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DIMENSIONS AND SINKING SPEEDS OF
TROPICAL RADIOLARIAN SKELETONS
FROM THE PARFLUX SEDIMENT TRAPS

by

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TECHNICAL REPORT

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Legend:	W:	Width	L:	Length
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	Re:	Reynolds number		

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DIMENSIONS AND SINKING SPEEDS OF TROPICAL RADIOLARIAN
SKELETONS FROM THE PARFLUX SEDIMENT TRAPS

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ABSTRACT

Length, width and projected area (58 species) and weight (53 species) of radiolarian skeletons, mainly from the Panama Basin PARFLUX sediment trap ($5^{\circ}21.8'N$, $82^{\circ}01.4'W$) samples, were measured. Volume and density contrast were computed. The measured mean weight values for the examined species range from $0.05 \mu\text{g/shell}$ to $24 \mu\text{g/shell}$. The weight is best correlated with projected area among the studied size dimensions of Radiolaria as a whole group. The density contrast of the radiolarian skeletons, relative to seawater, generally falls between 0.01 and 0.5 g/cm^3 and appear to be constant with an order of magnitude increase of the shell diameter.

The sinking speeds of specimens of 55 radiolarian species measured in 3, 10 and $20^{\circ}C$ seawater range from 13 to 416 m/day. Despite the wide variety of morphology between the species, the sinking speed is best correlated with weight/shell with reasonably small deviations from a regression line. Using the sinking speeds residence times of the 55 species in the 5 Km pelagic water column range from 2 weeks to 14 months.

INTRODUCTION

Radiolaria are one of the major groups of marine planktonic protozoans belonging to the class Actinopoda and characterized by a geometrically complex skeleton composed of amorphous silica. Their ubiquitous and copious distribution in the world oceans results in their being one of the major skeletal components in pelagic sediments. Until recently, sedimentation processes and rates of production of Radiolaria had been poorly documented (e.g., LISITZIN, 1972; RENZ, 1976), primarily because of the lack of reliable data concerning vertical flux (TAKAHASHI and HONJO, 1981) and sinking speed (TAKAHASHI, 1981).

Sinking speed is a function of size and density according to Stokes Law. Size dimensions of radiolarian species can be readily measured using a microscope. These dimensions can be correlated with weight and sinking speed. Therefore, length, width and projected area, for 58 taxa were measured. Prior data for radiolarian size dimensions have been available only for specimens recovered from the sediments (e.g., NIGRINI and MOORE, 1979), perhaps due to scarcity of radiolarian plankton studies. Similar available weight data came mainly from shells in sediments; moreover, they are not species level information but are from "Radiolaria" as a group (MOORE, 1969; LISITZIN, 1972; TAKAHASHI and HONJO, 1981).

Measurements on sinking speed of radiolarian skeletons from the water column are an important parameter in estimating the time an individual spends during descent to the bottom. Notably, dissolution of biogenic opal is partly a function of the exposure time in seawater. Based on PARFLUX sediment trap experiments in the tropical Atlantic and Pacific, TAKAHASHI and HONJO (1981) and TAKAHASHI (1981) demonstrated that the majority of radiolarian skeletons settle as individually within the bathypelagic zone, as do most planktonic Foraminifera, an ecologically closely related protozoans with Radiolaria (HONJO, 1978; BISHOP, COLLIER, KETTENS AND EDMOND, 1980). This contrasts strongly with smaller particles that tend to settle with fecal pellets or other biogenically produced aggregates.

It is not hard to anticipate that individual radiolarian species behave differently because of diversified morphology and size. Thus, the sinking speeds need to be measured individually, preferably at species level.

To understand sedimentation processes of Radiolaria, a prerequisite is to obtain samples which have not been subjected to significant dissolution. This is certainly an important point since biocoenosis, the living assemblage in the water column, is completely different in composition and abundance from its corresponding thanatocoenosis, a death assemblage in the underlying sediments (RENZ, 1976; TAKAHASHI, 1981).

I hereby report measurements of radiolarian size, weight and laboratory sinking speeds (Tables 2, 3) conducted on skeletons recovered from PARFLUX sediment trap experiments in the Atlantic and Pacific (HONJO, 1978, 1980). Results of the measurements are discussed in detail elsewhere (TAKAHASHI and HONJO, in review).

METHODS

Source of samples

The samples used in this study were collected from sediment traps placed at three PARFLUX stations in the tropical Atlantic and Pacific (HONJO, 1980; HONJO et al., 1980)(Table 1). Most of radiolarian specimens that were used for size, weight and laboratory sinking speed analyses in this report were hand picked from the Panama Basin samples (Table 3).

Most specimens that were recovered appeared to be clean, with essentially no microscopically observed organic matter. Effect of dissolution in the water column as well as in the receiving cup was discussed by TAKAHASHI (1981). Based on an extensive morphological study using transmission electron microscopy (TEM) we consider that the dissolution effect on polycystine Radiolaria was negligible for the measured values reported in this paper. Phaeodarian Radiolaria from the traps were more dissolved, resulting porous skeletons which cause slower sinking speeds than specimens sampled by plankton nets in the surface layers. For the sake of deep sea sedimentation process studies, however, these sediment trap specimens are closer to reality than other types of samples presently available.

Method of analysis

The samples were wet-sieved through a 1 mm mesh screen upon arrival in the laboratory and split into four aliquots by an Erez-Honjo precision rotary liquid splitter (HONJO, 1978). An aliquot of material finer than 1 mm was further split into 1/64 or 1/256 of the original sample. The resulting aliquot was wet-sieved and desalted through 250, 125 and 63 μm screens on to purple grid 47 mm HA Millipore[®] filters with 0.45 μm pore size. After washing and drying, specimens of radiolarians were handpicked under a dissecting microscope. The specimens were then sorted and placed in holders according to species. Although care was taken not to discriminate size, it was perhaps inevitable to have picked specimens of greater size within a given species due to limited resolution using the dissecting microscope. Very small-sized taxa (e.g., less than 60 μm) were not studied.

Reflected light micrographs of each taxa were taken at x20 and x40 magnification. The micrographs were converted to positive slides and projected onto an image digitizer (LW International) for measurements of length, width and maximum projected area. These dimension data were processed by a computer using the SPSS Program to compute statistics and other variables.

After photography, specimens were dried in high vacuum at 150°C for 2 days, cooled in a desiccator for 10 minutes and weighed on a Cahn 25 Automatic Electrobalance[®] at room humidity less than 40 %. The minimum number of specimens needed to get a total weight which could be accurately weighed varied depending on weight/shell of species (Table 3).

Trapped air within the shell structure was eliminated by placing dry specimens in plastic vials with 1 cm diameter and 2.5 cm height. Methanol was added and the specimens were kept in a low vacuum overnight. At several-hour intervals about 20% of the methanol was replaced with an equivalent volume of filtered water using a micropipet. After ten times of this procedure, the filtered water had replaced the methanol. Seawater collected from the Sargasso Sea was then used for replacement of the filtered water using the same procedure. By the end of this process generally 80% or more of the specimens were retained in the vial; the rest were lost.

The system for the sinking speed experiment is illustrated (Fig. 1). The experiment was conducted in a dark room with the illumination device and a sheet of black background paper in order to enhance visibility with Tindal effect. The sinking column system was designed to become a lens so that a sinking specimen could be readily located without using a microscope. Since plexiglass has poor thermal conductivity, the outer plastic surface did not exhibit water condensation at 3°C during normal laboratory temperature and humidity conditions. Temperature of the inner seawater column equilibrated with the circulating water in the outer column within an hour. The seawater column was examined for stability by using a dye; no convection was observed after the temperature equilibrium.

Sinking speed measurements were conducted in the laboratory using the Sargasso Sea water (salinity 36.1⁰/oo) at 3°C for 55 taxa, at 10°C for 13 taxa and 20°C for 10 taxa (5 taxa each in Salinity 36.1⁰/oo and 30.5⁰oo) (see Table 1). The results at 3°C are the most relevant. This temperature characterizes much of the bathypelagic layer of the world oceans. A pretreated wet specimen, retained in a water drop, was individually picked using a brush, then placed just below the surface of the still seawater column in order to avoid surface tension. The temperature of the specimen generally equilibrated with the surrounding water within a few seconds according to heat flux calculations. The specimen usually reached a steady settling rate well above the starting-line of the sinking time measurement, 51 mm below the surface; the finish-line was located 23 mm from the bottom. The measured sinking time for the 83 mm interval was converted to m/day. With the method used here specimens greater than approximately 200 μ m (e.g., Anthocyrtidium ophirens) were readily recognized and traceable in the experimental column without using a microscope. Those approximately 100 μ m (e.g., C. profunda) or smaller in size required an effort for positive identification with a magnifying lens before they reached the starting-line. Generally the particles sank through the center of the column. Occasionally their pathways veered from the centerline; where the particles slowed due to side wall drag; the data were discarded and not included in this report.

Figure 1. A. Illustration of a system for the sinking speed experiment. B. An enlarged view of the sinking column. The system consists of: (a) a narrow-neck graduated cylinder for the sinking column, 2.5 cm diameter, 16 cm high, Pyrex; (b) a temperature bath cylinder, 87 mm outer diameter with 6 mm-thick plexiglass (plastic), 18 cm high, closed by a lid with an O-ring and connected to a thermostat with plastic hoses; (c) a thermostat which controls the temperature up to $\pm 0.5^{\circ}\text{C}$; (d) a mobile illumination device of fiberglass optics; (e) thermal filters; and (f) a dissecting microscope.

Taxonomic grouping by suborders gives a convenient division for morphological and dimensionally different groups of Radiolaria. These suborders are Spumellaria, Nassellaria and Phaeodaria. The parameters discussed above were measured for species belong to these three suborders.

Method of computations

Computed projected area (CPA) and bulk volume (V_b)(μm^3), which includes a void space between skeletal material, were computed using length and/or width, and thickness where applicable, by formulae presented for individual species (Appendix Table 1). The proportion of skeleton in bulk volume (P_{skel}) and volume of skeleton (V_{skel})(μm^3) were computed as:

$$P_{\text{skel}} = \frac{WT \cdot 10^{-6}}{V_b \cdot 10^{-12} \cdot 2.0} \quad (1)$$

$$V_{\text{skel}} = P_{\text{skel}} \cdot V_b = \frac{WT}{2.0 \cdot 10^{-6}} \quad (2)$$

where WT (μg) is weight/shell and 2.0 (g/cm^3) is the assumed density of biogenic opal.

Bulk density (ρ_b) was computed as:

$$\rho_b = \frac{WT \cdot 10^{-6} + \rho_{\text{water}}(\text{temp}) \cdot (V_b - V_{\text{skel}}) \cdot 10^{-12}}{V_b \cdot 10^{-12}} \quad (3)$$

where $\rho_{\text{water}}(\text{temp})$ is the density of seawater at a given temperature. The $\rho_{\text{water}}(\text{temp})$ at 3°C and 10°C for salinity of 36 ‰ are 1.02870 and 1.02775 g/cm^3 respectively.

Bulk density contrast ($\Delta\rho(\text{temp})$) was computed as:

$$\Delta\rho(\text{temp}) = \rho_b - \rho_{\text{water}}(\text{temp}) \quad (4)$$

In order to determine whether a Stokes Law is applicable to the settling scheme of radiolarian skeletons, Re , Reynold's number of the sinking particle, was determined:

$$\text{Re} = \frac{\rho \cdot W_{\text{obs}} \cdot D}{\mu} \quad (5)$$

where ρ and μ are the water density and dynamic viscosity, W_{obs} is the sinking speed of a particle, and D is the average diameter (average of length and width where available) of the particle. Most of the Reynolds numbers are less than 0.5 (Table 3); thus, the following Stokes equation is applicable (e.g., RAUDKIVI, 1976) to the sinking speed of radiolarian skeletons:

$$W_{\text{theor}} = \frac{1}{18} \cdot \frac{1}{\mu} \cdot \Delta\rho \cdot g \cdot D^2 \quad (6)$$

where W_{theor} is the Stokes settling rate, $\Delta\rho$ is the bulk density contrast between the water and the sinking particle, g is the acceleration of gravity (981 cm/sec^2), and D is the nominal diameter of the particle. A correlation between Stokes law and the measured sinking speed, residual factor α ($W_{\text{obs}}/W_{\text{theor}}$ ratio), are plotted against average diameter.

Pertinent logarithmic or semi-logarithmic relationships between variables are listed (Table 4).

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Table 1. Stations and depths of PARFLUX sediment traps from which specimens used in this report were recovered.

I.D.#	Station	Latitude	Longitude	Duration	
				Month/year	days
1	PB	5°21'N,	81°53'W	8/79-12/79	112
2	P ₁	15°21.1'N,	151°28.5'W	7/78-11-78	61
3	E	13°30.2'N,	54°00.1'W	11/77-2/78	98
Depth					
1	3769/3791 m (PB)				
2	4280/5582 m (P ₁)				
3	978 m (P ₁)				
4	4280 m (P ₁)				
6	All depths				
7	389 m (E)				

Table 2. Dimensions and laboratory sinking speeds of Radiolaria from PARFLUX sediment traps.

Species	Station I.D.#	Depth I.D.#	Length (μm)	Width (μm)	Maximum Projected Area (μm ²)	Sinking Time for 83 mm (Sec)	Temperature for sinking water column (°C)	Weight/shell (μg)	Analytical uncertainty (μg)	Number of specimens used (shells)	Miscellaneous measurements (see foot notes on last page of Table)	Salinity (°/oo)
Sp	St	z	L	W	PA	Sink t	T	WT	±	n	Misc	S
			(μm)	(μm)	(μm ²)	(sec)	(°C)	(μg/shell)				(°/oo)

Sp	St	z	L	W	PA	Sink t	T	WT	$\pm$	n	Misc	S
			(μm)	(μm)	(μm^2)	(sec)	($^{\circ}\text{C}$)	($\mu\text{g}/\text{shell}$)				($^{\circ}/\dots$)
01	1	1			<u>Acrosphaera</u>	<u>murrayana</u>	(Haeckel)	.46	.01	207.		
01	1	1	196									
01	1	1	166									
01	1	1	182									
01	1	1	198									
01	1	1	219									
01	1	1	193									
01	1	1	176									
01	1	1	197									
01	1	1	188									
01	1	1	152									
01	1	1	183									
01	1	1	205									
01	1	1	174									
01	1	1	157									
01	1	1	170									
01	1	1	161									
01	1	1	179									
01	1	1	193									
01	1	1	165									
01	1	1	161									
01	1	1	152									
01	1	1	182									
01	1	1	184									
01	1	1	171									
01	1	1	175									
01	1	1	165									
01	1	1	173									
01	1	1	165									
01	1	1	170									
01	1	1	146									
01	1	1	165									
01	1	1	161									
01	1	1	193									
01	1	1	191									
01	1	1	174									
01	1	1	197									
01	1	1	179									
01	1	1	178									
01	1	1	174									
01	1	1	178									
01	1	1	172									
01	1	1	165									
01	1	1	196									
01	1	1	187									
01	1	1	178									
01	1	1	196									
01	1	1	164									
01	1	1	180									
01	1	1	152									
01	1	1	153									
01	1	1	169									
01	1	1	147									
01	1	1	180									
01	1	1	177									
01	1	1	180									
01	1	1	218									
01	1	1	173									

