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LABORATOIRE OCEANOGRAPHIQUE DE L'ATLANTIQUE
INSTITUT de BEDFORD

Dartmouth, Nova Scotia
Canada

RECENT FORAMINIFERA OF THE CONTINENTAL SHELF OFF EASTERN CANADA: A PRELIMINARY REPORT

by

KENNETH HOOPER

REPORT A.O.L. 70-3

JUNE 1970

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ABSTRACT

Foraminifera of 40 bottom sediment samples collected from depths ranging from 5 to 457 metres between English Point, Quebec, and Flemish Cap, 360 miles east of Newfoundland were mechanically and faunally analysed. 318 species and varieties of Foraminifera were recognized.

Raw data of foraminiferal counts were processed by computer to produce data matrices, the elements of which express species as a percentage of the total foraminiferal fauna per sample (station). These data were used as input for a factor-vector analysis, the results of which indicated that seven benthonic foraminiferal assemblages exist in the region of the continental shelf off eastern Canada.

Inspection of depth data suggests that division into seven depth-assemblages agrees well with oceanographic data on water-mass characteristics.

Faunal lists are given of (1) species characteristic of each assemblage, (2) assemblage-ubiquitous species and, (3) assemblage-indicator species.

NOTE: Appendices D, E, F and G which include the data matrices are not part of this report but may be obtained from the author.

RECENT FORAMINIFERA OF THE CONTINENTAL SHELF OFF EASTERN CANADA: A PRELIMINARY REPORT

INTRODUCTION

Previous work:

Published work (to 1965) on recent foraminifera off eastern Canada is sparse, and lacks comprehensiveness. Dawson (1860, 1870), Cushman (1918-31) and Whiteaves (1869, 1875) were the main contributors. Unpublished work, mostly in report form in the case of governmental institutions, and in the form of dissertations in the case of universities, deals mainly with littoral, sub-littoral and inner shelf environments (Bartlett, 1962, 1963, 1964, 1965; Athearn, 1954; Sproule, 1962).

Present study:

The present study is an attempt to elucidate the broad picture of foraminiferal distribution over the continental shelf from a comparatively small number (40) of bottom sediment samples relative to the area covered (some 300,000 sq. miles). No claim is made for the randomness of the samples in a statistical sense. Indeed, they have been chosen from a larger number to represent as wide a range of depths and geographical positions as possible, in the expectation that the major marine environments of the region would thus be represented.

The bottom sediment samples were collected in May and June of the years 1959 and 1965 from stations between English Point, Quebec, in the west, Flemish Cap in the east, and the southern limit of the Grand Banks - the so-called Tail - in the south (Figure 1). They were collected from depths between 5 and 457 metres using a short tube (Phleger) corer and a Dietz-LaFond grab, the choice depending upon the physical characteristics of the sediment; mud and clay commonly were collected by means of the short tube corer, silt and sand by means of the Dietz-LaFond grab.

The following abbreviations are used:
S43 followed by station number refers to cruise number 43 of C.N.A.V. *SACKVILLE* in May, 1969.

S44 followed by station number refers to cruise number 44 of C.N.A.V. *SACKVILLE* in June, 1959.

An M followed by station number refers to a cruise of the longliner *MARC ST.* out of Fox River, P.Q., in June 1965. The letters S.I. followed by station number refers to the Sept Iles Bay samples collected on the same cruise. Table 1 is a table of cruise data compiled mostly from ship's log during the cruises.

All specimens of foraminifera obtained from the bottom samples are assumed to be modern forms, although not all samples were stained to show protoplasm. Samples of S43 and S44 were not injected with staining medium, but those of the M and S.I. series were. However, in this preliminary study, all have been processed by the computer program as if they had not been injected with staining solution. This is denoted on computer printout as TOTL MATRIX (for a matrix based on total populations).

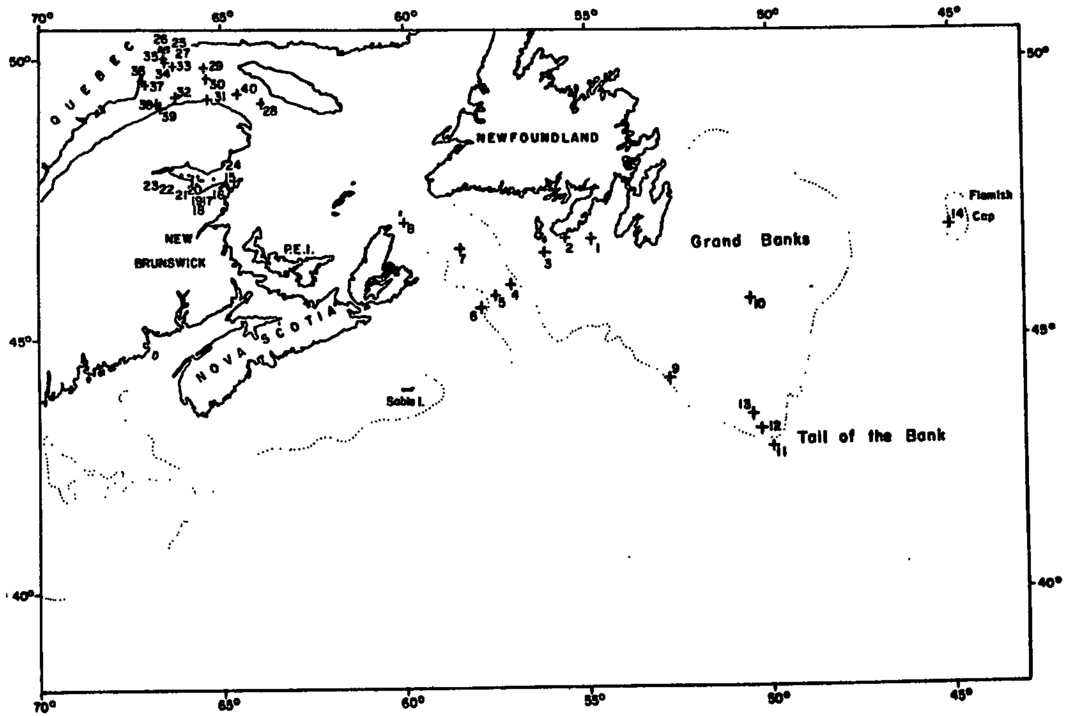

Figure 1 - Locality chart showing sampling stations represented by numerals. The dotted line indicates the outer limit of the continental shelf at 187 metres depth.

Table 1

CRUISE DATA

Sample No. (This Report)	Station No. (Shipboard)		Position Lat.	Position Long.	Depth in Metres	Dietz-Lafond Grab	Phleger Corer	Sediment Type M-mud St-silt S-sand	Temperature °C.
1	Sackville 43	17	46° 48'	54° 53'	237	X		M	-0.97
2	"	18	46° 49'	55° 36'	74	X		S-M	-1.03
3	"	19	46° 31'	56° 10'	135	X		S	-1.04
4	"	21	45° 58'	57° 08'	218		X	M	2.77
5	"	22	45° 46'	57° 30'	457		X	M	4.80
6	"	23	45° 32'	57° 55'	255		X	M	5.09
7	"	27	46° 37'	58° 30'	430		X	Clay	4.74
8	"	35	47° 06'	59° 59.5'	292		X	S-M	4.79
9	"	47	44° 11.5'	52° 45'	135	X		S	—
10	"	52	45° 39'	50° 30'	74	X		S	—
11	"	63	42° 51'	49° 57'	164	X		S	2.48
12	"	64	43° 11'	50° 12'	65	X		S	1.70
13	"	65	43° 29'	50° 27'	58	X		S	1.29
14	"	82	47° 00'	45° 00'	164	X		M	3.02
15	Sackville 44	16B	47° 49.5'	64° 56'	5	X		S	12.74
16	"	21B	47° 54'	65° 18'	64	X		—	
17	"	27	47° 52'	65° 30'	62		X		-0.20
18	"	28C	47° 48'	65° 40.2'	50		X	St.M	11.40
19	"	29	47° 54'	65° 36'	26		X		4.20
20	"	30	47° 55.8'	65° 37.5'	38		X	M-S	5.20
21	"	32A	47° 56.5'	65° 46'	34		X	M	—
22	"	34	47° 58'	65° 54'	32		X	—	3.60
23	"	35	47° 58'	66° 04'	12		X	M	1.20
24	"	57A	48° 07'	64° 57'	82		X	St.M	-0.45
25	Marc	SI.2	50° 12.5'	66° 22'	7	X		M	—
26	"	SI.6	50° 12'	66° 29'	12	X		M	—
27	"	SI.9	50° 10'	66° 27.5'	36	X		M	—
28	"	M.13	49° 15'	63° 52'	365	X		M	4.31
29	"	M.35	49° 51.5'	65° 26'	82	X		Clay	—
30	"	M.37	49° 41.5'	65° 25'	274	X		M	—
31	"	M.43	49° 16'	65° 19'	56	X		S	2.87
32	"	M.47	49° 22'	66° 12'	317	X		—	4.64
33	"	M.53	49° 54'	66° 19.5'	250	X		M	4.71
34	"	M.54B	49° 57'	66° 21'	222	X		—	3.47
35	"	M.55A	50° 05.5'	66° 22'	142	X		M	1.77
36	"	M.57C	49° 37'	67° 11'	237	X		M	0.23?
37	"	M.58	49° 35'	67° 07'	106	X		S-M	0.23
38	"	M-63	49° 12'	66° 49'	274	X		M	4.68
39	"	M.64B	49° 09'	66° 42'	191	X		M	3.40
40	"	M.F	49° 24'	64° 31'	398	X		M	4.72

N.B. MARC series temperatures compiled from data supplied by Canadian Oceanographic Data Centre(Department of Energy, Mines and Resources).

PREPARATION OF SAMPLES FOR ANALYSIS

Laboratory procedures:

(a) General

The amount of sediment collected by the Dietz-LaFond-type grab varied considerably from station to station. The samples collected on cruises S43 and S44, in 1959, were either split into putative aliquot portions or not, according to the amount of material available. The top 6 cm only of the sediments collected by the short tube (Phleger-type) corer were used. On the cruise of the longliner *MARC ST.* the Phleger-type corer was irreparably damaged at the first station. As a consequence of this damage, all samples were taken by Dietz-LaFond grab. Great care was taken to ensure that the sample reached the laboatory without being inverted or contorted.

Supposed representative portions were taken of each sample by pressing a 3-inch length of a cylindrical plastic core liner 1¼ inches in diameter into the sediment sample from above, and recovering the top 6 cm of material. This sediment, with its overlying sea-water, had been preserved in alcohol and was subsequently stained with rose bengal. Normally, only one insertion of the cylindrical plastic liner was needed to extract sufficient sediment for particle-size analysis and faunal analysis.

(b) Grading of samples

Sediment samples of the S43 and S44 series were divided into six grades by washing through a nest of sieves, the size of mesh openings of which are as follows:

Grade 1, > 1190mu; Grade 2, > 590mu < 1190mu; Grade 3, > 297mu < 590mu; Grade 4, > 149mu < 297mu; Grade 5, > 62mu < 149mu; and Grade 6, < 62mu.

In order not to damage the foraminifers 'Ro-tapping' was avoided. Instead, grains were assisted to pass through the sieves by a gentle water-jet. This procedure may introduce error into the mechanical analysis, but this error is not thought to be high. In any case, because the primary purpose of grading was to assist faunal analysis, it was decided to accept this risk of error in the mechanical analysis.

Dispersing agents were not used because it was suspected that they disintegrate some agglutinating foraminifers. However, in the pipette analysis of grade 6 (fine) material in the sedimentation column, calcium oxalate was used as a dispersing agent. The fauna of grade 6 was not analysed.

Apart from the procedures outlined above the method is essentially that of Twenhofel and Tyler (1941, pp. 46-55) for the mechanical analysis of sediments. Particle-size analysis was conducted for each sample. The weights of each grade obtained from sieve analysis were combined with those obtained from the sedimentation column (pipette method). The weight percentage of the range was calculated for each class interval (grade). Cumulative weight percentages were also calculated. Details of the processing of these data are given in the section on particle-size analysis.

After the sediments were dried, each grade (except grade 6) was treated in the manner described in the next section for the separation of foraminifers from sediment. Grade 6 (fine material of particle size less than 62 mu) was not analysed faunally because foraminifers and other organisms contained in it are too small for reliable specific identification using a stereomicroscope with a maximum magnification of approximately x 100, and because early growth stages of many foraminifers are so similar as to be specifically indistinguishable. The drying of material before faunal analysis has the disadvantage that some agglutinating foraminifers may disintegrate.

The sediments collected in 1965 on the cruise of the *MARC ST.* were kept in the wet state throughout. After passing through grading sieves the material was stored in plastic vials. Any lost liquid was replaced, so that the foraminifers at no time were allowed to dry out.

These samples were not separated and concentrated by the bromoform method. Instead, the foraminifers were identified and counted under water. Such counting is very tedious where the ratio of foraminifers to mineral grains is low.

(c) Separation of foraminifers from sediment

The procedure described below was only carried out on samples of the S43 and S44 cruises. Foraminifers were separated from mineral grains by the use of the heavy liquid bromoform. The sediments were passed through a succession of heavy-liquid mixtures of decreasing density. Foraminifers and grains were separated according to whether their density was greater or less than that of the mixture. Bromoform (S.G. = 2.88) was diluted by the addition of alcohol to obtain solutions of various specific gravities. Solution 1 was adjusted to a specific gravity intermediate between calcite (S.G. = 2.72) and quartz (S.G. = 2.66), solution 2 was adjusted to a specific gravity slightly below that of quartz and solution 3 was adjusted to a specific gravity of approximately 1.5 by the addition of alcohol.

The grains that sank in solution 1 commonly consisted of calcite and some heavier minerals, plus some calcareous organic remains (i.e. pieces of shell) and some calcareous foraminifera. The floating portion was collected in a separate beaker, filtered and placed in solution 2. This float usually contained light minerals, quartz grains, chitinous organisms, some arenaceous foraminifers and many foraminifers containing trapped air. The particles in solution 2 were treated in a manner similar to those in solution 1. The heavy portion (S.G. about 2.66) sank and commonly contained quartz grains and some arenaceous foraminifers. The float from solution 2 contained the lighter grains, chitinous organisms and foraminifers containing trapped air. The float was then placed in solution 3 (S.G. approximately 1.5) and allowed to settle. Grains and some foraminifers sank in this solution. Most of the foraminifers containing trapped air floated, as did the chitinous organisms and the fragments of plant material. The main bulk of the fauna was found in this portion. The portions are called fractions.

(d) Identification and counting of foraminifers

In order to obtain a statistically valid sample, identification and counting of foraminifers in each sample fraction or split was continued until more than 300 specimens of the most abundant species had been counted. However, once a split portion had been selected it was counted in its entirety. If the count was less than 300 another portion was taken, and so on, until a total count of about 300 was reached. The weight of the sediment so analysed was noted.. With samples of low foraminiferal number it was not always possible to realize this ideal, and counting had to be stopped at a lower number.

