INTRODUCTION

Recent investigations of the microscopic skeletal debris of fishes (Helms and Riedel, 1971; Doyle et al., in press) have indicated that these microfossils can be used for assigning approximate ages to otherwise unfossiliferous Cenozoic pelagic sediments. Therefore Carolyn Glockhoff took some samples for this purpose during Leg 32 of the Deep Sea Drilling Project. The samples that we report on are from the top two cores collected at Site 311 (28°07.46'N, 179°44.25'E, in 5775 m of water) and from the first core of Site 307 (28°55.26'N, 161°00.28'E, in 5696 m of water). At Site 311, which was continuously cored, calcareous nanofossils in Core 3 indicate an age of early late Oligocene. At Site 307, radiolarians in the first 9 cm of Core 1 are of Quaternary age; the second core was cut 28 meters below the first, and the radiolarians indicate a Cretaceous age.

Table 1 lists the ichthyoliths found in Cores 311-1 and 311-2, with stratigraphic ranges as established mainly by Doyle et al. (in press). Some hitherto undescribed forms are also included, and their ranges determined in assemblages of known ages (Table 2). Many of these reference assemblages are the same as those used in the ichthyolith contributions to Volumes 7 and 26 of the DSDP Initial Reports, one notable omission being JYN V 10P at about 9 meters, which is now believed on the basis of its ichthyoliths to be not older than early Miocene, rather than late Eocene as originally supposed on the evidence of radiolarians (now believed to be reworked).

The system of describing and naming the ichthyoliths (Doyle et al. in press) requires modification and expansion to accommodate the new forms described here.

RESULTS

Table 1 gives the numbers of specimens found of stratigraphically significant specimens in samples from Site 311. Table 2 presents the data establishing the stratigraphic ranges of new forms. Reference samples (indicated by asterisks) not used by Helms and Riedel (1971) nor in the Leg 26 report are the following:

PAPA 120G, 160-168 cm, an SIO core from 20°56'N, 112°03'W, in 3379 meters of water. Radiolarians indicate a Quaternary age (Jean M. Westberg, personal communication).

BNFC 53P, 490-510 cm and 515-517 cm, an SIO core from 11°52'N, 110°00.0'W, in 3892 meters of water. Nanofossils indicate a late Pliocene age (D. Bukry, personal communication).

TRI 5P, 210-215 cm, an SIO core from 15°38'N, 112°57'W in 3929 meters of water. Radiolarians indicate a Pliocene-Quaternary age (Jean M. Westberg, personal communication).

Age assignments for the following DSDP cores are discussed in the appropriate volumes of DSDP Initial Reports:

- 42-1-4 and 42-2-3 from 13°50.56'N, 140°11.31'W in 4844 meters of water, late Oligocene.
- 82A-2-3 from 02°35.48'N, 106°56.52'W in 3689 meters of water, Pliocene.
- 304-2, CC from 39°20.87'N, 155°04.19'E in 5630 meters of water, Pliocene.
- 310-10-6, 310-10, CC and 310-11-3 from 36°52.11'N, 176°54.09'E in 3516 meters of water; 310-10-6 and 310-10, CC middle Eocene, 310-11-3 early Eocene.
- 313-1-2, 4, 5, 6, CC from 21°10.52'N, 170°57.15'W in 3484 meters of water; 313-1-2, 4, 5 Pliocene-Quaternary, 313-1-6 and 313-1, CC late Miocene.

The assemblages from 311-1-1 and 311-1-2 are evidently late Miocene or younger, those from 311-1-3 and 311-1-4 are middle Miocene or younger, those from 311-1-5 through 311-2-2 at 40-42 cm are late Oligocene to early Miocene, and those from 311-2-2, 60-64 cm through 311-2-3, 50-54 cm are early Oligocene to early Miocene.