Sp	St	z	L	W	PA	Sink t	T	WT	<u>+</u>	n	Misc	S
			(μm)	(μm)	(μm^2)	(sec)	($^{\circ}\text{C}$)	($\mu\text{g}/\text{shell}$)				(%/..)
01	1	1	191									
01	1	1	175									
01	1	1	174									
01	1	1	196									
01	1	1	166									
01	1	1	178									
01	1	1	156									
01	1	1	174									
01	1	1	167									
01	1	1	178									
01	1	1	163									
01	1	1	180									
01	1	1	152									
01	1	1	181									
01	1	1	168									
01	1	1	164									
01	1	1	212									
01	1	1	163									
01	1	1	160									
01	1	1	174									
01	1	1	166									
01	1	1	168									
01	1	1	188									
01	1	1	176									
01	1	1	173									
01	1	1	177									
01	1	1	190									
01	1	1	188									
01	1	1	174									
01	1	1	164									
01	1	1	116									
01	1	1	176									
01	1	1	168									
01	1	1	172									
01	1	1	189									
01	1	1	139									
01	1	1	172									
01	1	1	121									
01	1	1	170									
01	1	1	179									
01	1	1	165									
01	1	1	148									
01	1	1	152									
01	1	1	174									
01	1	1	181									
01	1	1	197									
01	1	1	183									
01	1	1	135									
01	1	1	185									
01	1	1	183									
01	1	1	190									
01	1	1	205									
01	1	1	164									
01	1	1	181									
01	1	1	185									
01	1	1	182									
01	1	1	186									
01	1	1	201									
01	1	1	185									
01	1	1	214									

Sp	St	z	L (μm)	W (μm)	PA (μm^2)	Sink t (sec)	T ($^{\circ}\text{C}$)	WT ($\mu\text{g/shell}$)	$\pm$	n	Misc	S ($^{\circ}/\dots$)
01	1	1	197									
01	1	1	156									
01	1	1	152									
01	1	1	183									
01	1	1	206									
01	1	1	171									
01	1	1	208									
01	1	1	203									
01	1	1	190									
01	1	1				80.4	3.					36.1
01	1	1				124.8	3.					36.1
01	1	1				103.6	3.					36.1
01	1	1				126.8	3.					36.1
01	1	1				115.6	3.					36.1
01	1	1				110.4	3.					36.1
01	1	1				116.8	3.					36.1
01	1	1				158.2	3.					36.1
01	1	1				122.8	3.					36.1
01	1	1				132.6	3.					36.1
01	1	1				114.6	3.					36.1
01	1	1				100.2	3.					36.1
01	1	1				89.6	3.					36.1
01	1	1				110.4	3.					36.1
01	1	1				36.0	10.					36.1
01	1	1				38.3	10.					36.1
01	1	1				40.3	10.					36.1
01	1	1				40.7	10.					36.1
01	1	1				46.0	10.					36.1
01	1	1				81.6	10.					36.1
01	1	1				69.0	10.					36.1
01	1	1				81.3	10.					36.1
01	1	1				70.6	10.					36.1
01	1	1				130.0	10.					36.1
01	1	1				64.8	10.					36.1
02	3	6				<u>Actinomma acadophorum</u> Haeckel			.87	.02	133.	
02	3	6							.95	.01	140.	
02	1	1	245									
02	1	1	243									
02	1	1	285									
02	1	1	276									
02	1	1	281									
02	1	1	291									
02	1	1	230									
02	1	1	300									
02	1	1				67.9	3.					36.1
02	1	1				157.6	3.					36.1
02	1	1				67.0	3.					36.1
02	1	1				87.4	3.					36.1
02	1	1				73.4	3.					36.1
02	1	1				121.5	3.					36.1
02	1	1				122.8	3.					36.1
02	1	1				91.6	3.					36.1
02	1	1				116.8	3.					36.1
02	1	1				142.0	3.					36.1
02	1	1				139.4	3.					36.1
02	1	1				110.2	3.					36.1
02	3	7				81.7	10.					36.1
02	3	7				91.0	10.					36.1
02	3	7				78.9	10.					36.1
02	3	7				96.0	10.					36.1

Sp	St	z	L (μm)	W (μm)	PA (μm^2)	Sink t (sec)	T ($^{\circ}\text{C}$)	WT ($\mu\text{g/shell}$)	$\pm$	n	Misc	S ($^{\circ}/\cdot\cdot$)
02	3	7				67.4	10.					36.1
02	3	7				72.3	10.					36.1
02	3	7				65.8	10.					36.1
02	3	7				82.0	10.					36.1
02	3	7				80.0	10.					36.1
02	3	7				105.6	20.					36.1
03	1	1			<u>Amphirhopalum ypsilon</u>	Haeckel	.57	.06		7.		
03	1	1	261	133								
03	1	1	292	183	45307.							
03	1	1	353	207	58976.							
03	1	1	363	222	65765.							
03	1	1	280	146	33154.							
03	1	1	281	175	41813.							
03	1	1				133.0	3.					36.1
03	1	1				95.2	3.					36.1
03	1	1				160.0	3.					36.1
03	1	1				66.0	3.					36.1
03	1	1				123.4	3.					36.1
04	1	1			<u>Dictycoryne truncatum</u>	(Ehrenberg)		1.79	.07	27.		
04	1	1						1.91	.29	7.		
04	1	1						2.31	.33	6.		
04	1	1	395									
04	1	1	346									
04	1	1	280									
04	1	1	300									
04	1	1	261									
04	1	1	322									
04	1	1	336									
04	1	1	288									
04	1	1	290									
04	1	1	344									
04	1	1	341									
04	1	1	250									
04	1	1	253									
04	1	1									131.*4	
04	1	1				33.6	3.					36.1
04	1	1				42.3	3.					36.1
04	1	1				42.4	3.					36.1
04	1	1				45.2	3.					36.1
04	1	1				36.2	3.					36.1
04	1	1				35.2	3.					36.1
04	1	1				39.8	3.					36.1
04	1	1				40.0	3.					36.1
04	1	1				59.4	3.					36.1
04	1	1				48.7	3.					36.1
04	1	1				31.7	3.					36.1
04	1	1				44.3	3.					36.1
05	1	1			<u>Euchitonia elegans</u>	(Ehrenberg)		.69	.02	93.		
05	2	2						.46	.03	67.		
05	3	6						.56	.02	66.		
05	1	1									40.*5	
05	1	1	381	248	54916.							
05	1	1	318	242	48565.							
05	1	1	450	327	69202.							
05	1	1	351	199	45555.							
05	1	1	437	356	96095.							
05	1	1	417	358	81025.							
05	1	1	396	237	68561.							
05	1	1	321	203	41688.							
05	1	1	427	355	81919.							

Sp	St	z	L	W	PA	Sink t	T	WT	n	Misc	S
			(μm)	(μm)	(μm^2)	(sec)	($^{\circ}\text{C}$)	($\mu\text{g}/\text{shell}$)			($^{\circ}/\bullet\bullet$)
05	1	1	372	279	62387.						
05	1	1	378		57817.						
05	1	1	401	261	79043.						
05	1	1	357	221	44474.						
05	1	1	371	237	51735.						
05	1	1	370	213	52951.						
05	1	1	369	291	61081.						
05	1	1	425	332	83617.						
05	1	1	350	252	56628.						
05	1	1	372	300	73382.						
05	1	1		291							
05	1	1		346							
05	1	1	369	390	77274.						
05	1	1	332	315	62411.						
05	1	1	430	330	69309.						
05	1	1	279	312	51534.						
05	1	1	373	362	81863.						
05	1	1	382	326	78429.						
05	1	1	365	281	66668.						
05	1	1	412	332	91082.						
05	1	1	416	342	65191.						
05	1	1	304	247	49954.						
05	1	1	322	225							
05	1	1	303	249							
05	1	1	311	216							
05	1	1	387	214							
05	1	1	321	200							
05	1	1	417	248							
05	1	1	404	300							
05	1	1	344	211							
05	1	1	362	216							
05	1	1	313	206							
05	1	1	444	340							
05	1	1	333	257							
05	1	1	320								
05	1	1	365	239							
05	1	1				106.6	3.				36.1
05	1	1				132.2	3.				36.1
05	1	1				135.0	3.				36.1
05	1	1				175.6	3.				36.1
05	1	1				126.8	3.				36.1
05	1	1				173.6	3.				36.1
05	1	1				102.3	3.				36.1
05	1	1				84.8	3.				36.1
05	1	1				133.0	3.				36.1
05	1	1				151.5	3.				36.1
05	1	1				93.9	3.				36.1
05	1	1				170.0	3.				36.1
05	1	1				188.6	3.				36.1
05	1	1				155.8	3.				36.1
05	1	1				136.6	3.				36.1
05	1	1				79.7	3.				36.1
05	1	1				93.1	3.				36.1
05	1	1				109.0	3.				36.1
05	1	1				81.4	3.				36.1
05	1	1				83.5	3.				36.1
05	1	1				67.9	3.				36.1
05	1	1				72.4	3.				36.1
05	1	1				59.8	3.				36.1
05	1	1				85.5	3.				36.1

Heliodiscus asteriscus	Haeckel	.36	.04	11.
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Sp	St	z	L (μm)	W (μm)	PA (μm^2)	Sink t (sec)	T ($^{\circ}\text{C}$)	WT ($\mu\text{g}/\text{shell}$)	$\pm$	n	Misc	S ($^{\circ}/\bullet\bullet$)
06	1	1	191									
06	1	1				75.3	3.					36.1
06	1	1				87.7	3.					36.1
06	1	1				104.8	3.					36.1
06	1	1				215.0	3.					36.1
06	1	1				170.0	3.					36.1
06	1	1				135.0	3.					36.1
06	1	1				72.2	3.					36.1
06	1	1				150.0	3.					36.1
07	1	1	<u>Dictyocoryne profunda</u>			Ehrenberg	>350	μm	1.64	.05	42.	
07	1	1							1.69	.13	15.	
07	1	1							1.75	.13	15.	
07	1	1	419									
07	1	1	420									
07	1	1	374									
07	1	1	407									
07	1	1	437									
07	1	1	453									
07	1	1	400									
07	1	1	407									
07	1	1	400									
07	1	1	440									
07	1	1	420									
07	1	1	456									
07	1	1	508									
07	1	1	395									
07	1	1				40.8	3.					36.1
07	1	1				54.1	3.					36.1
07	1	1				62.6	3.					36.1
07	1	1				63.7	3.					36.1
07	1	1				34.0	3.					36.1
07	1	1				28.7	3.					36.1
07	1	1				60.0	3.					36.1
07	1	1				41.3	3.					36.1
07	1	1				31.5	3.					36.1
07	1	1				40.8	3.					36.1
07	1	1				43.5	3.					36.1
07	1	1				44.1	3.					36.1
07	1	1				52.8	3.					36.1
07	1	1				51.8	3.					36.1
07	1	1				37.3	10.					36.1
07	1	1				36.4	10.					36.1
07	1	1				31.0	10.					36.1
07	1	1				37.6	10.					36.1
07	1	1				44.3	10.					36.1
07	1	1				40.2	10.					36.1
07	1	1				47.3	10.					36.1
07	1	1				37.5	10.					36.1
07	1	1				35.4	10.					36.1
07	1	1				51.7	10.					36.1
07	1	1				34.7	10.					36.1
07	1	1				40.1	10.					36.1
07	1	1				42.6	10.					36.1
07	1	1				24.8	20.					36.1
07	1	1				37.0	20.					36.1
07	1	1				41.0	20.					36.1
07	1	1				29.7	20.					36.1
07	1	1				34.0	20.					36.1
07	1	1				33.3	20.					36.1
07	1	1				34.5	20.					36.1

[illegible]

Sp	St	z	L (μm)	W (μm)	PA (μm^2)	Sink t (sec)	T ($^{\circ}\text{C}$)	WT ($\mu\text{g/shell}$)	+	n	Misc	S ($^{\circ}/\bullet\bullet$)
08	1	1	317									
08	1	1	281									
08	1	1				61.3	3.					36.1
08	1	1				67.0	3.					36.1
08	1	1				71.3	3.					36.1
08	1	1				89.4	3.					36.1
08	1	1				78.7	3.					36.1
08	1	1				105.0	3.					36.1
08	1	1				55.5	3.					36.1
08	1	1				95.7	3.					36.1
08	1	1				62.7	3.					36.1
08	1	1				57.3	3.					36.1
08	1	1				47.7	10.					36.1
08	1	1				69.7	10.					36.1
08	1	1				61.7	10.					36.1
08	1	1				58.3	10.					36.1
08	1	1				81.8	10.					36.1
08	1	1				63.0	10.					36.1
08	1	1				68.5	10.					36.1
08	1	1				57.8	10.					36.1
08	1	1				67.0	10.					36.1
08	1	1				62.7	10.					36.1
09	1	1			<u>Myelastrium quadrifolium</u>	Takahashi		2.32	.16	13.		
09	1	1	745	845	547683.							
09	1	1	650	758	410025.							
09	1	1	674	692	415634.							
09	1	1	752	734	415876.							
09	1	1	663	774	370376.							
09	1	1	663	780	405212.							
09	1	1	711	748	485928.							
09	1	1	691	726	375801.							
09	1	1	805	838	573224.							
09	1	1	744	785	437037.							
09	1	1	645	679	338731.							
09	1	1	698	722	373548.							
09	1	1				138.0	3.					36.1
09	1	1				230.8	3.					36.1
09	1	1				150.0	3.					36.1
09	1	1				146.3	3.					36.1
09	1	1				162.8	3.					36.1
09	1	1				211.3	3.					36.1
09	1	1				130.4	3.					36.1
09	1	1				333.7	3.					36.1
09	1	1				321.0	3.					36.1
09	1	1				152.0	3.					36.1
09	1	1				193.1	3.					36.1
10	1	1			<u>Myelastrium trinibrachium</u>	Takahashi		.75	.13	16.		
10	1	1	925		242664.							
10	1	1	973		230706.							
10	1	1	1114		293997.							
10	1	1	912		303409.							
10	1	1	938		340569.							
10	1	1	1100									
10	1	1	1224		260162.							
10	1	1			315481.							
10	1	1									609.*10	
10	1	1				280.0	3.					36.1
10	1	1				270.0	3.					36.1
10	1	1				217.4	3.					36.1
10	1	1				328.3	3.					36.1

Sp	St	z	L (μm)	W (μm)	PA (μm^2)	Sink t (sec)	T ($^{\circ}\text{C}$)	WT ($\mu\text{g/shell}$)	+	n	Misc	S ($^{\circ}/\cdot\cdot$)
10	1	1				230.0	3.					36.1
10	1	1				339.2	3.					36.1
10	1	1				229.6	3.					36.1
10	1	1				223.8	3.					36.1
11	1	1			<u>Saturnalis circularis</u>			.05	.05	4.		
11	1	1	203	217							113.*11	
11	1	1	204	237							108.*11	
11	1	1	214	281							118.*11	
11	1	1	200	246							105.*11	
11	1	1				234.2	3.					36.1
11	1	1				379.0	3.					36.1
11	1	1				294.5	3.					36.1
12	1	1			<u>Spongaster tetras tetras</u>			1.23	.15	13.		
12	1	1	233									
12	1	1	295									
12	1	1	378									
12	1	1	183									
12	1	1	221									
12	1	1	233									
12	1	1	274									
12	1	1	234									
12	1	1	222									
12	1	1	167									
12	1	1	340									
12	1	1	312									
12	1	1				39.0	3.					36.1
12	1	1				88.2	3.					36.1
12	1	1				34.0	3.					36.1
12	1	1				41.6	3.					36.1
12	1	1				77.0	3.					36.1
12	1	1				50.0	3.					36.1
12	1	1				49.4	3.					36.1
12	1	1				53.2	3.					36.1
12	1	1				79.7	3.					36.1
12	1	1				32.0	3.					36.1
12	1	1				65.9	3.					36.1
12	1	1				29.0	3.					36.1
13	1	1			<u>Spongocore cylindrica</u>			.36	.09	22.		
13	1	1	123									
13	1	1	248	95	21311.							
13	1	1	300	100	21391.							
13	1	1	207	73	10946.							
13	1	1	335	94	26636.							
13	1	1	268	76	18955.							
13	1	1	327	130	31320.							
13	1	1				171.5	3.					36.1
13	1	1				150.0	3.					36.1
13	1	1				227.0	3.					36.1
13	1	1				136.9	3.					36.1
13	1	1				105.7	3.					36.1
13	1	1				105.1	3.					36.1
13	1	1				115.8	3.					36.1
13	1	1				161.3	3.					36.1
13	1	1				137.7	3.					36.1
13	1	1				62.6	3.					36.1
13	1	1				54.4	3.					36.1
13	1	1				94.2	3.					36.1
13	1	1				76.8	3.					36.1
13	1	1				69.2	3.					36.1
13	1	1				177.2	3.					36.1