The samples of the S43 and S44 series were divided into grades and, these in turn, were divided into fractions. When the number of foraminifers concentrated in the fraction was very high, the fraction was split into smaller portions by means of a simple splitting device capable of dividing the fraction into two approximately equal portions. The device consisted of a hopper into which the fraction was placed. The foraminifers were passed over four knife edges and sent down four alternating chutes into two boxes. The contents of one of the boxes were weighed (split weight) and the contained foraminifers were identified and counted. The *MARC ST.* samples, which were divided into grades, were treated differently as described below. For microscope work it was necessary to remove the alcohol - rose bengal solution, the colour of which gave a pink hue to all tests and the vapour of which can irritate the mucous membranes. This was done by filtration and dilution with distilled water.

Where the amount of material of a grade-size was small, all the contained foraminifers were identified and counted. In cases where a large quantity of material was present in the vial containing a grade, the contents were shaken and then allowed to settle. When all the material had settled a length of capillary tubing (bore diam. = 5 mm) was inserted vertically into the sediment. With a finger tightly capping it, the tube was withdrawn and the contents were allowed to drain into a tray. It was sometimes necessary to repeat the process in order to obtain a statistically valid sample of foraminifers.

Evaluation of the staining technique presented problems. A specimen stained pink with rose bengal was recorded as living when collected only if its own protoplasm, as indicated by the shape and homogeneity of the stained mass, had taken the stain. Uneven, granular type staining was interpreted as due to foreign protoplasm, probably of algal or bacterial origin, that entered the test after death. Live protoplasm commonly contracts to a spherical globule within the test after contact with the fixing alcohol. However, it was not always easy to be sure of the nature of the stained protoplasm. In most instances the stained protoplasm could be seen within the test, but in other cases the test wall was not translucent enough and had to be broken. Thus, many tests were destroyed and counting was time-consuming.

After identification and counting of the foraminifers, the material comprising the fraction was weighed (fraction weight). The grade weight was also determined.

PARTICLE-SIZE ANALYSIS

Method of Moments:

A FORTRAN program was written for the method of moments, and textural parameters of sediment samples 1 to 40 were computed using an IBM 1620 computer.

Moment measures are obtained by summing the individual moments for each class interval. The measure obtained in this way is called a 'data moment' about the origin and is defined as,

$$n_k = \frac{1}{N} \sum_{i=1}^{h} X_i^k \, f_i \qquad \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots 1$$

where X_i is the class mid-point of the i^{th} class, f_i is the class frequency, and h is the number of classes.

Data moments yield less exact results than theoretical moments, but may approach them if the number of classes, h, is high.

The first moment about the origin of the distribution, n, is the arithmetic mean, M. The next three moments are computed about the mean, (Inman, 1951). They are given by

$$m_k = \frac{1}{N} \sum_{i=1}^{h} (X_i - M)^k \; f_i \quad \text{.........................} 2$$

Also, standard deviation is

$$\sigma = \sqrt{m_2} \quad \text{....................................} 3$$

Skewness is

$$_3 = m_3 / \sigma^3 \quad \text{....................................} 4$$

and kurtosis is

$$\beta_2 = m_4 / \sigma^4 \quad \text{....................................} 5$$

The FORTRAN program may be obtained from the author.

The results, expressed in phi units, are shown in Table 2. They are approximate, no correction having been made for class interval.

The values of mean grain diameter (in phi units) are also shown in column eleven of the re-ordered oblique projection matrix (Table 4, p. 20).

Relation of mean size of grains to depth:

Figure 2 shows mean diameters (in phi units) against depth in metres. The scatter of points indicates only a weak correlation of particle size with depth. However, a general trend of decreasing particle size with increasing depth of water is seen.

DATA MATRICES

During the course of identification and counting, forms were seen which were thought to be varieties of certain species. It was deemed desirable to distinguish these forms from those that were more characteristic of the species as described in the literature in order to facilitate later evaluation of their ecological significance, if any. They were therefore given a number and then treated as separate entities (species) by the computer. The factor-vector analysis program does not recognize taxonomic or phylogenetic relationships.

The great amounts of data on grade weights, fraction weights, split weights and the foraminiferal counts amassed during the first stages of the study were processed by Control Data G-20 computer using a program described by

Table 2

Particle Size Analysis of Sediments - Phi Units

Station Number	Mean	Standard Deviation	Skewness	Kurtosis
1	4.77	1.86	1.38	4.14
2	.86	1.75	1.09	4.56
3	3.21	.51	-1.41	8.64
4	6.01	1.79	- .05	2.34
5	7.09	1.77	- .14	2.98
6	5.97	1.32	.01	2.33
7	4.31	2.17	- .62	3.15
8	1.71	1.25	.62	6.18
9	2.45	.61	- .33	10.52
10	1.65	.77	- .58	5.07
11	1.82	.92	- .66	5.04
12	2.39	.44	1.26	5.20
13	1.34	.64	- .26	3.54
14	2.46	1.65	.21	4.03
15	1.76	.67	.62	3.42
16	6.29	1.89	.43	3.16
17	5.17	1.30	- .89	4.82
18	2.68	2.65	.22	2.13
19	4.79	1.71	.36	3.11
20	3.73	2.44	.99	3.46
21	4.03	3.02	.17	2.34
22	4.65	1.85	.23	2.57
23	4.63	1.82	.69	2.90
24	5.46	1.44	- .42	3.62
25	4.00	1.73	1.32	5.66
26	4.93	1.97	.95	3.84
27	4.37	1.79	1.00	4.69
28	6.41	2.39	- .31	2.75
29	6.22	2.92	- .39	2.30
30	5.53	3.10	- .30	1.80
31	2.29	2.64	1.32	4.43
32	7.30	1.87	- .26	2,93
33	6.68	1.97	.15	2.79
34	3.82	3.00	.55	2.31
35	5.45	2.09	.56	3.47
36	6.70	2.07	- .07	3.19
37	3.41	2.28	1.05	4.00
38	7.00	2.57	- .60	3.00
39	6.20	2.60	.09	2.00
40	7.56	1.95	- .53	3.33

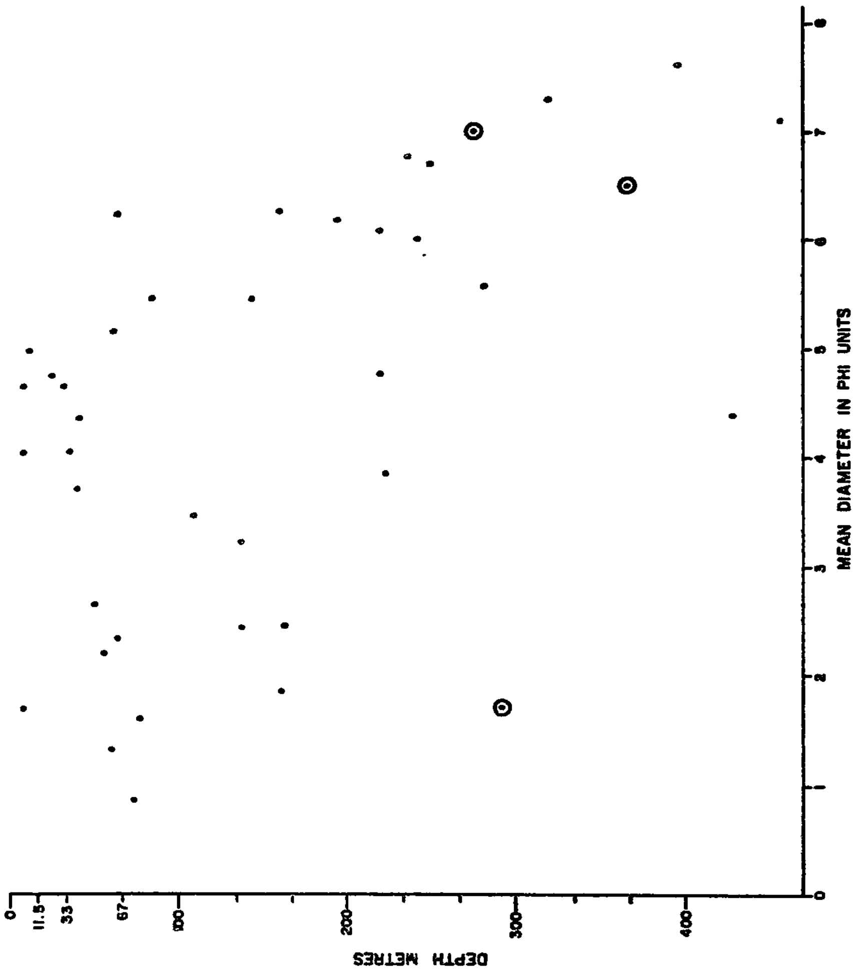

Figure 2 - The relation of mean size of grains to depth of occurrence of the faunal assemblages.

the present author at the International Planktonic Conference in Geneva, 1967. In the resulting data matrices (Appendices D - G) columns represent stations (samples).

The composition of the planktonic fauna, shown as percentage per species for each station, is given in Appendix D.

The percentage of foraminifera of all species per grade; the number of species in each class (porcellaneous, arenaceous, hyaline benthonic, planktonic) as a percentage of the total number of species; the foraminifera of each class as a percentage of the total benthonic foraminifera; and the foraminifera of each class as a percentage of the total foraminifera, are given for each station in Appendix B.

The number of benthonic foraminifers per species as a percentage of the total benthonic foraminifera of each station, and the number of benthonic foraminifers per species as a percentage of the total foraminifera of each station are contained in two matrices in Appendices F and G.

FACTOR-VECTOR ANALYSIS

One of the data matrices, that which gives the number of benthonic specimens per species as a percentage of the total benthonic foraminiferal fauna per station, was punched on cards by the computer. These cards constitute the input for a factor-vector analysis program described by Manson and Imbrie (1964).

In order to accommodate the large number of species (318) in the present study, the program was modified so that it could be run in the QQ mode. The statements of Table 3 were substituted for the original ones. Statements 074 and 079 must of necessity be changed; statements 197, 198, 218, 345, 377A are preferable to those published. The IBM 7094 computer at the Institute of Computer Science, University of Toronto, was made available to carry out the program. The systems tape in use with this installation necessitated the omission of the A PLOT subroutine in order to free space in memory.

The results of the factor-vector analysis are given on the re-ordered oblique projection matrix (Table 4) the elements of which are a measure of faunal similarity. Each faunal sample is resolved into contributions of seven end-members. Samples 36, 17, 31, 26, 7, 35 and 12 each have 100 per cent of end-members A, B, C, D, E, F and G, respectively. These samples are referred to as end-member samples, or simply, end-members. In the matrix they are underlined. Maximum faunal similarity is represented by unity, while zero indicates that samples have nothing in common. In this study a coefficient of faunal similarity greater than 0.69 is regarded as indicating a high degree of faunal similarity.

Based on available data the writer postulates that the most probable explanation of the distribution of benthonic foraminiferal faunal assemblages of the region relates them to their depth of occurrence. However, there are some samples which appear to be anomalous if a depth-assemblage zonation is accepted. Most of the anomalies may be explained in terms of sediments which have been displaced downslope.

A sediment which has been displaced downslope may (1) lose some material, (2) gain some material, or (3) retain substantially the same composition. In the first and second cases a lowering of the value of the coefficient of

Table 3

MODIFYING STATEMENTS QQ-MODE

```
21 DO 25 I = 1,100                                          COVA 074
   DO 25 J = 1,100                                          COVA 079
   SEG1 = SQRTF (ABSF((6.0*CMO*CM1)/(CM2*CP1*CP3)))         COVA 197
   SEG2 = SQRTF (ABSF((24.0*CMO*CM1*CM1)/(CM3*CM2*CP3*CP5))) COVA 198
   A(I,12) = A(I,11)*SQRTF (ABSF(0.5+0.25*A(I,5)))          COVA 218
   IF(NORMAT)1290,1290,2371                                 COVA 345
2371 CONTINUE                                               COVA377A
```

Table 4

QQ-Analysis of Eastern Canadian Shelf Forams by Hooper
Geology-Carleton try QQ Mode M7-5 Trial Series MTX 3
Reordered Oblique Projection Matrix

Name	Index	M0057C 36	S44027 17	M00043 31	SI0006 26	S43027 7	M0055A 35	S43064 12	Depth (M)	Mean, Phi
M0057C	36	1.00	0.00	0.00	0.00	0.00	0.00	0.00	237	6.7
M00047	32	0.99	-0.01	0.08	0.01	0.09	-0.09	-0.22	317	7.2
M00037	30	0.92	-0.01	0.10	-0.02	0.26	-0.07	-0.56	274	5.5
*M00013	28	0.85	-0.01	0.27	-0.00	0.60	-0.08	-0.58	365	6-4[1]
M00053	33	0.73	-0.01	-0.23	-0.03	0.18	0.02	0.26	250	6.6
M00035	29	0.69	-0.01	0.09	-0.01	0.37	-0.05	-0.18	166	6.2
*S43019	3	0.59	0.41	0.33	0.35	-0.14	0.57	-0.41	135	3.2[2]
S43017	1	0.58	0.06	0.53	0.15	-0.10	0.29	-0.55	237	4.7
*S4457A	24	0.51	0.51	0.36	0.48	-0.10	0.41	-0.50	82	5.4[3]
M0054B	34	0.48	-0.01	-0.21	-0.06	0.01	0.21	0.46	222	3.8
S44027	17	0.00	1.00	0.00	0.00	0.00	0.00	0.00	62	5.1
S4432A	21	-0.04	0.99	-0.03	-0.17	0.02	-0.08	0.05	34	4.0
S4428C	18	-0.04	0.98	-0.03	-0.17	0.02	-0.08	0.05	50	2.6
S44035	23	-0.04	0.98	-0.03	-0.17	0.02	-0.08	0.05	12.5	4.6
S44034	22	-0.01	0.98	-0.01	-0.09	0.01	-0.03	0.01	32	4.6
S44029	19	0.01	0.98	0.02	0.03	0.01	0.01	-0.01	26	4.7
S4421B	16	0.05	0.86	0.09	0.28	-0.01	0.14	-0.06	64	6.2
S44030	20	-0.01	0.78	0.11	-0.13	0.04	-0.01	-0.03	38	3.7
M00043	31	0.00	0.00	1.00	0.00	0.00	0.00	0.00	56	2.2
S43052	10	-0.42	0.01	0.90	-0.04	0.42	0.02	0.22	74	1.6
S43018	2	-0.20	-0.01	0.90	-0.02	0.04	-0.02	0.24	73	.8
*S43035	8	0.64	-0.01	0.65	0.04	0.29	-0.03	-0.26	292	1.7[4]

*[1] Displaced? Or could go in assemblage 5?
*[2] Could go in assemblage No. 6?
*[3] Correlation with this fauna uncertain, could go in 2, 4, 6. Probably 2
*[4] Displaced? Coeff. 0.65 could go in assemblage No. 1?

(Cont.)

Table 4 (Cont.)