In addition to the samples from Site 311, three samples were examined from Site 307. The top two of these (307-1-1, 90-94 cm and 307-1-4, 50-54 cm) contained very few ichthyoliths, but a sample from 307-1, CC yielded several hundred specimens. The subtypes present in 307-1, CC, and the number of each, are as follows: Two curved triangles long base (1), Kid-shaped elongate prominence (1), Small triangle creata margin (1), Triangle short wing (4), Triangle pointed margin ends (1), Asymmetrical peaks narrow depression (4), Triangle broad wing (1), Triangle medium wing (1), Triangle one canal above (1), Asymmetrical peak wide depression (1), Flexed triangle 15/13/14 (1), Triangle inline halfway (1), Triangle hooked margin (2), Triangle with parallel inline (1), Curved triangle 15/13/14 (1), Triangle with triangular projection (10), Triangle sigmoid (3), Triangle transverse line across (1), Flexed triangle shallow inbase (14), Triangle with canals (4), Short side peaks differentiated margin (1), Rhombus undulating margin (1), Rounded apex triangle (4), Curved triangle inline constricted (1), Small dentidic many radiating lines (20), Small dentidic few radiating lines (6), Large with numerous lines (12), Rectangular serially saw-toothed (3), Small circular center (2), Skewed four or five peaks (2). Narrow triangle ragged base (7). This assemblage indicates that 307-1, CC is late Oligocene to middle Miocene in age, evidently with some Eocene or older admixture.
TABLE 1
Distribution of Subtypes of Ichthyoliths in Site 311 (Numbers of Specimens Found)

<table>
<thead>
<tr>
<th></th>
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</tr>
</thead>
<tbody>
<tr>
<td>Samples(b)</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>311-1-1, 40-44 cm</td>
<td>3</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>2</td>
</tr>
<tr>
<td>311-1-2, 50-54 cm</td>
<td>1</td>
<td>2</td>
<td>1</td>
<td>1</td>
<td>2</td>
</tr>
<tr>
<td>311-1-3, 40-44 cm</td>
<td>1</td>
<td>2</td>
<td>1</td>
<td>1</td>
<td>2</td>
</tr>
<tr>
<td>311-1-4, 70-74 cm</td>
<td>1</td>
<td>2</td>
<td>1</td>
<td>1</td>
<td>2</td>
</tr>
<tr>
<td>311-1-5, 40-44 cm</td>
<td>1</td>
<td>2</td>
<td>1</td>
<td>1</td>
<td>2</td>
</tr>
<tr>
<td>311-1-6, 120-124 cm</td>
<td>3</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>2</td>
</tr>
<tr>
<td>311-2-1, 40-44 cm</td>
<td>1</td>
<td>2</td>
<td>1</td>
<td>1</td>
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</tr>
<tr>
<td>311-2-2, 50-54 cm</td>
<td>1</td>
<td>2</td>
<td>1</td>
<td>1</td>
<td>2</td>
</tr>
<tr>
<td>311-2-3, 40-44 cm</td>
<td>1</td>
<td>2</td>
<td>1</td>
<td>1</td>
<td>2</td>
</tr>
<tr>
<td>311-2-4, 70-74 cm</td>
<td>1</td>
<td>2</td>
<td>1</td>
<td>1</td>
<td>2</td>
</tr>
</tbody>
</table>

\(a\) The following subtypes were looked for in these samples, but not found – Kite-shaped irregular network, Two curved triangles, Plain lanceolate, Triangle broad wing, Two curved triangles long base, Triangle short wing, Triangle pointed margin ends, Triangle one canal above, Triangle inline halfway, Triangle hooked margin, Triangle double flex, Triangle sigmoid, Triangle with base angle, Short kite-shaped, Three equal peaks flared base, Giant lanceolate, Kite-shaped longitudinal line, Rhombus smooth margin, Short side peaks differentiated margin, Triangle notched corner, Curved triangle inline constricted, Three similar peaks, Small dendrile many radiating lines, Tall median peak transverse lines, Small circular center, Narrow curved triangle, Stippled triangle, Skewed with transverse lines, Narrow triangle ragged base, Three tall peaks.

\(b\) The following samples proved to be unproductive of ichthyoliths, and thus could not be stratigraphically interpreted – 311-1-6, 100-104 cm; 311-2-4, 90-94 cm; 311-2-5, 70-74 cm; 311-2-6, 70-74 cm.