Sp	St	z	L (μm)	W (μm)	PA (μm^2)	Sink t (sec)	T ($^{\circ}\text{C}$)	WT ($\mu\text{g/shell}$)	+	n	Misc	S ($^{\circ}/\bullet\bullet$)
15	1	1	278									
15	1	1	213									
15	1	1	246									
15	1	1				62.3	3.					36.1
15	1	1				99.5	3.					36.1
15	1	1				79.1	3.					36.1
15	1	1				112.4	3.					36.1
15	1	1				67.0	3.					36.1
15	1	1				69.8	3.					36.1
15	1	1				90.3	3.					36.1
15	1	1				125.7	3.					36.1
15	1	1				68.4	3.					36.1
15	1	1				96.4	3.					36.1
15	1	1				68.5	3.					36.1
15	1	1				125.7	3.				75.2*15	36.1
16	1	1			<i>Spongosphaera polycantha</i> Müller							
16	1	1	500									
16	1	1	170									
16	1	1	360									
16	1	1	160									
16	1	1				73.6	3.					36.1
16	1	1				36.3	3.					36.1
16	1	1				123.5	3.					36.1
16	1	1				181.0	3.					36.1
16	1	1				122.0	3.					36.1
16	1	1				117.5	3.					36.1
16	1	1				235.0	3.					36.1
17	1	1			<i>Spongosphaera</i> sp. aff <i>S. helioides</i> Haeckel	.10		.20		2.		
17	1	1	875									
17	1	1	880									
17	1	1				73.6	3.					36.1
17	1	1				36.8	3.					36.1
18	1	1			<i>Cladococcus scoparius</i> Haeckel			1.00	1.00	1.		
18	1	1	150									
18	1	1	61									
18	1	1				377.6	3.					36.1
19	1	1			<i>Spongotrochus glacialis</i> Popofsky	.43		.02		86.		
19	1	1				.41		.07		30.		
19	1	1	232									
19	1	1	252									
19	1	1	304									
19	1	1	213									
19	1	1	226									
19	1	1	268									
19	1	1	192									
19	1	1	266									
19	1	1	297									
19	1	1	246									
19	1	1	204									
19	1	1	213									
19	1	1	173									
19	1	1	221									
19	1	1	262									
19	1	1	200									
19	1	1	248									
19	1	1				85.7	3.					36.1
19	1	1				104.0	3.					36.1
19	1	1				95.7	3.					36.1
19	1	1				78.8	3.					36.1
19	1	1				119.3	3.					36.1

Sp	St	z	L (μm)	W (μm)	PA (μm^2)	Sink t (sec)	T ($^{\circ}\text{C}$)	WT ($\mu\text{g/shell}$)	$\pm$	n	Misc	S ($^{\circ}/\dots$)
19	1	1				93.3	3.					36.1
19	1	1				61.1	3.					36.1
19	1	1				114.8	3.					36.1
19	1	1				138.4	3.					36.1
19	1	1				97.0	3.					36.1
19	1	1				68.5	10.					36.1
19	1	1				70.0	10.					36.1
19	1	1				69.0	10.					36.1
19	1	1				53.8	10.					36.1
19	1	1				81.3	10.					36.1
19	1	1				137.3	10.					36.1
30	1	1			<i>Acanthodesmia vinctulata</i> (Müller)			.11	.02	17.		
30	1	1	96	147								
30	1	1	114	127								
30	1	1	99	160								
30	1	1	100	112								
30	1	1		150								
30	1	1		156								
30	1	1		162								
30	1	1		153								
30	1	1		110								
30	1	1	107	143								
30	1	1	91	154								
30	1	1		179	14990.							
30	1	1	106		11610.							
30	1	1	95	139	11145.							
30	1	1	103	124	10029.							
30	1	1	122	159	22868.							
30	1	1		134								
30	1	1			13374.							
30	1	1	129	140								
30	1	1	104	153								
30	1	1	79	102								
30	1	1		132								
30	1	1		121								
30	1	1	120	144								
30	1	1	105	160								
30	1	1	122									
30	1	1	121	208								
30	1	1		171								
30	1	1	113	154								
30	1	1	106	152								
30	1	1	102	167								
30	1	1				280.0	3.					36.1
30	1	1				237.2	3.					36.1
30	1	1				289.8	3.					36.1
30	1	1				291.2	3.					36.1
30	1	1				209.4	3.					36.1
30	1	1				208.6	3.					36.1
30	1	1				178.6	3.					36.1
30	1	1				206.6	3.					36.1
30	1	1				302.0	3.					36.1
30	1	1				229.4	3.					36.1
30	1	1				191.4	3.					36.1
30	1	1				229.3	3.					36.1
31	1	1			<i>Liriospyris thorax</i> (Haeckel)			.25	.02	24.		
31	1	1	229	304	55558.							
31	1	1	204									
31	1	1	167	204	28214.							
31	1	1	148	134	17138.							

Sp	St	z	L (μm)	W (μm)	PA (μm^2)	Sink t (sec)	T ($^{\circ}\text{C}$)	WT ($\mu\text{g/shell}$)	$\pm$	n	Misc	S ($^{\circ}/\dots$)
31	1	1	234	264	48145.							
31	1	1	192	202	32348.							
31	1	1				165.3	3.					36.1
31	1	1				213.0	3.					36.1
31	1	1				224.8	3.					36.1
31	1	1				180.4	3.					36.1
31	1	1				165.6	3.					36.1
31	1	1				218.4	3.					36.1
31	1	1				307.2	3.					36.1
31	1	1				200.0	3.					36.1
31	1	1				144.6	3.					36.1
31	1	1				208.0	3.					36.1
31	1	1				183.4	3.					36.1
31	1	1				261.3	3.					36.1
31	1	1				208.4	3.					36.1
31	1	1				248.4	3.					36.1
31	1	1				248.0	3.					36.1
31	1	1				112.0	10.					36.1
31	1	1				97.2	10.					36.1
31	1	1				132.0	10.					36.1
31	1	1				126.6	10.					36.1
31	1	1				114.6	10.					36.1
31	1	1				128.0	10.					36.1
31	1	1				148.0	10.					36.1
31	1	1				124.8	10.					36.1
31	1	1				93.2	20.00					30.5
31	1	1				89.3	20.00					30.5
31	1	1				75.0	20.00					30.5
31	1	1				92.0	20.00					30.5
31	1	1				84.0	20.00					30.5
32	1	1	<u>Anthocytidium ophirens</u> (Ehrenberg)					.14	.01	77.		
32	1	1	186	132	14877.							
32	1	1	183	128	13186.							
32	1	1	184	132	13820.							
32	1	1	190	129	14385.							
32	1	1	214		16854.							
32	1	1		132								
32	1	1		136								
32	1	1	187									
32	1	1				276.0	3.					36.1
32	1	1				289.2	3.					36.1
32	1	1				252.0	3.					36.1
32	1	1				299.4	3.					36.1
32	1	1				258.0	3.					36.1
32	1	1				223.4	3.					36.1
32	1	1				378.1	3.					36.1
32	1	1				355.2	3.					36.1
32	1	1				242.4	3.					36.1
32	1	1				294.0	3.					36.1
32	1	1				190.4	3.					36.1
32	1	1				222.3	3.					36.1
32	1	1				96.8	10.					36.1
32	1	1				128.0	10.					36.1
32	1	1				121.	10.					36.1
32	1	1				129.	10.					36.1
32	1	1				146.4	10.					36.1
33	1	1	<u>Anthocytidium zaquebaricum</u> (Ehrenberg)					.08	.03	14.		
33	1	1	148	92	8737.							
33	1	1	159	81	7713.							
33	1	1	131	82	6515.							

Sp	St	z	L (μm)	W (μm)	PA (μm^2)	Sink t (sec)	T ($^{\circ}\text{C}$)	WT ($\mu\text{g/shell}$)	$\pm$	n	Misc	S ($^{\circ}/\dots$)
33	1	1	145	85	7177.							
33	1	1	166	88	9100.							
33	1	1	173	92	9635.							
33	1	1	127	80	6589.							
33	1	1	167	90	9340.							
33	1	1	169	80	8331.							
33	1	1	164	89	8995.							
33	1	1	168	82	9137.							
33	1	1				257.6	3.					36.1
33	1	1				223.6	3.					36.1
33	1	1				196.0	3.					36.1
33	1	1				464.0	3.					36.1
34	2	2			<u>Callimitra annae</u> Haeckel			.06	.03	14.		
34	3	6						.07	.07	15.		
34	2	6	277	229	51664.							
34	2	6	288	238	56602.							
34	2	6	274	220	47081.							
34	2	6	253	224	44652.							
34	2	6	334	300	70990.							
34	2	6	342	274	72482.							
34	2	6	377	310	100245.							
34	2	6	351	290	88256.							
34	2	6	327	258	65336.							
34	2	6	292	256	59894.							
34	2	6	250	217	41909.							
34	2	6	236	217								
34	2	6	305	230	53659.							
34	2	6				395.4	3.					36.1
34	2	6				924.0	3.					36.1
34	2	6				247.0	3.					36.1
34	2	6				430.6	3.					36.1
34	2	6				381.2	3.					36.1
34	2	6				581.0	3.					36.1
34	2	6				811.4	3.					36.1
35	2	6	322	342	93693.	<u>Callimitra emmae</u> Haeckel						
35	2	2				214.2	3.					36.1
35	2	2				529.6	3.					36.1
36	1	1	101	69	<u>Carpocanistrum</u> spp.							
36	1	1	131	79								
36	1	1	92	75								
36	1	1	127	85								
36	1	1	126	86								
36	1	1	97	72								
36	1	1	88	70								
37	1	1			<u>Conicavus tipiopsis</u> Takahashi			.58	.04	25.		
37	1	1	545	364	144180.							
37	1	1	540	396	157331.							
37	1	1	540	369	140629.							
37	1	1	546	365	142332.							
37	1	1		353								
37	1	1	525	364	154803.							
37	1	1	555	388	166558.							
37	1	1	689	421	192996.							
37	1	1	343	251	69951.							
37	1	1	577	392	156564.							
37	1	1	553	353	145974.							
37	1	1	529	393	150338.							
37	1	1	527	394	148935.							
37	1	1	579	377	151419.							
37	1	1	677	348	196729.							

Sp	St	z	L (μ m)	W (μ m)	PA (μ m ²)	Sink t (sec)	T (°C)	WT (μ g/shell)	±	n	Misc	S (°/°°)
37	1	1	654	435	192325.							
37	1	1		394								
37	1	1	496	327	125438.							
37	1	1	500	337	136845.							
37	1	1	622	371	151461.							
37	1	1	593	389	162980.							
37	1	1	647	432	172259.							
37	1	1	816	409	186998.							
37	1	1	591	402	158778.							
37	1	1	537	357	154529.							
37	1	1	692	373	143737.							
37	1	1		329								
37	1	1		423								
37	1	1	597	400	182323.							
37	1	1	486									
37	1	1	594	415	162561.							
37	1	1	550	370	135015.							
37	1	1	485	370	137960.							
37	1	1	400	241	82883.							
37	1	1	601	382	168352.							
37	1	1		343								
37	1	1		353								
37	1	1				169.1	3.					36.1
37	1	1				198.8	3.					36.1
37	1	1				138.3	3.					36.1
37	1	1				233.3	3.					36.1
37	1	1				203.9	3.					36.1
37	1	1				179.4	3.					36.1
37	1	1				157.6	3.					36.1
37	1	1				326.8	3.					36.1
37	1	1				189.4	3.					36.1
37	1	1				171.7	3.					36.1
37	1	1				134.2	3.					36.1
37	1	1				190.2	3.					36.1
37	1	1				268.0	3.					36.1
37	1	1				183.7	3.					36.1
38	1	1			<u>Cephalospyris cancellata</u> Haeckel			.11	.02	19.		
38	1	1	262	160	32405.							
38	1	1	202	134	23250.							
38	1	1	196	184	29539.							
38	1	1	357	301	81732.							
38	1	1	345	167	48465.							
38	1	1	334	191	49879.							
38	1	1	321	257	70002.							
38	1	1	343	241	64244.							
38	1	1	299	193	48986.							
38	1	1	344	232	59467.							
38	1	1	309	206	45952.							
38	1	1				220.0	3.					36.1
38	1	1				448.6	3.					36.1
38	1	1				300.0	3.					36.1
38	1	1				480.0	3.					36.1
38	1	1				1094.4	3.					36.1
38	1	1				800.0	3.					36.1
38	1	1				1236.0	3.					36.1
38	1	1				504.8	3.					36.1
38	1	1				544.0	3.					36.1
39	1	1			<u>Cornutella profunda</u> Ehrenberg			.08	.01	29.		
39	1	1	154	61	6721.							
39	1	1	149	62	5758.							