QQ-Analysis of Eastern Canadian Shelf Forams by Hooper
Geology-Carleton try QQ Mode M7-5 Trial Series MTX 3
Reordered Oblique Projection Matrix

Name	Index	M0057C	S44027	M00043	SI0006	S43027	M0055A	S43064	Depth (M)	Mean,Phi
		36	17	31	26	7	35	12		
SI0006	26	0.00	0.00	0.00	1.00	0.00	0.00	0.00	12	4.9
SI0009	27	0.04	0.05	0.03	0.98	-0.03	0.22	-0.06	36	4.3
SI0002	25	-0.07	-0.06	-0.07	0.70	0.04	-0.17	0.10	7	4.0
S43027	7	0.00	0.00	0.00	0.00	1.00	0.00	0.00	430	4.3
S43022	5	0.34	-0.01	-0.02	0.01	0.74	-0.08	-0.32	457	7.0
M0000F	40	0.04	0.01	0.14	-0.04	0.72	0.36	0.10	398	7.5
S43021	4	0.06	-0.01	-0.17	0.01	0.69	-0.02	0.43	218	6.0
*S4416B	15	-0.43	0.12	0.48	-0.05	0.58	0.06	0.12	5	1.7[5]
S43023	6	0.15	-0.01	-0.04	0.04	0.53	-0.05	-0.17	255	5.9
M0055A	35	0.00	0.00	0.00	0.00	0.00	1.00	0.00	142	5.4
M00058	37	0.07	0.08	0.05	0.40	-0.07	0.98	-0.75	106	3.4
M0064B	39	-0.04	-0.01	-0.05	-0.04	0.01	0.77	0.09	191	6.1
*M00063	38	0.24	-0.01	-0.06	-0.06	0.06	0.76	-0.07	274.5	6.9[6]
S43064	12	0.00	0.00	0.00	0.00	0.00	0.00	1.00	65	2.3
S43063	11	-0.01	-0.01	0.09	-0.01	-0.12	0.05	0.98	164	1.8
S43065	13	-0.13	0.02	0.27	-0.02	0.06	0.01	0.93	58	1.3
S43047	9	0.07	0.01	0.12	0.01	-0.07	0.26	0.75	136	2.4
S43082	14	-0.05	-0.00	-0.14	0.01	-0.05	0.06	0.42	165	2.4

*[5] Probably statistically invalid. Only 14 specimens.

*[6] High Coeff. Displaced downslope? Steep slope.

faunal similarity will result, when the sample is compared with the end-member of the depth-assemblage in which the sample originated in the first place. In the third case the coefficient of faunal similarity will remain unchanged, and it will normally be a 'high' value.

A very low coefficient of faunal similarity may indicate that the fauna is so unlike the end-member with which it is compared that a great deal of loss or gain on displacement may have occurred, or it may represent a quite distinct fauna. In the latter case a completely different facies to those now existing in the region, or a fauna of different age, may be indicated. These possibilities should be carefully considered if the sample has a low coefficient with respect to all other end-members and hence depth-assemblages in the region under study.

Samples of doubtful statistical validity may also produce anomalies. If the number of specimens counted is so low as to be statistically non-significant, then the number of species recorded is likely to be non-significant also, although the percentages will be quite high. In such cases, the sample studied is not representative of the fauna. Such a sample may have a moderate or even high coefficient of faunal similarity when compared with one or more end-member samples, and is not detectable as anomalous from the re-ordered oblique projection matrix. However, if also the sample has been grouped in an intermediate or deep water depth-assemblage, although it was, in fact, collected from shallow water, it is clearly suspect, as samples are not likely to be displaced upslope in nature.

In reading the re-ordered oblique projection matrix (Table 4) the following points should be borne in mind: (1) although the values are given to two decimal places only the first may be significant; (2) the first column (heading 'name') is the cruise number and station number of the sample; (3) the second column (heading 'index') is the sample number according to the sequence given in this study (see also cruise data -- Table 1); (4) the seven subsequent columns are headed by their end-member samples; (5) the tenth column (heading 'depth') is the depth in metres at which the sample was found. These values, which are not part of the computer output, have been added to the matrix by hand; (6) the eleventh column (heading 'mean phi') is the average size of sedimentary grains in the sample expressed in phi units. These values, which are not part of the computer output, have been added to the matrix by hand; and (7) the elements of the matrix (columns 3 to 9) are coefficients of faunal similarity.

There are seven groupings of samples in relation to end-members in the re-ordered oblique projection matrix. Each represents a benthonic foraminiferal assemblage. In each assemblage coefficients of faunal similarity 0.69 and greater are enclosed by a continuous line.

Assemblage No. 1, having special problems, will be considered as the last assemblage in this section.

Assemblage No. 2:

All samples have coefficients of faunal similarity higher than 0.69. Inspection of the list of depths of occurrence reveals a range from 12.5 to 64 metres. Mean grain size of sedimentary grains, in phi units, ranges from 2.6 to 6.2, with an average value of 4.4.

Assemblage No. 3:

Three samples have coefficients of faunal similarity above 0.69. Sample 8 with a coefficient of 0.65 when compared with end-member sample 31, has a moderate degree of faunal similarity. However, it also has a coefficient of 0.64 with respect to end-member sample 36 in assemblage 1. Its depth of occurrence at 292 m seems more appropriate to assemblage 1. Even so, it might be displaced downslope from assemable 3 which, on the basis of samples 31, 10 and 2 has a depth range of 56 to 74 m. The mean size of sedimentary grains ranges from 0.8 to 2.2, with an average of 1.6 phi units. Sample 8, with a mean grain size of 1.7 phi fits well in this assemblage.

Assemblage No. 4:

Three samples, all with high coefficients, have a depth range of 7 to 36 metres. Mean grain sizes range from 4 to 4.9 phi, with an average of 4.4.

Assemblage No. 5:

Four samples have high coefficients of faunal similarity. They range in depth from 218 to 457 m. Sample 6 has a moderate coefficient and a depth (255 m) which is within the range for this depth-assemblage. Sample 15 has a moderate coefficient with respect to end-member sample 7, but it also has a moderate one with respect to end-member sample 31, so that it would almost as well fit assemblage 3. Its depth of occurrence (5 m) seems more appropriate to assemblage 3 with which it also agrees in mean grain size. However, this sample is based on a count of only 14 specimens and cannot be regarded as statistically reliable. It is probably better to disregard it. Mean grain size ranges from 4.3 to 7.5 phi, with an average of 6.1.

Assemblage No. 6:

All four samples in this assemblage have high coefficients of faunal similarity. The first three have a depth range from 106 to 191 m. Sample 38 with a depth of occurrence of 274.5 m is probably below the lower limit of the depth zone which this assemblage seems to characterize. This sample was recovered from near the foot of a slope, and displacement downslope seems a very reasonable explanation for its presence here. Mean grain size ranges from 3.4 to 6.9 phi with an average of 5.5

Assemblage No. 7:

Four samples have high coefficients. They range in depth from 58 to 164 m. Sample 14 has a moderate coefficient when compared with the end-member sample. It has no appreciable similarity to other end-members. It is therefore placed in this assemblage, extending the depth range by 1 m to 165 m. Mean grain size range is 1.3 to 2.4 phi, with an average of 2.0.

Assemblage No. 1:

The first six samples have high coefficients when compared to end-member sample 36. Their depths of occurrence range from 166 to 3.65 m. Sample 28 with a depth of 365 m has a moderate coefficient of faunal similarity with respect to end-member sample 7 and could possibly fit in assemblage 5. Alternatively, it could have been displaced downslope -- it occurred in deep water (365 m) when compared with the other samples in depth-assemblage 1. Its mean grain size of 6.4 phi is appropriate to either assemblage 5 or assemblage 1. The mean grain size of assemblage 1 based on the first six samples ranges from 5.5 to 7.2 phi; the average is 6.4

Sample 3 has a moderate coefficient of faunal similarity when compared with end-member sample 36, and it has a comparable one with respect to end-member sample 35, suggesting it fits almost as well in depth-assemblage 6. On the basis of depth of occurrence (135 m) this alternative would be acceptable as it is within the depth range of that assemblage. The mean grain size of sample 3 is 3.2 phi, which is slightly outside the range of both assemblages, but it deviates less for assemblage 6 than it does for assemblage 1.

Sample 1 has a moderate coefficient when compared with end-member sample 36, as it has also when compared to end-member sample 31. Its depth (237 m) is more compatible with depth-assemblage 1. The mean grain size (4.7 phi), however, is not compatible, and inclusion of the sample in the assemblage necessitates the extension of the range of mean grain size, which becomes from 4.7 to 7.2 phi, with an average of 6.2.

Sample 24 has a moderate coefficient when compared with end-member sample 36, but it also has similar coefficients when compared with end-member samples 17, 26 and 35. Of these latter possibilities, association with end-member sample 17 (assemblage 2) seems the most reasonable on the basis of the value of the coefficient (0.51), the depth of occurrence (82 m) and the mean grain size (5.4 phi), although this arrangement would necessitate extending the lower limit of depth for depth-assemblage 2 from 64 to 82 m.

Sample 34 has a moderate to low coefficient (0.48) of faunal similarity when compared with end-member sample 36, and a similar value (0.46) when compared with end-member sample 12. However, its depth of occurrence is within the range of depth-assemblage 1, while it is not within that of depth-assemblage 7. Its mean grain size (3.8 phi) does not fit well into either assemblage.

DEPTH-ASSEMBLAGES

Seven depth-assemblages are indicated based on the interpretation of the re-ordered oblique projection matrix given above, and with samples 8 and 38 interpreted as displaced, sample 15 as statistically invalid, sample 3 transferred to assemblage 6, and sample 24 to assemblage 2. The depth-assemblages may be classified in two groups according to grain size. Group 1, low mean diameter, 0.8 to 2.5 phi, includes assemblages 3 and 7, and group 2, high mean diameter, 2.5 to 7.5 phi, includes assemblages 1, 2, 4, 5 and 6 (Table 5).

THE RELATION OF DEPTH-ASSEMBLAGES TO WATER MASSES

The region is dominated by the cold Labrador Current as it floods the shelf and slope of eastern Canada, extending well over the Grand Banks. Incursions of warmer slope water sometimes modify the water masses, especially over the outer shelf and shelf edge. On occasion, frictionally induced eddies bring warm Gulf Stream water over the outer and inner shelf.

Table 5

Depth-Assemblages

Depth-assemblage	Depth range metres	Zone	Mean grain size of the assemblage in phi units	
No. 1	82? 135? 166 - 317 or 375?	Deep	6.2 (approx.)	Laurentian Channel slope in the NW. Gulf and south of Newfoundland
No. 2	12.5 - 64 or 82	Shallow	4.4	Chaleur Bay
No. 3	56 - 74	Shallow	1.6	NW. Gulf St. Lawrence and the Bank south of Newfoundland
No. 4	7 - 36	Shallow	4.4	Bay of Sept-Iles
No. 5	218 - 457	Deep	6.1	St. Lawrence Channel
No. 6	106 - 191	Intermediate	5.0 (approx.)	NW. Gulf of St. Lawrence
No. 7	58 - 165	Intermediate	2.0	SE. Grand Banks and the edge of the shelf

Hachey (1961) has summarized the oceanography of the Gulf of St. Lawrence and the continental shelf. For the Nova Scotian sector of the shelf he recognizes three water-mass layers. The 'upper' layer is of variable thickness, but it has an average lower limit at approximately 85 metres. Inshore waters consist of this layer. The cold intermediate layer, which may be continuous with the intermediate layer of Lauzier in the Gulf of St. Lawrence, has limits at approximately 50 and 160 metres. This layer determines the water characteristics on most of the offshore banks. The upper limit of the 'bottom' layer of relatively warmer water occurs at approximately 170 metres. This layer extends to the bottom on the shelf.

In the Gulf of St. Lawrence, Lauzier has recognized three water-mass layers (Hachey, 1961). The surface layer has an approximate lower limit of 70 metres. Wide variations of temperature and salinity are characteristic of it. Inshore waters consist of this layer. The cold intermediate layer ranges from approximately 70 to 160 metres. A relatively warmer deep layer is characteristic of the Laurentian Channel and its slopes. It ranges from approximately 180 metres to the bottom of the Channel (about 500 metres).

Bailey (1954) pointed out that at the confluence of the Labrador Current and the Gulf Stream in the area southwest of the Grand Banks, and to the westward, large scale mixing processes occur that provide a type of 'slope water' that largely contributes to the characteristic waters that are in contact with the continental shelf. In August, the surface layer over the Grand Banks has temperatures ranging from 13°C, in the north, to 19°C at the the southern shelf edge. Salinities range from 31 to 33‰. At 50 metres, the temperatures range from -1°C, in the north, to more than 10°C (with a very steep temperature gradient), near the southern shelf edge. At 100 metres temperatures range from -1°C, in the north, to more than 8°C at the southern shelf edge. Salinities range from 33.0 to 35.0‰. At 100 metres the influence of bottom topography is most pronounced as the main banks are of depths less than 100 metres. Waters of oceanic origin underlie all coastal waters where there is sufficient depth.

The seven depth-assemblages suggested by the factor-vector analysis are correlated with the three water-mass layers of Lauzier for the Gulf of St. Lawrence and the three water-mass layers of Hachey for the Nova Scotian shelf. These latter layers may be extrapolated eastward where they are modified by slope water as indicated by Bailey (1954, and personal communication) for the Grand Banks.

Reference to figures 3 and 4 shows that three shallow depth-assemblages are found in Lauzier's and Hachey's surface layer. They are (a) depth-assemblage 2 in the Chaleur Bay area and depth-assemblage 4 in the Sept-Iles area, both are in the northwest Gulf of St. Lawrence; and (b) depth-assemblage 3, mainly on the shelf, south of Newfoundland, but with one station (31) in the northwest Gulf of St. Lawrence.

Depth-assemblages 2 and 4 are shallow bay assemblages which are subjected to lower than normal marine salinities. Depth-assemblage 3 is slightly deeper and its environment is typically more saline.

Two intermediate depth-assemblages are found in Lauzier's and Hachey's intermediate water-mass layer. They are (a) depth-assemblage 6 in the northwest Gulf of St. Lawrence and (b) depth-assemblage 7 on the southeast banks (the Tail) and the shelf edge extending eastwards to Flemish Cap. The water-

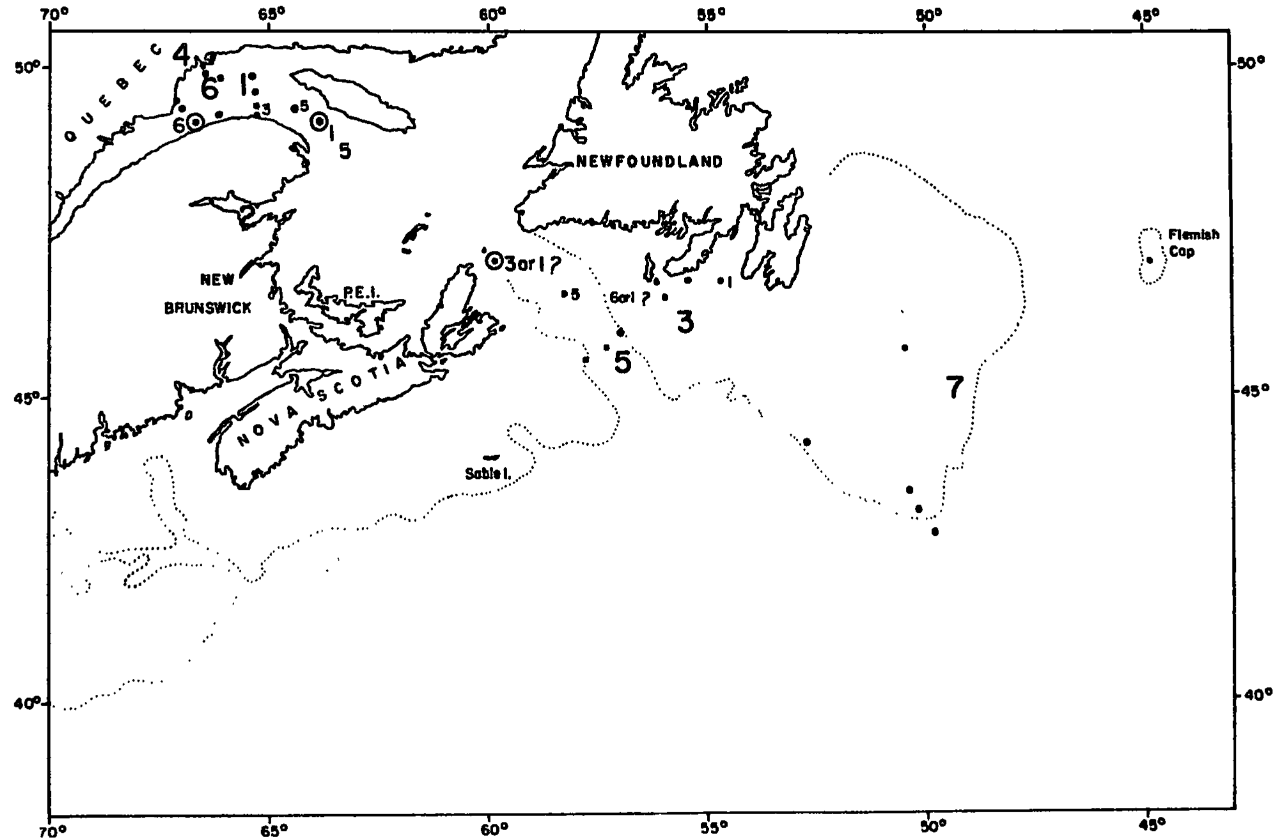

Figure 3 - Chart of depth assemblages. Numerals indicate depth assemblage according to text.