CHANGES TO THE DESCRIPTIVE SYSTEM

To accommodate the hitherto undescribed forms, the following modifications and additions are made to the descriptive system established in the Leg 26 report.

1) In Type a2 / b2, add the character k with the following states:
   k. shape of peaks’ apexes
   1. neither of the following
   2. sharp
   3. blunt

2) The definition of Type a7 / b1 is modified to accommodate forms with “two or more tooth-like projections”

3) In Type a7 / b1, we do not use the character-state d.1, but add the following character-states:
   d.4 short and stubby, without a flared base or two closely parallel basal lines
   d.5 short and stubby, with a flared base
   d.6 short and stubby, with two closely parallel basal lines

4) In Type a7 / b1, we do not use the character-states e.1, e.2 and e.3, but add the following character-states:
   e.4 triangular, not markedly longer than broad
TABLE 2
Stratigraphic Distribution of Thirteen New Ichthyolith Subtypes

<table>
<thead>
<tr>
<th>Age</th>
<th>Subtypes</th>
</tr>
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<tr>
<td>JYN V 38PG, 58-101 cm</td>
<td></td>
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<tr>
<td>*PAPA 120G, 100-138 cm</td>
<td></td>
</tr>
<tr>
<td>PROA 128G, 67-70 cm</td>
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<tr>
<td>PROA 1740, 120-131 cm</td>
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</tr>
<tr>
<td>*DSDP 313-1-2, 50-54 cm</td>
<td></td>
</tr>
<tr>
<td>*DSDP 313-1-3, 50-54 cm</td>
<td></td>
</tr>
<tr>
<td>TRI 5P, 210-215 cm</td>
<td></td>
</tr>
<tr>
<td>AMPH 98P, 300-305 cm</td>
<td></td>
</tr>
<tr>
<td>AMPH 100G, 500-505 cm</td>
<td></td>
</tr>
<tr>
<td>JYN 38PG, 60-64 cm</td>
<td></td>
</tr>
<tr>
<td>JYN 39PG, 70-75 cm</td>
<td></td>
</tr>
<tr>
<td>MSN 153G, 40-45 cm</td>
<td></td>
</tr>
<tr>
<td>MSN 165G, 50-55 cm</td>
<td></td>
</tr>
<tr>
<td>DSDP 313-1-4, 50-54 cm</td>
<td></td>
</tr>
<tr>
<td>*DSDP 313-1-5, 50-54 cm</td>
<td></td>
</tr>
<tr>
<td>DSDP 313-1-6, 50-54 cm</td>
<td></td>
</tr>
<tr>
<td>DSDP 313-1-7, 50-54 cm</td>
<td></td>
</tr>
<tr>
<td>DSDP 313-1-8, 50-54 cm</td>
<td></td>
</tr>
</tbody>
</table>

5) In Type a9 / b1, we do not use the character-states c.2 and c.3, but add the following character-states:

c.15 crenate, saw-toothed, or some other incised pattern on upper half of margin. At least one lateral projection longer than 30µ

c.16 crenate, saw-toothed, or some other incised pattern on upper half of margin. At least one lateral projection longer than 30µ

c.17 crenate, saw-toothed, or some other incised pattern on lower half of margin. No lateral projection longer than 30µ

c.18 crenate, saw-toothed, or some other incised pattern on lower half of margin. At least one lateral projection longer than 30µ

6) In Type a9 / b1, we do not use the character-state f.2, but add the following character-states:

f.6 distinct striations radiating from apex of inline toward outline, or sub-parallel, and extending into the upper quarter of the outline

f.7 distinct striations radiating from apex of inline toward outline, or sub-parallel, but not extending into the upper quarter of the outline

7) In a9 / b1 / f4, a9 / b5 / i4, and a9 / b5 / i2, the use of the term "lateral shadow" needs clarification. Two kinds of difficulties have arisen in attempting to apply the description "lateral shadow" consistently. The first arises from an inadequacy of the original verbal definition, though the meaning should be clear from the accompanying sketch—a "lateral shadow" is not one which is most intensive at the margin and diminishing inward, as occurs in most ichthyoliths, but rather is a dark lateral zone separated from the edge by a narrow light zone. The second difficulty is more difficult to resolve, since with some microscopes and under some conditions of transmitted illumination, a lateral shadow cannot be seen in specimens in which it should be visible. The only solution to this dilemma is to move the specimen until its cross-section can be determined, in which a median, convex zone will be seen to separate two flattened lateral zones. Our reason for not requiring this as part of the routine examination is our desire to avoid threedimensional descriptions as far as possible.

