A field investigation of the Foraminifera of Pitcairn and nearby islands

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Preliminary examination of the collections

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This document provides preliminary observations of the specimens collected on Pitcairn Island and four islands of the Gambier Group (Mangareva, Akamaru, Mekiro, and Tauna). It is a working draft, and is updated on a regular basis. For the current version, please contact the any of the authors.

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Contents

The Collections

During May-June 2018, collections of sand and algae were made at Pitcairn Island, and at four islands in the Gambier Group: Mangareva, Akamaru, Mekiro, and Tauna.

There were 11 collections from Pitcairn and 9 from the Gambier Group. Each collection was about 500 cc. The individual collections were air-dried for several days, then individually packed in Ziplock bags. A small number of algal specimens were kept wet in alcohol.

Collections being processed on Pitcairn Island.

The Photos of collection <006> below were taken with Canon macro lens during the drying period. In the second image we have circled some of the identifiable forams (ca. 1 mm dia.) in this collection.

Once the collection was completely dry, a preliminary examination was made using the USB_Digital field microscope, after which the collection was packaged in ziplock bags for transport to the laboratory in Califonira.

The collections are listed in **Table 1** (there is no collection <012>).

Table 1 – List of the collections

Collection	Island	Location	Latitude	Longitude	Depth*	Date
<001>	Pitcairn	New Dock	-25.062532	-130.115955	(2)	5/24/2018
<002>	Pitcairn	Down Cabin	-25.064795	-130.119971	1	5/24/2018
<003>	Pitcairn	St. Paul's Pool	-25.075189	-130.088732	2	5/25/2018
<004>	Pitcairn	Bounty Bay Landing	-25.068654	-130.09613	1	5/25/2018
<005>	Pitcairn	Sandy Harbor	-25.065729	-130.121438	1	5/25/2018
<006>	Pitcairn	Claymore 28 m depth	-25.064653	-130.090858	28	5/26/2018
<007>	Pitcairn	Sandy Harbor	-25.065729	-130.121438	1	5/26/2018
<008>	Pitcairn	St. Paul's Pool	-25.075189	-130.088732	1	5/28/2018
<009>	Mangareva	Main Dock #1	-23.1175361	-134.968888	5	5/29/2018
<010>	Mangareva	Main Dock #2	-23.118161	-134.968611	5	5/29/2018
<011>	Mangareva	Main Dock #3	-23.117717	-134.968888	3	5/29/2018
<012>						
<013>	Mangareva	Main Dock #4	-23.117717	-134.968888	2	5/29/2018
<014>	Pitcairn	Bounty Bay Pier	-25.068654	-130.09613	2,(1)	5/28/2018
<015>	Pitcairn	Bounty Bay Landing	-25.068654	-130.09613	2	5/28/2018
<016>	Pitcairn	Down Isaacs	-25.064467	-130.099961	1	5/31/2018
<017>	Mangareva	Beach	-23.108017	-134.963049	0	6/8/2018
<018>	Akamaru	Beach roadhead	-23.179664	-134.914203	0	6/9/2018
<019>	Mekiro	Multiple beaches	-23.175918	-134.920554	(0-1)	6/9/2018
<020>	Tauna	Sand spit & beach	-23.147952	-134.851485	1	6/9/2018
<021>	Mangareva	Beach	-23.108017	-134.963049	1-2	6/11/2018

*Depths are in m. (y) indicates above sea level.

All collections on Pitcairn were done by hand in the field by R. W. Schmieder, F. Belton, and S. Christian, with the exception of <006>, which was done by the crew of the vessel Claymore II using a Peterson grab. Collections <009>, <010>, <011>, and <013> were done on Mangareva (near the main dock) by the crew of the Claymore II, and delivered to the authors at Pitcairn a few days later.

Procedures

Separations of the collections

Upon return to the lab in California, the collections were distributed into 28 jars:

In some cases, the original collections <0nm> were divided into sub-collections, e.g., <019>→<019a>+<019b>, which in turn might be divided further. The jars are listed in **Table 2** (for Pitcairn) and **Table 3** (for the Gambier Group). In the tables, fractions indicate the fractional fill of the jar (e.g., ⅓ == ⅓ full). Due to ongoing processing of the collections, these jar names may change. The convention for extending these collections will be <collection or sub-collection).(slide or vial number)>, i.e., <0nm>→<0nmabcd…>. Thus, we might have <019>→<019bac.s05>, etc. A separation of a vial would be written <019b.v01a>, etc.

Slides

For some collections, forams were extracted onto a microscope slide. These are indicated in the text as **<0nm.spq>**, where **0nm** is the collection number, **s** = "slide", and **pq** is the sequential number of the slide for that collection. Example: **<016.s01>**.

Vials

For some collections, forams were extracted into a vial. These are indicated in the text as **<0nm.spq>**, where **0nm** is the collection number, **v** = "vial", and **pq** is the sequential number of the slide for that collection. Example: **<006.v01>**.

Microscopy

The microscopic examinations were done using very small samples from the collections; typically about 0.5 cc. Before examination, the collection was hand-mixed, although probably not completely. Unless otherwise noted, the samples were not washed. By far the emphasis was on capturing images of forams, but a few images of gastropods and other objects were also taken when there seemed to be a relatively high number in the collection or a particularly interesting object was found. In some cases, some of the forams (but by no means all) were extracted to slides or vials. After the examination, the sample was returned to the collection.

Selected specimens were examined while on Pitcairn using the **USB_Digital** microscope, connected to a laptop running the software MicroCapture. Initially, the screen images of the laptop display were captured with the iPhone or the Canon 35 mm camera. After the first day, the software was used to save a .jpg file with an automatically-generated filename constructed from the DateTime. For instance, DateTime 2018 May 30 12:57:55127 → FileName 18531125755127. [But note that the date is 1 day off; the filename should have been 18530125755127.

A total of 110 images were saved; they are listed in **Table 10** (appendix), arranged as follows:

Collection	Location	Filename [.jpg]	Size [byte]	Date
<002>	**Pitcairn Down Cabin**	18531125755127	2,790,576	5/30/2018 12:57
<002>		18531131327548	3,044,763	5/30/2018 13:13

After return from the expedition, the microscopy was done with the **AmScope 5M-2TZ-LED-5M** microscope. In addition to the **1X** objective, two Barlow lenses were used with the objective: **0.5X** and **2X**. In many (but not all) images, a 1 mm square grid is in the background. The zoom ratio of the microscope is 6.4:1. Typically, the zoom was used to optimize the image, but no attempt was made to calibrate the zoom, other than the 1 mm grid.

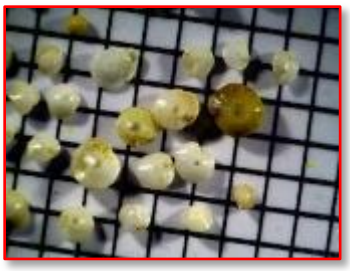
Photographs and notes

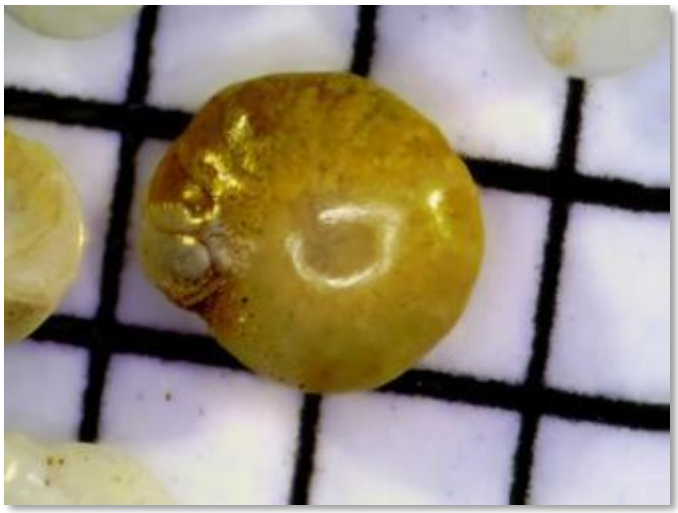
An entry such as <002> indicates that the examination was made before the collection <002> was divided into sub-collections <002a> and <002b>, and therefore generally it is not known whether a particular object was recorded and subsequently moved to a particular sub-collection.

The screenshots and USB_Digital images are generally printed small (1” high) in this document. Some of these images (identified with a red boundary) are also printed enlarged and/or enhanced.



The images taken with the AmScope microscope generally are printed larger (typically 2” high). As with the USB_Digital images, selected images (marked with a red boundary) were cropped and processed using various filters (brightness, contrast, sharpening, etc.), and presented immediately following the original image (see below).





With the AmScope microscope, the technique of Enhanced Depth of Focus (EDF) was used when the specimen height was greater than the depth of focus. In EDF, the microscope focus is scanned, and multiple successive images (ca. 5-20) are taken; the software then stitches these images into a single image of greater depth of focus. The exact conditions, number of images, and options in the stitching procedure were not recorded. The best image obtained was included in this document.

Identifications

The microscopy and initial identifications were done by R. W. Schmieder using the microscopes and printed images. Additional identifications were made by M. McGann from the printed images.

The images in this document are meant to be samples rather than quantitative measures. The images are of varying quality. No attempt was made to record relative counts or standardize the images. The goal of this preliminary examination was to obtain a general idea of the contents of the collections, hence the emphasis was on diversity; that is, anything relatively interesting, with strong bias for forams, was recorded.

Pitcairn Island

Environment

To a great extent, Pitcairn Island is ringed by high-energy surf, an environment not optimal for foraminiferans. There are a few spots that have relatively calm water, mostly as tide pools.

The Bounty Bay Landing site is usually calm inside the concrete harbor, although intermittently it is subject to high waves.

The St. Paul's Pool site is washed by incoming flooding from breakers outside the pooling area, but is generally calm (but flowing) inside the pool.

The other four coastal sites, Sandy Harbor, Down Cabin, New Dock, and Down Isaacs, have nearly continuous high-energy surf that fills and washes the chaotic volcanic beachfront.

The collection done by the Claymore II (<006>) was at 28 m depth, which is generally calm, using a Peterson Grab.

Bounty Bay

St. Paul's Pool

Down Isaacs

Sandy Harbor

The collections

Table 2 – Listing of the collection jars from Pitcairn Island

Collection	Key	Jar	Fill	Description	Location	Waypoint
<001>	SP_001	**<001>**	1	very fine sand	New Dock	WP_014
<002>	SP_002a	**<002a>**	½	mixed sand	Down Cabin	WP_015
<002>	SP_002a	**<002b>**	½	mixed sand	Down Cabin	
<003>	SP_003	**<003>**	½	mixed sand	St. Paul's Pool	WP_017
<004>	SP_004a	**<004a>**	½	mixed sand	Bounty Bay Landing	WP_020
<004>	SP_004b	**<004b>**	⅔	coarse sand	Bounty Bay Landing	
<005>	SP_005a	**<005a>**	¾	fine sand	Sandy Harbor	WP_022
<005>	SP_005b	**<005b>**	1	fine sand	Sandy Harbor	
<005>	SP_005c	**<005c>**	½	fine sand	Sandy Harbor	
<006>	SP_006	**<006>**	$^{1}/_{10}$	fine sand, rocks	Claymore 28 m depth	WP_0X2
<007>	SP_007	**<007>**	1	shells	Sandy Harbor	WP_022
<008>	SP_008	**<008>**	1	algae, 2 vials (ALCH)	St. Paul's Pool	WP_017
<014>	SP_014a	**<014a>**	1	algae dry	Bounty Bay Pier	WP_020
<014>	SP_014b	**<014b>**	⅓	algae dry	Bounty Bay Pier	
<014>	SP_014c	**<014c>**	$^{1}/_{10}$	very fine sand, 2 vials (ALCH)	Bounty Bay Pier	
<015>	SP_015	**<015>**	1	algae, 2 vials (ALCH)	Bounty Bay Landing	WP_020
<016>	SP_016	**<016>**	¾	fine sand (large jar)	Down Isaacs	WP_0X1

The collection name <0nm> and the corresponding key SP_0nm are synonyms. The jar names <0nmabc…> are unique.

The coordinates of the collections are listed in Table 1 and the coordinates of the waypoints are listed in Table 9 (Appendix).

Preliminary examinations

The USB_Digital images were taken onsite Pitcairn and Mangareva Islands, while the Amscrope images were taken in the laboratory in Walnut Creek, CA, after return from the trip.

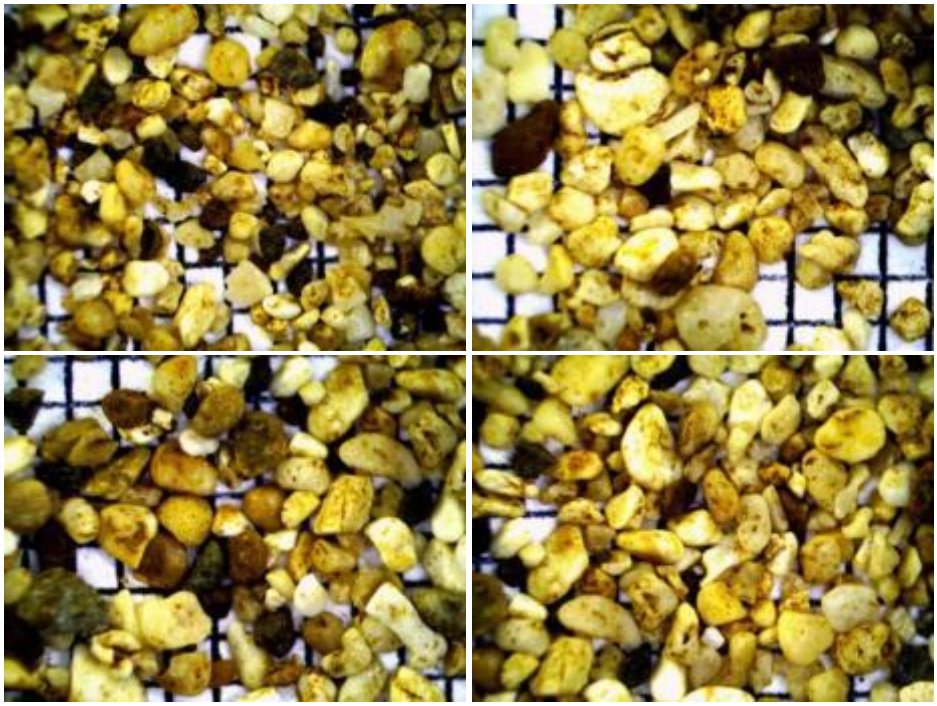
<001> SP_001 **Pitcairn Tedside New Dock** USB_Digital microscope Canon screenshot

	A	B	C	D
1				
2				
3				

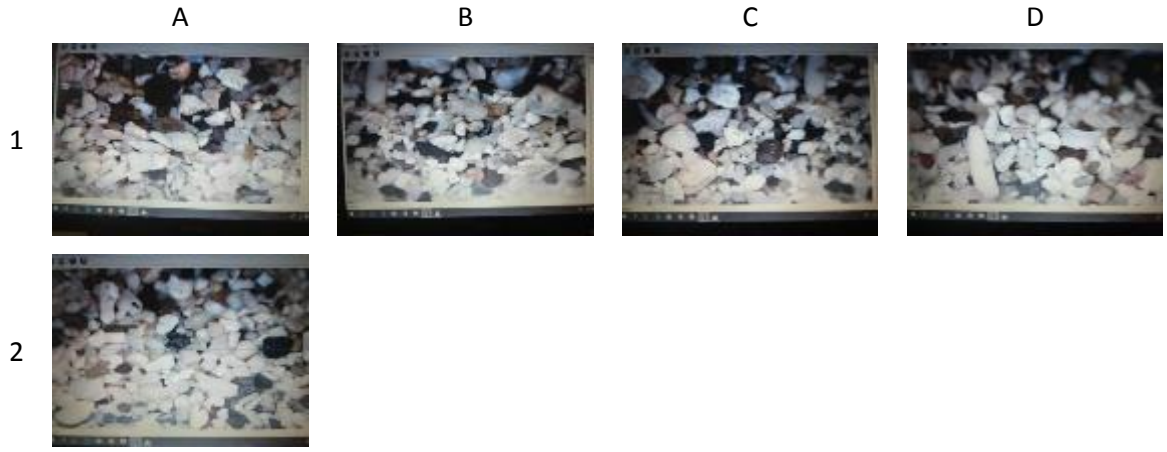
<002> SP_002 **Pitcairn Tedside Down Cabin** USB_Digital microscope

	A	B	C	D
1				

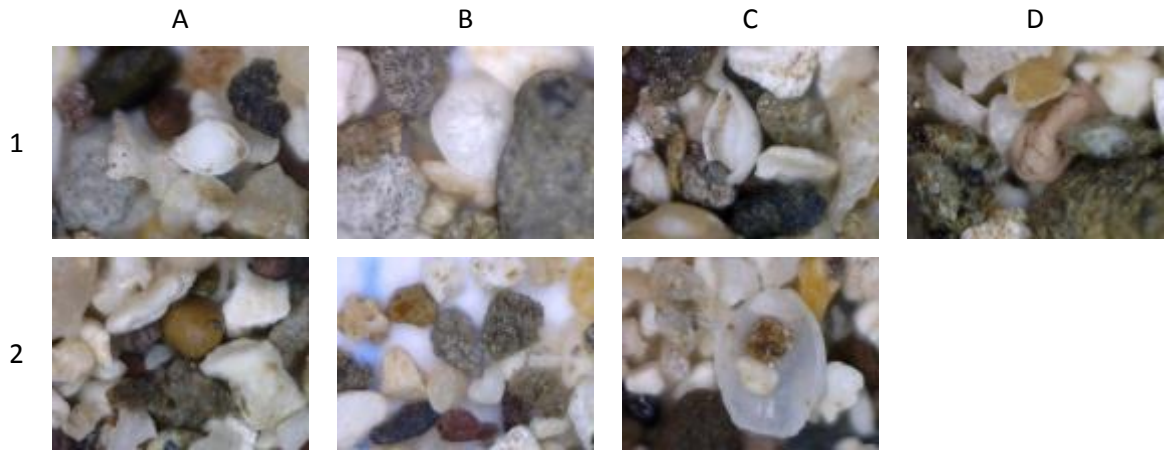
<002b> SP_002b **Pitcairn Tedside Down Cabin** AmScope **1X**



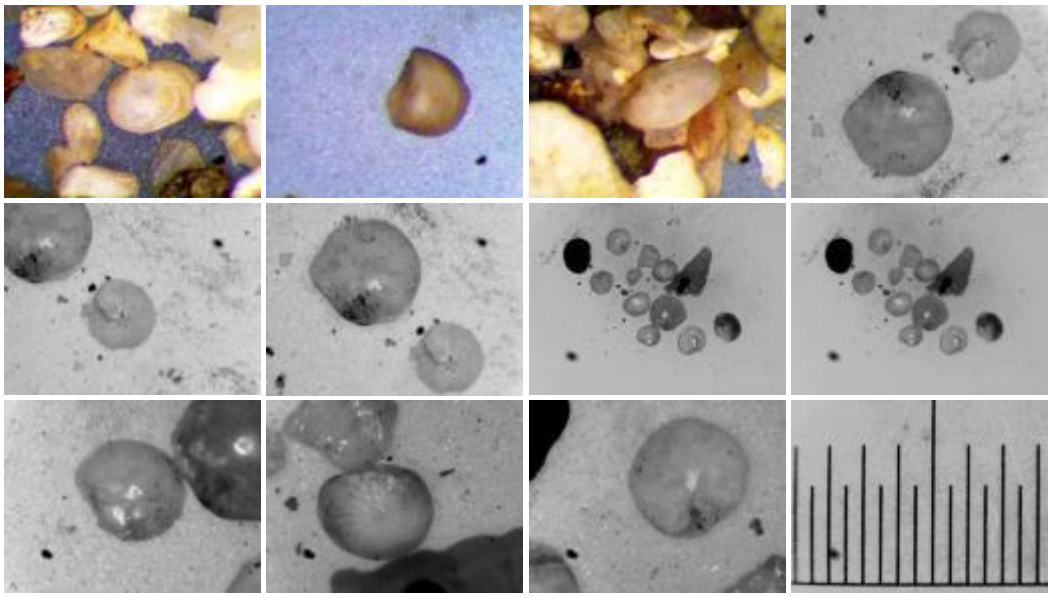
<003> SP_003 **Pitcairn St. Paul's Pool** USB_Digital microscope Canon screenshot