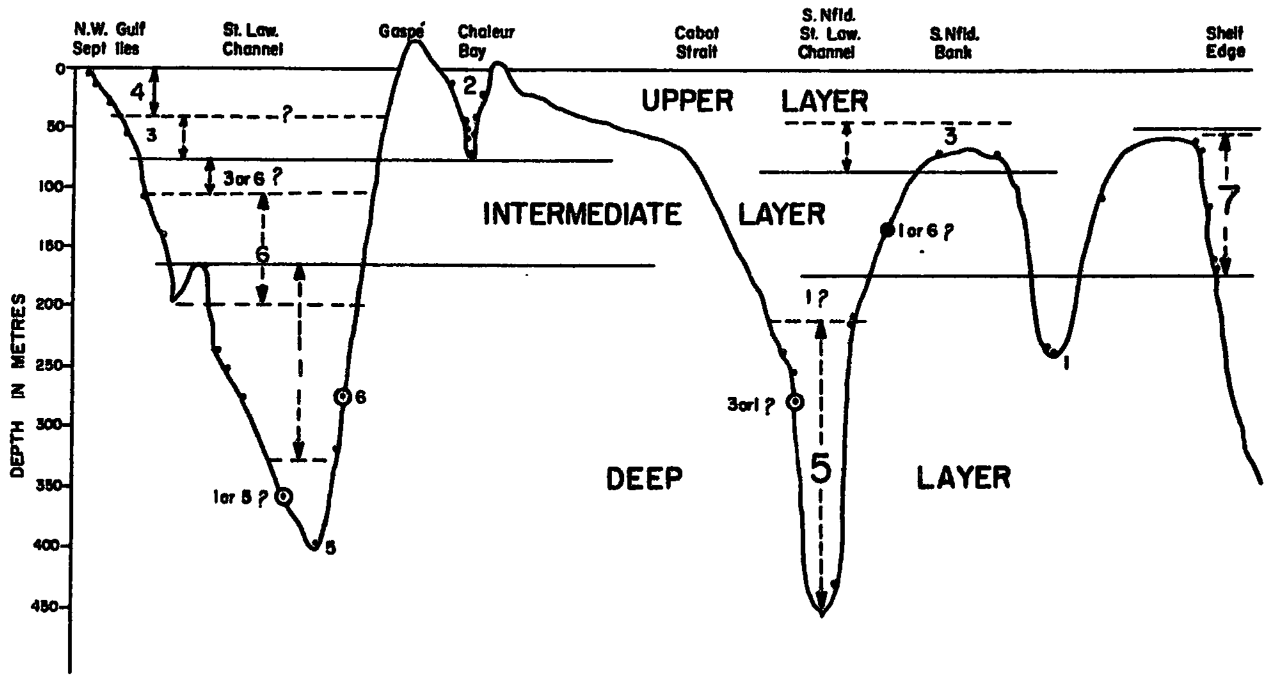

Figure 4 - Diagrammatic profile of depth-assemblages. Assemblages are indicated by numerals according to the text.

mass associated with this latter depth-assemblage is liable to mixing with slope water.

Two deep depth-assemblages are noted. They are found in the Deep Channel layer of Lauzier and the Bottom layer of Hachey. Depth-assemblage 1 is best represented in the northwest Gulf of St. Lawrence, but it extends south-eastward and is also found on the deeper parts of the shelf, south of Newfoundland.

Depth-assemblage 5 is characteristic of the Laurentian Channel south of Cabot Strait and Newfoundland. This assemblage, which tends to occur at greater depths than assemblage 1, is also represented at one station (40) in the Laurentian Channel in the northwest Gulf of St. Lawrence.

SPECIES COMPOSITION OF MICROFAUNAL ASSEMBLAGES

The species composition of the benthonic foraminiferal assemblages is given in Appendix A. In these faunal lists, which are printed by computer, official names are followed by the name of the original author and the year in which the species was erected. Unofficial names of possible varieties are in an abbreviated form that is intended as a guide, and they have no official status. Sample 8 is assigned to assemblage 1 from assemblage 3. This assignment, which is based on depth and coefficient of similarity, is very tentative.

ASSEMBLAGE-UBIQUITOUS SPECIES

Some forms are found in each and every sample of an assemblage. They are here called assemblage-ubiquitous species, because they are ubiquitous within the assemblage. They may also occur in other assemblages, and they may even be assemblage-ubiquitous for more than one assemblage. For example, *Angulogerina fluens* Todd, 1947, is ubiquitous in assemblages 1 and 3.

The species are given in Appendix B.

ASSEMBLAGE-INDICATOR SPECIES

They are here called indicator species. They are restricted to one assemblage. Their abundance is usually less than five per cent. Of these forms some are fully described in the literature and are identifiable. Each of these is given with author's name and date of the first description. They are the most useful as indicator species (Appendix C).

Other forms are of three kinds as follows (1) those that are thought to be new species, but that have not yet been described; (2) forms that might possibly be new species, but that are comparable to or have affinities with known species, and that may be merely variants of them, (these forms are less useful as indicator species); and (3) forms that are indeterminate. These have the least usefulness as indicators.

DISCUSSION

Sources of possible error:

The samples were collected by means of different instruments. Those collected by means of Dietz-Lafond grab possibly are more liable to inversion and distortion than those collected by means of Phleger type corer. In the MARC series special care was taken to ensure that inversion and distortion of sediment did not occur during shipment. In the S43 and S44 series no special precautions were taken.

Laboratory procedures produce error. For example, loss of material occurs during handling, weighing and transfer in the various stages of mechanical and faunal analysis. Checks were done from time to time on weighings and foraminiferal counts -- they always proved reproducible within a tolerance of three per cent.

Samples of the S43 and S44 series were dried out, and some agglutinating foraminifers possibly were disintegrated as a result. Thus, these samples may be deficient in arenaceous forms when compared with those of the MACR series. It is, however, interesting to note that the factor-vector analysis distinguishes an arenaceous Chaleur Bay assemblage (dried out) and an arenaceous Sept-Iles Bay assemblage (not dried out).

Forty stations covering a region of 300,000 sq. miles may not constitute a sufficient number to give a statistically valid sampling of the assemblages present. However, this depends upon the degree of variation of the assemblages. If there is a large number of assemblages then 40 localities may not provide for adequate sampling. On the other hand, if the region is characterized by rather uniform conditions the number of assemblages is likely to be low, and 40 stations may represent an adequate sample. Future addition of data from more stations possibly will result in the removal of some assemblage-indicator species from the list.

The writer believes that this preliminary survey gives the broad picture of the distribution of the main benthonic foraminiferal depth-assemblages of the region, and provides a framework into which undiscovered microfaunal assemblages might be expected to fit. More detailed sampling and more refined taxonomy probably will result in subdivision of the main depth-assemblages described here. In particular, it is to be expected that the many bays and estuaries of the upper water-mass layer, with their wide variation of temperature, salinity and other factors, contain many different environments and will give rise to a corresponding diversity of benthonic foraminiferal assemblages.

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APPENDIX A

SPECIES COMPOSITION OF FAUNAL ASSEMBLAGES

THE FOLLOWING 142 SPECIES OCCUR IN BENTHIC FORAMINIFERAL ASSEMBLAGE 1 OF THE FACTOR ANALYSIS IN QQ-MODE FOR M=7

NO.	SPECIES NAME	1	8	28	29	30	32	33	34	36
	STATION NUMBERS	1	8	28	29	30	32	33	34	36
	DEPTH IN METERS	237	292	365	166	274	317	250	222	237
1	ADERCOTRYMA GLOMERATA (BRADY) 1878	4.0			0.2				1.3	
2	ALVEOLOPHRAGMIUM JEFFREYSI (WILLIAMSON) 1858			0.1	0.2			0.2	0.7	
4	ASTRONONION STELLATUM CUSHMAN + EDWARDS 1937		2.0		0.2				2.6	
5	ANGULOGERINA FLUENS TODD 1947	0.2	1.6	0.7	6.4	3.8	3.2	19.1	27.3	12.3
6	BOLIVINA SP.	0.2	0.3							
7	BOLIVINA PSEUDOPUNCTATA HOGLUND 1947	1.2					0.4			
8	BULIMINA SP.	R								
9	BULIMINA EXILIS BRADY 1884		4.6	19.6	2.5	4.9	8.5	9.8	0.5	1.6
10	BUCCELLA INUSITATA ANDERSEN 1952	11.7	17.9	27.5	19.7	27.6	49.1	10.8	3.9	26.9
11	BUCCELLA FRIGIDA (CUSHMAN) 1922	1.5	1.6	3.3	0.3		0.4		0.1	
12	CASSIDULINA ISLANDICA NORVANG 1945	R	5.5	3.0	7.8	2.2	20.8	15.9	17.0	19.5
13	CASSIDULINA TERETIS TAPPAN 1951	42.6	6.2	2.4	0.2			1.8	2.8	6.6
14	CASSIDULINA NORCROSSI CUSHMAN 1933	0.5		3.5	5.7	1.8		1.6		
15	CIBICIDES LOBATULUS (WALKER + JACOB) 1798		15.0	1.4	1.3	1.5		0.2	1.2	
17	CIBICIDES SP.	0.1	0.3		R					
18	CIBICIDES PSEUDOUNGERIANUS (BRADY) 1884	R								
20	DENTALINA ITTAI LOEBLICH + TAPPAN 1953	0.2								
23	PROTELPHIDIUM SP.		1.3							
24	DISCORBIDAE IMMATURE		0.6							
26	ELPHIDIUM BARTLETTI CUSHMAN 1933		2.6							
27	ELPHIDIUM SP. CF. E. BARTLETTI			2.0	0.1			8.1		
28	ELPHIDIUM SP.	0.2							0.5	
29	ELPHIDIUM CLAVATUM CUSHMAN 1930	4.0	2.3	10.5	5.6		0.4		3.0	
31	ELPHIDIUM SUBARCTICUM CUSHMAN 1944		1.0							
32	ELPHIDIUM INCERTUM CUSHMAN 1930	0.2	0.6			0.3			R	
33	ESOSYRINX CURTUS (CUSHMAN + OZAWA) 1930		0.3	0.3						
34	EGGERELLA SCABRA (WILLIAMSON) 1858	0.2								
35	ELPHIDIELLA ARCTICA (PARKER + JONES) 1864					0.1				
36	EPISTOMINELLA NARAENSIS (KUWANO) 1950	15.1	1.0							
37	FISSURINA MARGINATA (MONTAGU) 1803		0.3		0.6					
39	FISSURINA SEMIMARGINATA (REUSS) 1870				0.2					
40	FISSURINA CUCURBITASEMA LOEBLICH + TAPPAN 1953	0.2								
41	GLANDULINA LAEVIGATA (ORBIGNY) 1826			0.1	0.1	0.3		0.4		
42	GLOBOBULIMINA AURICULATA (BAILEY) 1851		6.8	1.2	1.1	5.3	1.1	6.1	10.9	7.1
47	GUTTULINA SP.		0.3				0.7			
49	LAGENA FLATULENTA LOEBLICH + TAPPAN 1953					0.1				
50	LAGENA LAEVIS (MONTAGU) 1803			0.2	0.2	0.4		0.4	0.2	0.4
51	LAGENA MERIDIONALIS WIESNER 1931								R	
52	LAGENA MOLLIS CUSHMAN 1944	R		0.3	0.8	1.0	0.7	2.4	0.1	0.6
53	LAGENA SEMILINEATA WRIGHT 1886			R						
56	NONION SP.	R	0.3							
59	NONION(ELLA) LABRADORICA	R			0.2			0.4		
60	NONION LABRADORICUM (DAWSON) 1860		5.2	2.3	1.5	2.9	2.1	5.3	4.6	9.0
61	NONION SP. CF. N. POMPILIOIDES		0.3							
62	NONIONELLA AURICULA HERON-ALLEN + EARLAND 1930	R			0.3					
66	PARAFISSURINA FUSULIFORMIS LOEBLICH + TAPPAN 1953				0.2					
69	PROTELPHIDIUM ORBICULARE (BRADY) 1881	R	3.3		R					
70	QUINQUELOCULINA SP. CF. Q. ARCTICA						1.1			

BENTHIC FORAMINIFERAL ASSEMBLAGE 1 FOR M=7 (CONTINUED)