8) In Type a9 / b1, we do not use the character-state h.1, but add the following character-states:

h.4 second margin 5%-15% longer than the first
M. J. DUNSWORTH, P. S. DOYLE, W. R. RIEDEL

9) In Type a9 / b1, add the following character-state:

i.10 reverse sigmoid

Remarks: This term is used when a sigmoid margin of a tooth has the upper part convex outward.

10) In Type a9 / b1, we do not use the character-state k.2, but add the following character-states:

k.8 approximately parallel to outline, but not with sides bowed in or markedly acuminate, and not closely approaching the outline at the base

k.9 approximately parallel to outline, not with sides bowed in or markedly acuminate, but closely approaching the outline at the base

11) In Type a9 / b5, we do not use the character-states c.2 and c.3, but add the following character-states (measured as in Type a9 / b1 / c15, 16, 17, 18):

c.14 crenate, saw-toothed, or some other incised pattern on upper half of margin. No lateral projection longer than 30µ

c.15 crenate, saw-toothed, or some other incised pattern on upper half of margin. At least one lateral projection longer than 30µ

c.16 crenate, saw-toothed, or some other incised pattern on lower half of margin. No lateral projection longer than 30µ

c.17 crenate, saw-toothed, or some other incised pattern on lower half of margin. At least one lateral projection longer than 30µ

12) In Type a9 / b5, we do not use the character-state i.2, but add the following character-states:

i.8 defined similarly to a9 / b1 / f6

i.9 defined similarly to a9 / b1 / f7

13) In Type a9 / b5, add the character-state:

j.4 stippling

14) In Type a9 / b5, add the character-state:

m.6 defined similarly to a9 / b1 / i10

15) In Type a9 / b5, add the character-state:

o.9 simply curved line terminating at margins at different levels (length of margins above the transverse line differ by at least 5%)

16) In Type a9 / b5 add the character u with the following states:

u. Features between inline and outline below transverse line

1. none of the following

2. "lateral shadow"

3. distance between inline and outline less than 10µ at its maximum

17) In Type a9 / b6 add the characters c, d, and e, with character-states as follows:

c. Number of projections

Numbers. Not encoded

d. Shape of middle projection

1. none of the following

2. unmodified triangle

3. triangle modified by the lower parts of the sides being convexly curved

4. distally truncate, straight or even a little depressed.

e. Shape of inline of middle projection

0. no inline within middle projection

1. none of the following

2. rounded, as in the diagrams

3. pointed, as in the diagrams

DESCRIPTIVE SECTION

a2 / b2 / c3 / d1 / e1 / f1 / g1 / h1 / i0 / j2 / k1, 3

Three tall peaks
(Plate 1, Figures 1, 2)

Approximately elliptical, with three peaks; length 300-550µ, greater than width; not skewed. Median peak less than twice the length of lateral peaks; apexes of peaks usually blunt; depressions U-shaped. Range: two specimens found in one late Pliocene sample.

a7 / b1 / c2 / d3 / e6

Rectangular serially saw-toothed
(Plate 1, Figure 3)

a7 / b1 / c2 / d3 / e3 (Rectangular saw-toothed), Doyle et al., in press, pl. 1D, fig. 3-8; pl. 2G, fig. 4-8 (in part). Elongated rectangular form with broad, angular, regularly shaped projections closely spaced. Height 150-275µ. Range: late Oligocene to Pliocene-Quaternary.
Undescribed form, Dengler et al., in press, pl. 5, fig. 13.

Tringles of narrow to medium width (apical angle 20°-35°) having two prominent flexures. Base of line above termination of the flexures. Overall length 390-950µ, width 160-330µ.

Range: middle Eocene to early Miocene.

a8 / b1 / c2 / d2 / e3 / e60-100 / f20-35

Triangle double flex
(Plate 1, Figure 6)

Undescribed form, Dengler et al., in press, pl. 5, fig. 13.