Sp	St	z	L (μ m)	W (μ m)	PA (μ m ²)	Sink t (sec)	T (°C)	WT (μ g/shell)	+	n	Misc	S (°/°°)
39	1	1	171	52	6168.							
39	1	1	199	74	9886.							
39	1	1	158	60	5791.							
39	1	1	145	66	7035.							
39	1	1	156	78	7150.							
39	1	1				456.0	3.					36.1
39	1	1				132.6	3.					36.1
39	1	1				480.0	3.					36.1
39	1	1				299.2	3.					36.1
39	1	1				390.0	3.					36.1
39	1	1				200.0	3.					36.1
39	1	1				361.2	3.					36.1
39	1	1				385.6	3.					36.1
39	1	1				476.0	3.					36.1
39	1	1				192.6	3.					36.1
39	1	1				337.2	3.					36.1
39	1	1				267.0	3.					36.1
39	1	1				517.6	3.					36.1
39	1	1				784.0	3.					36.1
39	1	1				685.2	3.					36.1
39	1	1				812.4	3.					36.1
39	1	1				92.2	20.00					30.5
39	1	1				100.4	20.00					30.5
39	1	1				99.2	20.00					30.5
39	1	1				159.3	20.00					30.5
39	1	1				90.0	20.00					30.5
39	1	1				110.2	20.00					30.5
39	1	1				96.7	20.00					30.5
39	1	1				118.3	20.00					30.5
39	1	1				82.2	20.00					30.5
39	1	1				130.0	20.00					30.5
39	1	1				120.3	20.00					30.5
40	1	1	<u>Eucyrtidium acuminatum</u> (Ebg)+ <u>hexagonatum</u> Hkl.29					.02		41.		
40	1	1	201	77	13493.							
40	1	1	193	86	13360.							
40	1	1	257	125	23614.							
40	1	1	300	111	27752.							
40	1	1	315	117	26930.							
40	1	1	201	91	13779.							
40	1	1	164	84	10445.							
40	1	1	198	95	13170.							
40	1	1	276	95	21859.							
40	1	1	238	95	16501.							
40	1	1	308	124	26974.							
40	1	1	272	116	23624.							
40	1	1	267	120	23129.							
40	1	1	248	100	19575.							
40	1	1	247	97	19753.							
40	1	1	325	119	32379.							
40	1	1	192	102	15178.							
40	1	1	249	114	21865.							
40	1	1	274	118	26377.							
40	1	1	232	114	21331.							
40	1	1	278	107	23737.							
40	1	1	242	106	20861.							
40	1	1	270	105	23317.							
40	1	1	205	90	14787.							
40	1	1				98.6	3.					36.1
40	1	1				112.1	3.					36.1
40	1	1				87.7	3.					36.1

Sp	St	z	L (μm)	W (μm)	PA (μm^2)	Sink t (sec)	T ($^{\circ}\text{C}$)	WT ($\mu\text{g/shell}$)	+	n	Misc	S ($^{\circ}/\bullet\bullet$)
40	1	1				100.5	3.					36.1
40	1	1				118.0	3.					36.1
40	1	1				118.1	3.					36.1
40	1	1				132.0	3.					36.1
40	1	1				88.0	3.					36.1
40	1	1				184.0	3.					36.1
40	1	1				147.5	3.					36.1
40	1	1				115.1	3.					36.1
40	1	1				161.5	3.					36.1
40	1	1				140.0	3.					36.1
41	1	1	<u>Lamprocyclus maritális maritális</u>			Haeckel	.49	.04		23.		
41	1	1	239	148	18205.							
41	1	1	206	142								
41	1	1	201	135								
41	1	1	215	135								
41	1	1	267	153	24658.							
41	1	1	219	132	17734.							
41	1	1	225	149	17705.							
41	1	1	232	154	20274.							
41	1	1	232	140	14995.							
41	1	1	235	144	18270.							
41	1	1	236	133	16977.							
41	1	1	252	138	17888.							
41	1	1	221	150								
41	1	1	280	166	24590.							
41	1	1	259	171	25708.							
41	1	1	214	136	17490.							
41	1	1	230	134	17588.							
41	1	1	206	136								
41	1	1	207	136								
41	1	1	209	134	15112.							
41	1	1	204	132	15329.							
41	1	1	214	132	16690.							
41	1	1	257	167	24200.							
41	1	1		162								
41	1	1				71.3	3.					36.1
41	1	1				75.2	3.					36.1
41	1	1				69.8	3.					36.1
41	1	1				118.0	3.					36.1
41	1	1				42.3	3.					36.1
41	1	1				66.4	3.					36.1
41	1	1				70.0	3.					36.1
41	1	1				68.0	3.					36.1
41	1	1				65.0	3.					36.1
41	1	1				132.4	3.					36.1
41	1	1				74.3	3.					36.1
41	1	1				46.0	3.					36.1
41	1	1				53.2	20.					36.1
42	1	1	<u>Lithostrobis hexagonalis</u>			Haeckel		.14	.03	14.		
42	1	1	218	146	26170.							
42	1	1	228	165	28813.							
42	1	1		134								
42	1	1	209	162	26233.							
42	1	1		129								
42	1	1	166	127	17961.							
42	1	1	154	125	14975.							
42	1	1		141								
42	1	1	176	121	16583.							
42	1	1	239	175	31744.							
42	1	1		147								

Sp	St	z	L (μm)	W (μm)	PA (μm^2)	Sink t (sec)	T ($^{\circ}\text{C}$)	WT ($\mu\text{g}/\text{shell}$)	$\pm$	n	Misc	S ($^{\circ}/\bullet\bullet$)
42	1	1	171	134	18363.							
42	1	1	160	122	16980.							
42	1	1				161.0	3.					36.1
42	1	1				60.8	3.					36.1
42	1	1				135.6	3.					36.1
42	1	1				201.7	3.					36.1
42	1	1				182.2	3.					36.1
42	1	1				218.9	3.					36.1
42	1	1				257.0	3.					36.1
42	1	1				215.0	3.					36.1
42	1	1				233.6	3.					36.1
42	1	1				408.4	3.					36.1
43	1	1	<u>Lophospyris pentagona pentagona</u> (Ehrenberg).					10	.04	9.		
43	1	1	151	181								
43	1	1	100	120								
43	1	1	104	137								
43	1	1	115	147								
43	1	1	114	138								
43	1	1	130	151								
43	1	1	108	135								
44	1	1			<u>Nephrosyris renilla</u> Haeckel	1.00	.17	6.				
44	1	1	398	514	170394.							
44	1	1	529	613	261921.							
44	1	1	338	420	110015.							
44	1	1	475	555	195931.							
44	1	1	348	400	113235.							
44	1	1	398	486								
44	1	1	363	484	144434.							
44	1	1	367									
44	1	1	501	584	245257.							
44	1	1		529								
44	1	1				102.2	3.					36.1
44	1	1				112.0	3.					36.1
44	1	1				93.3	3.					36.1
44	1	1				70.0	3.					36.1
44	1	1				215.7	3.					36.1
44	1	1				232.0	3.					36.1
45	1	1			<u>Androsyris reticulidisca</u> Takahashi	.78	.11	9.				
45	1	1				.64	.11	9.				
45	1	1	296	351	101032.							
45	1	1	331	338	99732.							
45	1	1	340	343	105799.							
45	1	1	304	330	95951.							
45	1	1	284	323	90619.							
45	1	1	317	340	96632.							
45	1	1	313	326	96013.							
45	1	1	347	367	116603.							
45	1	1	330		82500.							
45	1	1	397	283	74108.							
45	1	1	392	334	88013.							
45	1	1	420	336	102398.							
45	1	1	402	344	97694.							
45	1	1		360.								
45	1	1	396	303	87491.							
45	1	1	416	360	115239.							
45	1	1	412	334	95940.							
45	1	1	394	336	100170.							
45	1	1	401	336	94641.							
45	1	1	404	342	97953.							
45	1	1	373	331	89170.							

Sp	St	z	L (μ m)	W (μ m)	PA (μ m ²)	Sink t (sec)	T (°C)	WT (μ g/shell)	+	n	Misc	S (°/°)
45	1	1				119.3	3.					36.1
45	1	1				152.6	3.					36.1
45	1	1				74.6	3.					36.1
45	1	1				85.6	3.					36.1
45	1	1				153.8	3.					36.1
45	1	1				67.2	3.					36.1
45	1	1				139.1	3.					36.1
45	1	1				88.6	3.					36.1
45	1	1				126.4	3.					36.1
46	1	1	<u>Pterocorys zancleus</u> (Mlr) + <u>campanula</u>			Hk1.06		.03		40.		
46	1	1	155	88								
46	1	1	169	102								
46	1	1	175	101								
46	1	1	141	92								
46	1	1	162	93								
46	1	1	213	100								
46	1	1	205	103								
46	1	1	173	91								
46	1	1	161	95								
46	1	1	170	103								
46	1	1	165	99								
46	1	1	157	101								
46	1	1	146	85								
46	1	1						.08	.03	38.		
46	1	1	162	116								
46	1	1	178	113								
46	1	1	214	133								
46	1	1	195	122								
46	1	1	165	106								
46	1	1	164	121								
46	1	1	176	109								
46	1	1	180	101								
46	1	1	199	127								
46	1	1	224	145								
46	1	1	200	111								
46	1	1	231	128								
46	1	1	224	130								
46	1	1	184	122								
46	1	1	215	126								
46	1	1						.08	.01	80.		
46	1	1	153	102	13390.							
46	1	1	154	111	11777.							
46	1	1	151	95	10968.							
46	1	1	148	89	9483.							
46	1	1	182	111	15364.							
46	1	1	173	99	12235.							
46	1	1	143	87	9432.							
46	1	1	189	108	14851.							
46	1	1		104	11087.							
46	1	1	114	87	7229.							
46	1	1	161	92	9590.							
46	1	1	132	89	9332.							
46	1	1	131	92	9255.							
46	1	1	205	125	17452.							
46	1	1	119	74	7748.							
46	1	1	151	103	11794.							
46	1	1	196	123	18845.							
46	1	1	149	86	11629.							
46	1	1	150	112	11519.							
46	1	1	205	94	15038.							

Sp	St	z	L (μm)	W (μm)	PA (μm^2)	Sink t (sec)	T ($^{\circ}\text{C}$)	WT ($\mu\text{g/shell}$)	+	n	Misc	S ($^{\circ}/\bullet\bullet$)
46	1	1	195	92	14177.							
46	1	1	146	106	9752.							
46	1	1	161	108	12703.							
46	1	1	158	95	11761.							
46	1	1	211	135	19026.							
46	1	1	147	83	10055.							
46	1	1	134	102	10103.							
46	1	1	153	91	11777.							
46	1	1	128	97	9352.							
46	1	1	165	84	10303.							
46	1	1				210.6	3.					36.1
46	1	1				248.6	3.					36.1
46	1	1				204.8	3.					36.1
46	1	1				297.6	3.					36.1
46	1	1				493.2	3.					36.1
46	1	1				224.0	3.					36.1
46	1	1				332.0	3.					36.1
46	1	1				266.8	3.					36.1
46	1	1				217.2	3.					36.1
46	1	1				305.2	3.					36.1
46	1	1				439.2	3.					36.1
46	1	1				260.8	3.					36.1
46	1	1				361.6	3.					36.1
46	1	1				324.0	3.					36.1
46	1	1				250.0	3.					36.1
46	1	1				280.8	3.					36.1
46	1	1				320.8	3.					36.1
46	1	1				340.8	3.					36.1
46	1	1				234.8	3.					36.1
46	1	1				304.8	3.					36.1
46	1	1				280.0	3.					36.1
46	1	1				295.2	3.					36.1
46	1	1				298.8	3.					36.1
46	1	1				520.0	3.					36.1
46	1	1				169.0	10.					36.1
46	1	1				240.0	10.					36.1
46	1	1				280.5	10.					36.1
46	1	1				530.0	10.					36.1
46	1	1				277.0	10.					36.1
46	1	1				291.6	10.					36.1
47	1	1										
47	1	1	221	125	20542.				.07	.01	69.	
47	1	1	195	117	16783.							
47	1	1	193	101	17112.							
47	1	1	205	126	18304.							
47	1	1	221	109	19383.							
47	1	1	243	126	25184.							
47	1	1	158	124	14552.							
47	1	1	222	130	21768.							
47	1	1	204	111	16017.							
47	1	1	207	130	19171.							
47	1	1	213	136	20974.							
47	1	1	199	123	16320.							
47	1	1	203	123	17024.							
47	1	1	263	118	24009.							
47	1	1	195	108	17031.							
47	1	1	184	105	14701.							
47	1	1	178	128	12538.							
47	1	1	229	127	20326.							
47	1	1	212	123	20501.							

Sp	St	z	L (μm)	W (μm)	PA (μm^2)	Sink t (sec)	T ($^{\circ}\text{C}$)	WT ($\mu\text{g}/\text{shell}$)	+	n	Misc	S ($^{\circ}/\bullet\bullet$)
47	1	1	230	128	20366.							
47	1	1				226.4	3.					36.1
47	1	1				310.4	3.					36.1
47	1	1				430.0	3.					36.1
47	1	1				200.4	3.					36.1
47	1	1				336.2	3.					36.1
47	1	1				443.6	3.					36.1
47	1	1				468.2	3.					36.1
47	1	1				338.4	3.					36.1
47	1	1				577.4	3.					36.1
48	1	1	<u>Eucecryphalus tricostatus</u> (Haeckel)					.10	.03	30.		
48	1	1	217		41549.							
48	1	1	175									
48	1	1	201									
48	1	1	207									
48	1	1	253									
48	1	1	232									
48	1	1	190									
48	1	1	226									
48	1	1	156									
48	1	1	162									
48	1	1	232									
48	1	1	180									
48	1	1	176									
48	1	1	202									
48	1	1	210									
48	1	1	274									
48	1	1				419.2	3.					36.1
48	1	1				846.8	3.					36.1
48	1	1				615.2	3.					36.1
48	1	1				719.0	3.					36.1
48	1	1				423.2	3.					36.1
48	1	1				544.8	3.					36.1
48	1	1				342.4	3.					36.1
48	1	1				651.2	3.					36.1
48	1	1				264.0	3.					36.1
48	1	1				293.2	3.					36.1
48	1	1				1000.4	3.					36.1
48	1	1				780.8	3.					36.1
48	1	1				622.4	3.					36.1
48	1	1				439.2	3.					36.1
48	1	1				736.0	3.					36.1
48	1	1				515.2	10.					36.1
48	1	1				305.2	10.					36.1
48	1	1				89.0	20.00					30.5
48	1	1				80.0	20.00					30.5
48	1	1				105.0	20.00					30.5
48	1	1				119.8	20.00					30.5
48	1	1				200.0	20.00					30.5
48	1	1				137.8	20.00					30.5
48	1	1				116.5	20.00					30.5
48	1	1				125.0	20.00					30.5
48	1	1				128.0	20.00					30.5
48	1	1				100.0	20.00					30.5
48	1	1				173.5	20.00					30.5
49	1	1	<u>Dictyocodon elegans</u> (Haeckel)					.25	.10	4.		
49	1	1	314	256	55753.							
49	1	1	349	232	64458.							
49	1	1	253	172	34592.							
49	1	1	383	260	71398.							

[illegible]

Sp	St	z	L (μm)	W (μm)	PA (μm^2)	Sink t (sec)	T ($^{\circ}\text{C}$)	WT ($\mu\text{g}/\text{shell}$)	$\pm$	n	Misc	S ($^{\circ}/\bullet\bullet$)
81	1	1	737									
81	1	1	391									
81	1	1	437									
81	1	1	436									
81	1	1	446									
81	1	1	352									
81	1	1				16.3	3.					36.1
81	1	1				43.5	3.					36.1
81	1	1				43.5	3.					36.1
81	1	1				10.9	3.					36.1
81	1	1				88.7	3.					36.1
81	1	1				68.4	3.					36.1
81	1	1				69.2	3.					36.1
81	1	1				111.2	3.					36.1
81	1	1				86.8	3.					36.1
81	1	1				122.6	3.					36.1
81	1	1				108.1	3.					36.1
81	1	1				101.0	3.					36.1
81	1	1				107.5	3.					36.1
81	1	1				94.8	3.					36.1
81	1	1				135.0	3.					36.1
81	1	1				59.0	3.					36.1
81	1	1				58.0	3.					36.1
81	1	1				93.6	3.					36.1
81	1	1				90.2	3.					36.1
81	1	1				188.6	3.					36.1
81	1	1				62.7	3.					36.1
81	1	1				68.2	3.					36.1
81	1	1				56.3	3.					36.1
81	1	1				61.5	3.					36.1
81	1	1				48.2	3.					36.1
81	1	1				54.6	3.					36.1
81	1	1				53.8	3.					36.1
81	1	1				62.1	3.					36.1
81	1	1				118.2	3.					36.1
81	1	1				64.6	3.					36.1
81	1	1				194.6	3.					36.1
81	1	1				51.0	3.					36.1
81	1	1				37.8	20.00					30.5
81	1	1				65.8	20.00					30.5
81	1	1				34.9	20.00					30.5
81	1	1				73.5	20.00					30.5
81	1	1				30.0	20.00					30.5
81	1	1				17.8	20.00					30.5
81	1	1				20.1	20.00					30.5
81	1	1				37.8	20.00					30.5
81	1	1				60.0	20.00					30.5
81	1	1				38.0	20.00					30.5
81	1	1				41.0	20.00					30.5
81	1	1				31.0	20.00					30.5
81	1	1				36.0	20.00					30.5
81	1	1				32.6	20.00					30.5
81	1	1				34.9	20.00					30.5
82	1	1			Castanellids from	131.0	3.					36.1
82	1	1			Sta. PB <300 μm	173.0	3.					36.1
82	1	1				155.0	3.					36.1
82	1	1				130.8	3.					36.1
82	1	1				127.4	3.					36.1
82	1	1				152.6	3.					36.1
82	1	1				147.8	3.					36.1