NO.	SPECIES NAME		1	8	28	29	30	32	33	34	36
		STATION NUMBERS	1	8	28	29	30	32	33	34	36
		DEPTH IN METERS	237	292	365	166	274	317	250	222	237
79	REOPHAX CURTUS CUSHMAN 1920								0.2	0.2	
80	REOPHAX SCORPIURUS MONTFORT 1808					0.2					
82	REOPHAX SCOTTII CHASTER 1890-91		R				0.1	1.8			0.4
83	SACCAMMINA SP.				R		0.1	0.4			
84	SPIROPLECTAMMINA BIFORMIS (PARKER + JONES) 1865		3.5							0.1	
85	REOPHAX ARCTICA BRADY 1881		1.6								
89	TROCHAMMINA OCHRACEA (WILLIAMSON) 1858		0.6								
91	PROTEONINA ATLANTICA CUSHMAN 1944					0.1			0.6	8.8	
95	ARENACEOUS INDETERMINATE							0.4			0.4
97	AMMODISCUS SP.								0.2		
99	CIBICIDES SP. CF. C. LOBATULUS		6.1								
100	ELPHIDIUM SP. CF. E. CLAVATUM						1.0		8.3		
101	EGGERELLA ADVENA (CUSHMAN) 1922		R	1.3							
102	GLOMOSPIRA SP.		R								
106	NONIONELLA SP. CF. N. AURICULA			2.0							
108	ELPHIDIDAE IMMATURE					1.0					
109	PSAMMOSPHAERA SP.					R					
116	TROCHAMMINA SP.										0.6
120	ASTRONONION SP.		0.4								
121	BOLIVINA SUBAENARIENSIS CUSHMAN 1922			1.9	0.1	R				R	
122	BOLIVINA SUBSPINESCENS CUSHMAN 1922					0.3					
123	BULIMINA ACULEATA ORBIGNY 1826				0.6	24.3		1.1			
124	BULIMINA MARGINATA ORBIGNY 1826				18.0	4.9	39.9		4.7	7.5	3.1
127	TRITAXIS CONICA (PARKER + JONES) 1865			0.6						0.4	
130	DENTALINA FROBISHERENSIS LOEBLICH + TAPPAN 1953		R								
138	LAGENA GRACILLIMA (SEGUENZA) 1862			0.6							0.2
147	PULLENIA QUINQUELOBA (REUSS) 1851		0.2	8.2	0.9	2.8	1.4	0.7	0.2		
149	VIRGULINA COMPLANATA EGGER 1893			0.7		3.2			2.0	0.8	2.6
166	ANGULOGERINA ANGULOSA (WILLIAMSON) 1858		1.8								
167	BULIMINA SP. CF. B. EXILIS		R								
168	BUCCELLA SP.		R								
169	BULIMINA SP. CF. B. FUSIFORMIS		R								
170	CASSIDULINA SP. CF. C. ISLANDICA		2.5								
171	DENTALINA SP.		R			R				R	
172	EPONIDES SP.		R	0.3							
173	GAVELINOPSIS SP. NOV.		R								
174	LAGENA SP.		R				0.1				
175	NONION SP. CF. N. SCAPHUM		R								
176	NONIONELLA SP.		R								
177	OOLINA SP. CF. O. CAUDIGERA		R								
178	TEXTULARIA SP. CF. T. TORQUATA		0.6							0.1	
179	TROCHAMMINA LOBATA CUSHMAN 1944		R								
180	TROCHAMMINA SP. CF. T. NANA		0.2							0.1	
181	TROCHAMMINA SQUAMATA JONES + PARKER 1860		R								
182	TEXTULARIA SP.		R								
183	DISCORBIS SP. CF. D. OBTUSA		R								
188	CIBICIDES SP. CF. C. REFULGENS							0.7			
195	ANOMALINA SP.			0.3							

BENTHIC FORAMINIFERAL ASSEMBLAGE 1 FOR M=7 (CONTINUED)

NO.	SPECIES NAME	STATION NUMBERS	1	8	28	29	30	32	33	34	36
		DEPTH IN METERS	237	292	365	166	274	317	250	222	237
196	BULIMINA SP. CF. B. MARGINATA			0.3							
197	CASSIDULINA SP. CF. C. NORCROSSI			0.3							
198	DISCORBIS SP. CF. D. CHASTERI			1.3							
199	EPISTOMINELLA SP.			0.3							
201	GLABRATELLA SP. CF. G. WRIGHTII			0.3							
212	GYROIDINA SP.				0.6						
220	PROTEONINA SP.					R			0.6		
233	BOLIVINA PSEUDOPLICATA HERON-ALLEN + EARLAND 1930				0.3						
245	HYPERAMMINA SP.				R		0.8				
246	LENTICULINA SP.						0.1				
248	NONION IMMATURE				R	3.3					
262	BULIMINA ACULEATA AFF. B. MARGINATA							3.5			
263	BOLIVINA SP. A							0.4			
264	BOLIVINA SP. B							0.7			
265	NONION SP. OR ELPHIDIUM SP.						3.3	2.1			
266	REOPHAX PILULIFERA BRADY 1884								0.2	0.1	
267	NONIONELLA SP. CF. N. AURICULA AFF. NONION GRATELOUPI								0.2		
268	OOLINA SP. CF. O. LINEATA								0.2		
269	REOPHAX CURTUS AFF. R. SCORPIURUS									1.0	
270	ALVEOLOPHRAGMIUM SP.									1.0	
271	OOLINA SP.									R	
272	NONIONELLA AURICULA AFF. NONION GRATELOUPI				0.4	0.1				0.9	
273	PROTELPHIDIUM SP. CF. P. ORBICULARE									0.1	
274	ELPHIDIUM SP. CF. E. SUBARCTICUM									R	
275	TROCHAMMINELLA ATLANTICA PARKER 1952									0.2	
276	SILICOSIGMOILINA GROENLANDICA (CUSHMAN) 1933									R	
277	ANGULOGERINA SP. CF. A. ANGULOSA				0.3					0.1	
278	OOLINA LINEATA (WILLIAMSON) 1848					0.3				R	
280	TROCHAMMINA SP. CF. T. QUADRILOBA									1.1	
281	LAGENA SP. CF. L. GRACILLIMA									0.3	
282	TROCHAMMINA SP. CF. T. SQUAMATA									0.1	
290	ROTALIDS					R					
295	BOLIVINA SP. CF. B. PUNCTATA				0.3						
296	LAGENA PARRI LOEBLICH + TAPPAN 1953				R						
297	OOLINA LINEATO-PUNCTATA (HERON-ALLEN + EARLAND) 1922				R		0.8				
298	REOPHAX SP. CF. R. CURTUS				R						
299	DENTALINA PAUPERATA ORBIGNY 1846					R					
300	VALVULINA SP. CF. V. FUSCA					R					
301	RECTOGLANDULINA SP. CF. R. TORRIDA					0.1					
302	RECTOGLANDULINA ROTUNDATA (REUSS) 1850					0.1					
304	CASSIDULINA TERETIS AFF. C. LAEVIGATA					0.1					
305	TROCHAMMINA SP. CF. T. BULLATA					0.2					
306	BUCCELLA SP. CF. B. FRIGIDA					3.6					
312	CIBICIDES SP. A										0.6
313	CIBICIDES SP. B										0.6
314	ELPHIDIUM SP. OR NONION SP.										7.7

THE FOLLOWING 27 SPECIES OCCUR IN BENTHIC FORAMINIFERAL ASSEMBLAGE 2 OF THE FACTOR ANALYSIS IN QQ-MODE FOR M=7

NO.	SPECIES NAME									
	STATION NUMBERS	16	17	18	19	20	21	22	23	24
	DEPTH IN METERS	64	62	50	26	38	34	32	13	82
1	ADERCOTRYMA GLOMERATA (BRADY) 1878		0.1							5.9
2	ALVEOLOPHRAGMIUM JEFFREYSI (WILLIAMSON) 1858		0.1							
10	BUCCELLA INUSITATA ANDERSEN 1952				0.1					8.4
11	BUCCELLA FRIGIDA (CUSHMAN) 1922	1.8		0.6	0.5					0.7
12	CASSIDULINA ISLANDICA NORVANG 1945	1.8								
13	CASSIDULINA TERETIS TAPPAN 1951		0.1		1.2	11.5	0.4			19.3
14	CASSIDULINA NORCROSSI CUSHMAN 1933									5.9
18	CIBICIDES PSEUDOUNGERIANUS (BRADY) 1884	3.5								
29	ELPHIDIUM CLAVATUM CUSHMAN 1930	3.6	0.1	0.3	0.9	5.4	0.2			
32	ELPHIDIUM INCERTUM CUSHMAN 1930				0.1					
34	EGGERELLA SCABRA (WILLIAMSON) 1858	37.5	73.3	97.6	52.2	41.5	92.6	65.8	100	14.8
59	NONION(ELLA) LABRADORICA			0.1						
60	NONION LABRADORICUM (DAWSON) 1860				0.1					
79	REOPHAX CURTUS CUSHMAN 1920				0.1	2.6	0.2			
84	SPIROPLECTAMMINA BIFORMIS (PARKER + JONES) 1865	28.6	18.0		14.0			3.4		27.7
85	REOPHAX ARCTICA BRADY 1881	14.3	4.2		3.8			13.7		9.2
88	TEXTULARIA TORQUATA PARKER 1952	7.2	3.4		17.8			17.1		1.5
96	ALVEOLOPHRAGMIUM CRASSIMARGO (NORMAN) 1892	1.7	0.4			0.9				6.6
154	ELPHIDIUM INCERTUM AFF. E. CLAVATUM			0.4	0.4					
211	RECURVOIDES SP.				0.1					
253	REOPHAX FUSIFORMIS (WILLIAMSON) 1858		0.1	0.2			0.2			
254	TROCHAMMINA SQUAMATA AFF. T. MACRESCENS		0.1							
256	TROCHAMMINA SP. CF. T. ADAPERTA			0.5	1.1					
257	GYROIDINA QUINQUELOBA UCHIO 1960			0.2	1.1					
258	DISCORBIS SP. CF. PNINAELLA PULCHELLA			0.1						
259	INCERTAE SEDIS LEPTODERMELLA				6.6	38.1	6.2			
260	AMMOTIUM CASSIS (PARKER) 1870						0.2			

THE FOLLOWING 118 SPECIES OCCUR IN BENTHIC FORAMINIFERAL ASSEMBLAGE 3 OF THE FACTOR ANALYSIS IN QQ-MODE FOR M=7

NO.	SPECIES NAME	STATION NUMBERS 2 / DEPTH IN METERS 73	10 / 74	31 / 56
1	ADERCOTRYMA GLOMERATA (BRADY) 1878	0.2		0.1
2	ALVEOLOPHRAGMIUM JEFFREYSI (WILLIAMSON) 1858	R		
3	ASTACOLUS HYALACRULUS LOEBLICH + TAPPAN 1953	R		
4	ASTRONONION STELLATUM CUSHMAN + EDWARDS 1937	1.5		
5	ANGULOGERINA FLUENS TODD 1947	1.8	1.0	0.9
6	BOLIVINA SP.	R		
7	BOLIVINA PSEUDOPUNCTATA HOGLUND 1947	0.4	R	
8	BULIMINA SP.	R		
9	BULIMINA EXILIS BRADY 1884	R		R
10	BUCCELLA INUSITATA ANDERSEN 1952	1.8	1.7	7.9
11	BUCCELLA FRIGIDA (CUSHMAN) 1922	0.2	R	0.2
12	CASSIDULINA ISLANDICA NORVANG 1945	12.5	6.7	7.1
13	CASSIDULINA TERETIS TAPPAN 1951	2.7	1.1	13.4
14	CASSIDULINA NORCROSSI CUSHMAN 1933	R		0.1
15	CIBICIDES LOBATULUS (WALKER + JACOB) 1798	60.7	35.4	50.8
16	CIBICIDES LOBATULUS AFF. C. REFULGENS	R		
17	CIBICIDES SP.	R		
18	CIBICIDES PSEUDOUNGERIANUS (BRADY) 1884	R		
19	DENTALINA BAGGI GALLOWAY + WISSLER 1927	R		
20	DENTALINA ITTAI LOEBLICH + TAPPAN 1953	R		
21	DISCORBIS SP. CF. D. SQUAMATA	0.1		
22	DISCORBIS SP.	0.1		
24	DISCORBIDAE IMMATURE	0.1		
25	DISCORBIS SP. CF. TROCHAMMINA OCHRACEA	0.2	R	
26	ELPHIDIUM BARTLETTI CUSHMAN 1933	R	1.8	4.3
27	ELPHIDIUM SP. CF. E. BARTLETTI	0.2		
28	ELPHIDIUM SP.	R	R	
29	ELPHIDIUM CLAVATUM CUSHMAN 1930	9.4	46.1	5.7
30	ELPHIDIUM FRIGIDUM CUSHMAN 1933	R		
31	ELPHIDIUM SUBARCTICUM CUSHMAN 1944	0.7	1.0	0.2
32	ELPHIDIUM INCERTUM CUSHMAN 1930	0.2		
33	ESOSYRINX CURTUS (CUSHMAN + OZAWA) 1930	0.1		
34	EGGERELLA SCABRA (WILLIAMSON) 1858	0.5	0.1	
35	ELPHIDIELLA ARCTICA (PARKER + JONES) 1864	0.7	2.1	3.3
36	EPISTOMINELLA NARAENSIS (KUWANO) 1950	0.3		
37	FISSURINA MARGINATA (MONTAGU) 1803	0.5	R	0.9
38	FISSURINA SERRATA (SCHLUMBERGER) 1894	R	R	
39	FISSURINA SEMIMARGINATA (REUSS) 1870	R	R	
40	FISSURINA CUCURBITASEMA LOEBLICH + TAPPAN 1953	R	R	
41	GLANDULINA LAEVIGATA (ORBIGNY) 1826	R		

BENTHIC FORAMINIFERAL ASSEMBLAGE 3 FOR M=7 (CONTINUED)

NO.	SPECIES NAME	STATION NUMBERS 2 / DEPTH IN METERS 73	10 / 74	31 / 56
42	GLOBOBULIMINA AURICULATA (BAILEY) 1851	R		
43	GLABRATELLA WRIGHTII (BRADY) 1881	0.1		
44	GLOBULINA SP. CF. G. GLACIALIS	R		
45	GUTTULINA LACTEA (WALKER + JACOB) 1798	R		
46	GUTTULINA EARLANDI CUSHMAN + OZAWA 1930	R		
47	GUTTULINA SP.	R		
48	LAGENA APIOPLEURA LOEBLICH + TAPPAN 1953	0.1	R	0.1
49	LAGENA FLATULENTA LOEBLICH + TAPPAN 1953	R		0.2
50	LAGENA LAEVIS (MONTAGU) 1803	R		
51	LAGENA MERIDIONALIS WIESNER 1931	R		
52	LAGENA MOLLIS CUSHMAN 1944	R		
53	LAGENA SEMILINEATA WRIGHT 1886	R		0.1
54	LARYNGOSIGMA HYALASCIDIA LOEBLICH + TAPPAN 1953	R		0.1
55	LAMARCKINA HALIOTIDEA (HERON-ALLEN + EARLAND) 1911	R		
56	NONION SP.	R	R	
57	NONION SCAPHUM (FICHTEL + MOLL) 1798	0.3		
58	NONION SP. CF. N. GRATELOUPI	0.1		
59	NONION(ELLA) LABRADORICA	0.7		2.2
60	NONION LABRADORICUM (DAWSON) 1860	0.9		0.2
62	NONIONELLA AURICULA HERON-ALLEN + EARLAND 1930	R		
63	OOLINA COSTATA LOEBLICH + TAPPAN 1953	R		0.5
64	OOLINA MELO ORBIGNY 1839	R	R	0.1
65	OOLINA CAUDIGERA (WIESNER) 1931	R		0.2
66	PARAFISSURINA FUSULIFORMIS LOEBLICH + TAPPAN 1953	0.1		
67	PATELLINA CORRUGATA WILLIAMSON 1858	0.3		
68	POLYMORPHINA SP. NOV. AFF. P. FLINTII	R		
69	PROTELPHIDIUM ORBICULARE (BRADY) 1881	1.0	1.6	
70	QUINQUELOCULINA SP. CF. Q. ARCTICA	R		
71	QUINQUELOCULINA ARCTICA CUSHMAN 1933	R		
72	QUINQUELOCULINA AGGLUTINATA CUSHMAN 1917	R		
73	QUINQUELOCULINA SP.	R		
74	QUINQUELOCULINA NITIDA NORVANG 1945	R		
75	QUINQUELOCULINA SP. CF. Q. NORVANGI	R		
76	QUINQUELOCULINA SP. CF. Q. AKNERIANA	0.1		
77	QUINQUELOCULINA STALKERI LOEBLICH + TAPPAN 1953	0.1		
78	RECURVOIDES TURBINATUS (BRADY) 1881	R		
79	REOPHAX CURTUS CUSHMAN 1920	R		
80	REOPHAX SCORPIURUS MONTFORT 1808	R		
81	ROBERTINOIDES CHARLOTTENSIS (CUSHMAN) 1925	R		
82	REOPHAX SCOTTII CHASTER 1890-91	R	R	