Narrow triangles (apical angle ≤25°) having one prominent flexure with an angle greater than or equal to 120°. Base of line (or transverse line) above the termination of the flexure. Overall length (above transverse line) 250-480µ, width 90-200µ.

Range: late Oligocene to early Miocene and one specimen found in late Eocene.

a8 / b1.5 / c1 / d2.3 / e2-120 / f5-25

Flexed triangle shallow in base ≥120
(Plate 1, Figures 4, 5)

Wide triangle
(Plate 1, Figures 7, 8)

a9 / b1 / c1 / d1 / e1 / f1 / g1 / h3.4 / i3 / j3 / k8 / l0.2-0.8 / m<1 / n4-8 / o1 / p3

Narrow triangle ragged base
(Plate 1, Figures 17, 18)

a9 / b1 / c1 / d1 / e1 / f1 / g1 / h3.4 / i3 / j3 / k8 / l0.2-0.8 / m<1 / n4-8 / o1 / p3

Wide triangle
(Plate 1, Figures 7, 8)

a9 / b1 / c1 / d1 / e1 / f1 / g1 / h3.4 / i3 / j3 / k8 / l0.2-0.8 / m<1 / n4-8 / o1 / p3

Narrow triangle ragged base
(Plate 1, Figures 17, 18)

a9 / b1 / c1 / d1 / e1 / f1 / g1 / h3.4 / i3 / j3 / k8 / l0.2-0.8 / m<1 / n4-8 / o1 / p3

Triangle sigmoid
(Plate 1, Figures 11, 12; Plate 2, Figure 14)

Undescribed form, Dengler et al., in press, pl. 5, fig. 15, 16.

Sigmoidally curved long triangle (length to width ratios ≥4) with sharply pointed apex. Inline approximately parallel to outline, but with rounded apex. Overall length above transverse line 250-550µ, width 90-140µ.

Range: middle Eocene to early Miocene (and one specimen in Pliocene).

a9 / b1 / c1 / d1 / e1 / f1 / g1 / h5 / i9 / j9 / k8 / l0.75-0.95 / m=2.75 / n2 / o1 / p2

Triangle sigmoid
(Plate 1, Figures 11, 12; Plate 2, Figure 14)

Undescribed form, Dengler et al., in press, pl. 5, fig. 15, 16.

Sigmoidally curved long triangle (length to width ratios ≥2.75) with sharply pointed apex. Inline approximately parallel to outline, but with rounded apex. Overall length above transverse line 250-550µ, width 90-140µ.

Range: middle Eocene to early Miocene (and one specimen in Pliocene).

a9 / b1 / c1 / d1 / e1 / f1 / g1 / h5 / i9 / j9 / k8 / l0.75-0.95 / m=2.75 / n2 / o1 / p2

Small triangle long striations
(Plate 1, Figures 13, 14)

Triangle (range of length to width ratios 1.5-1.8) with straight margins, no lateral shadows, and striations extending from base into the upper quarter of the outline. Inline either absent or limited to bottom one-fourth of the outline. Rare specimens have a straight or slightly curved transverse line ending at the margins. Measurements above transverse line—length no greater than 150-300µ, width no greater than 80-200µ.

Range: early Miocene to Quaternary.

a9 / b5 / c1 / d1 / e1 / f1 / g1 / h5 / i9 / j9 / k8 / l0.75-0.95 / m=2.75 / n2 / o1 / p2

Large triangle saw-toothed margin
(Plate 2, Figure 2)

Undescribed form, Dengler et al., in press, pl. 5, fig. 14.

Long narrow triangle (length to width ratio below straight transverse line ≥4), only a small part of the outline above transverse line. Margins either straight or curved. Inline below transverse line parallel to outline, and separated from it by no more than 10µ. Overall length 300-900µ, width 45-100µ.

Range: early Eocene to late Oligocene.

a9 / b5 / c1 / d1 / e1 / f1 / g1 / h5 / i9 / j9 / k8 / l0.75-0.95 / m=2.75 / n2 / o1 / p2

Large triangle saw-toothed margin
(Plate 2, Figure 2)
strait, or even a little depressed. The inline does not extend into the middle projection. Overall length approximately 90-310µ, width 230-400µ.