Sp	St	z	L (μm)	W (μm)	PA (μm^2)	Sink t (sec)	T ($^{\circ}\text{C}$)	WT ($\mu\text{g}/\text{shell}$)	+	n	Misc	S ($^{\circ}/\bullet\bullet$)
82	1	1				151.4	3.					36.1
82	1	1				122.8	3.					36.1
82	1	1				88.6	3.					36.1
82	1	1				191.0	3.					36.1
82	1	1				61.3	3.					36.1
82	1	1				244.0	3.					36.1
82	1	1				144.0	3.					36.1
82	1	1				226.6	3.					36.1
82	1	1				42.0	10.					36.1
82	1	1				55.0	10.					36.1
82	1	1				78.0	10.					36.1
82	1	1				48.0	10.					36.1
82	1	1				65.2	10.					36.1
82	1	1				88.6	10.					36.1
82	1	1				72.0	10.					36.1
82	1	1				105.0	10.					36.1
82	1	1				174.0	10.					36.1
82	1	1				142.6	10.					36.1
82	1	1				139.0	10.					36.1
82	1	1				114.4	10.					36.1
82	1	1				134.6	10.					36.1
82	1	1				276.8	20.					36.1
82	1	1				191.2	20.					36.1
82	1	1				47.2	20.					36.1
82	1	1				57.6	20.					36.1
82	1	1				50.7	20.					36.1
82	1	1				44.7	20.					36.1
82	1	1				80.0	20.					36.1
82	1	1				163.0	20.					36.1
82	1	1				43.3	20.					36.1
82	1	1				172.2	20.					36.1
82	1	1				70.8	20.					36.1
82	1	1				99.8	20.					36.1
82	1	1				72.3	20.					36.1
82	1	1				49.5	20.					36.1
82	1	1				103.3	20.					36.1
83	1	1	Castanellids fragments			179.4	3.					36.1
83	1	1				190.0	3.					36.1
83	1	1				84.0	3.					36.1
83	1	1				300.0	3.					36.1
83	1	1				273.6	3.					36.1
83	1	1				293.0	3.					36.1
83	1	1				194.0	3.					36.1
83	1	1				98.0	3.					36.1
84	1	1	298	<u>Castanidium abuandiplanatum</u> Takahashi								
84	1	1	281									
84	1	1	315									
84	1	1	318								48.*84	
84	1	1	312								34.*84	
84	1	1	330									
84	1	1	322									
84	1	1	317									
84	1	1	320									
84	1	1	327									
84	1	1	271									
84	1	1	290								39.*84	
84	1	1	285									
84	1	1						.80	.02	22.		
84	1	1				64.8	3.					36.1
84	1	1				97.0	3.					36.1

Sp	St	z	L (μ m)	W (μ m)	PA (μ m ²)	Sink t (sec)	T (°C)	WT (μ g/shell)	$\pm$	n	Misc	S (°/°)
84	1	1				92.4	3.					36.1
84	1	1				110.0	3.					36.1
84	1	1				84.0	3.					36.1
84	1	1				164.0	3.					36.1
84	1	1				189.6	3.					36.1
84	1	1				100.0	3.					36.1
84	1	1				194.6	3.					36.1
84	1	1				252.6	3.					36.1
84	1	1				191.2	3.					36.1
84	1	1				197.4	3.					36.1
85	1	1			<u>Challengeria tizardi</u> Murray			.65	.03	12.		
85	1	1						.42	.33	6.		
85	1	1	373	277	66245.							
85	1	1	317									
85	1	1		237								
85	1	1		292								
85	1	1	361	306	67163.							
85	1	1		267								
85	1	1		308								
85	1	1	324									
85	1	1		225								
85	1	1	325	264								
85	1	1				121.0	3.					36.1
85	1	1				192.4	3.					36.1
85	1	1				170.0	3.					36.1
85	1	1				198.6	3.					36.1
85	1	1				171.4	3.					36.1
86	1	1	296	127	24780.	<u>Challengeron willemoesii</u> Haeckel						
86	1	1	214	113	16083.							
86	1	1						.07	.01	15.		
86	1	1				373.0	3.					36.1
86	1	1				405.2	3.					36.1
86	1	1				277.2	3.					36.1
86	1	1				401.2	3.					36.1
87	1	1			<u>Challengeron lingi</u> Takahashi			.07	.01	15.		
87	1	1	246	165								
87	1	1	238	169								
87	1	1	254	177								
87	1	1	193	111								
87	1	1	283	189								
87	1	1	223	114								
87	1	1		189								
87	1	1				294.0	3.					36.1
87	1	1				372.3	3.					36.1
88	1	1		185	<u>Challengerosium avicularia</u> Haecker							
88	1	1		180								
88	1	1		172								
88	1	1		169								
88	1	1		176								
88	1	1		171								
88	1	1		176								
88	1	1		185								
88	1	1		195								
88	1	1		175								
88	1	1		168								
88	1	1						.18	.03	8.		
88	1	1				356.0	3.					36.1
88	1	1				347.4	3.					36.1
88	1	1				346.0	3.					36.1
89	1	1			<u>Circoporus oxycanthus</u> Borgert			.10	.01	15.		

Sp	St	z	L (μm)	W (μm)	PA (μm^2)	Sink t (sec)	T ($^{\circ}\text{C}$)	WT ($\mu\text{g}/\text{shell}$)	+	n	Misc	S ($^{\circ}/\bullet\bullet$)
89	1	1	140									
89	1	1	120									
89	1	1	340									
89	1	1	320									
89	1	1	130									
89	1	1	336									
89	1	1				360.0	3.					36.1
89	1	1				452.0	3.					36.1
89	1	1				540.0	3.					36.1
89	1	1				796.3	3.					36.1
90	1	1			<u>Conchidium argiope</u>	Haeckel		.10	.01	126.		
90	1	1	216									
90	1	1	160	132								
90	1	1	192									
90	1	1	184									
90	1	1	208									
90	1	1	174	132	20504.							
90	1	1	190									
90	1	1	192									
90	1	1	190									
90	1	1	204	142	25404.							
90	1	1	188	144	21320.							
90	1	1	206									
90	1	1	210									
90	1	1	196									
90	1	1	192									
90	1	1	202									
90	1	1	214									
90	1	1	208									
90	1	1	198									
90	1	1				276.0	3.					36.1
90	1	1				288.0	3.					36.1
90	1	1				416.0	3.					36.1
90	1	1				400.0	3.					36.1
90	1	1				637.6	3.					36.1
90	1	1				396.0	3.					36.1
90	1	1				739.2	3.					36.1
90	1	1				479.2	3.					36.1
90	1	1				442.8	3.					36.1
90	1	1				496.0	3.					36.1
90	1	1				498.4	3.					36.1
90	1	1				588.8	3.					36.1
90	1	1				488.0	3.					36.1
90	1	1				273.0	3.					36.1
91	3	6			<u>Conchellium capsula</u>	Borgert		.50	.11	9.		
91	3	6	270									
91	3	6	270									
91	3	6	280									
91	3	6	250									
91	3	6				20.8	3.					36.1
92	3	6			<u>Conchopsis compressa</u>	Haeckel		3.17	.17	12.		
92	3	6						2.80	1.00	1.		
92	3	6						2.93	.20	15.		
92	3	6						3.30	.50	4.		
92	3	6	574	314	141060.							
92	3	6	582	291	138142.							
92	3	6	622	349	155108.							
92	3	6	611	345	157977.							
92	3	6	586	301	134201.							
92	3	6	570	360	165791.							

Sp	St	z	L (μm)	W (μm)	PA (μm^2)	Sink t (sec)	T ($^{\circ}\text{C}$)	WT ($\mu\text{g/shell}$)	$\pm$	n	Misc	S ($^{\circ}/\dots$)
92	3	6	614	329	152763.							
92	3	6	539	342	134695.							
92	3	6				41.6	3.					36.1
92	3	6				34.9	3.					36.1
92	3	6				35.0	3.					36.1
92	3	6				43.2	3.					36.1
92	3	6				39.4	3.					36.1
92	3	6				36.4	3.					36.1
92	3	6				41.0	3.					36.1
92	3	6				54.6	3.					36.1
92	3	6				35.8	3.					36.1
92	3	6				52.5	3.					36.1
92	3	6				43.4	3.					36.1
93	1	1						.05	.01	34.		
<u>Euphysetta elegans</u> Borgert												
93	1	1	126									
93	1	1	120									
93	1	1	110									
93	1	1	138									
93	1	1	120									
93	1	1	108	242	10668.							
93	1	1	104	278	12860.							
93	1	1	104	280	11744.							
93	1	1	112		11652.							
93	1	1	112		11380.							
93	1	1	94	256	10004.							
93	1	1	104	234	11628.							
93	1	1	106	256	11156.							
93	1	1	124		14520.							
93	1	1	136		18704.							
93	1	1	126	244	14936.							
93	1	1	104									
93	1	1	130									
93	1	1	94	264								
93	1	1	96	272	9948.							
93	1	1	100									
93	1	1	106									
93	1	1				548.0	3.					36.1
93	1	1				449.2	3.					36.1
93	1	1				482.0	3.					36.1
93	1	1				760.0	3.					36.1
93	1	1				499.2	3.					36.1
93	1	1				490.4	3.					36.1
93	1	1				640.0	3.					36.1
93	1	1				804.0	3.					36.1
93	1	1				415.2	3.					36.1
93	1	1				718.4	3.					36.1
93	1	1				546.8	3.					36.1
93	1	1				480.0	3.					36.1
93	1	1				562.4	3.					36.1
93	1	1				668.0	3.					36.1
<u>Haeckeliana porcellana</u> Haeckel												
94	2	3						17.25	.13	8.		
94	3	6						8.75	.05	40.		
94	3	6						9.90	.02	52.		
94	3	6						10.00	.40	5.		
94	3	6						8.77	.33	6.		
94	3	6						6.89	.29	7.		
94	3	6						6.57	.29	7.		
94	2	6	428									
94	2	6	400									
94	2	6	563									

Sp	St	z	L (μm)	W (μm)	PA (μm^2)	Sink t (sec)	T ($^{\circ}\text{C}$)	WT ($\mu\text{g}/\text{shell}$)	$\pm$	n	Misc	S ($^{\circ}/\bullet\bullet$)
94	2	6	425									
94	2	6	554									
94	2	6	413									
94	3	6	477		178902.							
94	3	6	391		111624.							
94	3	6	446		174756.							
94	3	6	371		122217.							
94	3	6	367		110953.							
94	3	6	365		106754.							
94	3	6	384									
94	3	6	380		116362.							
94	3	6	375		107959.							
94	3	6	362		110398.							
94	3	6	413		136874.							
94	3	6	429		155837.							
94	3	6	374		113600.							
94	3	6	426									
94	3	6	348		95748.							
94	3	6	430		151792.							
94	3	6	384		122412.							
94	3	6	434									
94	3	6	366		108188.							
94	3	6	348		108720.							
94	3	6	468		167988.							
94	3	6	324		96868.							
94	3	6	384		116680.							
94	3	6	368		113688.							
94	3	6	454		161912.							
94	3	6	362									
94	2	3				9.9	3.					36.1
94	2	3				9.4	3.					36.1
94	2	3				20.9	3.					36.1
94	2	3				10.1	3.					36.1
94	3	6				15.2	3.					36.1
94	3	6				29.6	3.					36.1
94	3	6				12.9	3.					36.1
94	3	6				24.0	3.					36.1
94	3	6				47.6	3.					36.1
94	3	6				37.3	3.					36.1
94	3	6				35.7	3.					36.1
94	3	6				14.4	3.					36.1
94	3	6				12.0	3.					36.1
94	3	6				22.8	3.					36.1
94	3	6				24.0	3.					36.1
94	3	6				28.8	3.					36.1
94	3	6				11.5	3.					36.1
94	3	6				27.4	3.					36.1
94	3	6				18.6	10.					36.1
94	3	6				14.2	10.					36.1
94	3	6				10.2	10.					36.1
94	3	6				12.3	10.					36.1
94	3	6				32.2	10.					36.1
94	3	6				21.0	10.					36.1
94	3	6				19.7	10.					36.1
94	3	6				19.2	10.					36.1
94	3	6				13.2	10.					36.1
94	3	6				13.1	10.					36.1
94	3	6				23.1	10.					36.1
94	3	6				8.4	20.					36.1
94	3	6				9.5	20.					36.1

Sp	St	z	L (μ m)	W (μ m)	PA (μ m ²)	Sink t (sec)	T (°C)	WT (μ g/shell)	$\pm$	n	Misc	S (°/°)
94	3	6				7.0	20.					36.1
94	3	6				16.0	20.					36.1
94	3	6				8.2	20.					36.1
94	3	6				8.1	20.					36.1
94	3	6				12.0	20.					36.1
94	3	6				12.0	20.					36.1
94	3	6				13.9	20.					36.1
94	3	6				16.6	20.					36.1
94	3	6				16.6	20.					36.1
95	1	1			<u>Protocystis sloggetti</u> (Haeckel)			.16	.04	5.		
95	1	1	230									
95	1	1	212	17C	24928.							
95	1	1	184	170	21268.							
95	1	1	228									
95	1	1	216									
95	1	1				179.7	3.					36.1
95	1	1				187.1	3.					36.1
96	1	1		205	<u>Protocystis murrayi</u> (Haeckel)							
96	1	1		213								
96	1	1		200								
96	1	1				240.0	3.					36.1
96	1	1				201.4	3.					36.1
96	1	1				98.0	3.					36.1
97	1	1			<u>Protocystis curva</u> Takahashi			.16	.01	44.		
97	1	1	185	152	17041.							
97	1	1	174	135	17362.							
97	1	1		183								
97	1	1	182	120	17225.							
97	1	1		132								
97	1	1				263.2	3.					36.1
97	1	1				260.2	3.					36.1
97	1	1				265.6	3.					36.1
97	1	1				372.6	3.					36.1
97	1	1				330.6	3.					36.1
97	1	1				240.0	3.					36.1
97	1	1				396.0	3.					36.1
97	1	1				358.5	3.					36.1
97	1	1				278.0	3.					36.1
97	1	1				72.4	3.					36.1
97	1	1				94.6	3.					36.1
98	1	1			<u>Protocystis honjoi</u> Takahashi			.10	.05	4.		
98	1	1		138								
98	1	1		164								
98	1	1		143								
98	1	1		148								
98	1	1				302.8	3.					36.1
98	1	1				334.4	3.					36.1
70	1	1			<u>Codonellopsis minor</u> (Brandt) +			.04	.02	23.		
70	1	1	221	92	<u>C. biedermani</u> (Brandt) (Tintinnids)							
70	1	1	242	92								
70	1	1	228	95								
70	1	1	261	9C								
70	1	1	177	95								
70	1	1	241	9C								
70	1	1	227	97								
70	1	1				194.4	3.					36.1
70	1	1				156.0	3.					36.1
70	1	1				280.0	3.					36.1
70	1	1				268.0	3.					36.1
70	1	1				200.0	3.					36.1

Sp	St	z	L	W	PA	Sink t	T	WT	$\frac{+}{-}$	n	Misc	S
			(μm)	(μm)	(μm^2)	(sec)	($^{\circ}\text{C}$)	($\mu\text{g}/\text{shell}$)				($^{\circ}/\infty$)
70	1	1				540.0	3.					36.1
70	1	1				332.0	3.					36.1
70	1	1				318.4	3.					36.1
70	1	1				269.2	3.					36.1
70	1	1				290.4	3.					36.1
70	1	1				160.0	3.					36.1
70	1	1				740.0	3.					36.1

Explanations for miscellaneous measurements:

- *4: μm , shell thickness;
- *5: μm , shell thickness;
- *10: μm , length for a small form with 4 arms;
- *11: μm , medullary shell length;
- *15: Sec, sinking speed for 2 shells attached;
- *81: μm , mouth diameter; and
- *84: μm , mouth diameter.