BENTHIC FORAMINIFERAL ASSEMBLAGE 3 FOR M=7 (CONTINUED)

NO.	SPECIES NAME	STATION NUMBERS 2 / DEPTH IN METERS 73	10 / 74	31 / 56
83	SACCAMMINA SP.	R		
84	SPIROPLECTAMMINA BIFORMIS (PARKER + JONES) 1865	R	R	
85	REOPHAX ARCTICA BRADY 1881	0.1		
86	TRILOCULINA SP. CF. T. ANGULARIS	R		
87	TRILOCULINA TRIHEDRA LOEBLICH + TAPPAN 1953	0.3	R	
88	TEXTULARIA TORQUATA PARKER 1952	0.1		
89	TROCHAMMINA OCHRACEA (WILLIAMSON) 1858	0.1		
90	TROCHAMMINA NANA (BRADY) 1881	0.1		
91	PROTEONINA ATLANTICA CUSHMAN 1944	R	R	
94	CALCAREOUS INDETERMINATE	0.1		
95	ARENACEOUS INDETERMINATE	0.2		
101	EGGERELLA ADVENA (CUSHMAN) 1922		0.1	
106	NONIONELLA SP. CF. N. AURICULA	R		
108	ELPHIDIDAE IMMATURE			0.5
116	TROCHAMMINA SP.		R	
136	GLABRATELLA SP. CF. DISCORBIS CHASTERI		0.1	
175	NONION SP. CF. N. SCAPHUM			0.1
183	DISCORBIS SP. CF. D. OBTUSA		R	
191	ASTRONONION SP. CF. A. STELLATUM		R	0.5
198	DISCORBIS SP. CF. D. CHASTERI	0.1	0.1	
203	GUTTULINA LACTEA AFF. G. PACIFICA		R	
213	CONORBINA SP.		R	
214	ELPHIDIELLA SP.		R	
215	EPISTOMINELLA SP. CF. E. NARAENSIS		0.7	
216	GUTTULINA LACTEA AFF. G. AUSTRIACA		R	0.1
217	HIPPOCREPINA SP. CF. H. INDIVISOR		R	
218	OOLINA STRIATOPUNCTATA (PARKER + JONES) 1865		R	
219	PLANORBULINA MEDITERRANENSIS ORBIGNY 1826		R	
220	PROTEONINA SP.		R	0.1
221	QUINQUELOCULINA AKNERIANA ORBIGNY 1846		R	
222	SCUTULORIS SP. NOV.		R	
223	THOLOSINA BULLA (BRADY) 1881		R	
224	TURRISPIRILLINA ARCTICA (CUSHMAN) 1933		R	
240	REOPHAX SP.		R	
278	OOLINA LINEATA (WILLIAMSON) 1848			0.2
297	OOLINA LINEATO-PUNCTATA (HERON-ALLEN + EARLAND) 1922			0.1
308	ELPHIDIUM SP. CF. E. EXCAVATUM			R
309	OOLINA SQUAMOSA (MONTAGU) 1893			0.1

THE FOLLOWING 31 SPECIES OCCUR IN BENTHIC FORAMINIFERAL ASSEMBLAGE 4 OF THE FACTOR ANALYSIS IN QQ-MODE FOR M=7

NO.	SPECIES NAME	25	26	27
	STATION NUMBERS	25	26	27
	DEPTH IN METERS	7	12	36
1	ADERCOTRYMA GLOMERATA (BRADY) 1878		R	4.3
82	REOPHAX SCOTTII CHASTER 1890-91			13.5
84	SPIROPLECTAMMINA BIFORMIS (PARKER + JONES) 1865		27.9	25.4
85	REOPHAX ARCTICA BRADY 1881			R
88	TEXTULARIA TORQUATA PARKER 1952			6.8
89	TROCHAMMINA OCHRACEA (WILLIAMSON) 1858		8.8	
91	PROTEONINA ATLANTICA CUSHMAN 1944			0.2
96	ALVEOLOPHRAGMIUM CRASSIMARGO (NORMAN) 1892		0.1	0.2
101	EGGERELLA ADVENA (CUSHMAN) 1922	39.9	53.7	24.0
109	PSAMMOSPHAERA SP.	0.3	0.1	0.1
115	TROCHAMMINA SP. CF. T. OCHRACEA	3.1		10.2
116	TROCHAMMINA SP.			1.7
118	WEBBINELLA SP.	0.1	2.9	
245	HYPERAMMINA SP.	0.2		
260	AMMOTIUM CASSIS (PARKER) 1870	40.4		R
275	TROCHAMMINELLA ATLANTICA PARKER 1952			R
283	MILIAMMINA FUSCA (BRADY) 1870	16.0	0.4	
284	PROTEONINA SP. CF. P. ATLANTICA		R	
285	AMMOTIUM SP. CF. A. CASSIS		R	
286	PROTEONINA SP. CF. P. DIFFLUGIFORMIS		R	
287	PROTEONINA SP. CF. P. AMPULLACEA		R	1.7
288	WEBBINELLA SP. CF. W. HEMISPHAERICA		0.1	10.6
289	AMMODISCUS SP. CF. A. PLANUS		2.9	
290	ROTALIDS		2.9	
291	HYPERAMMINA FRAGMENTS		0.1	
292	MILIAMMINA SP. CF. M. FUSCA			0.9
293	PROTEONINA FUSIFORMIS			0.2
294	AMMOSCALARIA SP. CF. A. TENUIMARGO			R
315	TEXTULARIA SP. CF. T. EARLANDI			2.5
316	HYPERAMMINA SP. A			0.5
317	HYPERAMMINA SP. B			0.3

THE FOLLOWING 115 SPECIES OCCUR IN BENTHIC FORAMINIFERAL ASSEMBLAGE 5 OF THE FACTOR ANALYSIS IN QQ-MODE FOR M=7

	STATION NUMBERS	4	5	6	7	40
	DEPTH IN METERS	218	457	255	430	398
NO.	SPECIES NAME					
1	ADERCOTRYMA GLOMERATA (BRADY) 1878					1.2
2	ALVEOLOPHRAGMIUM JEFFREYSI (WILLIAMSON) 1858		0.1			7.4
5	ANGULOGERINA FLUENS TODD 1947				0.2	
6	BOLIVINA SP.					1.2
7	BOLIVINA PSEUDOPUNCTATA HOGLUND 1947	0.3	0.2		0.3	3.7
9	BULIMINA EXILIS BRADY 1884	14.9	27.9	18.3	17.3	4.9
10	BUCCELLA INUSITATA ANDERSEN 1952	1.7	5.8	3.2	1.2	2.5
11	BUCCELLA FRIGIDA (CUSHMAN) 1922	1.2			2.0	
12	CASSIDULINA ISLANDICA NORVANG 1945	14.9			1.7	3.7
13	CASSIDULINA TERETIS TAPPAN 1951				0.1	3.7
14	CASSIDULINA NORCROSSI CUSHMAN 1933	2.1	0.7	49.8	2.3	
16	CIBICIDES LOBATULUS AFF. C. REFULGENS		0.3			
18	CIBICIDES PSEUDOUNGERIANUS (BRADY) 1884	0.3			0.5	
20	DENTALINA ITTAI LOEBLICH + TAPPAN 1953	0.1				
21	DISCORBIS SP. CF. D. SQUAMATA	1.4				
25	DISCORBIS SP. CF. TROCHAMMINA OCHRACEA	R				
26	ELPHIDIUM BARTLETTI CUSHMAN 1933	0.9			R	
27	ELPHIDIUM SP. CF. E. BARTLETTI		3.5			1.2
29	ELPHIDIUM CLAVATUM CUSHMAN 1930	3.3	1.8		7.5	8.6
32	ELPHIDIUM INCERTUM CUSHMAN 1930	1.4	1.6		10.4	
36	EPISTOMINELLA NARAENSIS (KUWANO) 1950	0.3				
37	FISSURINA MARGINATA (MONTAGU) 1803	1.7				
38	FISSURINA SERRATA (SCHLUMBERGER) 1894	R				
39	FISSURINA SEMIMARGINATA (REUSS) 1870	0.1		2.6	0.1	
40	FISSURINA CUCURBITASEMA LOEBLICH + TAPPAN 1953	R			0.2	
41	GLANDULINA LAEVIGATA (ORBIGNY) 1826	0.1	0.4		0.2	
42	GLOBOBULIMINA AURICULATA (BAILEY) 1851			0.1	4.3	7.4
48	LAGENA APIOPLEURA LOEBLICH + TAPPAN 1953	0.1				
50	LAGENA LAEVIS (MONTAGU) 1803	0.1	0.2		0.5	
51	LAGENA MERIDIONALIS WIESNER 1931	0.1				
52	LAGENA MOLLIS CUSHMAN 1944	R			0.6	
56	NONION SP.	0.1				1.2
58	NONION SP. CF. N. GRATELOUPI				R	
59	NONION(ELLA) LABRADORICA	5.2	0.4	1.4	4.1	
60	NONION LABRADORICUM (DAWSON) 1860	0.7	3.8	3.2	6.6	3.7
62	NONIONELLA AURICULA HERON-ALLEN + EARLAND 1930	R				
66	PARAFISSURINA FUSULIFORMIS LOEBLICH + TAPPAN 1953	R	0.2			
67	PATELLINA CORRUGATA WILLIAMSON 1858	0.4				
69	PROTELPHIDIUM ORBICULARE (BRADY) 1881	0.1				

BENTHIC FORAMINIFERAL ASSEMBLAGE 5 FOR M=7 (CONTINUED)

NO.	SPECIES NAME	STATION NUMBERS	4	5	6	7	40
		DEPTH IN METERS	218	457	255	430	398
80	REOPHAX SCORPIURUS MONTFORT 1808						1.2
89	TROCHAMMINA OCHRACEA (WILLIAMSON) 1858		R				
91	PROTEONINA ATLANTICA CUSHMAN 1944						3.7
96	ALVEOLOPHRAGMIUM CRASSIMARGO (NORMAN) 1892					R	
97	AMMODISCUS SP.						1.2
99	CIBICIDES SP. CF. C. LOBATULUS		0.3				1.2
106	NONIONELLA SP. CF. N. AURICULA					1.1	
108	ELPHIDIDAE IMMATURE		1.2	1.3			
116	TROCHAMMINA SP.					0.1	2.5
119	ASTACOLUS SP. CF. A. HYALACRULUS		0.3				
120	ASTRONONION SP.		0.6				
121	BOLIVINA SUBAENARIENSIS CUSHMAN 1922		1.3	22.4	7.9	3.7	
122	BOLIVINA SUBSPINESCENS CUSHMAN 1922		1.2	0.1			
123	BULIMINA ACULEATA ORBIGNY 1826		6.5	1.9	5.3	5.7	
124	BULIMINA MARGINATA ORBIGNY 1826		2.8	12.3	0.1	0.8	1.2
125	CASSIDULINA LAEVIGATA AFF. C. CARINATA		1.3				
126	FISSURINA SP. CF. F. SEMIMARGINATA						1.2
127	TRITAXIS CONICA (PARKER + JONES) 1865						1.2
128	CIBICIDES SP.IMMATURE		3.9				
129	DISCORBIS CHASTERI (HERON-ALLEN + EARLAND) 1913		R				
130	DENTALINA FROBISHERENSIS LOEBLICH + TAPPAN 1953		0.1				
131	LENTICULINA SP. CF. L. GIBBA					0.1	
132	DISCORBIS OBTUSA CUSHMAN 1931		R				
133	EPONIDES PUSILLUS PARR 1950		1.4				
134	FISSURINA SP.		0.3				
135	GLOBOBULIMINA SP. CF. G. TURGIDA		0.3			1.0	
136	GLABRATELLA SP. CF. DISCORBIS CHASTERI		0.1				
137	GYROIDINA SP. CF. G. QUINQUELOBA		0.1				
138	LAGENA GRACILLIMA (SEGUENZA) 1862		R	0.1			
139	LAGENA GRACILIS WILLIAMSON 1848		R	0.2			
140	LAGENA HISPIDA REUSS 1863		R				
141	NONIONELLA TURGIDA (WILLIAMSON) 1858		R				
142	OSANGULARIA SP.		R				
143	OOLINA HEXAGONA (WILLIAMSON) 1848		0.1				
144	PARAFISSURINA TECTULOSTOMA LOEBLICH + TAPPAN 1953		0.1				1.2
145	PARAFISSURINA FOLLICULA LOEBLICH + TAPPAN 1953		0.1				
146	PNINAELLA PULCHELLA PARKER 1952		R				
147	PULLENIA QUINQUELOBA (REUSS) 1851		22.3		0.4	11.7	8.6
148	SIPHOGENERINA ANNULATA BRADY 1884		0.4				

BENTHIC FORAMINIFERAL ASSEMBLAGE 5 FOR M=7 (CONTINUED)

NO.	SPECIES NAME STATION NUMBERS	4	5	6	7	40
	DEPTH IN METERS	218	457	255	430	398
149	VIRGULINA COMPLANATA EGGER 1893	1.1	2.0	7.4	12.0	8.6
150	VIRGULINA SP. CF. V. FUSIFORMIS	0.3				
152	ASTACOLUS SP.		0.2			
153	CIBICIDES SP. CF. C. PSEUDOUNGERIANUS		0.1			
154	ELPHIDIUM INCERTUM AFF. E. CLAVATUM		0.1			2.5
155	ELPHIDIUM SP. CF. E. BARTLETTI AFF. E. CLAVATUM		0.9			
156	FISSURINA SP. CF. F. MARGINATA		0.4			
157	FISSURINA LUCIDA (WILLIAMSON) 1848		0.2			
158	GLOBOBULIMINA SP.		0.4			
159	GLOBOBULIMINA TURGIDA (BAILEY) 1851		0.1			
160	LAGENA MOLLIS AFF. L. DISTOMA		0.4	0.1		
161	LARYNGOSIGMA SP.		0.2			
162	OOLINA SP. CF. O. HEXAGONA		0.2			
163	PULLENIA SP. CF. P. QUINQUELOBA		9.0			
164	PARAFISSURINA SP.		0.2			
165	RECTOGLANDULINA SP. CF. R. OCCIDENTALIS		0.5			
166	ANGULOGERINA ANGULOSA (WILLIAMSON) 1858			0.1		
174	LAGENA SP.					1.2
184	ALVEOLOPHRAGMIUM SUBGLOBOSUM (SARS) 1871					1.2
185	RECTOGLANDULINA SP. CF. GLANDULINA LAEVIGATA				0.1	
186	VAGINULINA SPINIGERA BRADY 1881				R	
187	BULIMINELLA CONVOLUTA (WILLIAMSON) 1858				R	
188	CIBICIDES SP. CF. C. REFULGENS				0.4	
189	LAGENA SP. CF. L. APIOPLEURA				0.2	
190	LAGENA SP. CF. L. STRIATA				0.1	
191	ASTRONONION SP. CF. A. STELLATUM				0.2	
192	GYROIDINA UMBONATA (SILVESTRI) 1898				0.3	
193	LAGENA SP. CF. L. SETIGERA				0.1	
194	NONION SP. CF. N. ZAANDAMAE				1.8	
198	DISCORBIS SP. CF. D. CHASTERI	1.7				
200	LEPTODERMELLA SP.					1.2
208	CYCLAMMINA CANCELLATA BRADY 1879					1.2
261	TROCHAMMINA SP. CF. T. ATLANTICA					4.9
268	OOLINA SP. CF. O. LINEATA					1.2
279	TROCHAMMINA QUADRILOBA HOGLUND 1948					1.2
297	OOLINA LINEATO-PUNCTATA (HERON-ALLEN + EARLAND) 1922					1.2
310	PROTEONINA DIFFLUGIFORMIS (BRADY) 1879					1.2