Range: four specimens found in early Miocene to Pliocene.

Comment: The specimen illustrated by Doyle et al., in press, pl. 11, fig. 5, is the type specimen of this new subtype.

LIST OF FORMS IDENTIFIED

Table 3 is a numerically arranged listing of the new subtypes described herein. Below is an alphabetically arranged list of the colloquial names of all of the new and previously described forms encountered, those not described by Doyle et al. (in press) being indicated by an asterisk.

Asymmetrical peak narrow depression
Asymmetrical peak wide depression
Circular with line across
Curved triangle inline constricted
Curved triangle pointed margin
Elliptical with line across
Flexed narrow triangle 120-128
Flexed triangle 102-112
Flexed triangle 115-118
Flexed triangle shallow inbase
*Flexed triangle shallow inbase ≥120
Kite-shaped elongate prominence
*Large triangle saw-toothed margin
Large with numerous lines
Long triangle stepped margin
*Long triangle thin wall
*Narrow triangle ragged base
Narrow triangle straight inbase
Plain lanceolate
*Rectangular serially saw-toothed
Rhombus undulating margin
Rounded apex triangle
Short side peaks differentiated margin
Short triangle stepped margin
Skewed four or five peaks
Small circular center
Small dendritic few radiating lines
Small dendritic many radiating lines
*Small triangle crenate margin
*Small triangle long striations
*Stippled triangle
*Three tall peaks

Triangle broad wing
Triangle crenulate
Triangle crenulate with canals
*Triangle double flex
Triangle hooked margin
Triangle inline halfway
Triangle medium wing
Triangle one canal above
Triangle pointed margin ends
Triangle short wing
*Triangle sigmoid
Triangle transverse line across
*Triangle with base angle
Triangle with canals
Triangle with parallel inline
Triangle with triangular projection
Two triangles
*Wide triangle
Wide triangle straight inbase

ACKNOWLEDGMENTS

This research was supported partly by NSF Grant GA-40158, and partly by the University of California. In addition to colleagues who determined ages on the basis of other groups of microfossils (see list of samples), we gratefully acknowledge the assistance of T. J. Walsh in providing samples from SIO collections. M. A. Hanger and M. A. Neely capably typed and proofread the manuscript, and Jean M. Westberg helped with the illustrations.

REFERENCES


TABLE 3

Numerically Arranged Name Descriptions, With Equivalent Colloquial Names, of Subtypes Described in This Chapter

<table>
<thead>
<tr>
<th>Name Descriptions</th>
<th>Colloquial Names</th>
</tr>
</thead>
<tbody>
<tr>
<td>a b c d e f g h i j k l m n o p q r s t u</td>
<td>Name Descriptions</td>
</tr>
<tr>
<td>2 2 3 1 1 1 1 1 0 2 1 3</td>
<td>Triangle double flex</td>
</tr>
<tr>
<td>8 1 2 2 2 2 2 2 2 2 2 2</td>
<td>Flexed triangle shallow inbase ≥120</td>
</tr>
<tr>
<td>9 1 1 1 1 1 1 1 1 1 1 1</td>
<td>Wide triangle</td>
</tr>
<tr>
<td>9 1 1 1 1 1 1 1 1 1 1 1</td>
<td>Narrow triangle ragged base</td>
</tr>
<tr>
<td>9 1 1 1 1 1 1 1 1 1 1 1</td>
<td>Triangle sigmoid</td>
</tr>
<tr>
<td>9 1 1 1 1 1 1 1 1 1 1 1</td>
<td>Small triangle long striations</td>
</tr>
<tr>
<td>9 1 1 1 1 1 1 1 1 1 1 1</td>
<td>Stippled triangle</td>
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<tr>
<td>9 1 1 1 1 1 1 1 1 1 1 1</td>
<td>Triangle with base angle</td>
</tr>
<tr>
<td>9 1 1 1 1 1 1 1 1 1 1 1</td>
<td>Small triangle crenulate margins</td>
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<td>Large triangle saw-toothed margin</td>
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<tr>
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<td>Triangle broad wing</td>
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<td>Triangle hooked margin</td>
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<td>9 1 1 1 1 1 1 1 1 1 1 1</td>
<td>Triangle medium wing</td>
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<td>Triangle one canal above</td>
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<td>Triangle pointed margin ends</td>
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<tr>
<td>9 1 1 1 1 1 1 1 1 1 1 1</td>
<td>Triangle with parallel inline</td>
</tr>
<tr>
<td>9 1 1 1 1 1 1 1 1 1 1 1</td>
<td>Triangle with triangular projection</td>
</tr>
<tr>
<td>9 1 1 1 1 1 1 1 1 1 1 1</td>
<td>Two triangles</td>
</tr>
<tr>
<td>9 1 1 1 1 1 1 1 1 1 1 1</td>
<td>*Wide triangle</td>
</tr>
<tr>
<td>9 1 1 1 1 1 1 1 1 1 1 1</td>
<td>Wide triangle straight inbase</td>
</tr>
</tbody>
</table>