Table 3. Radiolarians from the sediment traps: size, laboratory sinking speed and residence time in the water column. The S.D. is at 95% confidence level (2σ) and n is number of measurements (specimens). See text for explanations for τ_n .

	W E I G H T					L E N G T H					W I D T H					M E A S U R E D										
	(μg/shell)					(μm)					(μm)					(x10 ³ μm ²)										
	Mean	Err.	S.D	n*	Anal.	Mean	S.D.	n		Mean	S.D.	n	Mean	S.D.	n											
SPUMELLARIA																										
1. <i>Acrosphaera murrayana</i> (Haeckel)	.46	.01	-	207		176	18	126		-	-	-	-	-	-	-	-	-	-	-						
2. <i>Actinomma arcadophorum</i> Haeckel	.91	.02	.06	273		269	26	8		-	-	-	-	-	-	-	-	-	-	-						
3. <i>Amphirhopalum ypsilon</i> Haeckel	.57	.06	-	7		305	42	6		178	34	6				49.0	13.0	5								
4. <i>Cladococcus scoparius</i> Haeckel	1.00	1.00	-	1		106	63	2		-	-	-	-	-	-	-	-	-	-	-						
5. <i>Dictyocoryne profunda</i> Ehrenberg >350 μm	1.69	.05	.55	72		424	33	14		-	-	-	-	-	-	-	-	-	-	-						
6. <i>Dictyocoryne profunda</i> Ehrenberg <350 μm	.83	.03	.11	241		294	42	50		-	-	-	-	-	-	52.4	10.0	13								
7. <i>Dictyocoryne truncatum</i> (Ehrenberg)	2.00	.07	.27	40		308	43	13		-	-	-	-	-	-	-	-	-	-	-						
8. <i>Euchitonina elegans</i> (Ehrenberg)	.57	.03	.12	226		369	43	43		277	55	43				65.7	15.0	29								
9. <i>Heliodiscus asteriscus</i> Haeckel	.36	.04	-	11		176	16	9		-	-	-	-	-	-	-	-	-	-	-						
10. <i>Myelastrum quadrifolium</i> Takahashi	2.32	.16	-	13		704	49	12		757	51	12				429.1	72.0	12								
11. <i>Myelastrum trinibrachium</i> Takahashi	.75	.13	-	16		1027	120	7		-	-	-	-	-	-	283.9	40.0	7								
12. <i>Saturnalis circularis</i> Haeckel	.05	.05	-	4		205	6	4		245	27	4				-	-	-	-	-						
13. <i>Spongaster tetras tetras</i> Ehrenberg	1.23	.15	-	13		258	63	12		-	-	-	-	-	-	-	-	-	-	-						
14. <i>Spongocore cylindrica</i> (Haeckel)	.36	.09	-	22		280	49	6		99	22	7				21.8	7.0	6								
15. <i>Spongodiscus biconcavus</i> (Haeckel) >270 μm	.99	.08	.02	46		313	38	15		-	-	-	-	-	-	-	-	-	-	-						
16. <i>Spongodiscus biconcavus</i> (Haeckel) <270 μm	.62	.01	-	37		224	35	14		-	-	-	-	-	-	-	-	-	-	-						
17. <i>Spongosphaera polycantha</i> Müller	-	-	-	-		298	163	4		-	-	-	-	-	-	-	-	-	-	-						
18. <i>Spongosphaera</i> sp. aff <i>S. helioides</i> Haeckel	4.10	.20	-	2		878	4	2		-	-	-	-	-	-	-	-	-	-	-						
19. <i>Spongotrochus glacialis</i> Popofsky	.42	.02	.01	116		236	36	17		-	-	-	-	-	-	-	-	-	-	-						
NASSELLARIA																										
30. <i>Acanthodesmia vinculata</i> (Müller)	.11	.02	-	17		107	12	20		147	22	28				14.0	5.0	6								
31. <i>Androsipyris reticulidiscus</i> Takahashi	.71	.11	.10	18		363	45	20		336	19	20				96.4	10.0	20								
32. <i>Anthocytidium ophirens</i> (Ehrenberg)	.14	.01	-	77		191	12	6		132	3	6				14.6	2.0	5								
33. <i>Anthocytidium zanguebaricum</i> (Ehrenberg)	.08	.03	-	14		156	16	11		86	5	11				8.3	1.0	11								
34. <i>Callimitra annae</i> Haeckel	.07	.07	.01	29		300	43	13		251	33	13				62.7	18.0	12								
35. <i>Callimitra emmae</i> Haeckel	-	-	-	-		322	-	1		342	-	1				93.7	-	1								
36. <i>Carpocanistrum</i> spp.	-	-	-	-		109	18	7		77	7	7				-	-	-								

T A B L E 3 (cont.)

37. Cephalospyris cancellata Haeckel	.11	.02	-	19	301	57	11	206	48	11	50.4	18.0	11
38. Conicavus tipiopsis Takahashi	.58	.04	-	25	567	89	31	372	42	36	152.4	28.0	30
39. Cornutella profunda Ehrenberg	.08	.01	-	29	161	18	7	65	9	7	6.9	1.0	7
40. Dictyocodon elegans (Haeckel)	.25	.10	-	4	325	56	4	230	41	4	56.5	16.0	4
41. Euceryphalus tricostatus (Haeckel)	.10	.03	-	30	206	33	16	-	-	-	41.5	-	1
42. Eucyrtidium acuminatum (Ebg)+hexagonatum Hk1	.29	.02	-	41	248	43	24	105	13	24	20.6	6.0	24
43. Lamprocyclus maritimalis maritimalis Haeckel	.49	.04	-	23	229	22	23	144	12	24	19.0	4.0	17
44. Liriospyris thorax (Haeckel)	.25	.02	-	24	196	34	6	222	65	5	36.3	15.0	5
45. Lithostrobos hexagonalis Haeckel	.14	.03	-	14	191	32	9	141	18	13	22.0	6.0	9
46. Lophospyris pentagona pentagona (Ehrenberg)	.10	.04	-	9	117	18	7	144	19	7	-	-	-
47. Nephrosopyris renilla Haeckel	1.00	.17	-	6	413	71	9	509	71	9	177.3	60.0	7
48. Pterocorys zancleus (Mlr) + campanula Hk1	.07	.03	.01	158	170	28	57	104	15	58	11.9	3.0	30
49. Spirocystis scalaris Haeckel	.07	.01	-	69	209	23	20	121	9	20	18.6	3.0	20
<u>PHAEODARIA</u>													
80. Castanellids from E	24.15	.01	30.00	268	473	151	45	-	-	-	-	-	-
81. Castanellids from PB	12.77	.03	-	70	382	91	32	-	-	-	-	-	-
82. Castanellids from PB <300 µm	-	-	-	-	-	-	-	-	-	-	-	-	-
83. Castanellids fragments	-	-	-	-	-	-	-	-	-	-	-	-	-
84. Castanidium abundiplanatum Takahashi	.80	.02	-	22	308	21	18	-	-	-	-	-	-
85. Challengeria tizardi Murray	.54	.03	.16	18	340	25	5	272	30	8	66.7	.6	2
86. Challengeron willemoesii Haeckel	.07	.01	-	15	255	58	2	120	10	2	20.4	6.0	2
87. Challengeron lingi Takahashi	.07	.01	-	15	240	30	6	159	33	7	-	-	-
88. Challengerosium avicularia Haecker	.18	.03	-	8	-	-	-	177	8	11	-	-	-
89. Circoporus oxycanthus Borgert	.10	.01	-	15	231	111	6	-	-	-	-	-	-
90. Conchidium argiope Haeckel	.10	.01	-	126	196	14	19	138	6	4	22.4	3.0	3
91. Conchellium capsula Borgert	.50	.11	-	9	264	11	11	-	-	-	-	-	-
92. Conchopsis compressa Haeckel	3.05	.20	.23	322	587	28	8	329	25	8	147.5	12.0	8
93. Euphysetta elegans Borgert	.05	.01	-	34	258	16	9	112	13	22	12.4	3.0	12
94. Haeckelliana porcellana Haeckel	9.73	.02	-	125	407	54	32	-	-	-	126.8	26.0	22
95. Protocystis sloggetti (Haeckel)	.16	.04	-	5	214	18	5	170	-	2	23.1	3.0	2
96. Protocystis murrayi (Haeckel)	.47	.13	-	3	-	-	-	206	7	3	-	-	-
97. Protocystis curva Takahashi	.16	.01	-	44	180	6	3	145	24	5	17.2	.2	3
98. Protocystis honjoi Takahashi	.10	.05	-	4	-	-	-	148	11	4	-	-	-

n* = total number of specimens used rather than number of measurements

T A B L E 3 (cont.)

	COMPUTED PROJECTED AREA		BULK VOLUME V_b ($\times 10^6 \mu m^3$)	°/o VOLUME SKELETON IN V_b P_{skel} (°/o)	VOLUME OF SKELETON V_{skel} ($\times 10^3 \mu m^3$)	BULK DENSITY CONTRAST	
	(x10 ³ μm^2)					$\Delta\rho$ at 3°C (g/cm ³)	$\Delta\rho$ at 10°C (g/cm ³)
	Mean	S.D.					
<u>SPUMELLARIA</u>							
1. <i>Acrosphaera murrayana</i> (Haeckel)	24.6	5.0	126	8.1	230	.07838	.07846
2. <i>Actinomma arcadophorum</i> Haeckel	57.2	11.0	8	4.5	455	.04337	.04341
3. <i>Amphirhopalum ypsilon</i> Haeckel	-	-	-	19.1	285	.18578	.18596
4. <i>Cladococcus scoparius</i> Haeckel	10.3	10.0	2	0.1	500	.00137	.00137
5. <i>Dictyocoryne profunda</i> Ehrenberg >350 μm	94.9	15.0	14	78.2	845	.75995	.76068
6. <i>Dictyocoryne profunda</i> Ehrenberg <350 μm	-	-	-	4.1	415	.04007	.04011
7. <i>Dictyocoryne truncatum</i> (Ehrenberg)	62.9	18.0	13	5.9	1000	.05768	.05773
8. <i>Euchitonina elegans</i> (Ehrenberg)	-	-	-	5.2	285	.05042	.05047
9. <i>Heliodiscus asteriscus</i> Haeckel	24.5	4.0	9	6.8	180	.06647	.06654
10. <i>Myelastrum quadrifolium</i> Takahashi	-	-	-	30.1	1160	.29265	.29294
11. <i>Myelastrum trinibracium</i> Takahashi	-	-	-	1.2	375	.01205	.01207
12. <i>Saturnalis circularis</i> Haeckel	13.0	2.0	4	0.1	25	.00083	.00083
13. <i>Spongaster tetras</i> tetras Ehrenberg	70.1	35.0	12	139.8	615	1.35761	1.35893
14. <i>Spongocore cylindrica</i> (Haeckel)	-	-	-	4.0	180	.03869	.03872
15. <i>Spongodiscus biconcavus</i> (Haeckel) >270 μm	78.2	19.0	15	2.9	495	.22259	.22280
16. <i>Spongodiscus biconcavus</i> (Haeckel) <270 μm	40.3	12.0	14	5.1	310	.04920	.04925
17. <i>Spongosphaera polycantha</i> Müller	85.2	83.0	4	-	-	-	-
18. <i>Spongosphaera</i> sp. aff <i>S. helioides</i> Haeckel	604.8	5.0	2	14.8	2050	.14366	.14380
19. <i>Spongotrochus glacialis</i> Popofsky	44.8	14.0	17	8.0	210	.07726	.07734
<u>NASSELLARIA</u>							
30. <i>Acanthodesmia vinculata</i> (Müller)	-	-	-	6.3	55	.06070	.06076
31. <i>Androsipyris reticulidiscus</i> Takahashi	-	-	-	4.1	355	.03941	.03944
32. <i>Anthocyrtydium ophirensis</i> (Ehrenberg)	-	-	-	6.7	70	.06475	.06482
33. <i>Anthocyrtydium zanguebaricum</i> (Ehrenberg)	-	-	-	10.8	40	.10500	.10511
34. <i>Callimitra annae</i> Haeckel	-	-	-	1.1	35	.01079	.01080
35. <i>Callimitra emmae</i> Haeckel	-	-	-	-	-	-	-
36. <i>Carpocanistrum</i> spp.	6.9	2.0	7	-	-	-	-

TABLE 3 (cont.)

37. Cephalospyris cancellata Haeckel	-	-	-	3.34	1.7	55	.01599	.01601
38. Conicavus tipiopsis Takahashi.	-	-	-	20.54	1.4	290	.01371	.01373
39. Cornutella profunda Ehrenberg	-	-	-	.18	2.2	40	.21584	.21605
40. Dictyocodon elegans (Haeckel)	-	-	-	5.45	2.3	125	.02227	.02229
41. Eucecryphalus tricornatus (Haeckel)	34.1	11.0	16	1.83	2.7	50	.02654	.02656
42. Eucyrtidium acuminatum (Ebg) + hexagonatum Hk1	-	-	-	.87	16.7	145	.16188	.16204
43. Lamprocyclas maritima maritima Haeckel	-	-	-	1.50	16.3	245	.15864	.15880
44. Liriospyris thorax (Haeckel)	-	-	-	4.98	2.5	125	.02438	.02440
45. Lithostrobilus hexagonalis Haeckel	-	-	-	1.20	5.8	70	.05666	.05671
46. Lophospyris pentagona pentagona (Ehrenberg)	13.7	4.0	7	1.28	3.9	50	.03794	.03798
47. Nephrosyris renilla Haeckel	-	-	-	12.20	4.1	500	.03981	.03984
48. Pterocorys zancleus (Mlr) + campanula Hk1	-	-	-	.58	6.0	355	.05861	.05867
49. Spirocystis scalaris Haeckel	-	-	-	.97	3.6	35	.03504	.03508
PHAEODARIA								
80. Castaneilids from E	193.0	131.0	45	55.41	21.8	12075	.21166	.21187
81. Castaneilids from PB	120.7	68.0	32	29.19	21.9	6385	.21246	.21267
82. Castaneilids from PB <300 μ m	-	-	-	-	-	-	-	-
83. Castaneilids fragments	-	-	-	-	-	-	-	-
84. Castanidium abundiplanatum Takahashi	74.1	9.0	13	15.15	2.6	400	.02564	.02567
85. Challengeria tizardi Murray	-	-	-	8.23	3.3	270	.03186	.03189
86. Challengeron willemoesii Haeckel	-	-	-	1.54	2.3	35	.02207	.02209
87. Challengeron lingi Takahashi	24.8	9.0	7	1.59	2.2	35	.02138	.02140
88. Challengerosium avicularia Haecker	24.8	2.0	11	1.92	4.7	90	.04553	.04557
89. Circoporus oxycanthus Borgert	60.0	48.0	6	6.45	0.8	50	.00753	.00753
90. Conchidium argiope Haeckel	-	-	-	0.98	5.1	50	.04955	.04960
91. Conchellium capsula Borgert	56.3	5.0	4	5.04	5.0	250	.04818	.04823
92. Conchopsis compressa Haeckel	-	-	-	52.95	2.9	1525	.02800	.02800
93. Euphysetta elegans Borgert	-	-	-	0.74	3.4	25	.03281	.03284
94. Haekelliana porcellana Haeckel	-	-	-	35.30	13.8	4865	.13386	.13400
95. Protocystis slogetti (Haeckel)	-	-	-	1.95	4.1	80	.03985	.03988
96. Protocystis murrayi (Haeckel)	40.0	3.0	3	4.58	5.1	235	.04984	.04988
97. Protocystis curva Takahashi	-	-	-	1.19	6.7	80	.06529	.06536
98. Protocystis honjoi Takahashi	20.0	3.0	4	1.02	4.9	50	.04761	.04766

TABLE 3 (cont.)