<004> SP_004 **Pitcairn Bounty Bay** USB_Digital microscope



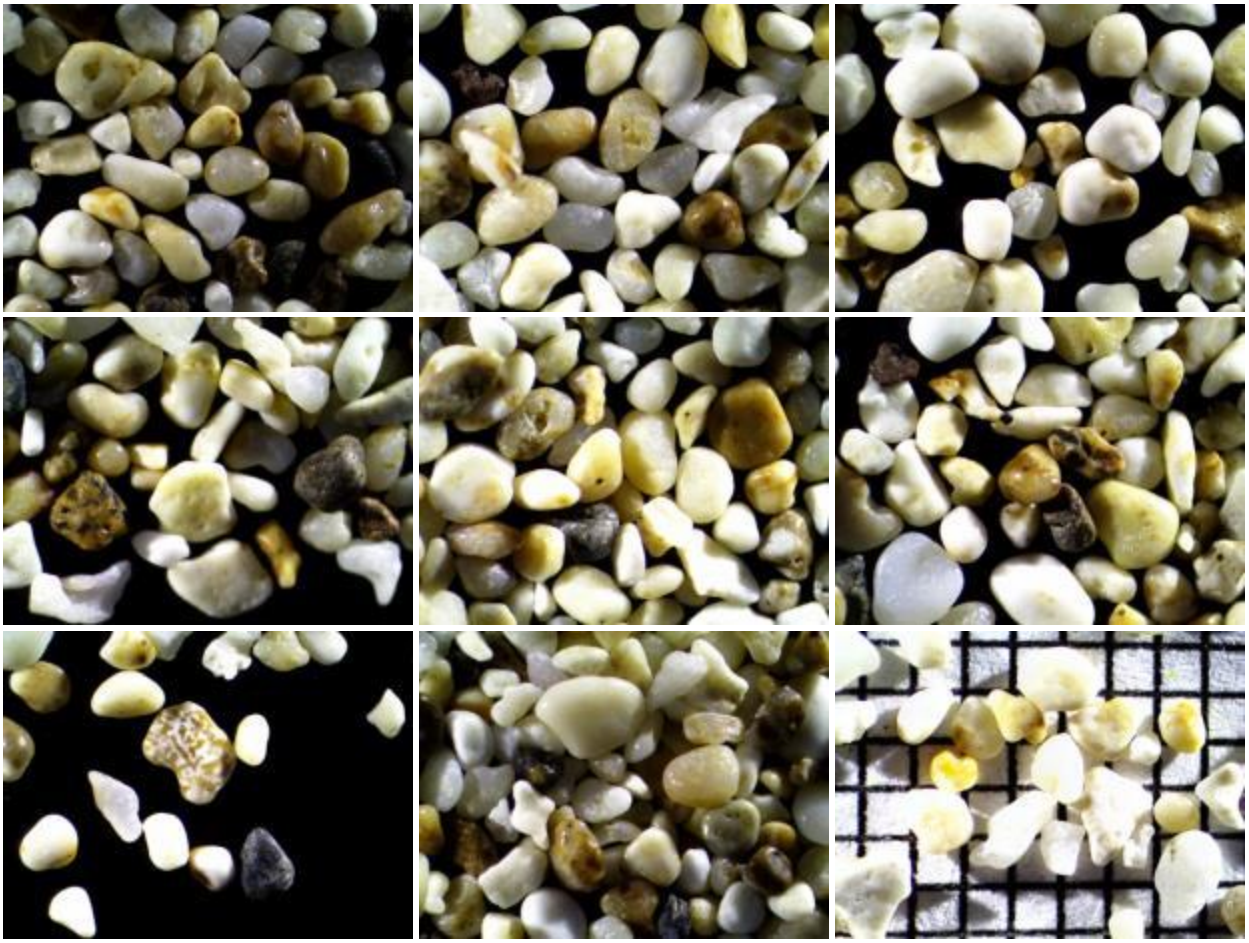
<004> SP_004 **Pitcairn Bounty Bay** AmScope microscope (before rebuild)



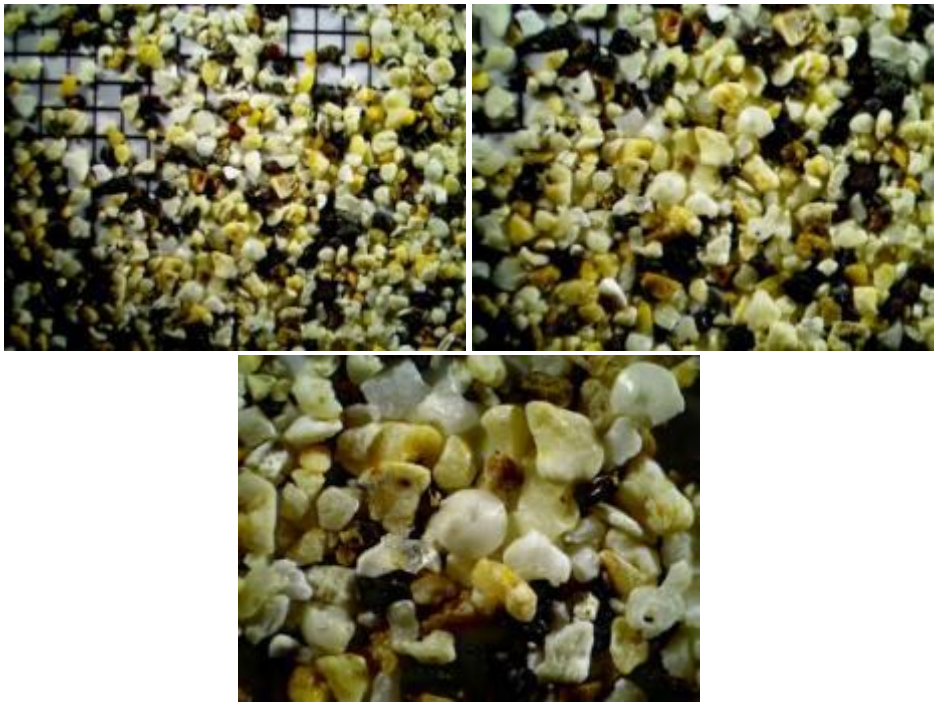
<004> SP_004 **Pitcairn Bounty Bay** Canon camera macro lens

<005a> SP_005a **Pitcairn Sandy Harbor** AmScope **2X**

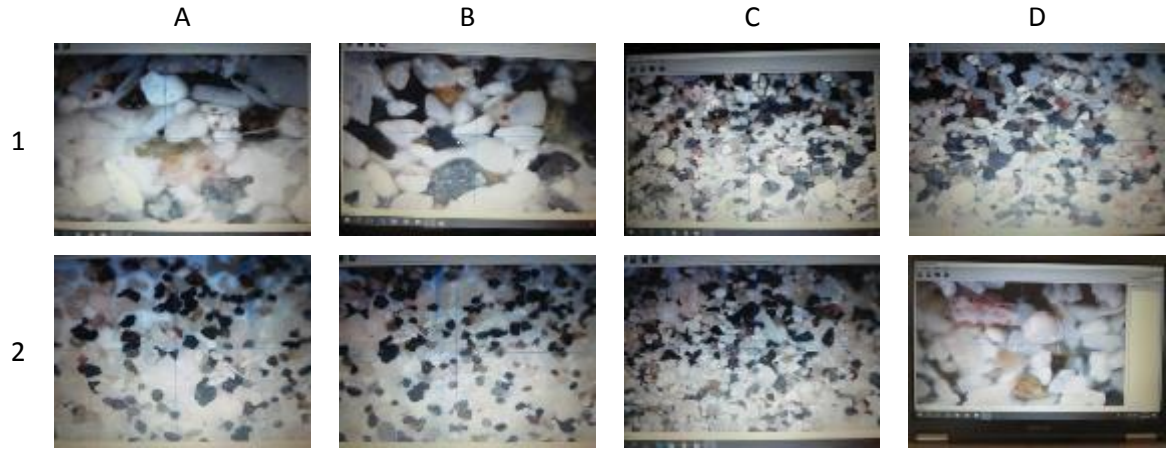
Very few forams in this jar. Mostly polished fine sand.



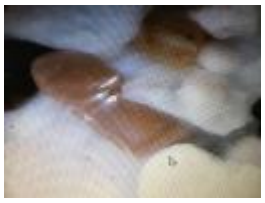
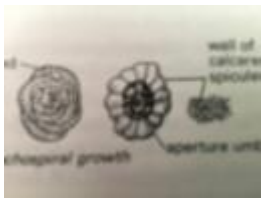
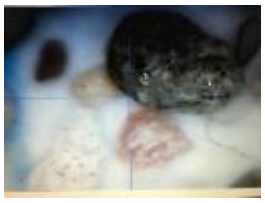
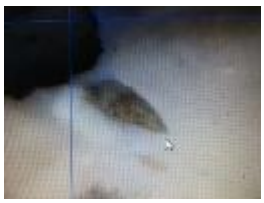
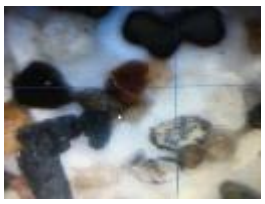
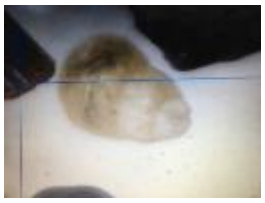
<006> SP_006 **Pitcairn Claymore anchorage 28 m** AmScope **1X** (second examination)



<014> SP_014 **Pitcairn Bounty Bay Pier** USB_Digital microscope Canon screenshots



<014> SP_014 **Pitcairn Bounty Bay Pier** USB_Digital microscope iPhone screen shots

	A	B	B	D
1				
2				
3				
4				
5				
6				
7				

8

9

10

11

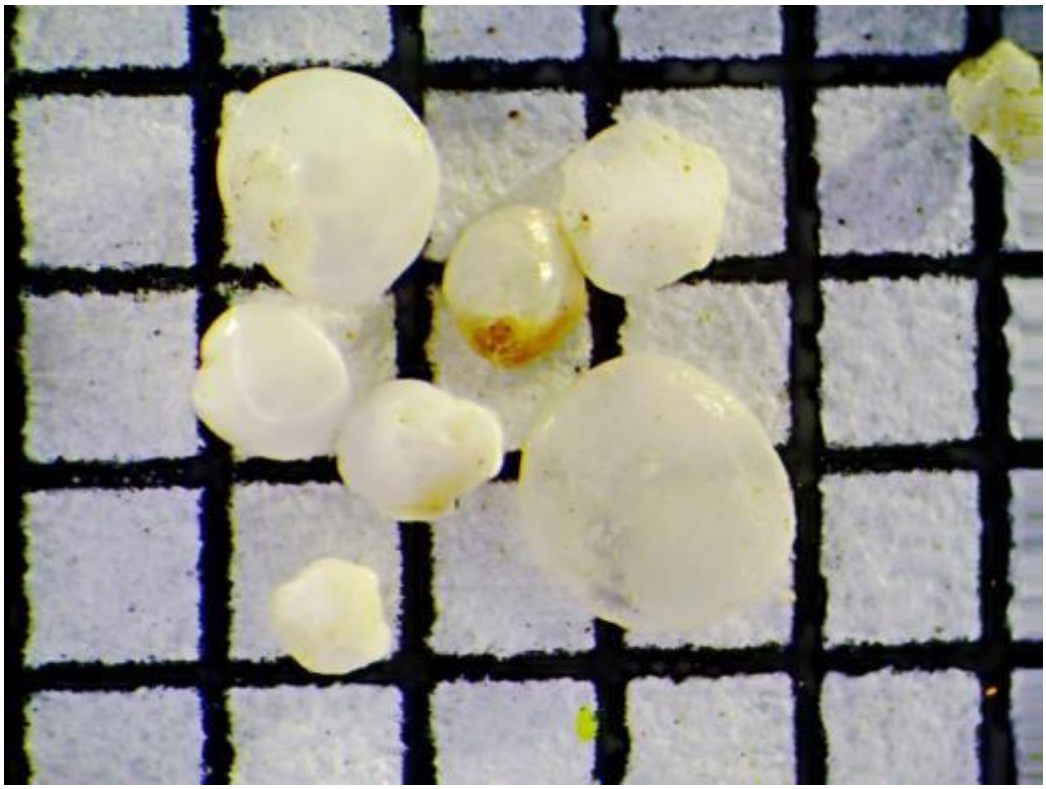
<014> SP_014 **Pitcairn Bounty Bay Pier** USB_Digital microscope

	A	B	C	D
1				
2				
3				

<016> SP_016 **Pitcairn Down Isaacs** UDB_Digital microscope

	A	B
1		

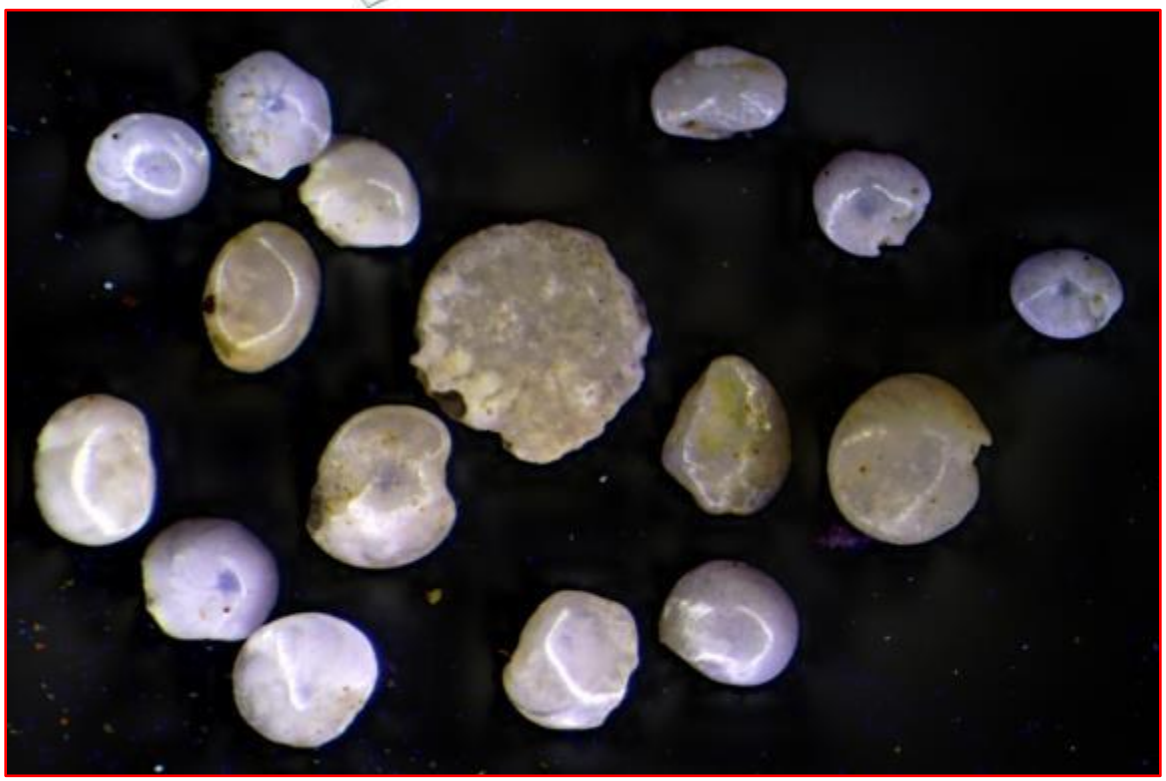
<001> SP_001 **Pitcairn Tedside New Dock** AmScope microscope **2X [Slide <001.s01>]**

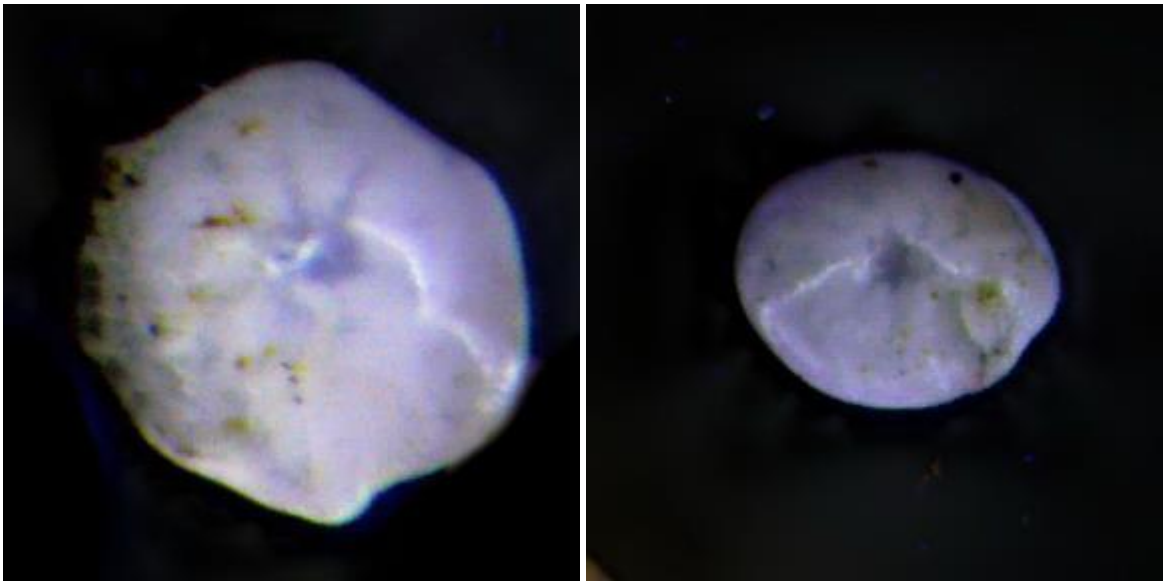


Grid 1 mm

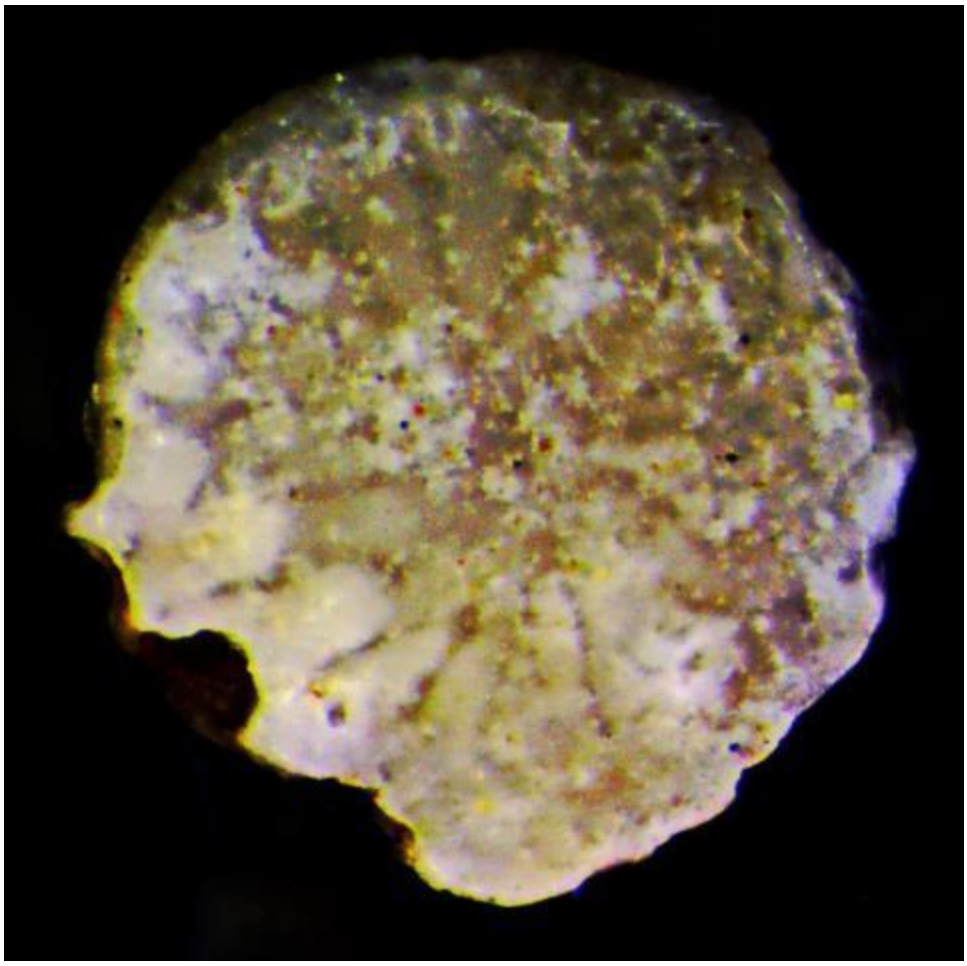
<001> SP_001 **Pitcairn Tedside New Dock** AmScope microscope **2X** (con't)

[Slide <001.s01>]

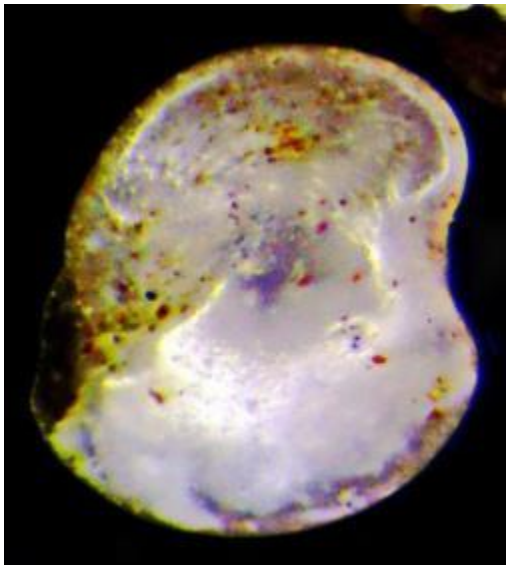




(above 2 images) Amphistegina sp.

