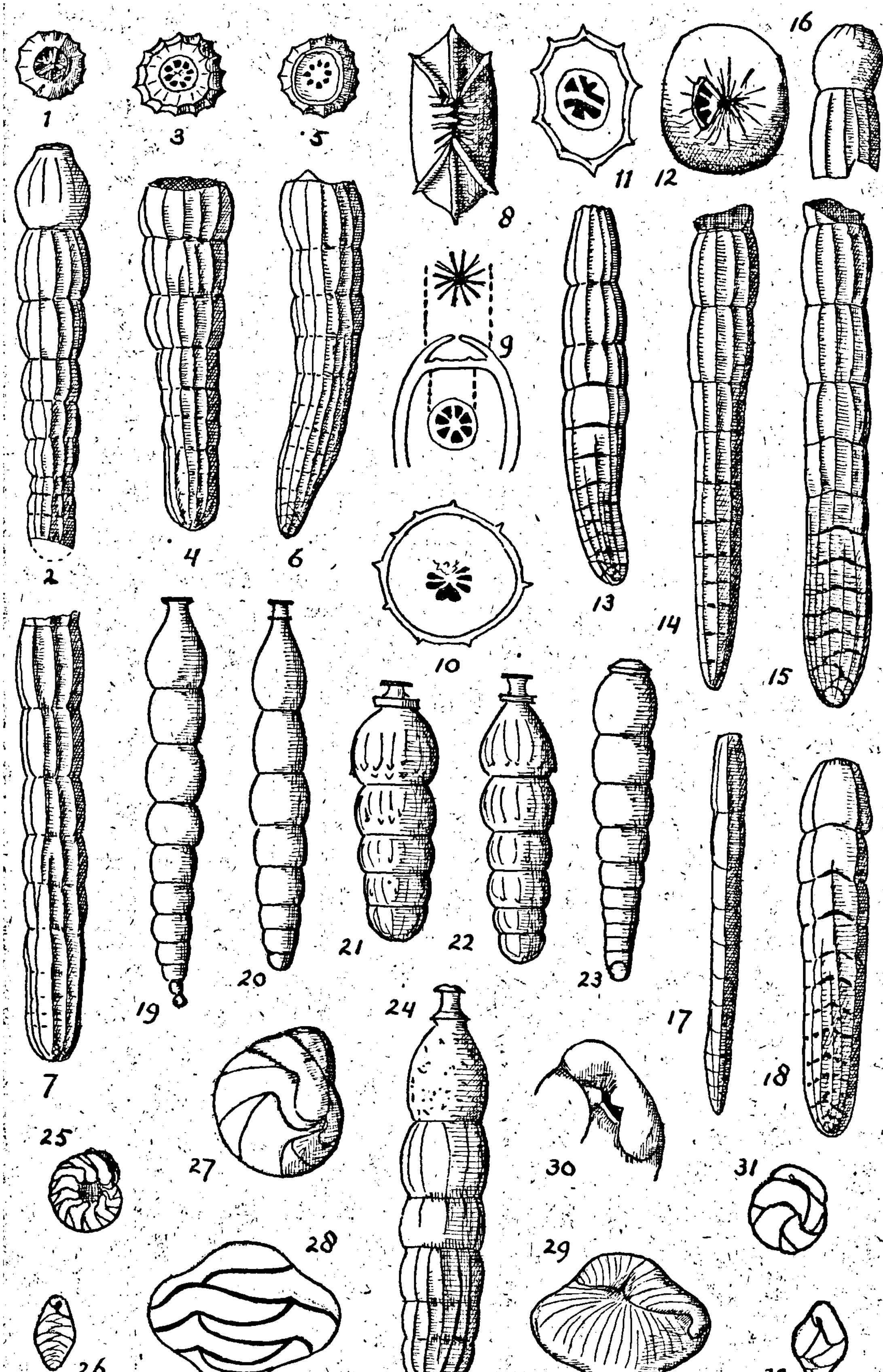
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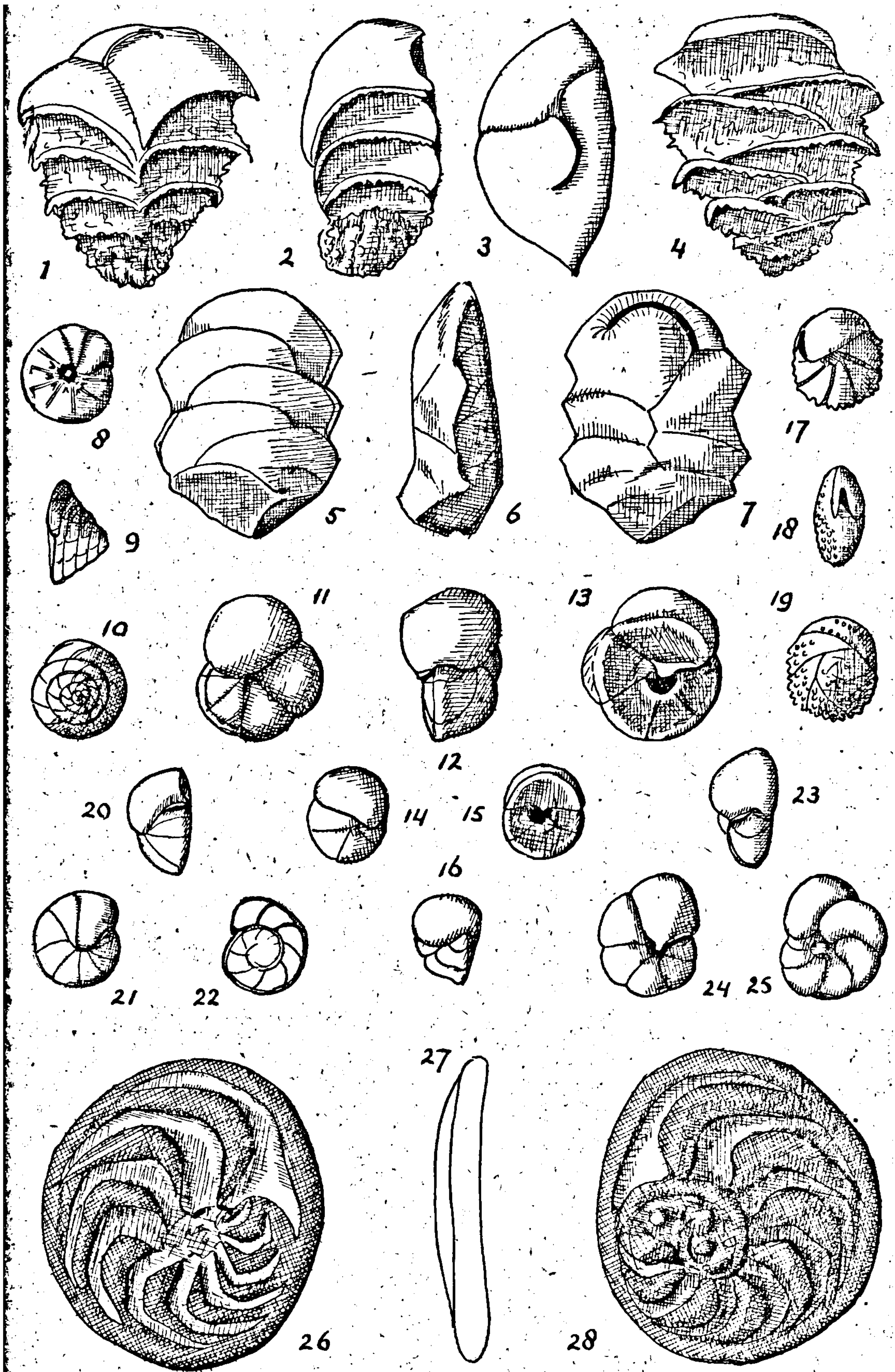
PLATE IV

1—4.	*Ehrenbergina rugosa* nov. sp. (× 105)	p. 282
5—7.	*Ehrenbergina* sp.	p. 282
8—10.	*Rotalia polygyrata* nov. sp.	p. 280
11—16.	*Ruttenella butonensis* nov. gen., nov. sp. 11—13. holotype; 14—16. paratype.	p. 280
17—19.	*Pseudoparrella pustulosa* nov. sp.	p. 281
20—22.	*Cibicides lobatulus* (WALKER & JACOB), var. *grossa* TEN DAM & REINHOLD)	p. 282
23—25.	*Valvulineria butonensis* nov. sp.	p. 280
26—28.	*Discorbis planulinaformis* nov. sp. (× 105)	p. 281

All figures (except 1—4, 26—28) .... × 35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