	S I N K I			N G S P E E D,			M o b s e r v e d			REYNOLDS				
	T=3°C, S=36.1°/oo (m/day)			T=10°C, S=36.1°/oo (m/day)			T=20°C, S=36.1°/oo (m/day)			T=20°C, S=30.5°/oo (m/day)		NUMBER		
	Mean	S.D.	n	Mean	S.D.	n	Mean	S.D.	n	Mean	S.D.	n	T=3°C T=10°C	
SPUMELLARIA														
1. <i>Acrosphaera murrayana</i> (Haeckel)	64.1	11.0	14	131.3	49.1	11	-	-	-	-	-	-	.085	.212
2. <i>Actinomma arcadophorum</i> Haeckel	71.8	21.9	12	91.5	11.1	9	-	-	-	-	-	-	.140	.217
3. <i>Amphirhopalum ypsilon</i> Haeckel	68.2	25.2	5	-	-	-	-	-	-	-	-	-	.135	-
4. <i>Cladococcus scoparius</i> Haeckel	19.0	-	1	-	-	-	-	-	-	-	-	-	.014	-
5. <i>Dictyocoryne profunda</i> Ehrenberg >350 μm	163.9	42.5	14	183.8	24.7	13	218.8	30.0	13	-	-	-	.847	1.154
6. <i>Dictyocoryne profunda</i> Ehrenberg <350 μm	100.8	21.4	10	114.4	16.5	10	-	-	-	-	-	-	.215	.297
7. <i>Dictyocoryne truncatum</i> (Ehrenberg)	177.3	29.6	12	-	-	-	-	-	-	-	-	-	.406	-
8. <i>Euchitonella elegans</i> (Ehrenberg)	69.3	22.9	27	115.1	58.6	16	93.5	33.0	12	166.0	34.8	20	.164	.331
9. <i>Heliodiscus asteriscus</i> Haeckel	65.2	24.9	8	-	-	-	-	-	-	-	-	-	.086	-
10. <i>Myelastrum quadrifolium</i> Takahashi	40.1	11.7	11	-	-	-	-	-	-	-	-	-	.263	-
11. <i>Myelastrum trinibrachium</i> Takahashi	27.8	4.7	8	-	-	-	-	-	-	-	-	-	.202	-
12. <i>Saturnalis circularis</i> Haeckel	24.6	5.9	3	-	-	-	-	-	-	-	-	-	.039	-
13. <i>Spongaster tetras tetras</i> Ehrenberg	152.9	55.4	12	-	-	-	-	-	-	-	-	-	.644	-
14. <i>Spongocore cylindrica</i> (Haeckel)	61.7	28.5	20	-	-	-	-	-	-	-	-	-	.085	-
15. <i>Spongodiscus biconcavus</i> (Haeckel) >270 μm	108.9	15.0	13	152.5	36.5	13	-	-	-	-	-	-	.290	.493
16. <i>Spongodiscus biconcavus</i> (Haeckel) <270 μm	85.7	21.0	12	-	-	-	-	-	-	-	-	-	.141	-
17. <i>Spongosphaera polycantha</i> Müller	77.6	56.9	7	-	-	-	-	-	-	-	-	-	-	-
18. <i>Spongosphaera</i> sp. aff. <i>S. heliodes</i> Haeckel	146.2	68.9	2	-	-	-	-	-	-	-	-	-	1.023	-
19. <i>Spongotrochus glacialis</i> Popofsky	76.1	18.5	10	97.5	26.6	6	-	-	-	-	-	-	.136	.212
NASSELLARIA														
30. <i>Acanthodesmia vinculata</i> (Müller)	31.0	5.4	12	-	-	-	-	-	-	-	-	-	.029	-
31. <i>Androsipyris reticulidiscus</i> Takahashi	70.0	22.4	9	-	-	-	-	-	-	-	-	-	.178	-
32. <i>Anthocytidium ophirensis</i> (Ehrenberg)	27.2	5.3	12	58.8	9.3	5	-	-	-	-	-	-	.033	.085
33. <i>Anthocytidium zanguebaricum</i> (Ehrenberg)	28.0	9.1	4	-	-	-	-	-	-	-	-	-	.026	-
34. <i>Callimitra annae</i> Haeckel	15.9	7.2	7	-	-	-	-	-	-	-	-	-	.031	-
35. <i>Callimitra emmae</i> Haeckel	23.5	14.1	2	-	-	-	-	-	-	-	-	-	-	-
36. <i>Carpocanistrum</i> spp.	-	-	-	-	-	-	-	-	-	-	-	-	-	-

TABLE 3 (cont.)

	RESIDENCE TIME			STOKES LAW		RESIDUAL FACTOR		SAMPLE SOURCE Station/depth (m)
	τ_1 Mean	τ_2 Mean	τ_3 Mean	W				
				$W_{\text{theoretical}}$ at 3°C at 10°C (m/day)	$\alpha = \frac{W_{\text{observed}}}{W_{\text{theoretical}}}$ at 3°C at 10°C			
<u>SPUMELLARIA</u>								
1. <i>Acrosphaera murrayana</i> (Haeckel)	80.0	13.3	71.6	67.2	81.7	.954	1.608	PB3769/3791
2. <i>Actinomma arcadophorum</i> Haeckel	75.4	21.3	67.2	86.8	105.5	.827	.867	E ⁺ ; PB3769/3791; E389
3. <i>Amphirhopalum ypsilon</i> Haeckel	80.5	25.2	-	299.8	364.4	.227	-	PB3769/3791
4. <i>Cladococcus scoparius</i> Haeckel	263.3	-	-	.4	.5	44.717	-	PB3769/3791
5. <i>Dictyocoryne profunda</i> Ehrenberg >350 μ m	32.4	7.9	30.0	3780.4	4594.9	.043	.040	PB3769/3791
6. <i>Dictyocoryne profunda</i> Ehrenberg <350 μ m	51.9	12.0	48.7	95.8	116.5	1.052	.982	P ₁ 4280/5582; E ⁺
7. <i>Dictyocoryne truncatum</i> (Ehrenberg)	29.0	5.3	-	151.4	184.0	1.171	-	PB3769/3791
8. <i>Euchitonina elegans</i> (Ehrenberg)	80.2	26.6	67.6	145.6	176.9	.476	.651	PB3769/3791; P ₁ 4280/5582; E ⁺
9. <i>Heliodiscus asteriscus</i> Haeckel	88.0	35.3	-	57.0	69.3	1.144	-	PB3769/3791
10. <i>Myelastrium quadrifolium</i> Takahashi	137.5	49.9	-	4321.2	5252.3	.009	-	PB3769/3791
11. <i>Myelastrium trinibrachium</i> Takahashi	184.6	33.5	-	351.8	427.6	.079	-	PB3769/3791
12. <i>Saturnalis circularis</i> Haeckel	211.0	50.7	-	1.2	1.4	21.141	-	PB3769/3791
13. <i>Spongaster tetras</i> Ehrenberg	37.1	14.0	-	2500.5	3039.3	.061	-	PB3769/3791
14. <i>Spongocore cylindrica</i> (Haeckel)	95.2	34.8	-	38.4	46.7	1.605	-	PB3769/3791
15. <i>Spongodiscus biconcavus</i> (Haeckel) >270 μ m	46.8	6.8	43.8	603.4	733.4	.180	.208	E ⁺ ; PB3769/3791
16. <i>Spongodiscus biconcavus</i> (Haeckel) <270 μ m	61.9	16.2	-	68.3	83.0	1.255	-	PB3769/3791
17. <i>Spongosphaera polycantha</i> Müller	88.5	45.7	-	-	-	-	-	PB3769/3791
18. <i>Spongosphaera</i> sp. aff. <i>S. helioides</i> Haeckel	38.5	18.1	-	3064.4	3724.7	.048	-	PB3769/3791
19. <i>Spongotrochus glacialis</i> Popofsky	68.9	15.3	63.4	119.1	144.7	.639	.674	PB3769/3791
<u>NASSELLARIA</u>								
30. <i>Acanthodesmia vinculata</i> (Müller)	165.8	29.6	-	27.1	32.9	1.144	-	PB3769/3791
31. <i>Androsypis reticulidiscus</i> Takahashi	78.0	23.4	-	133.2	161.9	.526	-	PB3769/3791
32. <i>Anthocytidium ophirens</i> (Ehrenberg)	190.6	38.0	168.0	46.7	56.8	.582	1.035	PB3769/3791
33. <i>Anthocytidium zanguebaricum</i> (Ehrenberg)	198.9	84.9	-	42.5	51.7	.658	-	PB3769/3791
34. <i>Callimitra annae</i> Haeckel	375.6	172.4	-	22.7	27.5	.702	-	P ₁ 4280/5582; E ⁺ ; P ₁
35. <i>Callimitra emmae</i> Haeckel	259.3	155.5	-	-	-	-	-	P ₁ 4280/5582
36. <i>Carpocanistrum</i> spp.	-	-	-	-	-	-	-	PB3769/3791

T A B L E 3 (cont.)

37. Cephalospyris cancellata Haeckel	436.0	242.4	-	-	28.4	34.6	.531	-	PB3769/3791
38. Conicavus tipiopsis Takahashi	136.7	35.8	-	-	83.6	101.7	.462	-	PB3769/3791
39. Cornutella profunda Ehrenberg	295.3	140.3	-	-	76.3	92.7	.282	-	PB3769/3791
40. Dictyocodon elegans (Haeckel)	228.3	21.6	-	-	47.5	57.7	.463	-	PB3769/3791
41. Euceryphalus tricostatus (Haeckel)	404.3	150.2	336.5	329.1	31.2	37.9	.459	.494	PB3769/3791
42. Eucyrtidium acuminatum (Ebg)+hexagonatum Hk1	86.0	20.1	-	-	139.5	169.6	.437	-	PB3769/3791
43. Lamprocyclas maritima maritima Haeckel	52.2	18.0	-	-	152.7	185.6	.688	-	PB3769/3791
44. Liriospyris thorax (Haeckel)	147.7	29.6	133.2	132.2	29.5	35.8	1.191	1.653	PB3769/3791
45. Lithostrobos hexagonalis Haeckel	144.6	62.9	-	-	43.2	52.5	1.002	-	PB3769/3791
46. Lophospyris pentagona pentagona (Ehrenberg)	-	-	-	-	17.9	21.7	-	-	PB3769/3791
47. Nephrosyris renilla Haeckel	95.9	47.8	-	-	234.1	284.5	.269	-	PB3769/3791
48. Pterocorys zancleus (Mlr) + campanula Hk1	212.4	57.2	198.3	-	30.4	37.0	.818	.730	PB3769/3791
49. Spirocystis scalaris Haeckel	258.0	84.2	-	-	26.4	32.1	.814	-	PB3769/3791
PHAEODARIA									
80. Castaneilids from E	22.1	19.4	-	-	1310.4	1592.7	.293	-	E ⁺
81. Castaneilids from PB	56.5	28.7	-	-	857.9	1042.7	.147	-	PB3769/3791
82. Castaneilids from PB <300 µm	104.5	32.6	87.6	87.4	-	-	-	-	PB3769/3791
83. Castaneilids fragments	140.5	58.0	-	-	-	-	-	-	PB3769/3791
84. Castanidium abundiplanatum Takahashi	101.0	41.9	-	-	66.9	81.3	.879	-	PB3769/3791
85. Challengeria tizardi Murray	119.0	21.3	-	-	82.6	100.3	.524	-	PB3769/3791
86. Challengeron willemoesii Haeckel	253.9	41.6	-	-	21.5	26.1	.941	-	PB3769/3791
87. Challengeron lingi Takahashi	232.3	38.6	-	-	23.5	28.6	.926	-	PB3769/3791
88. Challengerosium avicularia Haecker	243.9	3.8	-	-	39.5	48.0	.519	-	PB3769/3791
89. Circoporus oxycanthus Borgert	374.5	130.9	-	-	11.1	13.5	1.304	-	PB3769/3791
90. Conchidium argiope Haeckel	319.7	94.4	-	-	38.2	46.5	.445	-	PB3769/3791
91. Conchellium capsula Borgert	-	-	-	-	95.7	116.4	-	-	E ⁺
92. Conchopsis compressa Haeckel	29.0	4.7	-	-	162.4	197.3	1.084	-	E ⁺
93. Euphysetta elegans Borgert	401.6	85.1	-	-	31.1	37.8	.415	-	PB3769/3791
94. Haekeliana porcellana Haeckel	15.2	7.7	11.9	11.7	613.6	745.8	.679	.595	P ₁ 978; E ⁺ ; P ₁ ⁺
95. Protocystis slogetti (Haeckel)	127.9	3.6	-	-	40.6	49.4	.962	-	PB3769/3791
96. Protocystis murrayi (Haeckel)	125.3	51.2	-	-	58.5	71.1	.790	-	PB3769/3791
97. Protocystis curva Takahashi	185.8	72.7	-	-	47.7	58.0	.746	-	PB3769/3791
98. Protocystis honjoi Takahashi	222.1	15.6	-	-	28.9	35.1	.783	-	PB3769/3791

+ all depths

Table 4. Logarithmic and semilogarithmic relationships between variables of Radiolaria. Mean values of the variables are used unless otherwise stated.

Y	X	a	b	r***	Number of taxa used
$Y = 10^a X^b$					
Radiolaria:					
W**	L**	0.08	0.94	0.83	927*(58)
PA**	W**	0.78	1.66	0.93	344*(35)
PA**	L**	-0.00043	0.92	0.93	724*(53)
W	WT	2.48	0.33	0.69	33
L	WT	2.51	0.20	0.62	53
PA	WT	1.83	0.51	0.74	53
SS(3)	WT	1.88	0.50	0.86	51
SS(10)	WT	2.13	0.59	0.94	12
SS(20)	WT	2.20	0.37	0.88	8
SS(3)	W	0.75	0.34	0.31	33
SS(10)	W	-0.83	1.16	0.88	4
SS(20)	W	1.05	0.44	0.68	4
SS(3)	L	-0.19	0.77	0.41	50
SS(10)	L	-2.63	1.90	0.74	12
SS(20)	L	-1.99	1.70	0.84	8
SS(3)	PA	0.96	0.44	0.51	53
SS(10)	PA	0.52	0.88	0.75	12
SS(20)	PA	1.21	0.58	0.75	8
SS(3)	$\Delta\rho(3)$	2.16	0.38	0.56	51
SS(10)	$\Delta\rho(10)$	2.56	0.53	0.60	12
$\Delta\rho(3)$	W	-0.38	-0.44	-0.22	33
$\Delta\rho(3)$	L	-2.48	0.48	0.18	50
Re(3)	D ⁺	1.99	0.95	0.75	51
Re(10)	D ⁺	4.20	1.52	0.89	12

continued next page

Table 4 (cont.)