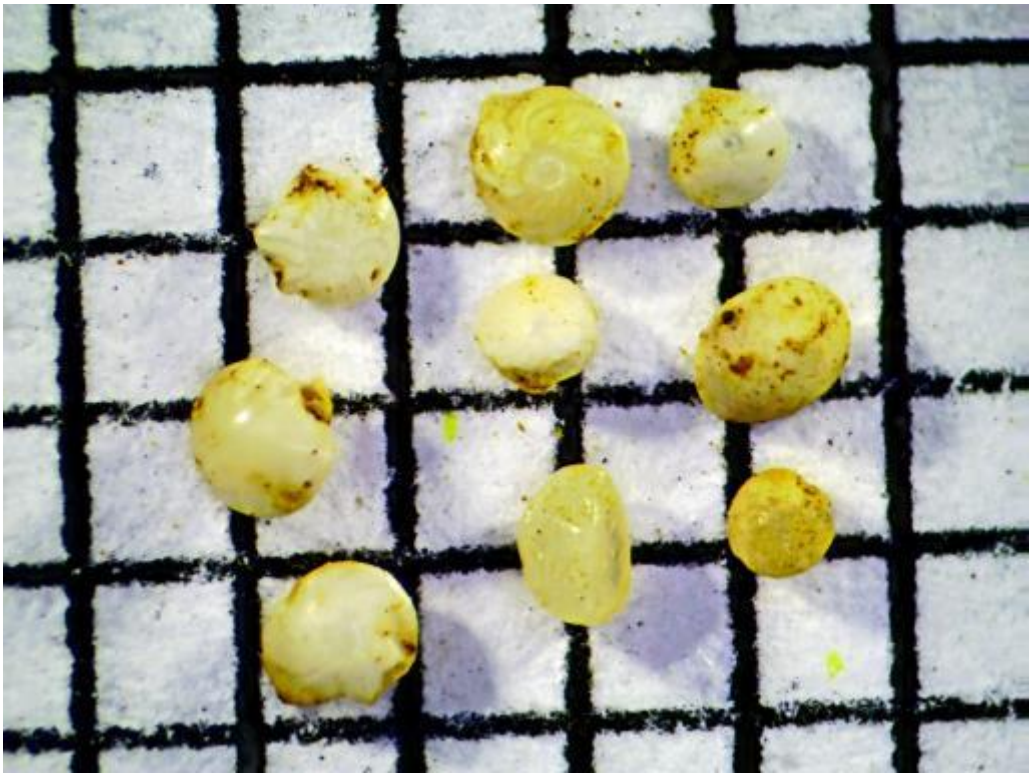


Heterostegina depressa

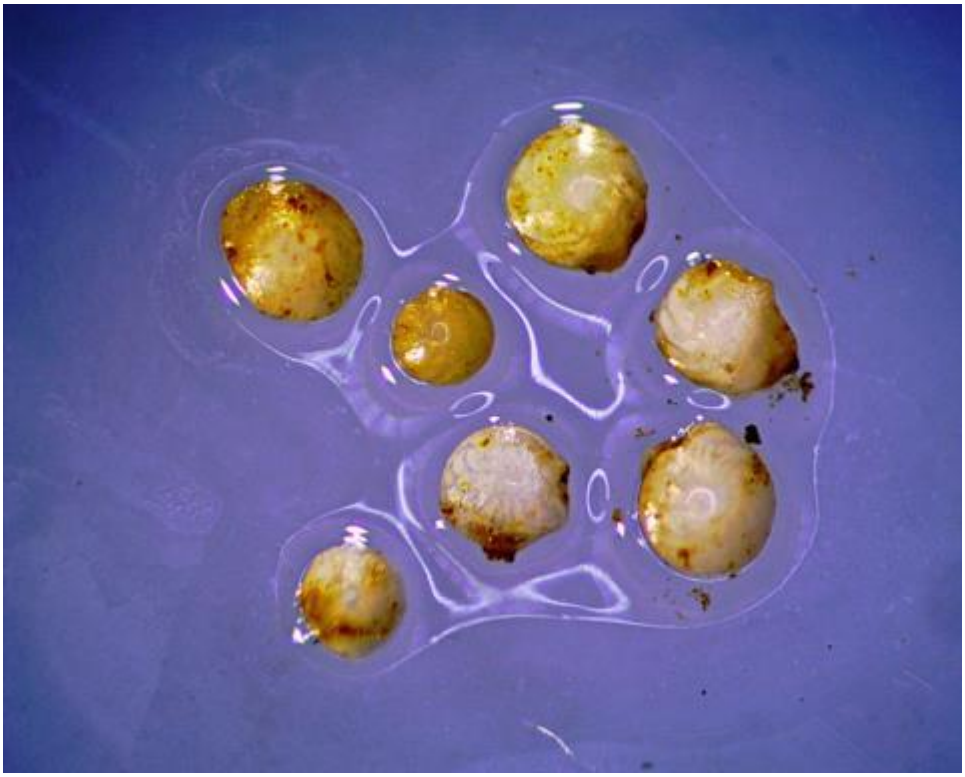


Unknown

<002b> SP_002b **Pitcairn Tedside Down Cabin** AmScope **1X (con't)**

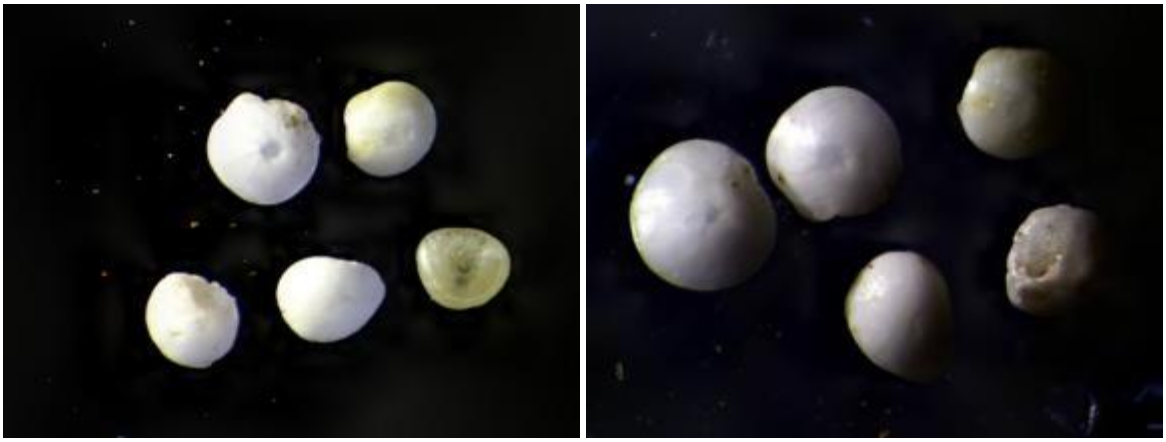


Mostly *Amphistegina* sp. [Grid 1 mm] This array was moved to slide <002.s01> (below)



[Slide <002b.s01>]

<003> SP_003 **Pitcairn St. Paul's Pool** AmScope microscope **2X**

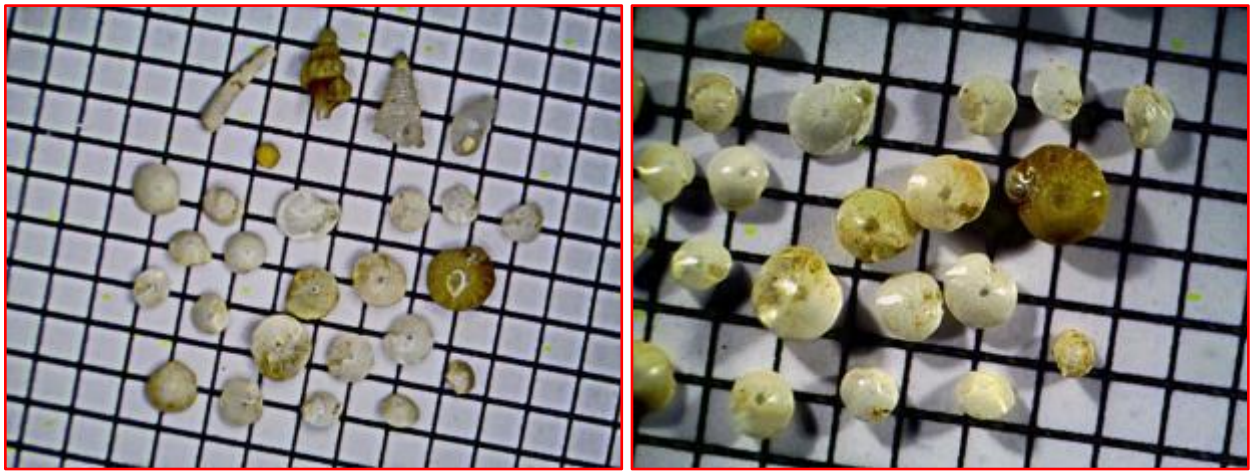


(above right) Mostly *Amphistegina* sp.

<003> SP_003 **Pitcairn St. Paul's Pool** AmScope microscope **2X**

The 8 images below are from a separate examination. These were held in #35 mesh (500 micron)

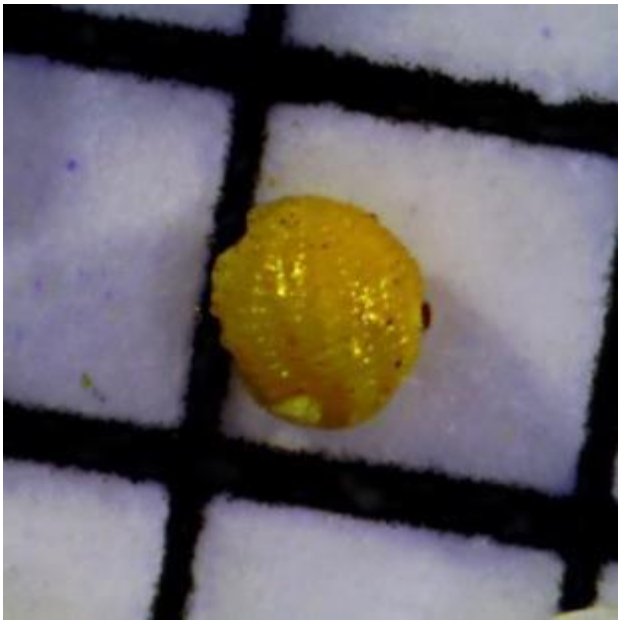
All specimens in the 8 images below were saved in vial <003.v01>.



Original image

Enlargement of previous image

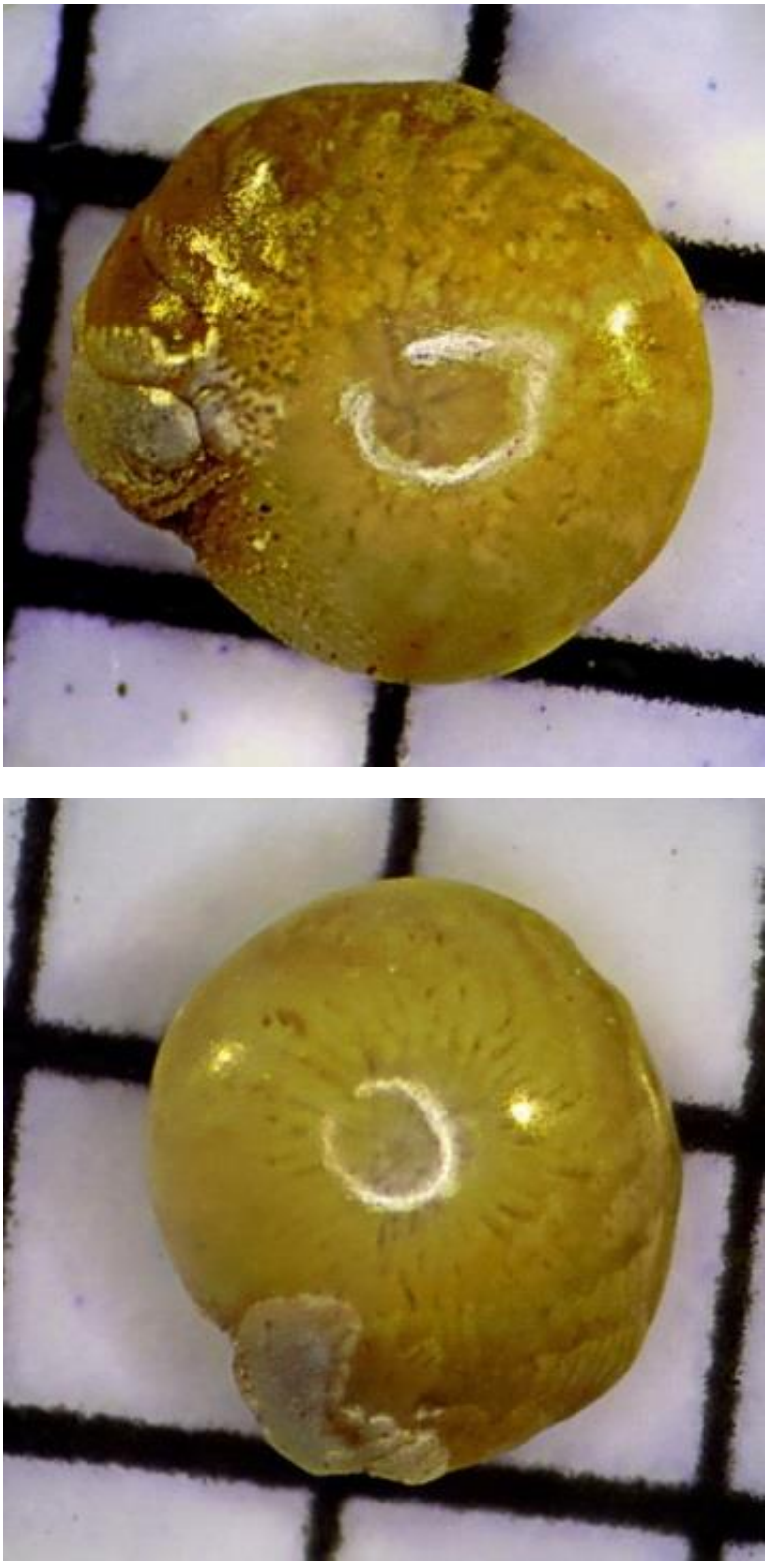
Details of above two images



Borealis melo?