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PLATES

In the explanations to the figures, the sample numbers and slide designations (in the form "S1.4", etc.) indicate preparations in our collection at Scripps Institution of Oceanography, and designations in the form "R45/1" indicate England Finder positions of the illustrated specimens on the slides.
All figures are magnified 110x.

Figures 1, 2
a2 / b2 / c3 / d2 / e2 / f2 / g1 / h2 / i0 / j2 / k1 / 3. 
Three tall peaks.
1. BNFC 53P, 515-517 cm, S1.1, M29/1.
2. RIS 8P, 650-655 cm, Cse.1, H21/0, type specimen.

Figure 3
Rectangular serially saw-toothed. AMPH 98P, 500-503 cm, S1.A, L35/2, type specimen.

Figures 4, 5
a8 / b1,5 / c1 / d2,5 / e2 / f2 / g1 / h2 / i1 / j1 / k2,5 / l2,5 / m2,5 / n2,5 / o2 / p2,3,7 / q0 / r1,5-2,5 / s2 / t2 / u3.
Flexed triangle shallow in base 120.
4. 19-3-4, 40-44 cm, S1.4, J37/4, type specimen.

Figure 6
a8 / b1 / c2 / d2,3 / e60-100 / f20-35.
Triangle double flex. 65.1-3, CC, S1.15, H43/0, type specimen.

Figures 7, 8
Narrow triangle ragged base.
7. AMPH 130G, 90-93 cm, S1.A, N37/1.
8. BNFC 53P, 490-510 cm, S1.1, M37/1, type specimen.

Figures 9, 10
a9 / b5 / c1 / d1 / e1 / f1 / g1 / h1 / i1 / j1 / k9 / 19 / l2,6 / m2 / n2,3 / o2 / p2,3,7 / q0 / r1,5-2,5 / s2 / t2 / u3.
Long triangle thin wall.
9. DODO 111P, 112-128 cm, S1.6, C43/1.
10. 311-2-2, 40-42 cm, S1.2, J23/1, type specimen.

Figures 11, 12
a9 / b1 / c1 / d1 / e1 / f1,3 / g1 / h5 / i9 / j9 / k8 / l0,75-0,95 / m2,75 / n2 / o1 / p2,75 / q0 / r1,5-2,5 / s2 / t2 / u3.
Triangle sigmoid.
11. 65.1-3, CC, S1.9, N21/2, type specimen.
12. DODO 30P, 534-544 cm, S1.1, F30/0.

Figures 13, 14
a9 / b1 / c1 / d1 / e1 / f6 / g1 / h5 / i2 / j2 / k0,5 / l0,75-1 / m1,5-1,8 / n2 / o1 / p1.
Small triangle long striations.

Figures 15, 16
a9 / b1 / c9,13 / d1 / e1 / f4+(6,7) / g1 / h4 / i2 / j2 / k7,8 / l0,2-0,6 / m1,6-2,8 / n2 / o1,2 / p1.
Triangle with base angle.
15. 15-6-3, 44-50 cm, S1.2, E35/1.
16. LSDH 96P, 400-411 cm, S1.4, J44/2, type specimen.