THE FOLLOWING 75 SPECIES OCCUR IN BENTHIC FORAMINIFERAL ASSEMBLAGE 6 OF THE FACTOR ANALYSIS IN QQ-MODE FOR M=7

NO.	SPECIES NAME	STATION NUMBERS 3	35	37	38	39
	DEPTH IN METERS	135	142	108	275	191
1	ADERCOTRYMA GLOMERATA (BRADY) 1878	9.4	42.4	33.5	15.6	16.7
2	ALVEOLOPHRAGMIUM JEFFREYSI (WILLIAMSON) 1858	1.6	14.8	0.1	21.0	5.0
4	ASTRONONION STELLATUM CUSHMAN + EDWARDS 1937	0.2				
5	ANGULOGERINA FLUENS TODD 1947	2.4			8.9	
7	BOLIVINA PSEUDOPUNCTATA HOGLUND 1947	4.2				
9	BULIMINA EXILIS BRADY 1884				0.8	
10	BUCCELLA INUSITATA ANDERSEN 1952	7.7			3.0	
11	BUCCELLA FRIGIDA (CUSHMAN) 1922	3.4				
12	CASSIDULINA ISLANDICA NORVANG 1945	2.8				
13	CASSIDULINA TERETIS TAPPAN 1951	14.3				
14	CASSIDULINA NORCROSSI CUSHMAN 1933	0.3				
26	ELPHIDIUM BARTLETTI CUSHMAN 1933	R				
32	ELPHIDIUM INCERTUM CUSHMAN 1930	1.0				
34	EGGERELLA SCABRA (WILLIAMSON) 1858	8.1				
37	FISSURINA MARGINATA (MONTAGU) 1803	0.1				
50	LAGENA LAEVIS (MONTAGU) 1803			0.8		
52	LAGENA MOLLIS CUSHMAN 1944	R				
56	NONION SP.	0.3				
59	NONION(ELLA) LABRADORICA	0.4				
60	NONION LABRADORICUM (DAWSON) 1860	0.5				
65	OOLINA CAUDIGERA (WIESNER) 1931	0.2				
73	QUINQUELOCULINA SP.	R				
78	RECURVOIDES TURBINATUS (BRADY) 1881	0.3				20.0
79	REOPHAX CURTUS CUSHMAN 1920	R	0.7	0.1		
80	REOPHAX SCORPIURUS MONTFORT 1808			0.8		1.7
82	REOPHAX SCOTTII CHASTER 1890-91			5.8	4.4	
83	SACCAMMINA SP.		0.7		4.4	
84	SPIROPLECTAMMINA BIFORMIS (PARKER + JONES) 1865	12.0		26.4		
85	REOPHAX ARCTICA BRADY 1881	17.1				
88	TEXTULARIA TORQUATA PARKER 1952	3.0		2.5		
91	PROTEONINA ATLANTICA CUSHMAN 1944		1.8	18.3	1.5	20.8
95	ARENACEOUS INDETERMINATE		1.8	0.1		
96	ALVEOLOPHRAGMIUM CRASSIMARGO (NORMAN) 1892	0.3		0.1		
97	AMMODISCUS SP.	0.1	0.4			
98	CAUSIA SP.	R				
99	CIBICIDES SP. CF. C. LOBATULUS	1.4				
100	ELPHIDIUM SP. CF. E. CLAVATUM	R				
101	EGGERELLA ADVENA (CUSHMAN) 1922	0.3				

BENTHIC FORAMINIFERAL ASSEMBLAGE 6 FOR M=7 (CONTINUED)

NO.	SPECIES NAME	STATION NUMBERS 3	35	37	38	39
	DEPTH IN METERS	135	142	108	275	191
102	GLOMOSPIRA SP.	0.2				
103	HYPERAMMINA SUBNODOSA BRADY 1884	0.3				
104	MARSIPELLA ELONGATA (RHUMBLER) 1913	R				
105	NONION POMPILIOIDES (FICHTEL + MOLL) 1798	R				
106	NONIONELLA SP. CF. N. AURICULA	1.0			8.9	
107	NONIONIDAE IMMATURE	0.4				
108	ELPHIDIDAE IMMATURE	0.1				
109	PSAMMOSPHAERA SP.	0.6		0.2		
110	PYRGO SP. CF. P. ELONGATA	R				
111	ROBERTINA ARCTICA ORBIGNY 1846	R				
112	REOPHAX SUBFUSIFORMIS EARLAND 1933	0.3				
113	ROTALIA SP.	1.4				
114	SPIRILINA SP.	0.1				
115	TROCHAMMINA SP. CF. T. OCHRACEA	0.9				
116	TROCHAMMINA SP.	0.3	15.5			
117	VIRGULINA SP. CF. V. BRADYI	0.6				
118	WEBBINELLA SP.	2.2	14.1	2.5		
124	BULIMINA MARGINATA ORBIGNY 1826				6.7	
127	TRITAXIS CONICA (PARKER + JONES) 1865				1.5	
138	LAGENA GRACILLIMA (SEGUENZA) 1862			0.8		
180	TROCHAMMINA SP. CF. T. NANA					10.2
184	ALVEOLOPHRAGMIUM SUBGLOBOSUM (SARS) 1871					23.9
240	REOPHAX SP.		1.1			
245	HYPERAMMINA SP.					1.7
266	REOPHAX PILULIFERA BRADY 1884				0.8	
270	ALVEOLOPHRAGMIUM SP.			2.1		
275	TROCHAMMINELLA ATLANTICA PARKER 1952				18.6	
276	SILICOSIGMOILINA GROENLANDICA (CUSHMAN) 1933		0.7	0.8		
282	TROCHAMMINA SP. CF. T. SQUAMATA			0.8		
289	AMMODISCUS SP. CF. A. PLANUS			0.8	1.5	
298	REOPHAX SP. CF. R. CURTUS			0.3		
306	BUCCELLA SP. CF. B. FRIGIDA				1.5	
310	PROTEONINA DIFFLUGIFORMIS (BRADY) 1879		3.9		0.8	
311	HYPERAMMINA SP. CF. H. SUBNODOSA		2.1			
316	HYPERAMMINA SP. A			0.5		
317	HYPERAMMINA SP. B			0.3		
318	DENDROPHRYA SP.			0.1		

THE FOLLOWING 106 SPECIES OCCUR IN BENTHIC FORAMINIFERAL ASSEMBLAGE 7 OF THE FACTOR ANALYSIS IN QQ-MODE FOR M=7

NO.	SPECIES NAME	STATION NUMBERS 9	11	12	13	14
	DEPTH IN METERS	136	64	65	58	165
1	ADERCOTRYMA GLOMERATA (BRADY) 1878	2.6	2.7			0.3
2	ALVEOLOPHRAGMIUM JEFFREYSI (WILLIAMSON) 1858	1.2	1.7			
4	ASTRONONION STELLATUM CUSHMAN + EDWARDS 1937					2.1
5	ANGULOGERINA FLUENS TODD 1947	0.4	2.0		1.1	
6	BOLIVINA SP.					R
7	BOLIVINA PSEUDOPUNCTATA HOGLUND 1947					R
10	BUCCELLA INUSITATA ANDERSEN 1952	1.0	0.8	3.9	2.0	R
11	BUCCELLA FRIGIDA (CUSHMAN) 1922			2.0		0.3
12	CASSIDULINA ISLANDICA NORVANG 1945	21.1	51.0	48.4	38.4	6.9
13	CASSIDULINA TERETIS TAPPAN 1951	10.5	3.1		0.3	0.1
14	CASSIDULINA NORCROSSI CUSHMAN 1933	1.8				0.3
15	CIBICIDES LOBATULUS (WALKER + JACOB) 1798	6.5	21.4	9.0	18.6	1.1
16	CIBICIDES LOBATULUS AFF. C. REFULGENS	10.6	1.5		1.4	4.9
17	CIBICIDES SP.	0.6	2.2	1.1		11.8
18	CIBICIDES PSEUDOUNGERIANUS (BRADY) 1884					R
21	DISCORBIS SP. CF. D. SQUAMATA			0.6		
22	DISCORBIS SP.					R
27	ELPHIDIUM SP. CF. E. BARTLETTI					R
29	ELPHIDIUM CLAVATUM CUSHMAN 1930	4.2	2.4	12.0	15.6	R
30	ELPHIDIUM FRIGIDUM CUSHMAN 1933					R
31	ELPHIDIUM SUBARCTICUM CUSHMAN 1944	0.1		2.9		
32	ELPHIDIUM INCERTUM CUSHMAN 1930	2.0			0.3	
33	ESOSYRINX CURTUS (CUSHMAN + OZAWA) 1930					R
34	EGGERELLA SCABRA (WILLIAMSON) 1858				1.1	
35	ELPHIDIELLA ARCTICA (PARKER + JONES) 1864			0.4		
36	EPISTOMINELLA NARAENSIS (KUWANO) 1950	0.5		2.4	1.4	
37	FISSURINA MARGINATA (MONTAGU) 1803	0.5		0.9	0.8	1.6
39	FISSURINA SEMIMARGINATA (REUSS) 1870					R
40	FISSURINA CUCURBITASEMA LOEBLICH + TAPPAN 1953			0.7	0.3	R
48	LAGENA APIOPLEURA LOEBLICH + TAPPAN 1953	0.1			0.3	
50	LAGENA LAEVIS (MONTAGU) 1803	0.1				R
51	LAGENA MERIDIONALIS WIESNER 1931					0.1
52	LAGENA MOLLIS CUSHMAN 1944					0.1
53	LAGENA SEMILINEATA WRIGHT 1886					R
56	NONION SP.	0.2				R
59	NONION(ELLA) LABRADORICA	0.4				0.1

BENTHIC FORAMINIFERAL ASSEMBLAGE 7 FOR M=7 (CONTINUED)

NO.	SPECIES NAME	9	11	12	13	14
	STATION NUMBERS / DEPTH IN METERS	136	64	65	58	165
60	NONION LABRADORICUM (DAWSON) 1860	2.6				
62	NONIONELLA AURICULA HERON-ALLEN + EARLAND 1930					R
63	OOLINA COSTATA LOEBLICH + TAPPAN 1953	0.1		0.2		
64	OOLINA MELO ORBIGNY 1839	0.1				R
67	PATELLINA CORRUGATA WILLIAMSON 1858					R
69	PROTELPHIDIUM ORBICULARE (BRADY) 1881	4.6				
76	QUINQUELOCULINA SP. CF. Q. AKNERIANA					R
77	QUINQUELOCULINA STALKERI LOEBLICH + TAPPAN 1953	0.1			0.6	
79	REOPHAX CURTUS CUSHMAN 1920		1.0			
83	SACCAMMINA SP.			0.4		
89	TROCHAMMINA OCHRACEA (WILLIAMSON) 1858			0.7	0.8	
91	PROTEONINA ATLANTICA CUSHMAN 1944	5.5			0.3	R
96	ALVEOLOPHRAGMIUM CRASSIMARGO (NORMAN) 1892		0.5			
101	EGGERELLA ADVENA (CUSHMAN) 1922		0.5	1.3	0.9	
108	ELPHIDIDAE IMMATURE					R
109	PSAMMOSPHAERA SP.		0.2	0.4	0.6	
116	TROCHAMMINA SP.					R
118	WEBBINELLA SP.					R
120	ASTRONONION SP.	2.1				
123	BULIMINA ACULEATA ORBIGNY 1826				0.3	
125	CASSIDULINA LAEVIGATA AFF. C. CARINATA					0.1
133	EPONIDES PUSILLUS PARR 1950	0.4				20.3
141	NONIONELLA TURGIDA (WILLIAMSON) 1858					0.3
147	PULLENIA QUINQUELOBA (REUSS) 1851	0.4		0.4		3.4
152	ASTACOLUS SP.					0.1
153	CIBICIDES SP. CF. C. PSEUDOUNGERIANUS			0.2		
166	ANGULOGERINA ANGULOSA (WILLIAMSON) 1858	13.5	0.5			40.9
173	GAVELINOPSIS SP. NOV.					3.0
174	LAGENA SP.					R
178	TEXTULARIA SP. CF. T. TORQUATA					R
186	VAGINULINA SPINIGERA BRADY 1881					R
188	CIBICIDES SP. CF. C. REFULGENS			5.3		
191	ASTRONONION SP. CF. A. STELLATUM		1.0			
198	DISCORBIS SP. CF. D. CHASTERI			2.6	0.3	
202	GUTTULINA DAWSONI CUSHMAN + OZAWA 1930	0.2				
203	GUTTULINA LACTEA AFF. G. PACIFICA	0.2			0.3	

BENTHIC FORAMINIFERAL ASSEMBLAGE 7 FOR M=7 (CONTINUED)

NO.	SPECIES NAME	9	11	12	13	14
	STATION NUMBERS	9	11	12	13	14
	DEPTH IN METERS	136	64	65	58	165
206	PSAMMOSPHAERA FUSCA SCHULZE 1875	3.4				
207	VIRGULINA FUSIFORMIS WILLIAMSON 1858	0.4				
209	TROCHAMMINA GLOBIGERINIFORMIS (PARKER + JONES) 1865	0.6				
210	QUINQUELOCULINA SP. CF. Q. SEMINULA	0.1				
211	RECURVOIDES SP.	0.1				
212	GYROIDINA SP.	0.3				
220	PROTEONINA SP.		0.5			
222	SCUTULORIS SP. NOV.				0.3	
225	CIBICIDES LOBATULUS AFF. C. PSEUDOUNGERIANA		5.1			
226	MARSIPELLA SP.		0.2			R
227	QUINQUELOCULINA SP. CF. Q. PULCHELLA		0.2			
228	SCUTULORIS TEGMINIS LOEBLICH + TAPPAN 1953		1.4			
230	ROSALINA COLUMBIENSIS (CUSHMAN) 1925			0.7		
231	DISCORBIS SP. CF. D. BERTHELOTI			0.7		
232	ANGULOGERINA SP. CF. A. FLUENS			0.9		
233	BOLIVINA PSEUDOPLICATA HERON-ALLEN + EARLAND 1930			0.4		
235	TROCHAMMINA CONICA EARLAND 1934			0.7		
236	ANGULOGERINA ANGULOSA AFF. A. FLUENS				0.3	
237	ELPHIDIUM BARTLETTI AFF. E. SUBARCTICUM				3.3	
238	ELPHIDIUM SUBARCTICUM AFF. E. BARTLETTI				7.3	
239	QUINQUELOCULINA SEMINULA (LINNAEUS) 1767				2.5	
240	REOPHAX SP.				0.3	
242	BOLIVINA SP. CF. B. SPATHULATA					R
243	CASSIDULINA SP.					R
244	DENTALINA MELVILLENSIS LOEBLICH + TAPPAN 1953					R
245	HYPERAMMINA SP.					R
246	LENTICULINA SP.					R
247	LAGENA SP. CF. L. STELLIGERA					0.4
248	NONION IMMATURE			0.9		1.1
249	EPONIDES SP. A					R
250	EPONIDES SP. B					R
251	DISCORBIS SP. A				0.3	
252	DISCORBIS SP. B				0.3	
272	NONIONELLA AURICULA AFF. NONION GRATELOUPI	0.3				