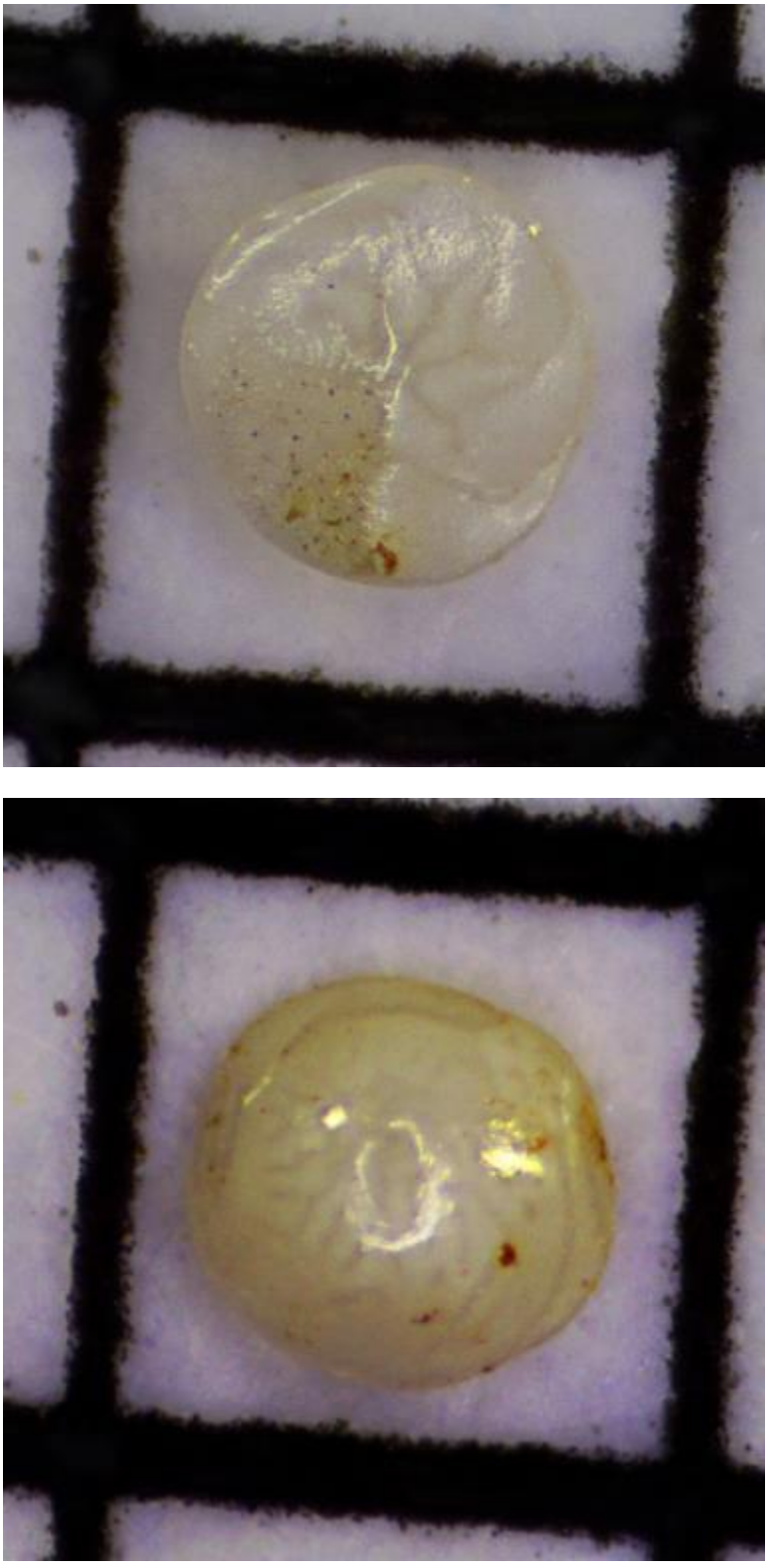
Heterostegina depressa

<003> (con't) Dorsal and ventral images of one individual (saved in vial <003.v01>)



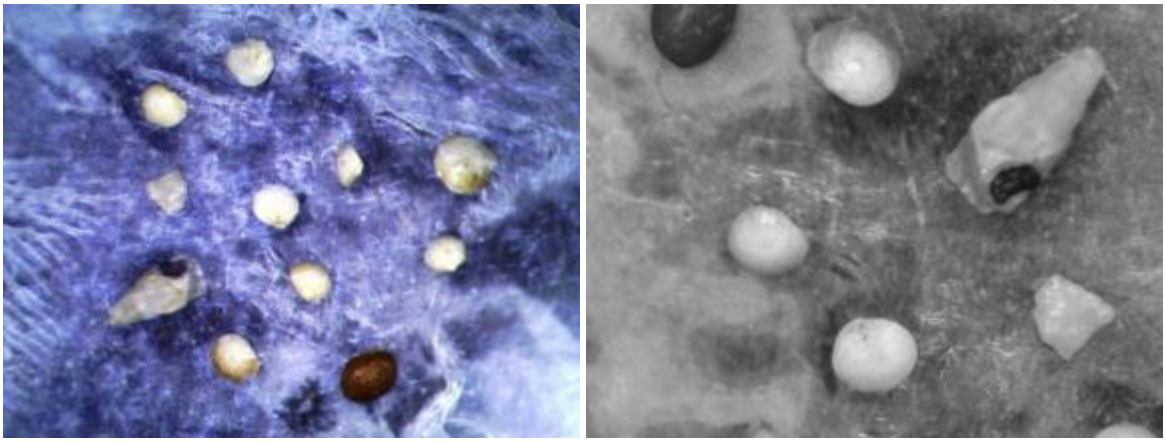
Amphistegina sp.

<003> (con't) Dorsal and ventral images of one individual (saved in vial <003.v01>)

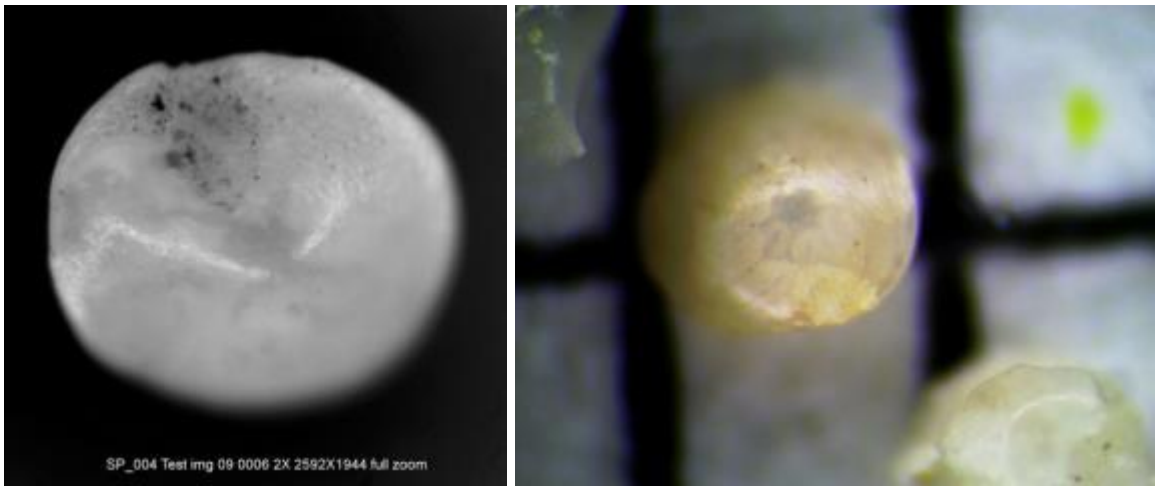


Amphistegina sp.

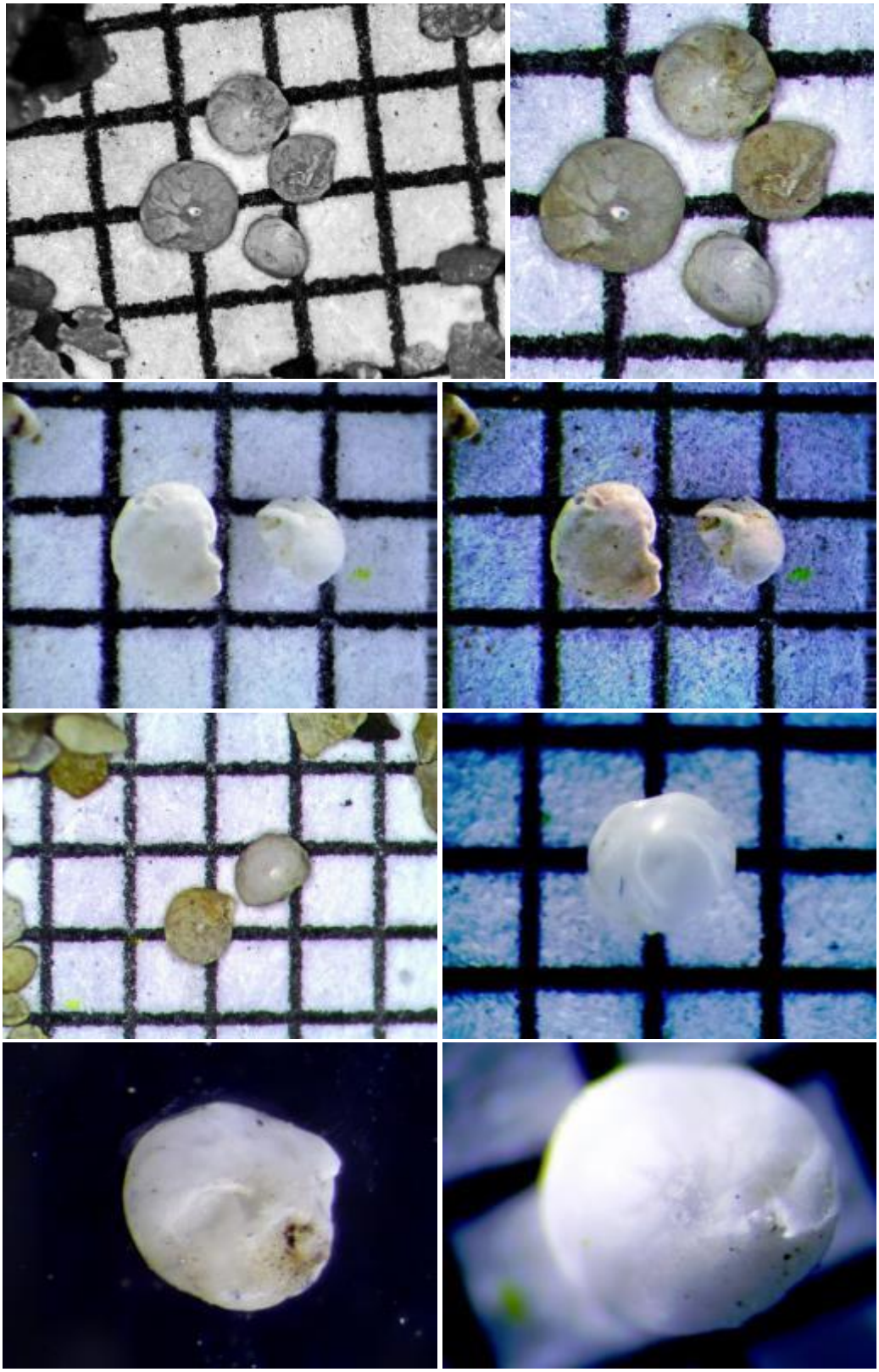
<004a> SP_004a **Pitcairn Bounty Bay** AmScope **2X [Slide <004.01>]**

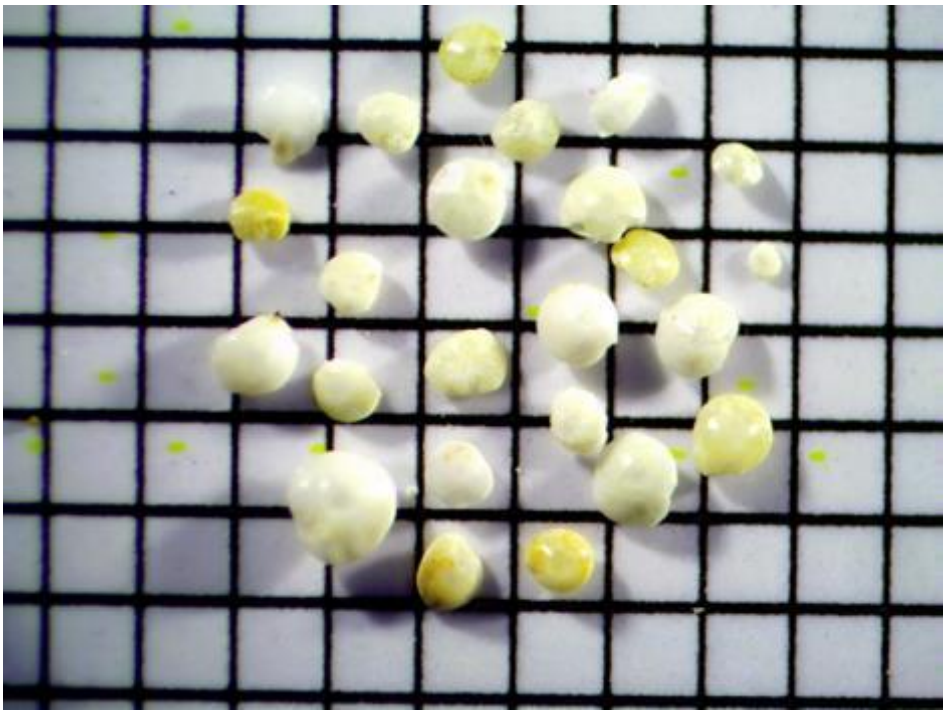


<004a> SP_004a **Pitcairn Bounty Bay** AmScope **2X**



<006> SP_006 **Pitcairn Claymore anchorage 28 m** AmScope **2X** (first examination)

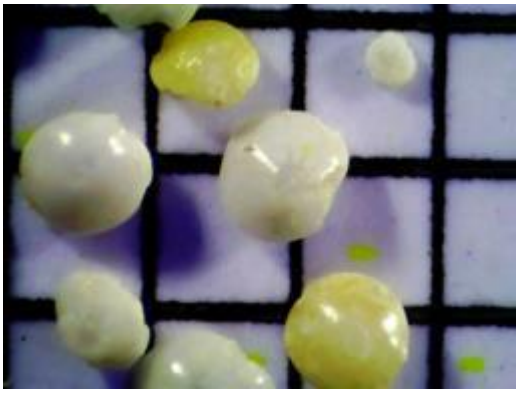


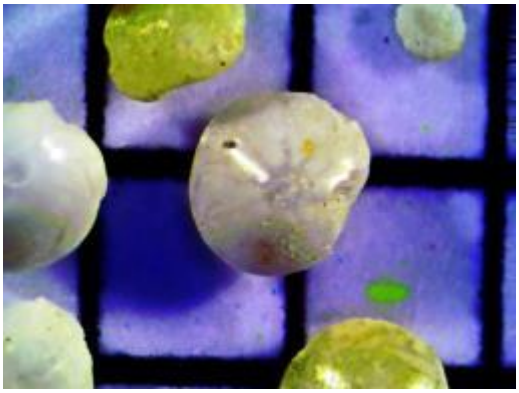


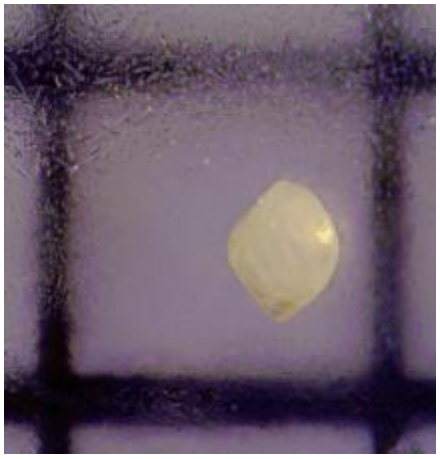
This collection saved in vial **<006.v01>]**

Grid 1 mm

<006> (second examination) (con't)





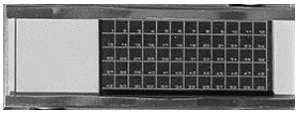


Miliolid

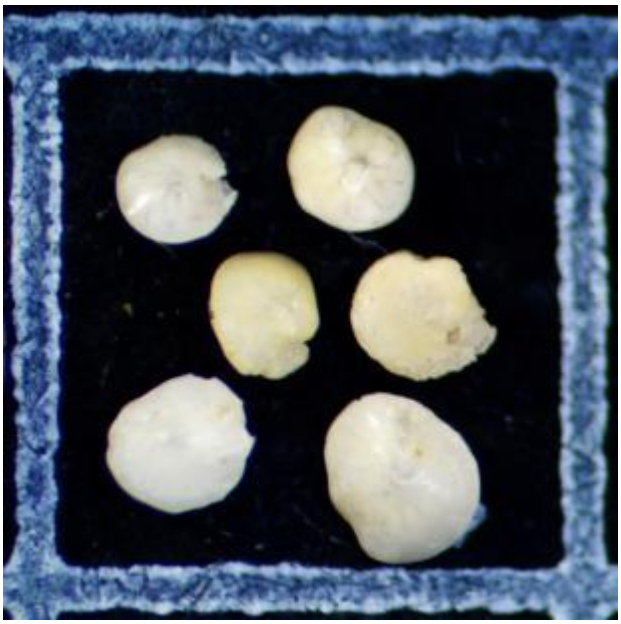
[Slide <006.s01>]

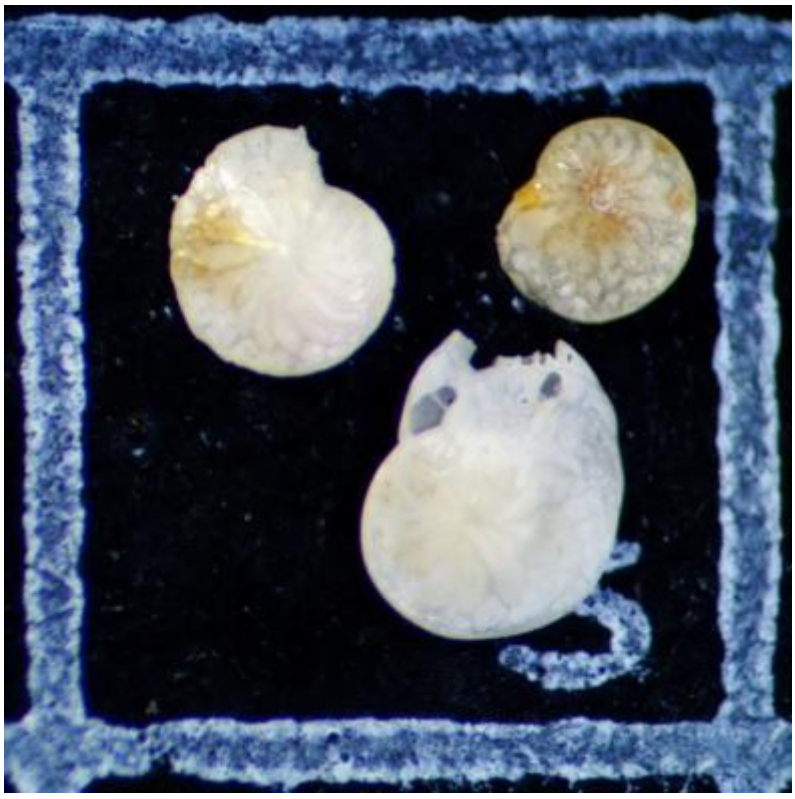
Grid: 1 mm

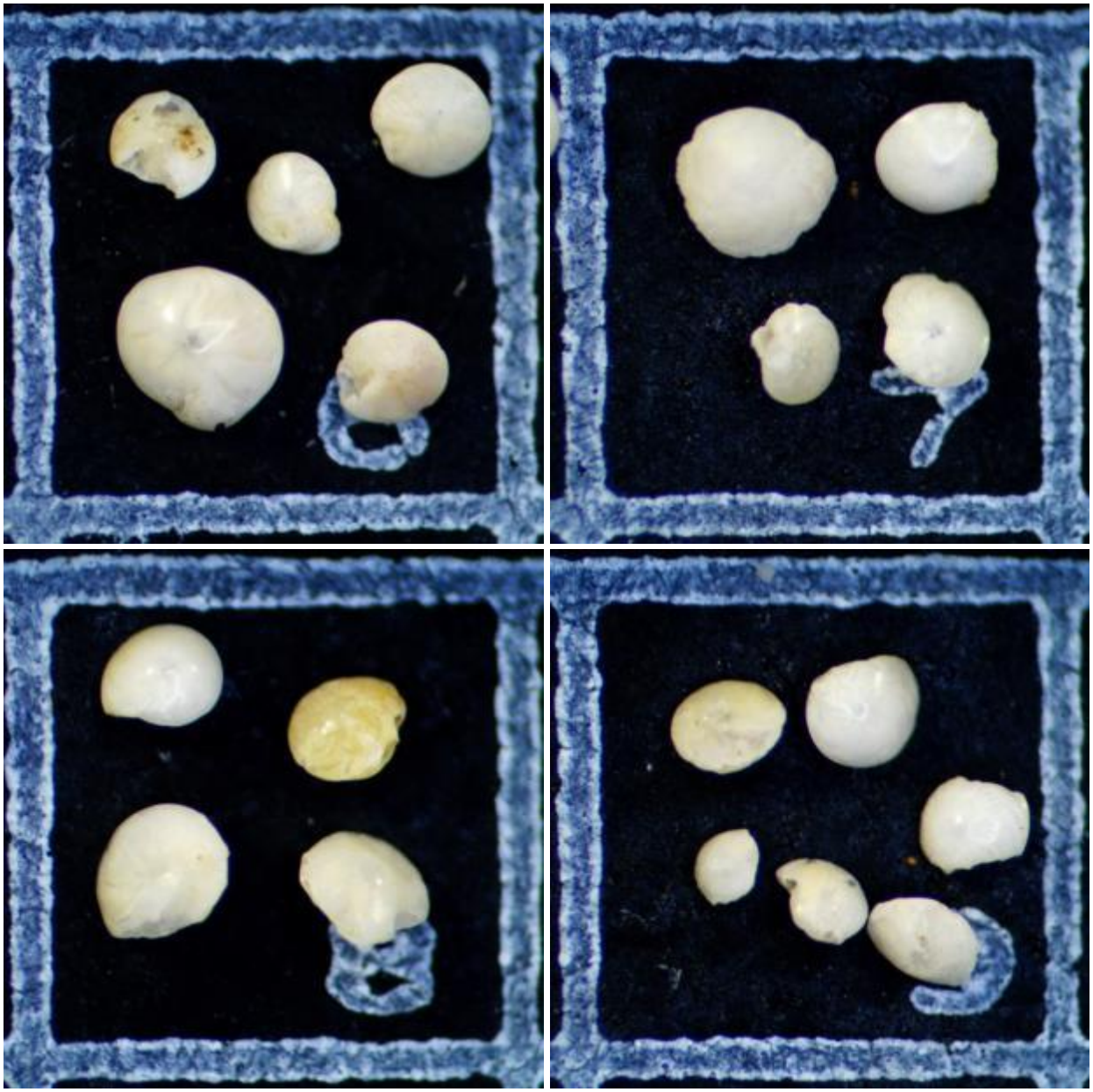
<006> SP_006 **Pitcairn Claymore anchorage 28 m** AmScope **1X** (second examination)