Y	X	a	b	r***	Number of taxa used
τ_1	WT	1.87	-0.47	-0.84	51
τ_2	WT	1.68	-0.65	-0.97	12
τ_3	WT	1.71	-0.72	-0.99	5
Spumellaria:					
PA	W	1.08	1.53	0.89	55*(5)
PA	L	0.58	1.69	0.94	311*(19)
W	L	0.17	0.92	0.90	364*(19)
Nassellaria:					
PA	W	0.61	1.74	0.97	229*(19)
PA	L	-0.23	1.97	0.93	246*(20)
W	L	0.13	0.88	0.79	328*(20)
Phaeodaria:					
PA	W	1.00	1.50	0.61	53*(11)
PA	L	0.11	1.91	0.96	160*(14)
W	L	0.43	0.82	0.88	228*(17)
$10^Y = 10^a x^b$					
Radiolaria:					
$\alpha(3)$	WT	0.58	-0.19	-0.32	49
$\alpha(10)$	WT	0.72	-0.25	-0.30	12
$\alpha(3)$	D ⁺	-0.69	0.42	-0.47	49
$\alpha(10)$	D ⁺	-2.00	-0.87	-0.56	12
$\alpha(3)$	$\Delta\rho(3)$	0.14	-0.42	-0.49	49
$\alpha(10)$	$\Delta\rho(10)$	-0.03	-0.73	-0.63	12
$\alpha(3)$	Re(3)	0.42	-0.23	-0.32	49
$\alpha(10)$	Re(10)	0.58	-0.33	-0.36	12

continued next page

Table 4 (cont.)

Y	X	a	b	r***	Number of taxa used
---	---	---	---	------	------------------------

$$Y = 10^{(bX + a)}$$

Radiolaria:

SS(3)	$\alpha(3)$	1.76	-0.11	-0.11	49
SS(10)	$\alpha(10)$	2.06	-0.13	-0.17	12

Legend:	W:	Width
	L:	Length
	D ⁺ :	Average diameter (L+W)/2 where both L and W are available. If only one of them is available, D ⁺ = L or W.
	PA:	Maximum projected area
	WT:	Weight
	SS(3,10,20):	Sinking speed in still water at 3, 10, 20°C respectively.
	$\alpha(3,10)$:	Residual factor (= W_{obs}/W_{theor}) at 3, 10°C respectively.
	$\Delta\rho(3,10)$:	Bulk density contrast at 3, 10°C respectively.
	Re(3,10):	Reynolds number at 3, 10°C respectively.
	τ_1 :	Residence time computed assuming 3°C - 5 Km water column.
	τ_2 :	Residence time computed assuming 10°C - 800 m, underlain by 3°C - 4200 m still water column.
	τ_3 :	Residence time computed assuming 20°C - 200 m, 10°C - 600 m, and 3°C - 4200 m water column.
	** :	All of the available raw values rather than mean values are used.
	*** :	Computed for the data fit with $\log Y = b \log X + a$.
	* :	Number of specimens used for the relationships between PA and W (35 taxa involved) and PA and L (53 taxa).

Figure 2. Plot of width vs. length for 927 data points of Radiolaria including 58 taxa. Symbols used in Figures 2-13 are: * : One datum point; numerals 2-8 correspond to number of data points superimposed upon; numeral 9: 9 or more of data points superimposed upon.

Figure 3.

Figure 4.

Figure 5.

Figure 6. Plot of projected area vs. length for 724 data points of Radiolaria including 53 taxa. See Figure 2 for the legend of symbols.

Figure 7.

Figure 8.

Figure 9.

Figure 10. Plot of projected area vs. width for 344 data points of Radiolaria including 35 taxa. See Figure 2 for the legend of symbols.

Figure 11.

Figure 12.

Figure 13.

Figure 14. Plot of length vs. weight/shell. Each datum point represents each species. Only representative standard deviations/analytical errors are given to several species for simplicity of the illustration. Symbols used in Figures 14-16, 19, 22-23, 26-29, 41 and 43-44 are: ○: Spumellaria; ■: Nassellaria; and ☆: Phaeodaria.

Figure 15. Plot of width vs. weight/shell. See Figure 14 for the legend of symbols.

Figure 16. Plot of projected area vs. weight/shell. Symbols are basically the same as in Figure 14 but all the open symbols are for observed projected areas and black ones are for computed projected areas.

Figure 17.

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SCATTERGRAM OF (DDAN) LOGDELPH3

Figure 18.

Figure 19. Plot of sinking speed in 3°C still water vs. length. See Figure 14 for the legend of symbols.

Figure 20.

Figure 21.

Figure 22. Plot of sinking speed in 3°C still water vs. width. See Figure 14 for the legend of symbols.

Figure 23. Plot of sinking speed in 3°C still water vs. projected area. The legend of symbols are basically same as in Figure 14. Open and solid symbols represent measured and computed projected area respectively.

Figure 24.

Figure 25.

Figure 26. Plot of sinking speed in 3°C still water vs. weight/shell. See Figure 14 for the legend of symbols.

Figure 27. Plot of sinking speed in 10°C still water vs. weight/shell. See Fig. 2 for the legend of symbols. A representative species in each suborder is illustrated to show relative size, using the same scale, and typical shape: *E. elegans* (Spumellaria); *A. ophirensis* (Nassellaria); and *H. porcellana* (Phaeodaria).

Figure 28. Plot of sinking speed in 20°C still water vs. weight/shell. See Figure 14 for the legend of symbols.

Figure 29. Plot of sinking speed in 3°C still water vs. density contrast, $\Delta\rho$. See Figure 14 for the legend of symbols.

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Figure 30.

$\log (\Delta \rho, \text{g/cm}^3)$

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FILE MEANS (CREATION DATE: 05/01/81)
SCATTERGRAP CF (DOWN) LOGS3

(ACROSS) ALPHA3

Figure 31.

$\frac{W_{\text{obs}}}{W_{\text{theor}}}$

Figure 33. Plot of the residual factor (W_{obs}/W_{theor}) vs. average shell diameter using either (where only one is available) or both (mean where available) length and width. The horizontal dashed line represents theoretical values using Stokes equation. Only 3 different shapes are separated since further divisions do not improve the understanding of sinking speed governing factors. Symbols: ● : spherical group (sphere, ellipsoidal, hemispherical, cylindrical and box in the APPENDIX Table 1); □ : discoidal group (discs and plates); ☆ : Conical group (conical and pyramidal; this group includes only nassellarians).

Figure 34. $\log (\text{Average Diameter } \mu\text{m} \times 10^{-4})^2$

Figure 35. $\log (\text{Weight, } \mu\text{g/shell})$

Figure 36.

Figure 37.

Figure 38.

Figure 39.

Figure 40.

Figure 41. Plot of Reynolds number (Re) vs. average diameter.
See Figure 14 for the legend of symbols.

Figure 42.

Figure 43. Plot of residence time (τ_1) vs. weight/shell.
See Figure 14 for the legend of symbols.

Figure 44. Plot of residence time (τ_2) vs. weight/shell.
 A regression line for τ_3 is almost superimposed upon
 that of τ_2 and hence not drawn here. See Figure 14 for
 the legend of symbols. Additional symbols used:
 ○: Spumellarian τ_3 ; ■: Nassellarian τ_3 ;
 ★: Phaeodarian τ_3 .

Figure 47.

Figure 48.

Figure 49.

Figure 50.

Figure 51.

Figure 52.

Figure 53.

Figure 54.

Figure 55.

Figure 57.

Figure 58.

Figure 59.

Figure 60.

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Figure 100.

Figure 101.

Figure 102.

Figure 103.

Figure 104.

Figure 105.

Figure 106.

Figure 107.

Figure 108.

Figure 111.

Figure 112.

APPENDIX

Table 1. Formulae for computed projected area and bulk volume computations.

	Shape	Computed maximum projected area, CPA	Bulk volume, V_b	Thickness h (μm)	Assumed thickness, h
SPUMELLARIA					
1. <i>Acrosphaera murrayana</i> (Haeckel)	Sphere	$\pi (L/2)^2$	$(4/3) \pi (L/2)^3$		
2. <i>Actinomma arcadophorum</i> Haeckel	Sphere	$\pi (L/2)^2$	$(4/3) \pi (L/2)^3$		
3. <i>Amphirhopalum ypsilon</i> Haeckel	Rectangular plate		PA.h		L/10
4. <i>Cladococcus scoparius</i> Haeckel	Sphere (thorny)	$\pi (L/2)^2$	$(4/3) \pi (L/2x3)^3$		
5. <i>Dictyocoryne profunda</i> Ehrenberg	Triangular plate	$(L^2/2) 1.05$	CPA.h		L/4
6. <i>Dictyocoryne profunda</i> Ehrenberg	Triangular plate		CPA.h		L/4
7. <i>Dictyocoryne truncatum</i> (Ehrenberg)	Triangular plate	$(L^2/2) 1.3$	CPA (2/3) h	130	
8. <i>Euchitonias elegans</i> (Ehrenberg)	Triangular plate		PA.h	40	
9. <i>Heliodiscus asteriscus</i> Haeckel	Discoideal plate		CPA.h		L/4
10. <i>Myelastrum quadrifolium</i> Takahashi	Discoideal plate		PA.h		L/10
11. <i>Myelastrum trinibrachium</i> Takahashi	Discoideal plate		PA.h		L/10
12. <i>Saturnalis circularis</i> Haeckel	Discoideal plate		CPA.h		L/6
13. <i>Spongaster tetras tetras</i> Ehrenberg	Saturn-like	$((L+W)/4)^2 \pi 0.324$	CPA.h		L/4
14. <i>Spongocore cylindrica</i> (Haeckel)	Quadrat plate	L^2	$\pi (W/2)^2 L$		
15. <i>Spongodiscus biconcavus</i> (Haeckel) >270 μm	Cylinder				
16. <i>Spongodiscus biconcavus</i> (Haeckel) <270 μm	Discoideal plate	$\pi (L/2)^2$	CPA.h		L/4
17. <i>Spongospaera polycantha</i> Müller	Discoideal plate	$\pi (L/2)^2$	CPA.h		L/4
18. <i>Spongospaera</i> sp. aff <i>S. helioides</i> Haeckel	Sphere	$\pi (L/2)^2$	$(4/3) \pi (L/2)^3$		
19. <i>Spongostrochus glacialis</i> Popofsky	Sphere	$\pi (L/2)^2$	$(4/3) \pi (L/2)^3$		
NASSELLARIA					
30. <i>Acanthodesmia vinculata</i> (Müller)	Discoideal plate		CPA.h		L/4
31. <i>Androsipyris reticulidiscus</i> Takahashi	Ellipsoid	$(4/3) \pi (L/2)^2 W/2$	PA.h		
32. <i>Anthocytartidium ophirensis</i> (Ehrenberg)	Discoideal plate		$(1/3) \pi (1.1W/2)^2 L$		
33. <i>Anthocytartidium zanguebaricum</i> (Ehrenberg)	Pseudo-cone		$(1/3) \pi (1.1W/2)^2 L$		
34. <i>Callimitra annae</i> Haeckel	Pseudo-cone		$(1/3) (W/2) L$		
35. <i>Callimitra emmae</i> Haeckel	Pyramid		$(1/3) (W/2) L$		
36. <i>Carpocanistrum</i> spp.	Pyramid		$(1/3) (W/2) L$		
37. <i>Cephalospyris cancellata</i> Haeckel	Pseudo-sphere	$\pi ((L+W)/4)^2$	$(4/3) \pi ((L+W)/4)^3$		
38. <i>Conicavus tipiopsis</i> Takahashi	Cone		$(1/3) \pi (W/2)^2 L$		

APPENDIX Table 1. (Cont.)

	Shape	Computed maximum projected area, CPA	Bulk volume, V_b	Thickness h (μm)	Assumed thickness, h
39. <i>Cornutella profunda</i> Ehrenberg	Cone		$(1/3)\pi(W/2)^2 L$		
40. <i>Dictyocodon elegans</i> (Haeckel)	Pseudo-cone		$(1/3)\pi(1.1W/2)^2 h$		8L/10
41. <i>Eucecryphalus tricostratus</i> (Haeckel)	Cone	$\pi(L/2)^2$	$(1/3)\pi(L/2)^2 h$		
42. <i>Eucyrtidium acuminatum</i> (Ebg)+ <i>hexagonatum</i> Hk1	Pseudo-cone		$(1/3)\pi(1.1W/2)^2 L$		
43. <i>Lamprocyclas maritima</i> Haeckel	Pseudo-cone		$(1/3)\pi(1.1W/2)^2 L$		
44. <i>Liriospyris thorax</i> (Haeckel)	Rectangular box		PA.h		7L/10
45. <i>Lithostrobus hexagonalis</i> Haeckel	Pseudo-cone		$(1/3)\pi(1.1W/2)^2 L$		
46. <i>Lophospyris pentagona</i> (Ehrenberg)	Rectangular box	$\pi((L+W)/4)^2$	CPA.h		8L/10
47. <i>Nephrospyris renilla</i> Haeckel	Discoidal plate		PA.h		L/6
48. <i>Pterocorys zancleus</i> (Mlr) + <i>campanula</i> Hk1	Pseudo-cone		$(1/3)\pi(1.1W/2)^2 L$		
49. <i>Spiroclyrtis scalaris</i> Haeckel	Pseudo-cone		$(1/3)\pi(1.1W/2)^2 L$		
PHAEODARIA					
80. <i>Castanellids</i> from E	Sphere	$\pi(L/2)^2$	$(4/3)\pi(L/2)^3$		
81. <i>Castanellids</i> from PB	Sphere	$\pi(L/2)^2$	$(4/3)\pi(L/2)^3$		
82. <i>Castanellids</i> from PB <300 μm					
83. <i>Castanellids</i> fragments					
84. <i>Castanidium abundiplanatum</i> Takahashi	Sphere	$\pi(L/2)^2$	$(4/3)\pi(L/2)^3$		
85. <i>Challengeria tizardi</i> Murray	Ellipsoid		$(4/3)\pi(L/2)(W/2)(L/4)$	L/2	
86. <i>Challengeron willenoesii</i> Haeckel	Ellipsoid		$(4/3)\pi(L/2)(W/2)^2 8/10$		
87. <i>Challengeron lingi</i> Takahashi	Ellipsoid	$\pi(W/2)^2 1.2$	$(4/3)\pi(L/2)(W/2)^2 5/10$		
88. <i>Challengerosium avicularia</i> Haecker	Ellipsoid	$\pi(W/2)^2$	$(4/3)\pi(W/2)(6W/20)(11W/20)$	6W/10	
89. <i>Circoporus oxycanthus</i> Borgert	Sphere	$\pi(L/2)^2 1.2$	$(4/3)\pi(L/2)^3$		
90. <i>Conchidium argiope</i> Haeckel	Hemi-ellipsoid		$(4/3)\pi(L/2)(W/2)^2 1/2$		
91. <i>Conchellium capsula</i> Borgert	Hemisphere	$\pi(L/2)^2$	$(4/3)\pi(L/2)^3 1/2$		
92. <i>Conchopsis compressa</i> Haeckel	Ellipsoid		$(4/3)\pi(L/2)^2(1/4)$		
93. <i>Euphysetta elegans</i> Borgert	Sphere		$(4/3)\pi(W/2)^3$		
94. <i>Haeckeliana porcellana</i> Haeckel	Sphere		$(4/3)\pi(L/2)^3$		
95. <i>Protocystis sloggetti</i> (Haeckel)	Triangular plate/ellipsoid		PA.h or $(4/3)\pi(L/2)(W/2)^2 6/10$		W/2
96. <i>Protocystis murrayi</i> (Haeckel)	Sphere	$\pi(W/2)^2 1.2$	$(4/3)\pi(W/2)^3$		
97. <i>Protocystis curva</i> Takahashi	Ellipsoid		$(4/3)\pi(L/2)(W/2)^2 6/10$		6W/10
98. <i>Protocystis honjoi</i> Takahashi	Ellipsoid	$\pi(W/2)^2 1.15$	$(4/3)\pi(W/2)^2(W/2)(6/10)$		

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