APPENDIX B

ASSEMBLAGE-UBIQUITOUS SPECIES

THE FOLLOWING 3 SPECIES WERE FOUND TO BE UBIQUITOUS FOR ASSEMBLAGE 1

SPECIES NUMBER	NAME
5	ANGULOGERINA FLUENS TODD 1947
10	BUCCELLA INUSITATA ANDERSEN 1952
12	CASSIDULINA ISLANDICA NORVANG 1945

THE FOLLOWING SPECIES WAS FOUND TO BE UBIQUITOUS FOR ASSEMBLAGE 2

SPECIES NUMBER	NAME
34	EGGERELLA SCABRA (WILLIAMSON) 1858

THE FOLLOWING 13 SPECIES WERE FOUND TO BE UBIQUITOUS FOR ASSEMBLAGE 3

SPECIES NUMBER	NAME
5	ANGULOGERINA FLUENS TODD 1947
10	BUCCELLA INUSITATA ANDERSEN 1952
11	BUCCELLA FRIGIDA (CUSHMAN) 1922
12	CASSIDULINA ISLANDICA NORVANG 1945
13	CASSIDULINA TERETIS TAPPAN 1951
15	CIBICIDES LOBATULUS (WALKER + JACOB) 1798
26	ELPHIDIUM BARTLETTI CUSHMAN 1933
29	ELPHIDIUM CLAVATUM CUSHMAN 1930
31	ELPHIDIUM SUBARCTICUM CUSHMAN 1944
35	ELPHIDIELLA ARCTICA (PARKER + JONES) 1864
37	FISSURINA MARGINATA (MONTAGU) 1803
48	LAGENA APIOPLEURA LOEBLICH + TAPPAN
64	OOLINA MELO ORBIGNY 1839

THE FOLLOWING 2 SPECIES WERE FOUND TO BE UBIQUITOUS FOR ASSEMBLAGE 4

SPECIES NUMBER	NAME
101	EGGERELLA ADVENA (CUSHMAN) 1922
109	PSAMMOSPHAERA SP.

APPENDIX B (Cont'd)

THE FOLLOWING 5 SPECIES WERE FOUND TO BE UBIQUITOUS FOR ASSEMBLAGE 5

SPECIES NUMBER	NAME
9	BULIMINA EXILIS BRADY 1884
10	BUCCELLA INUSITATA ANDERSEN 1952
60	NONION LABRADORICUM (DAWSON) 1860
124	BULIMINA MARGINATA ORBIGNY 1826
149	VIRGULINA COMPLANATA EGGER 1893

THE FOLLOWING 2 SPECIES WERE FOUND TO BE UBIQUITOUS FOR ASSEMBLAGE 6

SPECIES NUMBER	NAME
1	ADERCOTRYMA GLOMERATA (BRADY) 1878
2	ALVEOLOPHRAGMIUM JEFFREYSI (WILLIAMSON) 1858

THE FOLLOWING 4 SPECIES WERE FOUND TO BE UBIQUITOUS FOR ASSEMBLAGE 7

SPECIES NUMBER	NAME
10	BUCCELLA INUSITATA ANDERSEN 1952
12	CASSIDULINA ISLANDICA NORVANG 1945
15	CIBICIDES LOBATULUS (WALKER + JACOB) 1798
29	ELPHIDIUM CLAVATUM CUSHMAN 1930

APPENDIX C

ASSEMBLAGE-INDICATOR SPECIES

INDICATOR SPECIES FOR ASSEMBLAGE 1

23 PROTELPHIDIUM SP.
61 NONION SP. CF. N. POMPILIOIDES
167 BULIMINA SP. CF. B. EXILIS
168 BUCCELLA SP.
169 BULIMINA SP. CF. B. FUSIFORMIS
170 CASSIDULINA SP. CF. C. ISLANDICA
171 DENTALINE SP.
172 EPONIDES SP.
176 NONIONELLA SP.
177 OOLINA SP. CF. O. CAUDIGERA
179 TROCHAMMINA LOBATA CUSHMAN 1944
181 TROCHAMMINA SQUAMATA JONES + PARKER 1860
182 TEXTULARIA SP.
195 ANOMALINA SP.
196 BULIMINA SP. CF. B. MARGINATA
197 CASSIDULINA SP. CF. C. NORCROSSI
199 EPISTOMINELLA SP.
201 GLABRATELLA SP. CF. G. WRIGHTII
262 BULIMINA ACULEATA AFF. B. MARGINATA
263 BOLIVINA SP. A
264 BOLIVINA SP. B
265 NONION OR ELPHIDIUM
267 NONIONELLA SP. CF. N. AURICULA AFF. NONION GRATELOUPI
269 REOPHAX CURTUS AFF. R. SCORPIURUS
271 OOLINA SP.
273 PROTELPHIDIUM SP. CF. P. ORBICULARE
274 ELPHIDIUM SP. CF. E. SUBARCTICUM
277 ANGULOGERINA SP. CF. A. ANGULOSA
280 TROCHAMMINA SP. CF. T. QUADRILOBA
281 LAGENA SP. CF. L. GRACILLIMA
295 BOLIVINA SP. CF. B. PUNCTATA
296 LAGENA PARRI LOEBLICH + TAPPAN 1953
299 DENTALINA PAUPERATA ORBIGNY 1846
300 VALVULINA SP. CF. V. FUSCA
301 RECTOGLANDULINA SP. CF. R. TORRIDA
302 RECTOGLANDULINA ROTUNDATA (REUSS) 1850
304 CASSIDULINA TERETIS AFF. C. LAEVIGATA
305 TROCHAMMINA SP. CF. T. BULLATA
312 CIBICIDES SP. A
313 CIBICIDES SP. B

APPENDIX C (Cont'd)

INDICATOR SPECIES FOR ASSEMBLAGE 2

253 REOPHAX FUSIFORMIS (WILLIAMSON) 1858
254 TROCHAMMINA SQUAMATA AFF. T. MACRESCENS
256 TROCHAMMINA SP. CF. T. ADAPERTA
257 GYROIDINA QUINQUELOBA UCHIO 1960
258 DISCORBIS SP. CF. PNINAELLA PULCHELLA
259 INCERTAE SEDIS LEPTODERMELLA

INDICATOR SPECIES FOR ASSEMBLAGE 3

3 ASTACOLUS HYALACRULUS LOEBLICH + TAPPAN 1953
19 DENTALINA BAGGI GALLOWAY + WISSLER 1927
43 GLABRATELLA WRIGHTII (BRADY) 1881
44 GLOBULINA SP. CF. G. GLACIALIS
45 GUTTULINA LACTEA (WALKER + JACOB) 1798
46 GUTTULINA EARLANDI CUSHMAN + OZAWA 1930
54 LARYNGOSIGMA HYALASCIDIA LOEBLICH + TAPPAN 1953
55 LAMARCKINA HALIOTIDEA (HERON-ALLEN + EARLAND) 1911
57 NONION SCAPHUM (FICHTEL + MOLL) 1798
68 POLYMORPHINA SP. NOV. AFF. P. FLINTII
71 QUINQUALOCULINA ARCTICA CUSHMAN 1933
72 QUINQUELOCULINA AGGLUTINATA CUSHMAN 1917
74 QUINQUELOCULINA NITIDA NORVANG 1945
75 QUINQUELOCULINA SP. CF. Q. NORVANGI
81 ROBERTINOIDES CHARLOTTENSIS (CUSHMAN) 1925
86 TRILOCULINA SP. CF. T. ANGULARIS
87 TRILOCULINA TRIHEDRA LOEBLICH + TAPPAN 1953
90 TROCHAMMINA NANA (BRADY) 1881
94 CALCAREOUS INDETERMINATE
213 CONORBINA SP.
214 ELPHIDIELLA SP.
215 EPISTOMINELLA SP. CF. E. NARAENSIS
216 GUTTULINA LACTEA AFF. G. AUSTRIACA
217 HIPPOCREPINA SP. CF. H. INDIVISOR
218 OOLINA STRIATOPUNCTATA (PARKER + JONES) 1865
219 PLANORBULINA MEDITERRANENSIS ORBIGNY 1826
221 QUINQUELOCULINA AKNERIANA ORBIGNY 1846
223 THOLOSINA BULLA (BRADY) 1881
224 TURRISPIRILLINA ARCTICA (CUSHMAN) 1933
308 ELPHIDIUM SP. CF. E. EXCAVATUM
309 OOLINA SQUAMOSA (MONTAGU) 1893

APPENDIX C (Cont'd)

INDICATOR SPECIES FOR ASSEMBLAGE 4

283 MILIAMMINA FUSCA (BRADY) 1870
284 PROTEONINA SP. CF. P. ATLANTICA
285 AMMOTIUM SP. CF. A. CASSIS
286 PROTEONINA SP. CF. P. DIFFLUGIFORMIS
287 PROTEONINA SP. CF. P. AMPULLACEA
288 WEBBINELLA SP. CF. W. HEMISPHAERICA
291 HYPERAMMINA FRAGMENTS
292 MILIAMMINA SP. CF. M. FUSCA
293 PROTEONINA FUSIFORMIS
294 AMMOSCALARIA SP. CF. A. TENUIMARGO
314 ELPHIDIUM OR NONION SP.
315 TEXTULARIA SP. CF. T. EARLANDI
316 HYPERAMMINA SP. A
317 HYPERAMMINA SP. B

INDICATOR SPECIES FOR ASSEMBLAGE 5

119 ASTACOLUS SP. CF. A. HYALACRULUS
126 FISSURINA SP. CF. F. SEMIMARGINATA
128 CIBICIDES SP. IMMATURE
129 DISCORBIS CHASTERI (HERON-ALLEN + EARLAND) 1913
131 LENTICULINA SP. CF. L. GIBBA
132 DISCORBIS OBTUSA CUSHMAN 1931
134 FISSURINA SP.
135 GLOBOBULIMINA SP. CF. G. TURGIDA
137 GYROIDINA SP. CF. G. QUINQUELOBA
139 LAGENA GRACILIS WILLIAMSON 1848
140 LAGENA HISPIDA REUSS 1863
142 OSANGULARIA SP.
143 OOLINA HEXAGONA (WILLIAMSON) 1848
144 PARAFISSURINA TECTULOSTOMA LOEBLICH + TAPPAN 1953
145 PARAFISSURINA FOLLICULA LOEBLICH + TAPPAN 1953
146 PNINAELLA PULCHELLA PARKER 1952
148 SIPHOGENERINA ANNULATA BRADY 1884
150 VIRGULINA SP. CF. V. FUSIFORMIS
155 ELPHIDIUM SP. CF. E. BARTLETTI AFF. E. CLAVATUM
156 FISSURINA SP. CF. F. MARGINATA
157 FISSURINA LUCIDA (WILLIAMSON) 1848
158 GLOBOBULIMINA SP.
159 GLOBOBULIMINA TURGIDA (BAILEY) 1851
160 LAGENA MOLLIS AFF. L. DISTOMA
161 LARYNGOSIGMA SP.
162 OOLINA SP. CF. O. HEXAGONA
163 PULLENIA SP. CF. P. QUINQUELOBA
164 PARAFISSURINA SP.
165 RECTOGLANDULINA SP. CF. R. OCCIDENTALIS
185 RECTOGLANDULINA SP. CF. GLANDULINA LAEVIGATA

APPENDIX C (Cont'd)

187 BULIMINELLA CONVOLUTA (WILLIAMSON) 1858
189 LAGENA SP. CF. L. APIOPLEURA
190 LAGENA SP. CF. L. STRIATA
192 GYROIDINA UMBONATA (SILVESTRI) 1898
193 LAGENA SP. CF. L. SETIGERA
194 NONION SP. CF. N. ZAANDAMAE
200 LEPTODERMELLA SP.
208 CYCLAMMINA CANCELLATA BRADY 1879
261 TROCHAMMINA SP. CF. T. ATLANTICA
279 TROCHAMMINA QUADRILOBA HOGLUND 1948

INDICATOR SPECIES FOR ASSEMBLAGE 6

98 CAUSIA SP.
103 HYPERAMMINA SUBNODOSA BRADY 1884
104 MARSIPELLA ELONGATA (RHUMBLER) 1913
105 NONION POMPILIOIDES (RICHTEL + MOLL) 1798
107 NONIONIDAE IMMATURE
110 PYRGO SP. CF. P. ELONGATA
111 ROBERTINA ARCTICA ORBIGNY 1846
112 REOPHAX SUBFUSIFORMIS EARLAND 1933
113 ROTALIA SP.
114 SPIRILINA SP.
117 VIRGULINA SP. CF. V. BRADYI
311 HYPERAMMINA SP. CF. H. SUBNODOSA
318 DENDROPHRYA SP.

APPENDIX C (Cont'd)

INDICATOR SPECIES FOR ASSEMBLAGE 7

202 GUTTULINA DAWSONI CUSHMAN + OZAWA 1930
206 PSAMMOSPHAERA FUSCA SCHULZE 1875
207 VIRGULINA FUSIFORMIS WILLIAMSON 1858
209 TROCHAMMINA GLOBIGERINIFORMIS (PARKER + JONES) 1865
210 QUINQUELOCULINA SP. CF. Q. SEMINULA
225 CIBICIDES LOBATULUS AFF. C. PSEUDOUNGERIANA
226 MARSIPELLA SP.
227 QUINQUELOCULINA SP. CF. Q. PULCHELLA
228 SCUTULORIS TEGMINIS LOEBLICH + TAPPAN 1953
230 ROSALINA COLUMBIENSIS (CUSHMAN) 1925
231 DISCORBIS SP. CF. D. BERTHELOTI
232 ANGULOGERINA SP. CF. A. FLUENS
235 TROCHAMMINA CONICA EARLAND 1934
236 ANGULOGERINA ANGULOSA AFF. A. FLUENS
237 ELPHIDIUM BARTLETTI AFF. E. SUBARCTICUM
238 ELPHIDIUM SUBARCTICUM AFF. E. BARTLETTI
239 QUINQUELOCULINA SEMINULA (LINNAEUS) 1767
242 BOLIVINA SP. CF. B. SPATHULATA
243 CASSIDULINA SP.
244 DENTALINA MELVILLENSIS LOEBLICH + TAPPAN 1953
247 LAGENA SP. CF. L. STELLIGERA
249 EPONIDES SP. A
250 EPONIDES SP. B
251 DISCORBIS SP. A
252 DISCORBIS SP. B