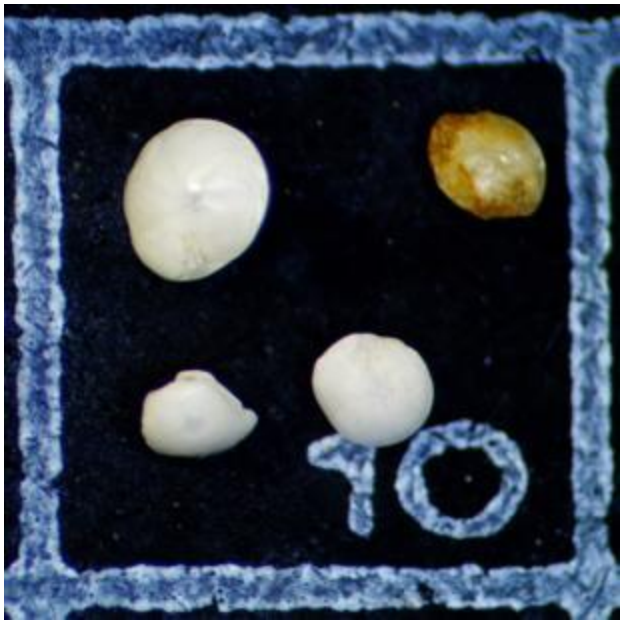
 Panels from **[Slide array <006.sa01.n>, n=4…12]**

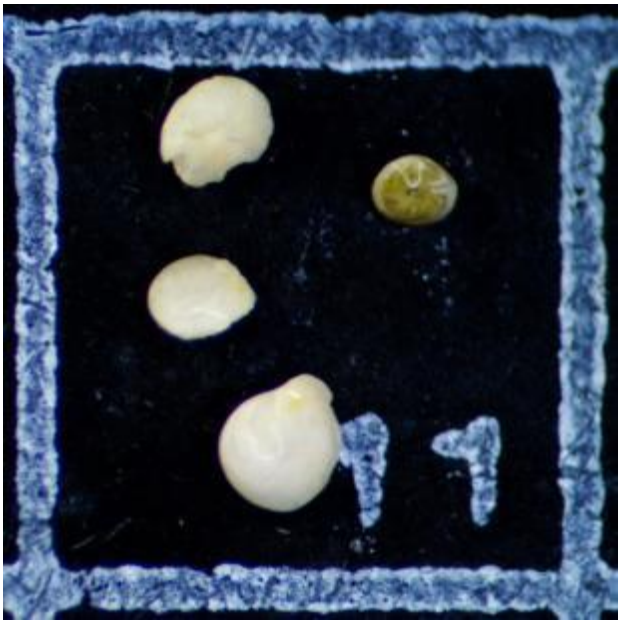
Grid square 3.8 mm line centers

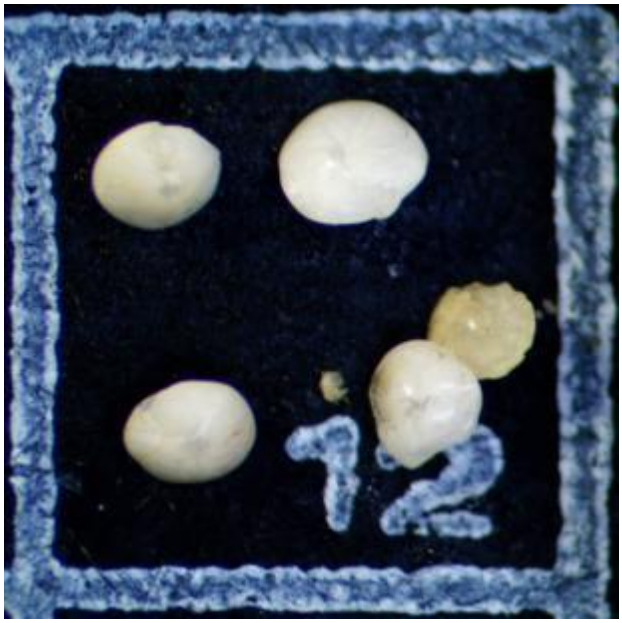


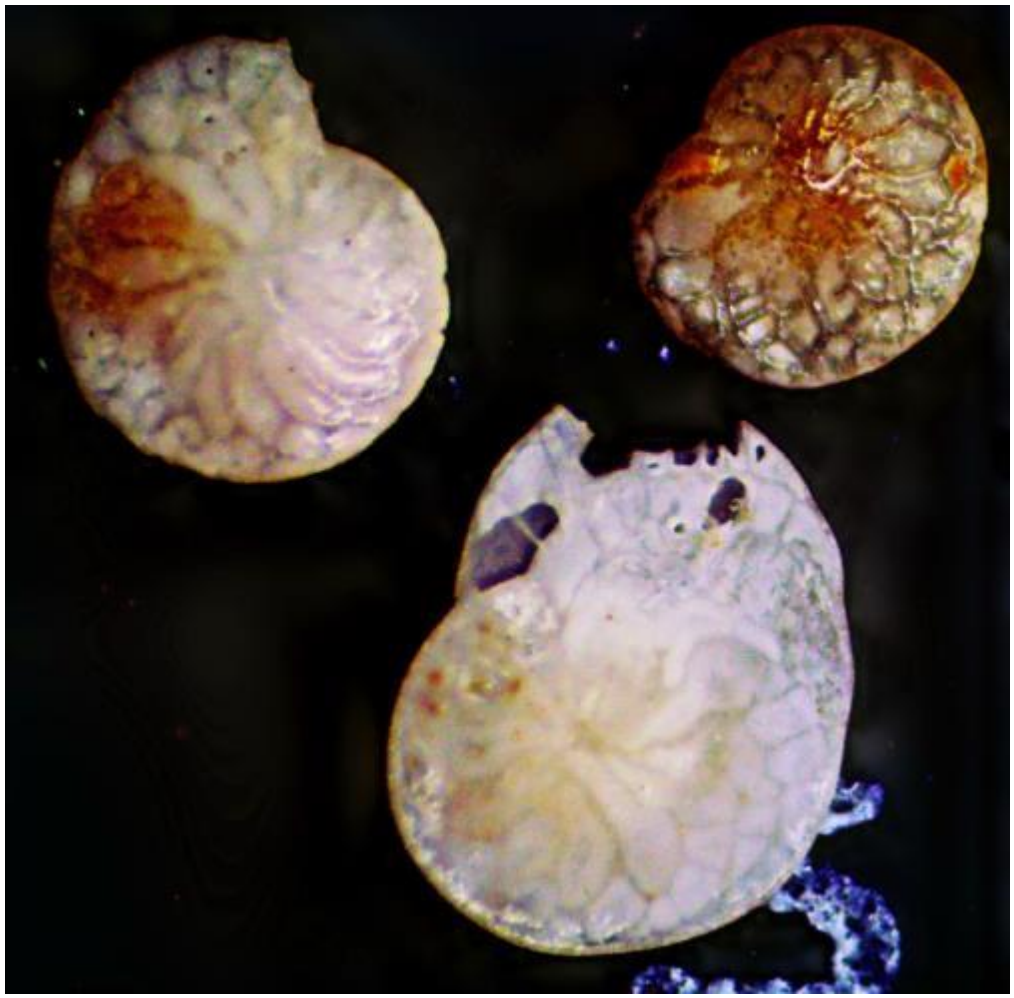
 [#5 see details below]

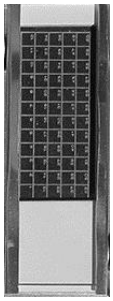



10

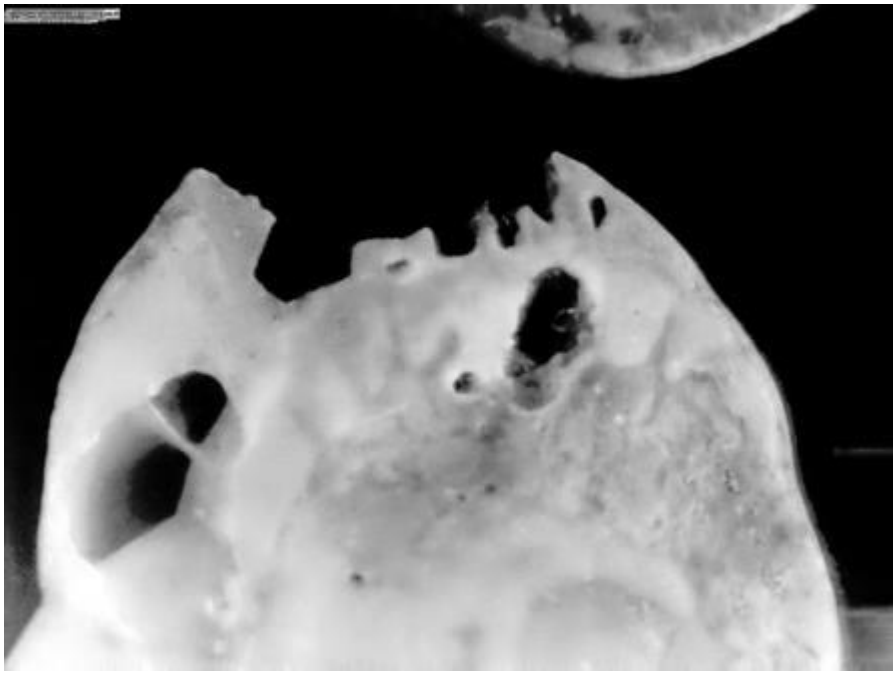

11


12

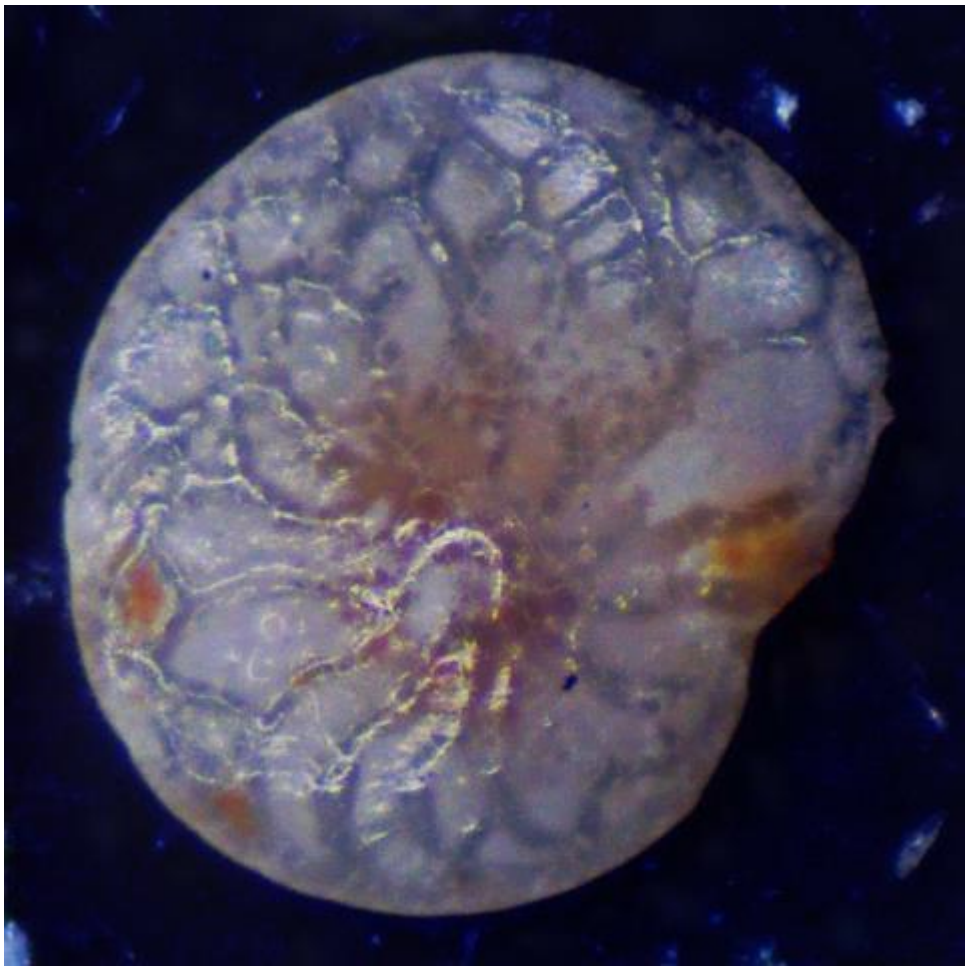




[Slide array <006.sa01.05>]

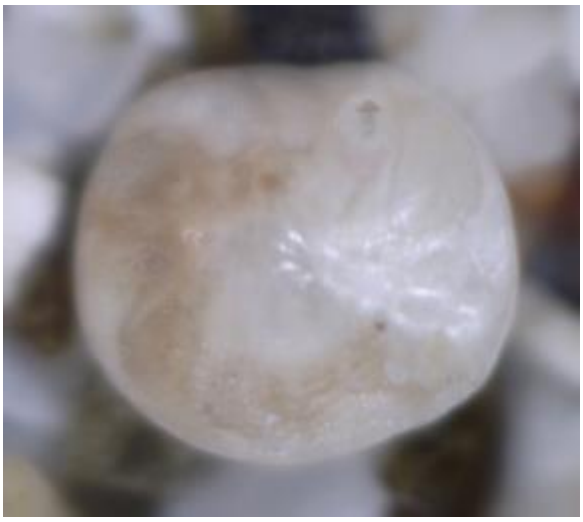


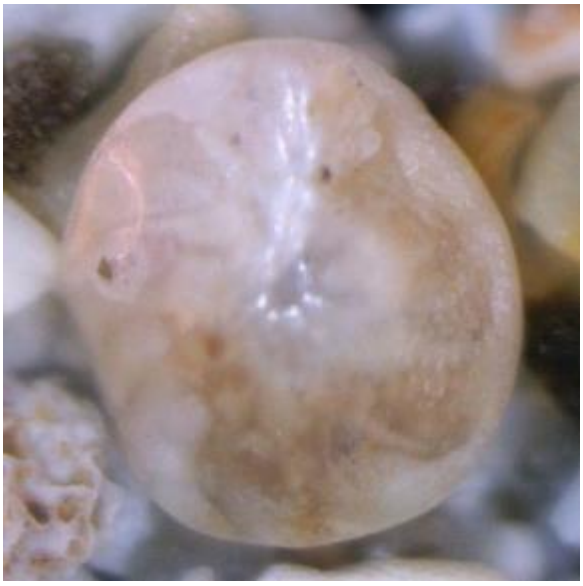
Detail from previous image (lower)



Detail from previous image (upper right) (rotated)

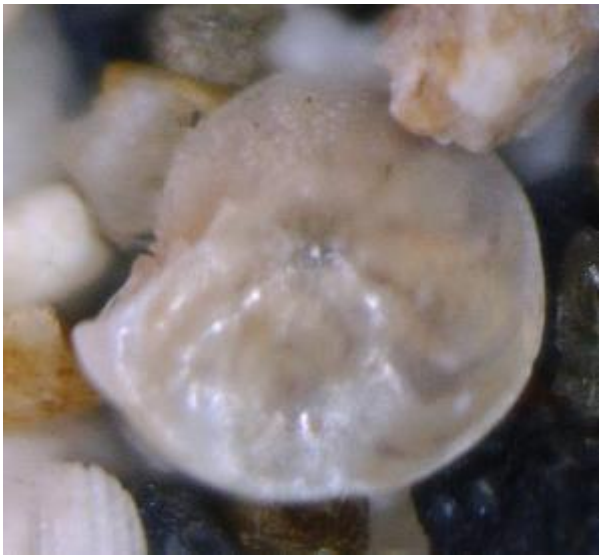
<014> SP_014 **Pitcairn Bounty Bay Pier** USB_Digital microscope iPhone screenshots [first group]





Amphistegina sp.

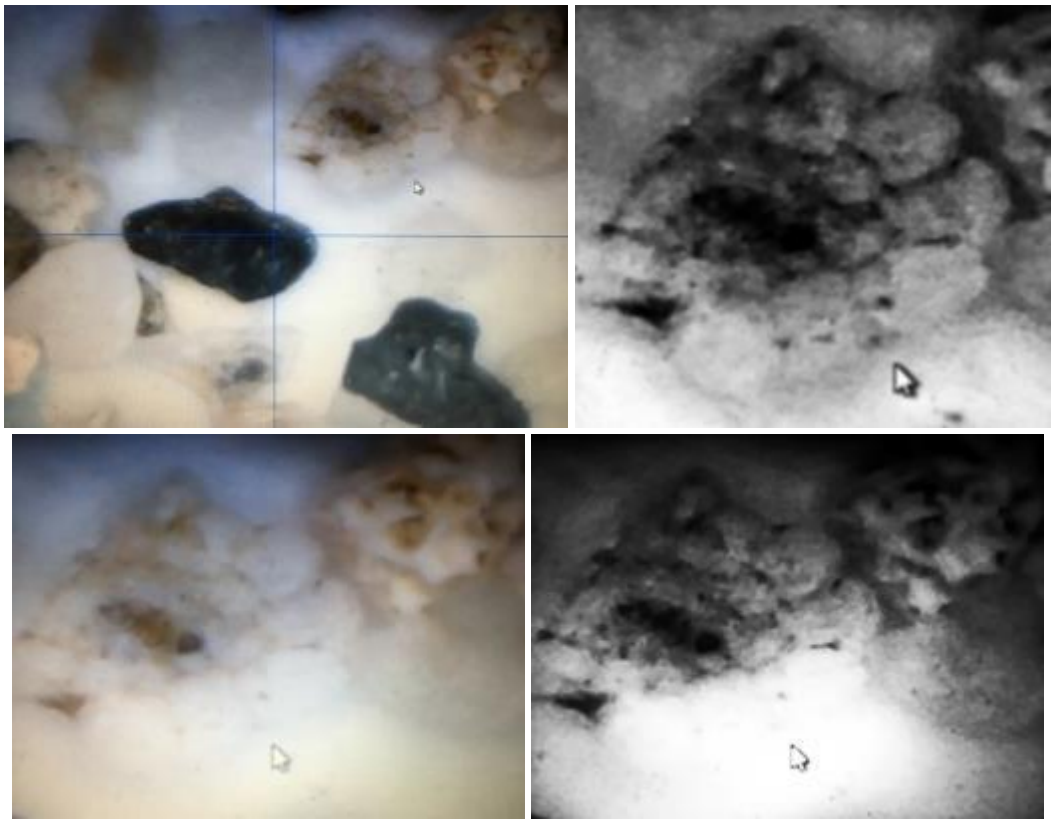
Heterostegina depressa



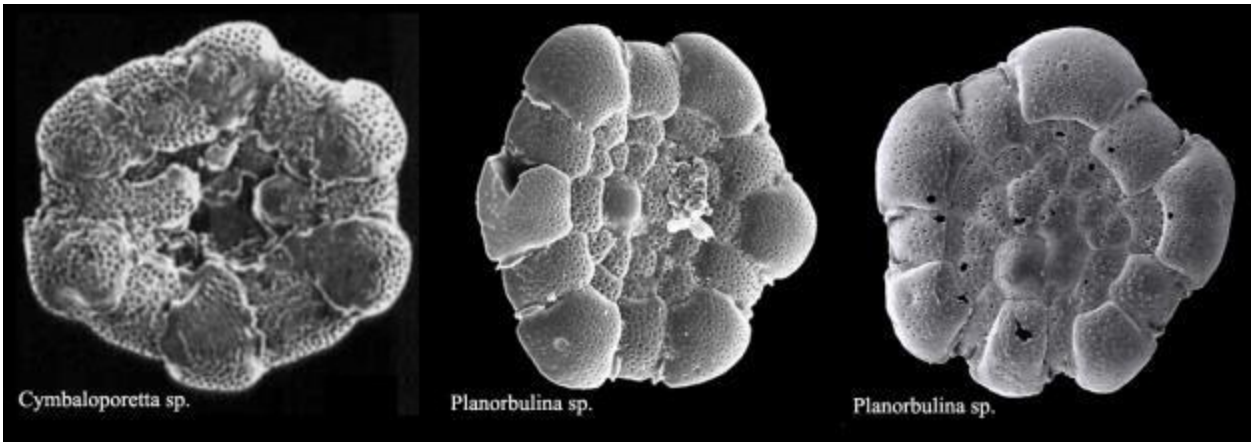
(next page)

Vial <014.v01> Vial contains possible *Cymbaloporetta* sp.