Figures 17, 18
a9 / b1 / c1 / d1 / e1 / f1 / g1 / h3,4,5 / i3 / j3 / k8 / l0,2-0,8 / m<1 / n4-8 / o1 / p3.
Wide triangle.
17. MSN 135P, 702-705 cm, S1.A, E55/1, type specimen.
18. 65,1-3, CC, S1.20, F29/0.

Figures 19-21
a9 / b1 / c9,15 / / 17 / d1 / e1,2 / f1 / g3 / h5 / i6,10 / j3 / k8 / l0,1-0,3 / m2 / n2 / o1,2 / p1.
Stippled triangle.
19. DODO 37P, 356-370 cm, S1.2, M44/2.

Figure 22
Undescribed form, 42-1, 50-56 cm, S1.1, K36/2.
PLATE 2

All figures are magnified 110X.

Figure 1
Undescribed form.
311-2-2, 140-142 cm, S1.3, T23/4.

Figure 2
\textit{a9 / b6 / c\geq 4 / d4 / e0}.
Large triangle saw-toothed margin.
PROA 103P, 300-320 cm, S1.5, G23/4.

Figure 3
Undescribed form.
MSN 7P, 850-860 cm, S1.16, K18/3.

Figures 4, 5
\textit{a9 / b1 / c1.5,17 / d1.5,17 / e1.2 / f1 / g1 / h5 / i2,3 / j2,3 / k9 / 10.25-0.5 / m0.5-1.4 / n1 / o1 / pl.}
Small triangle crenate margin.
4. MSN 7P, 850-860 cm, S1.6, M18/0, type specimen.
5. 65.1-3-CC, S1.17, R34/0.

Figures 6, 7
Undescribed forms.
6. MSN 7P, 850-860 cm, S1.19, W18/2.
7. 311-2-2, 40-42 cm, S1.3, J18/4.

Assemblage from 307-1-CC (Figures 8-20)

Figures 8-10
Undescribed forms.
8. S1.4 P33/2.
9. S1.5, F24/1. A form similar to Doyle et al., 1974, pl. 5, fig. 7.
10. S1.5, H18/0.

Figure 11
\textit{a7 / b6 / c2};
Asymmetrical two peaks depression, Doyle et al., 1974. S1.2, P41/2.

Figure 12
\textit{a5,6 / b3 / c1 / d3 / e1}.
Small circular center, Doyle et al., 1974. S1.3, U35/1.

Figure 13
Undescribed form.
S1.1, R25/0.

Figure 14
\textit{a9 / b1 / c1 / d1 / e1 / f1.3 / g1 / h5 / i9 / j9 / k8 / 10.75-0.95 / m\geq 2.75 / n2 / o1 / p2}
\textit{a9 / b5 / c1 / d2 / e1 / f1 / g1 / h1 / i1 / j1 / k9 / 19 / m1,4 / n1,3 / o9 / p3 / q0.75-0.95 / r\geq 2.75 / s0 / t2 / u1.}
Triangle sigmoid.
S1.1, T24/0.

Figures 15, 16
Undescribed forms.
15. S1.1, U21/0.
16. S1.1, M19/0.

Figure 17
\textit{a9 / b1 / c6 / d1 / e1 / f1,5 / g1 / h1,3 / i2 / j2,6 / k2 / l>0.25 / m<1.4 / n1 / o1 / pl,2.}
Triangle broad wing, Doyle et al., 1974.
S1.3, P40/0.

Figure 18
\textit{a9 / b1 / c1 / d1 / e1 / f1 / g1 / h1,2,3 / i2,3 / j2,3 / k2 / 10.25-0.45 / m1-1,5 / n4,5 / o1 / p3.}
Wide triangle straight inbase, Doyle et al., 1974.
S1.2, D32/3.

Figures 19, 20
Undescribed forms.
19. S1.2, N15/1. A form similar to Doyle et al., 1974, pl. 5, figs. 18, 24, 25; seen also in Late Cretaceous assemblages from the Caribbean (DSDP Leg 15).
20. S1.1, L41/2.
PLATE 2

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