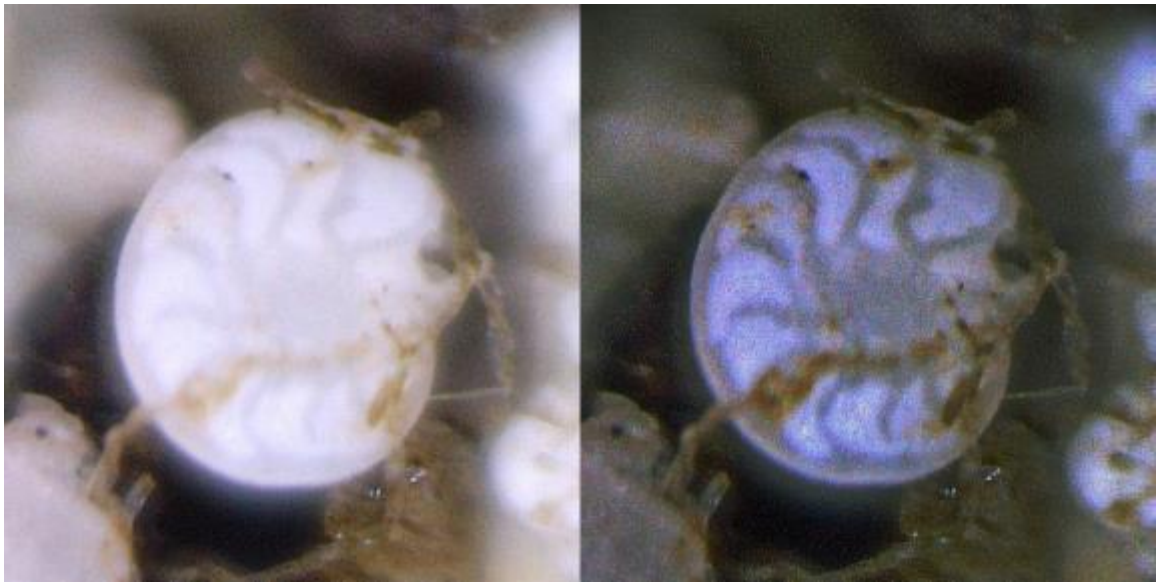
Ref. to Cymbaloporetta sp.



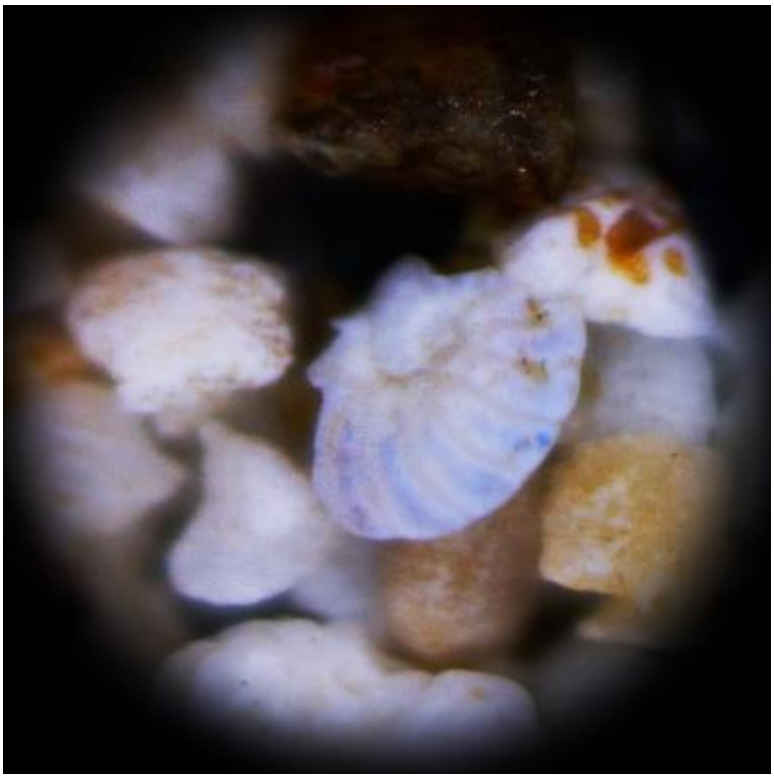
Images of a foram from Bounty Bay: (upper) SP_014_IMG_2631.JPG (lower) SP_014_IMG_2632.JPG. (left) the originals (right) the processed images (cropped, processed)



The literature gives images of *Cymbaloporetta* sp. [Whittaker and Hodgkinson, 1995] and *Planorbulina* sp. [foraminifera.eu]. If the organism observed on Pitcairn is either of these genera, it is a new record for Pitcairn. *Cymbaloporetta* is documented from Henderson and Oeno Islands, but *Planorbulina* is not listed from any of the Pitcairn Islands.



Unidentified foram Probably not *Amphistegina* sp. (two enhancements of same image)



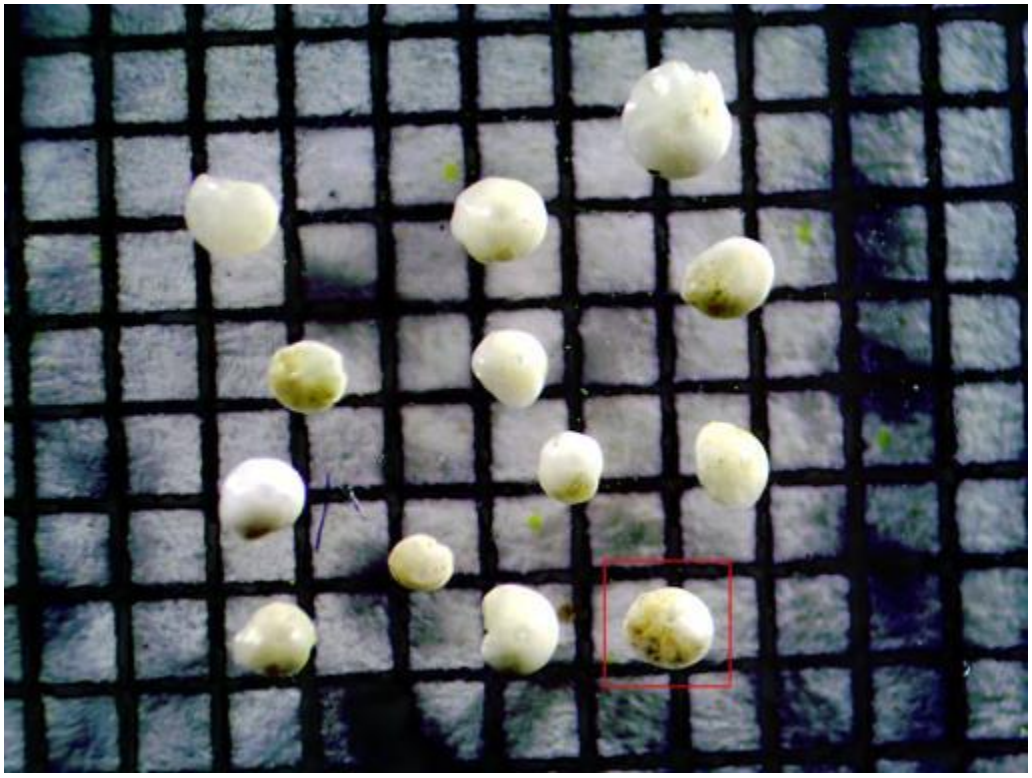
(above) Unidentified (probably) forams

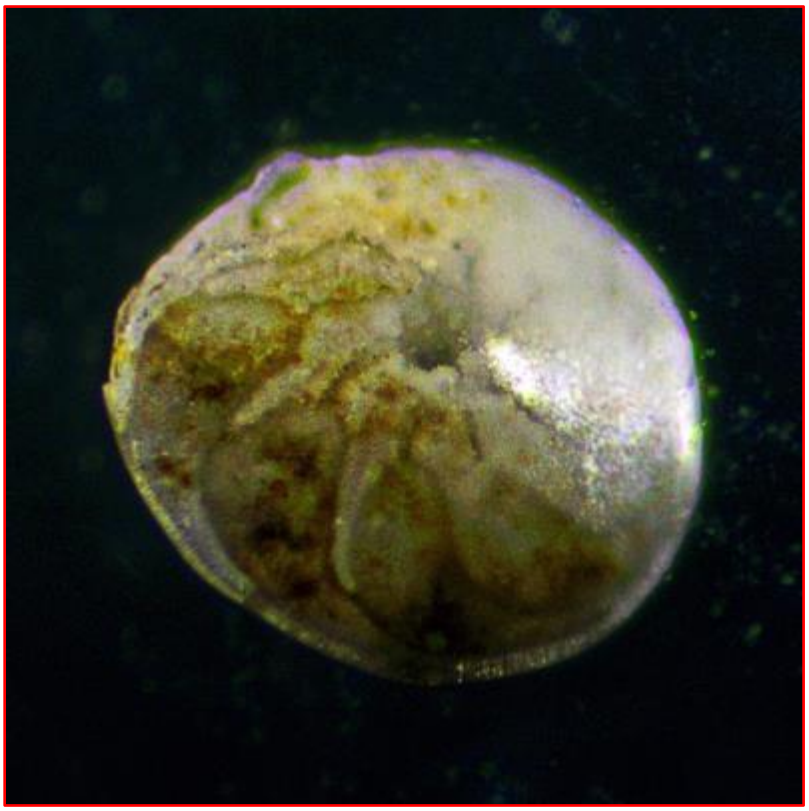
The images on this page have been highly processed to bring out the structure. The blue color was present in the originals, but not as intensely as shown in these images.

<016> SP_016 **Pitcairn Down Isaacs** USB_Digital microscope

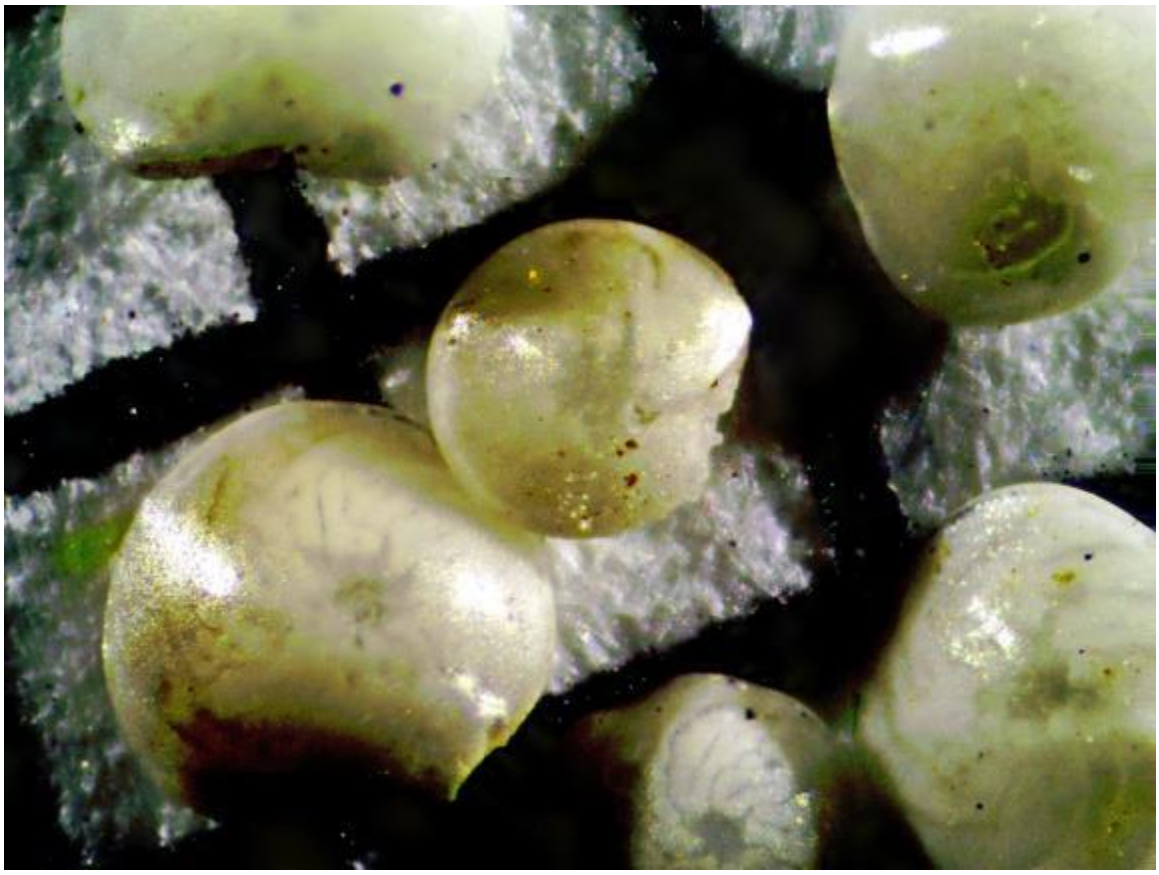
Unidentified foram

<016> SP_016 **Pitcairn Down Isaacs** AmScope **1X [Slide <016.s01>]** (con't)





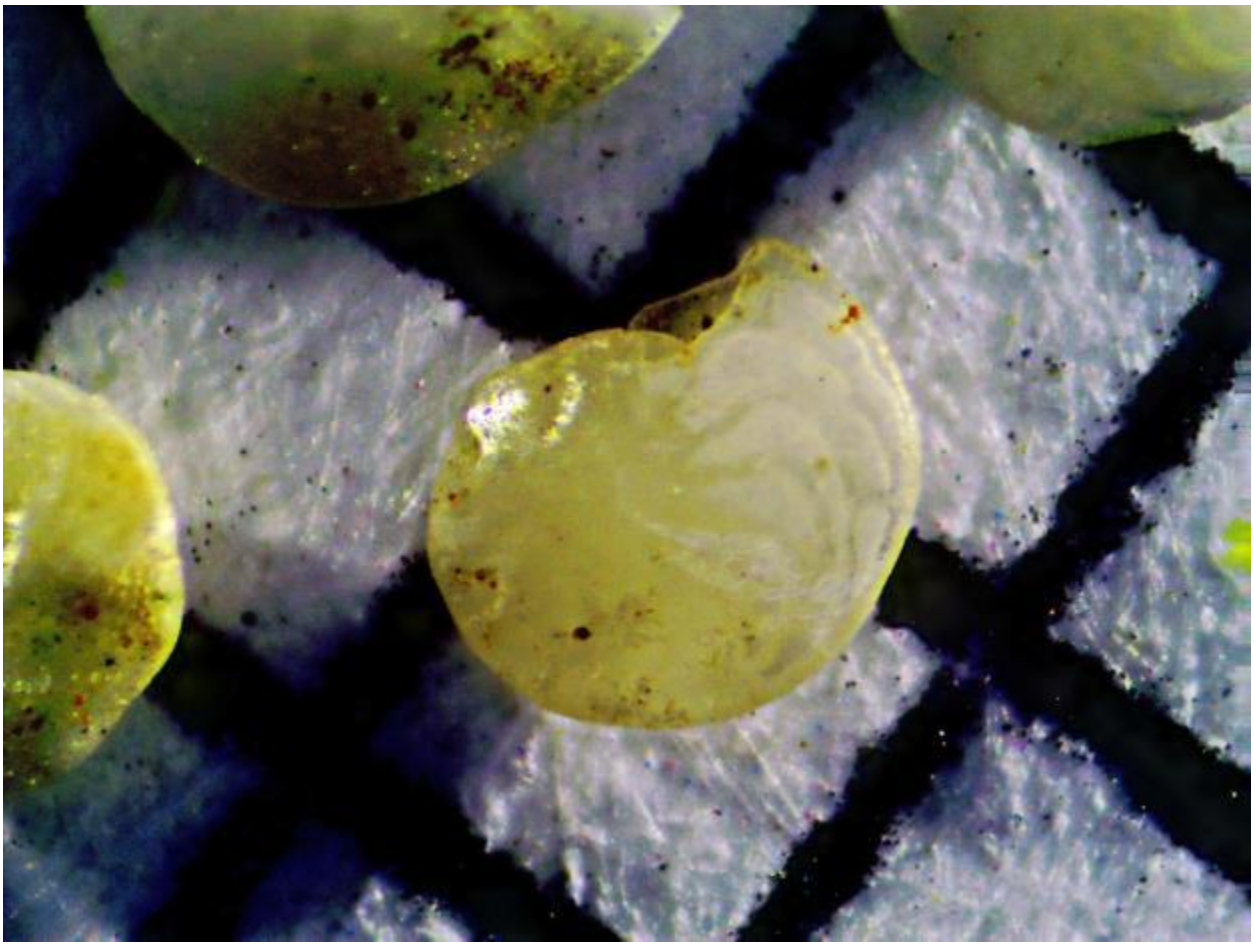
<016> SP_016 **Pitcairn Down Isaacs** AmScope **1X**



(above center) *Amphistegina* sp.

<016> SP_016 **Pitcairn Down Isaacs** AmScope **1X** (con't)

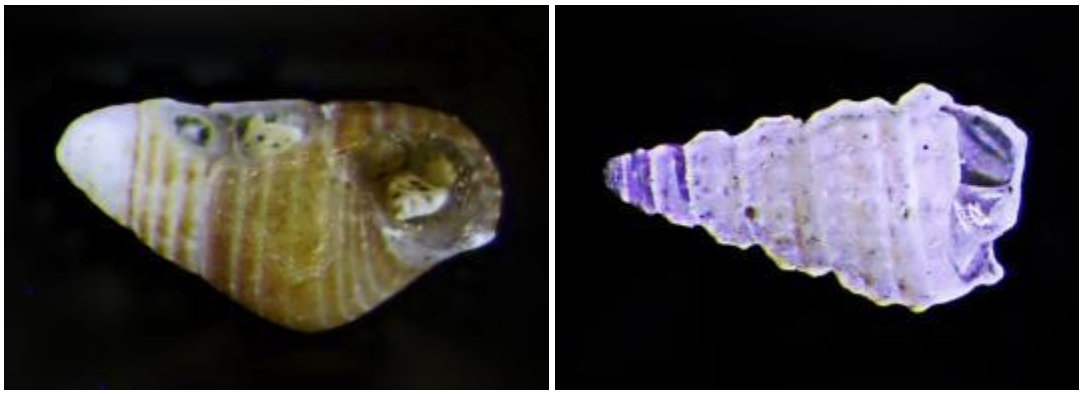
(upper left, lower left) *Amphistegina* sp.



Heterostegina depressa

Non-foraminiferal specimens

<002a> SP_002a **Pitcairn Tedside Down Cabin** AmScope **2X**

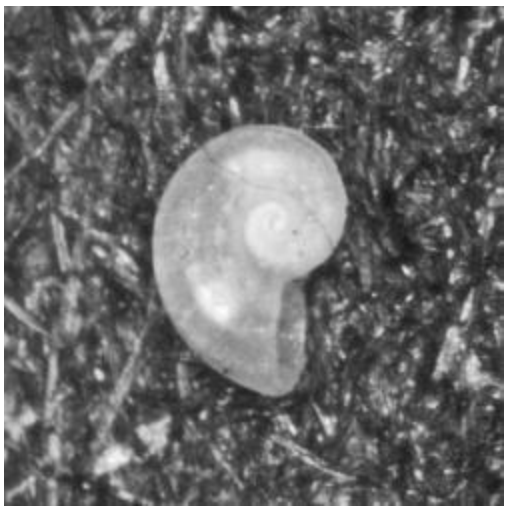


<003> SP_003 **Pitcairn St. Paul's Pool** AmScope microscope **2X**

The array of 5 forams and one gastropod are preserved on slide **<003.s01>.**

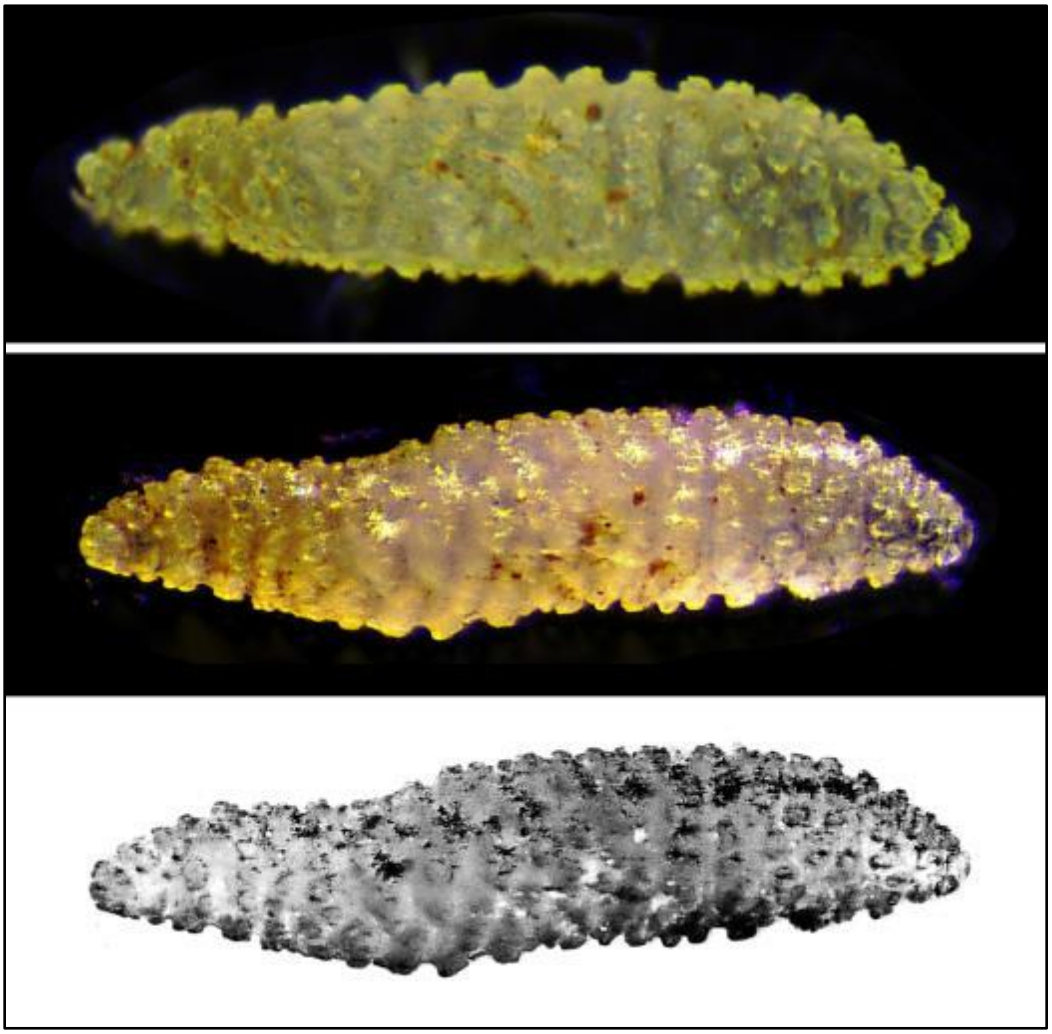
Grid 1 mm

<004a> SP_004a **Pitcairn Bounty Bay** AmScope **2X**



<004a> SP_004a **Pitcairn Bounty Bay** AmScope **2X** (con't)

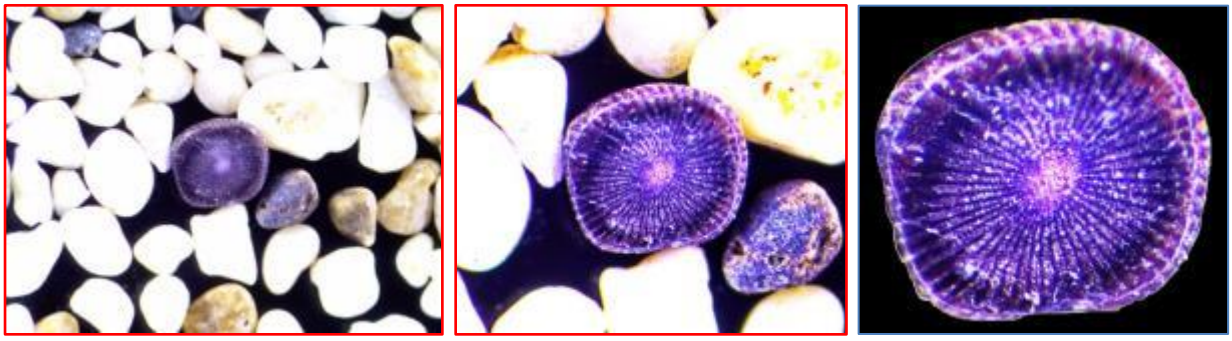
(below) (Bottom two images are of the same individual)



Sponge spicules

<005a> SP_005a **Pitcairn Sandy Harbor** AmScope **2X**

Echinoid spine. Below images retain actual color of specimen in <005a>

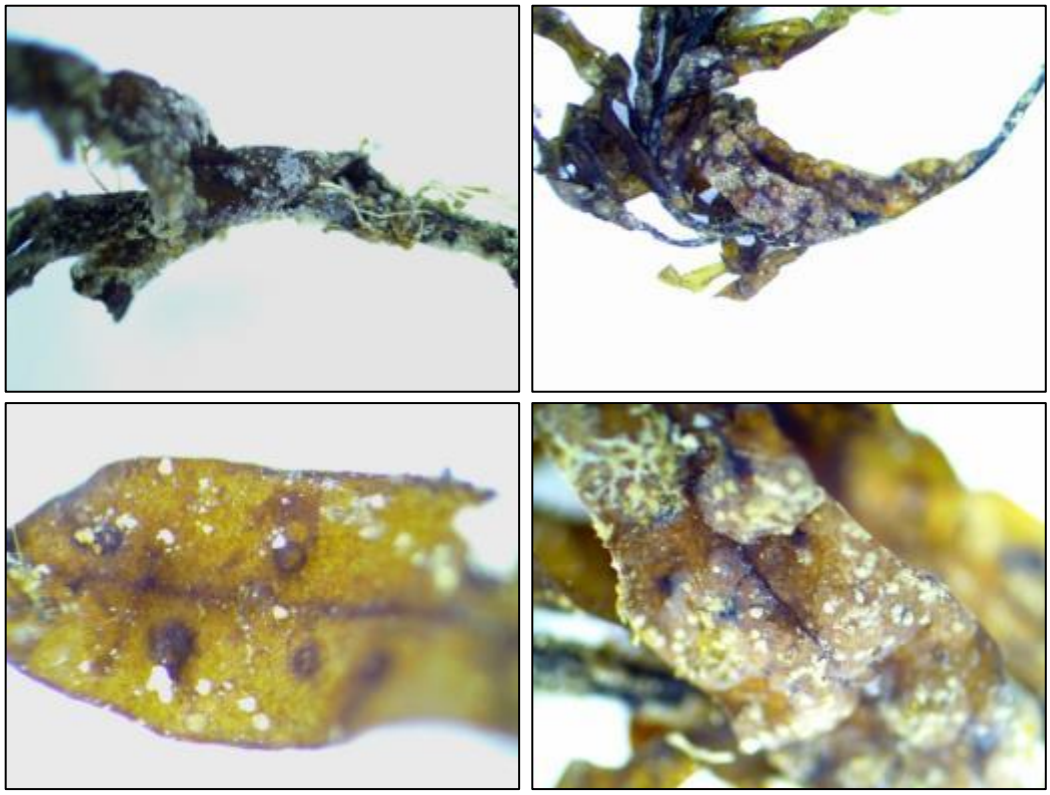


<007> SP_007 **Pitcairn Sandy Harbor**

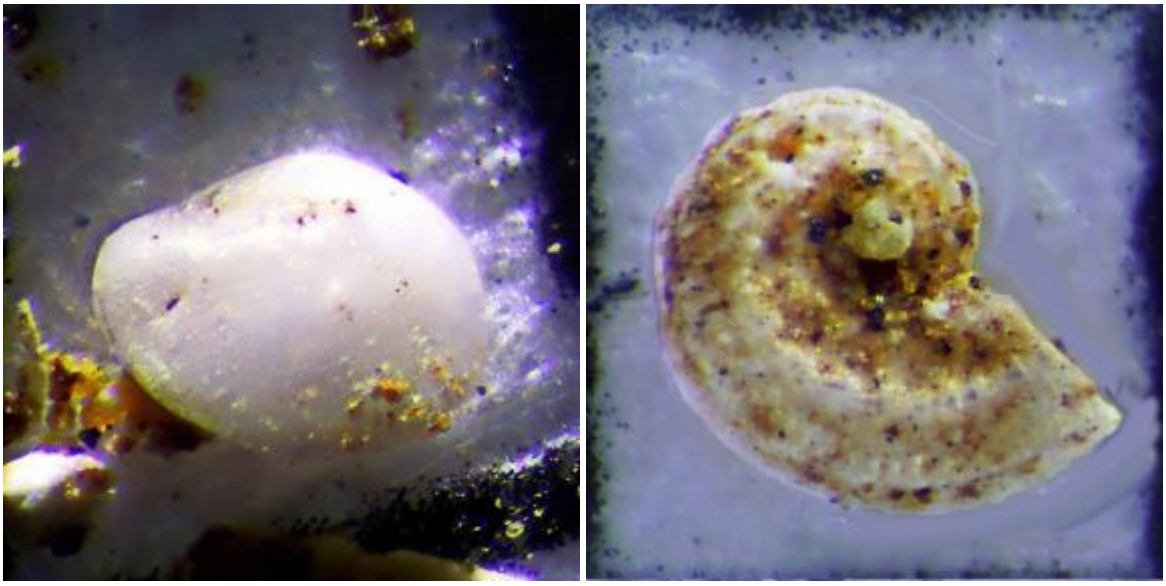
This jar contains large shells only, and was not examined for forams.

<008> SP_008 **Pitcairn St. Paul's Pool** Canon macro onsite Pitcairn

<008> SP_008 **Pitcairn St. Paul's Pool** AmScope **0.5X**



<014> SP_014 **Pitcairn Bounty Bay Pier** AmScope **2X**



The right-hand image above is contained in a 1 mm square grid.

<015> SP_15 **Pitcairn Bounty Bay landing shoreline** [algae]

The Gambier Islands

Environment

Collections <009>, <010>, <011>, and <013> were done by the Claymore II off the main dock 5/29/18 using the Peterson Grab. Fine to coarse sand.

Two collections were made at the beach 1 mi N of the main dock, <017> off water's edge 6/8/18 and <021> by snorkeling 6/11/18.

Note: There is no <012> collection

Land trip 6/7/18 – No collection

Boat trip 6/9/18:

Aukena Island	No collection
Akamaru Island	Protected beach. 1 collection <018>. Very fine uniform sand.
Mekiro Island	1 collection from several beaches <019>. Coarse mixed broken shells and sand.
Tauna Island	1 collection from sand spit <020>. Fine to medium coral sand.

The coordinates of the waypoints are listed in Table 9 (appendix).


Mangareva
Beach
<017>, <021>
MAIN DOCK


<011>
<013>
<009>
Mangareva
main dock
<010>

Mangareva

Akamaru

Mekiro

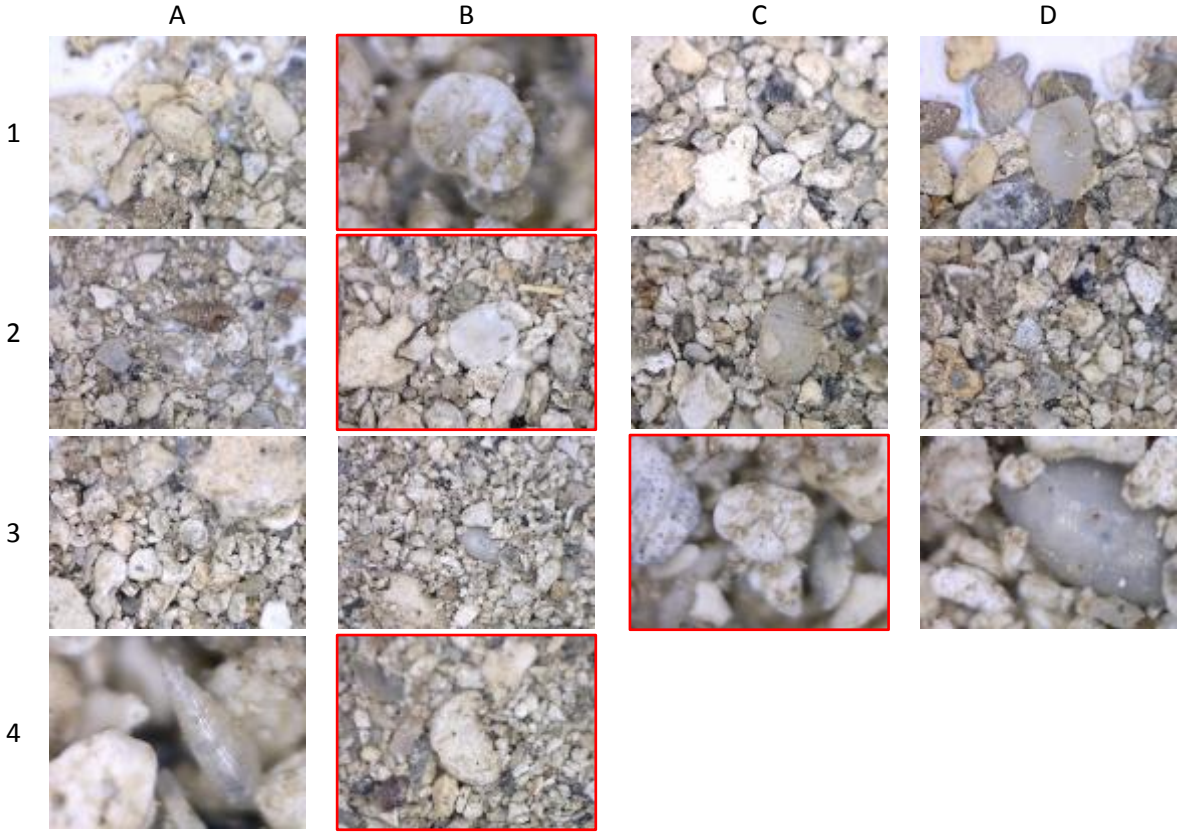
Tauna

Table 3 – Listing of the collection jars from the Gambier Islands

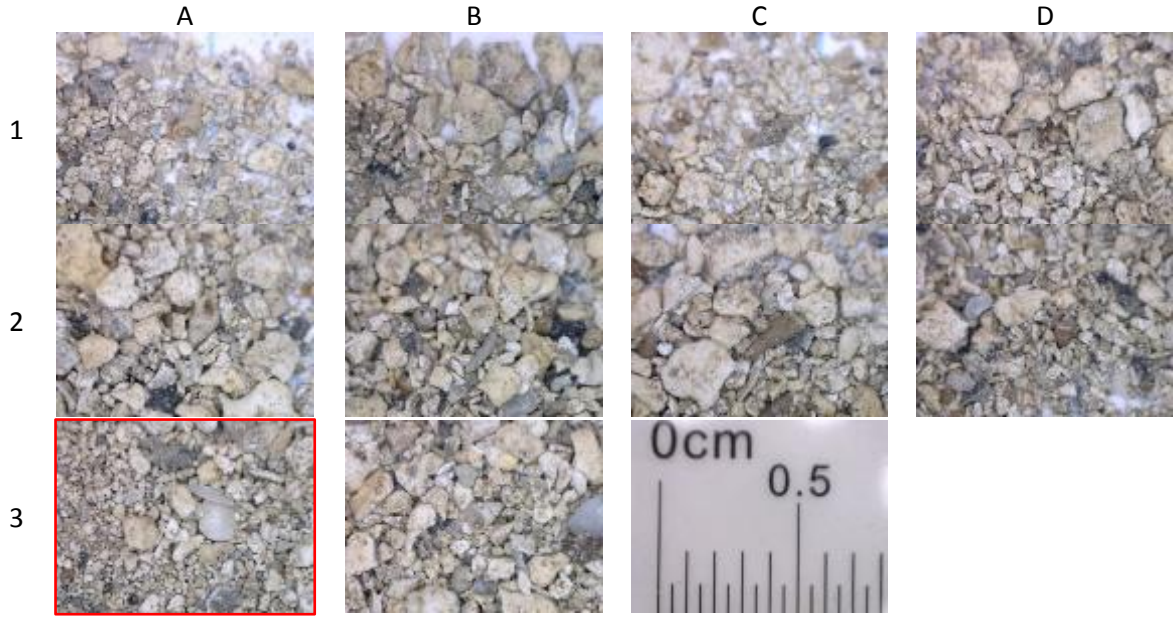
Coll.	Key	Jar	Fill	Description	Island	Location	Waypnt
<009>	SP_009	<009>	¼	mixed flakey sand	Mangareva	Main Dock #1	WP_0X3
<010>	SP_010	<010>	¼	mixed flakey sand	Mangareva	Main Dock #2	WP_0X4
<011>	SP_011	<011>	⅓	extremely fine sand	Mangareva	Main Dock #3	WP_0X5
<013>	SP_013	<013>	¾	very fine sand	Mangareva	Main Dock #4	WP_0X6
<017>	SP_017	<017>	½	very fine sand	Mangareva	Beach	WP_037
<018>	SP_018	<018>	¾	extremely fine sand	Akamaru	Beach roadhead	WP_042
<019>	SP_019a	<019a>	1	shells	Mekiro	Beaches	WP_043
<019>	SP_019b	<019b>	1	mixed sand	Mekiro	Beaches	WP_043
<019>	SP_019b	<019b>		Shell fragments	Mekiro	Beaches	WP_043
<019>	SP_019b#5	<019b#5>	1	4 mm (4000 µm)	Mekiro	Beaches	WP_043
<019>	SP_019b#10	<019b#10>	½	2 mm (2000 µm)	Mekiro	Beaches	WP_043
<019>	SP_019b#35	<019b#35>	1	0.5 mm (500 µm)	Mekiro	Beaches	WP_043
<019>	SP_019b#60	<019b#60>	⅛	0.250 mm (250 µm)	Mekiro	Beaches	WP_043
<019>	SP_019b#120	<019b#120>	$^{5}/_{8}$	0.125 mm (125 µm)	Mekiro	Beaches	WP_043
<019>	SP_019b#230	<019b#230>	$^{1}/_{50}$	0.063 mm (63 µm)	Mekiro	Beaches	WP_043
<020>	SP_020a	<020a>	1	Large shells	Tauna	Sand spit, beach	WP_045
<020>	SP_020b	<020b>	½	fine sand	Tauna	Sand spit, beach	WP_045
<021>	SP_021	<021>	1	algae (ETOH)	Mangareva	Beach	WP_037

Preliminary examinations

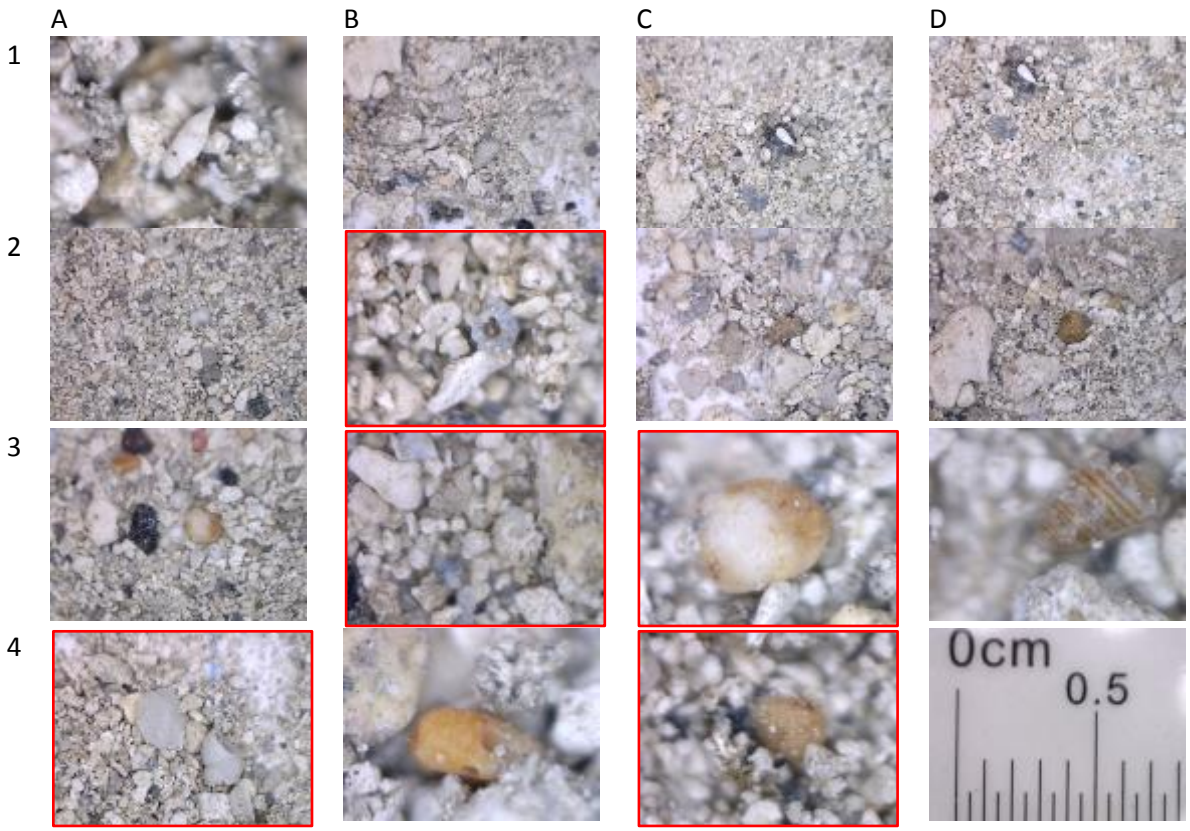
<009> SP_009 **Mangareva Island Main Dock #1** USB_Digital microscope



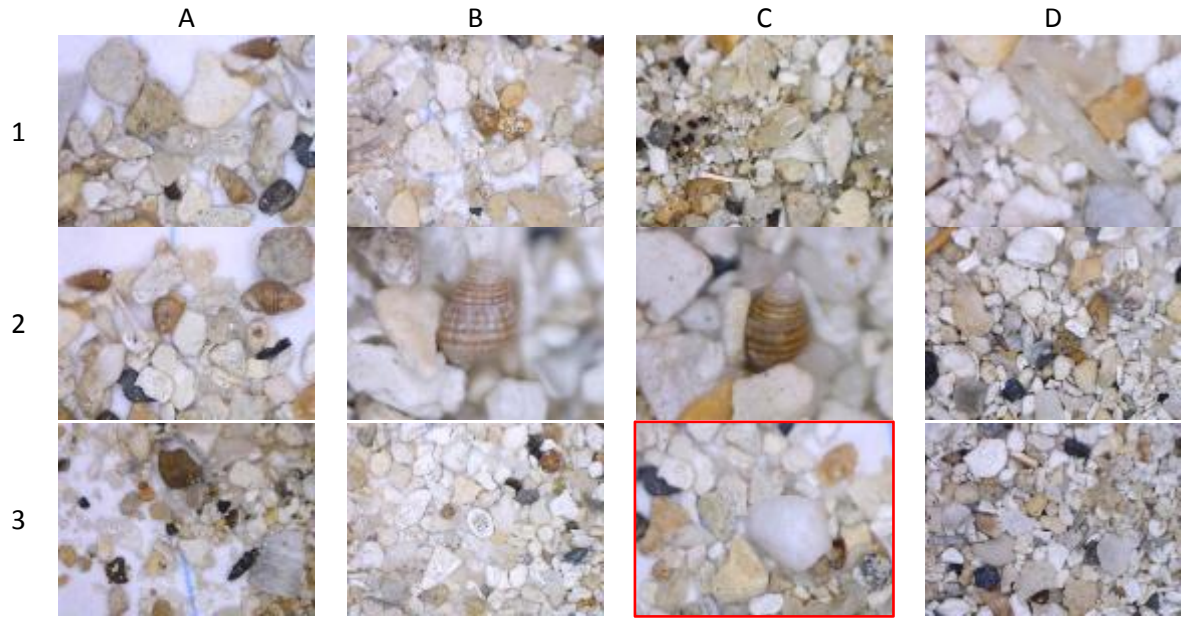
<010> SP_010 **Mangareva Island Main Dock #2** USB_Digital microscope



<011> SP_011 **Mangareva Island Main Dock #3** USB_Digital microscope



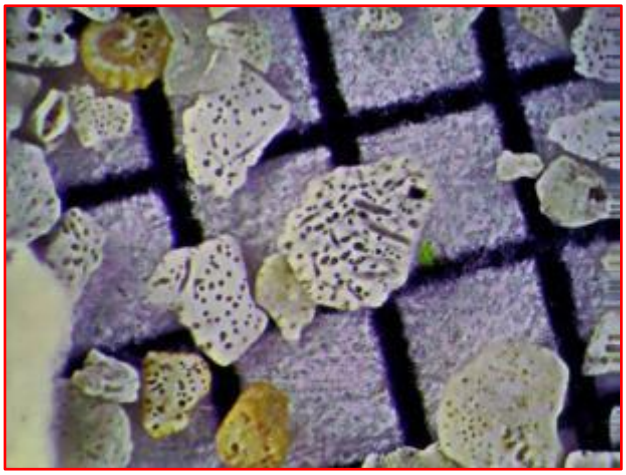
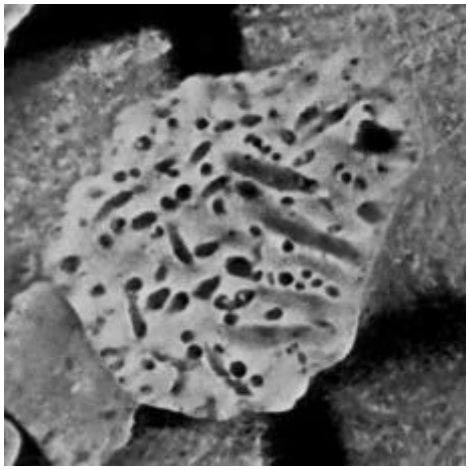
<013> SP_013 **Mangareva Island Main Dock #4** USB_Digital microscope



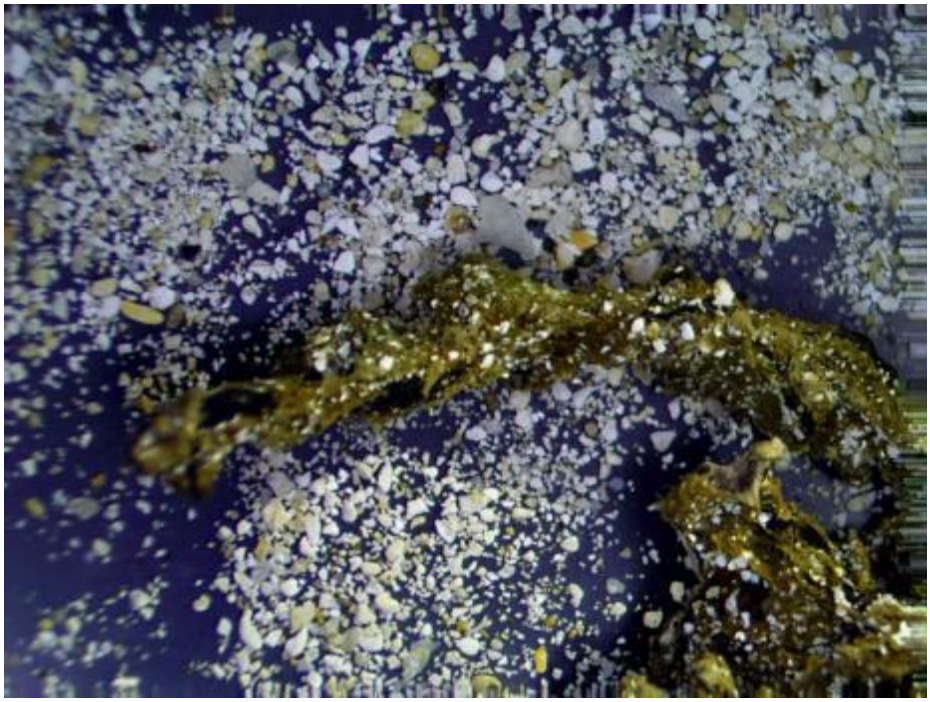
4

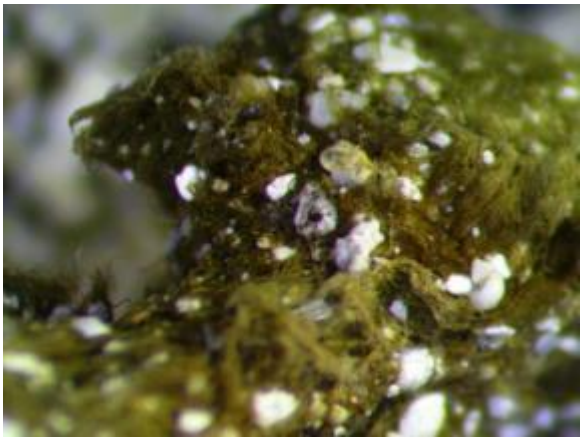
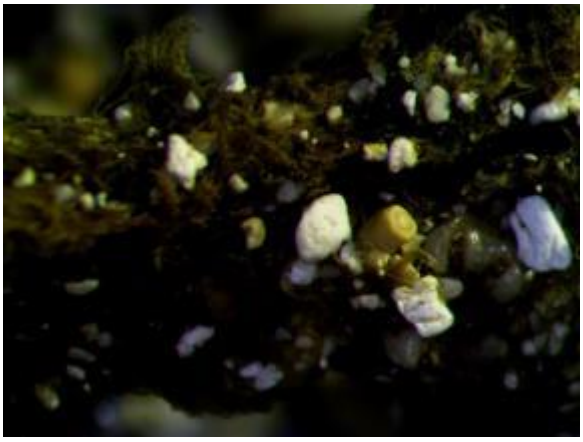



<017> SP_17 **Mangareva Island Beach 1 mi N main dock** AmScope microscope **0.5X** [Sand]

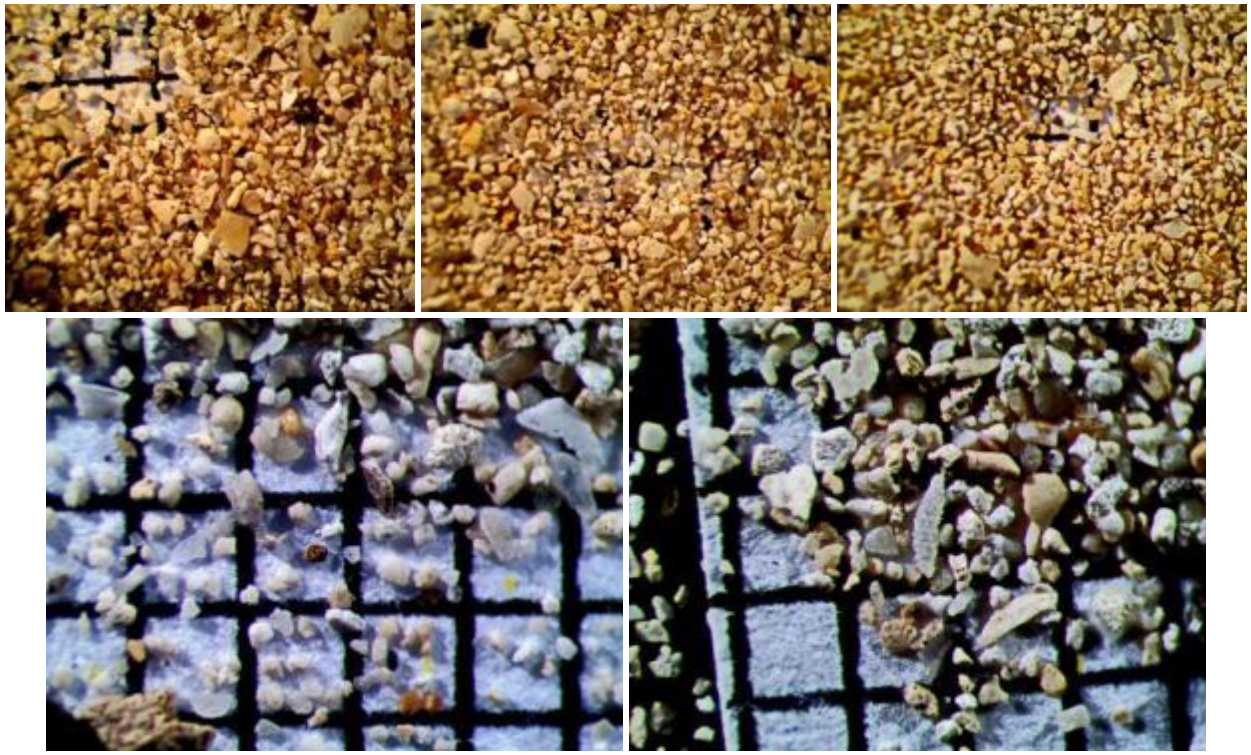



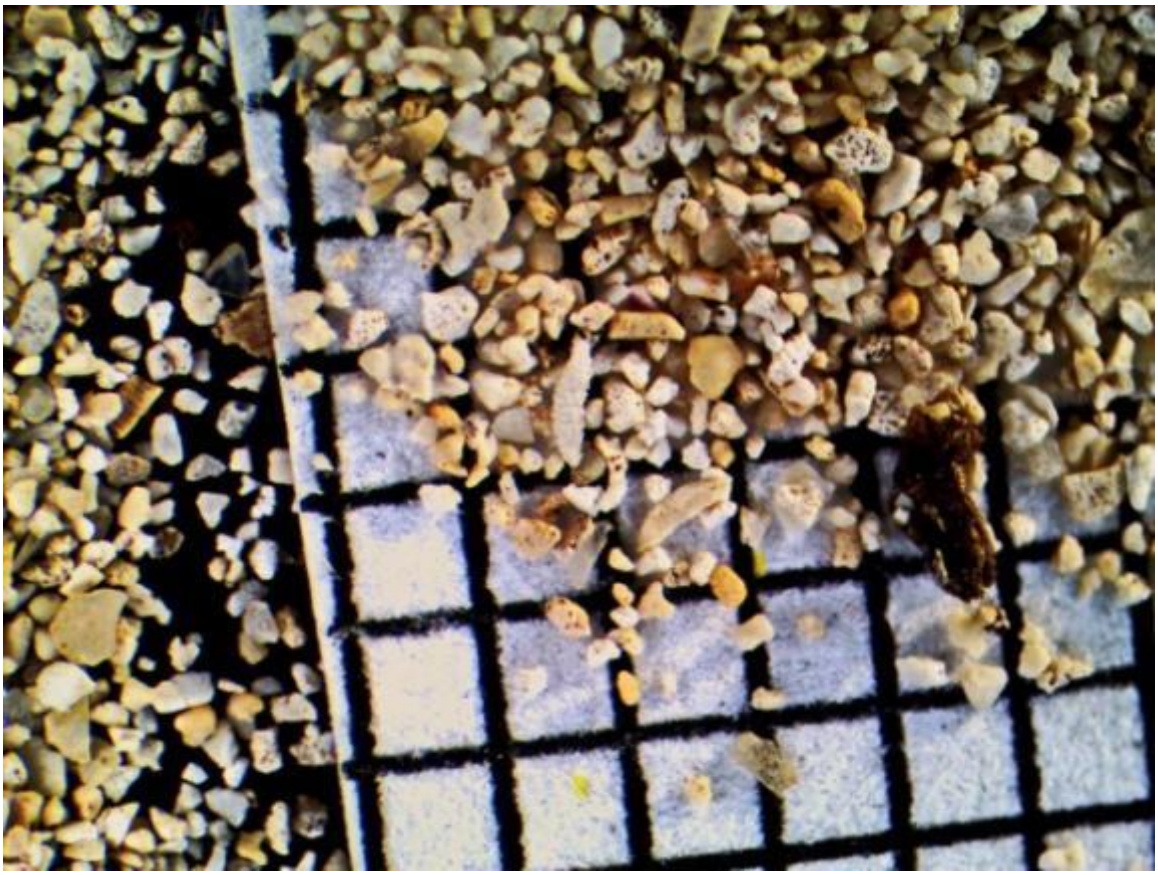

<017> SP_17 **Mangareva Island Beach 1 mi N main dock** AmScope microscope **0.5X** [Algal stipe]



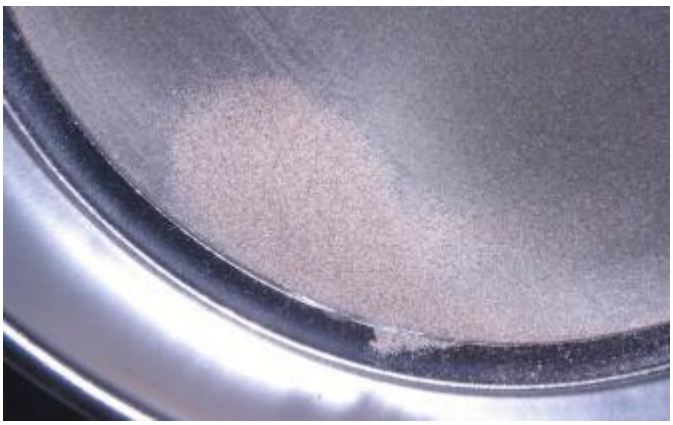
<018> SP_18 **Akamaru Island** AmScope microscope **0.5X**





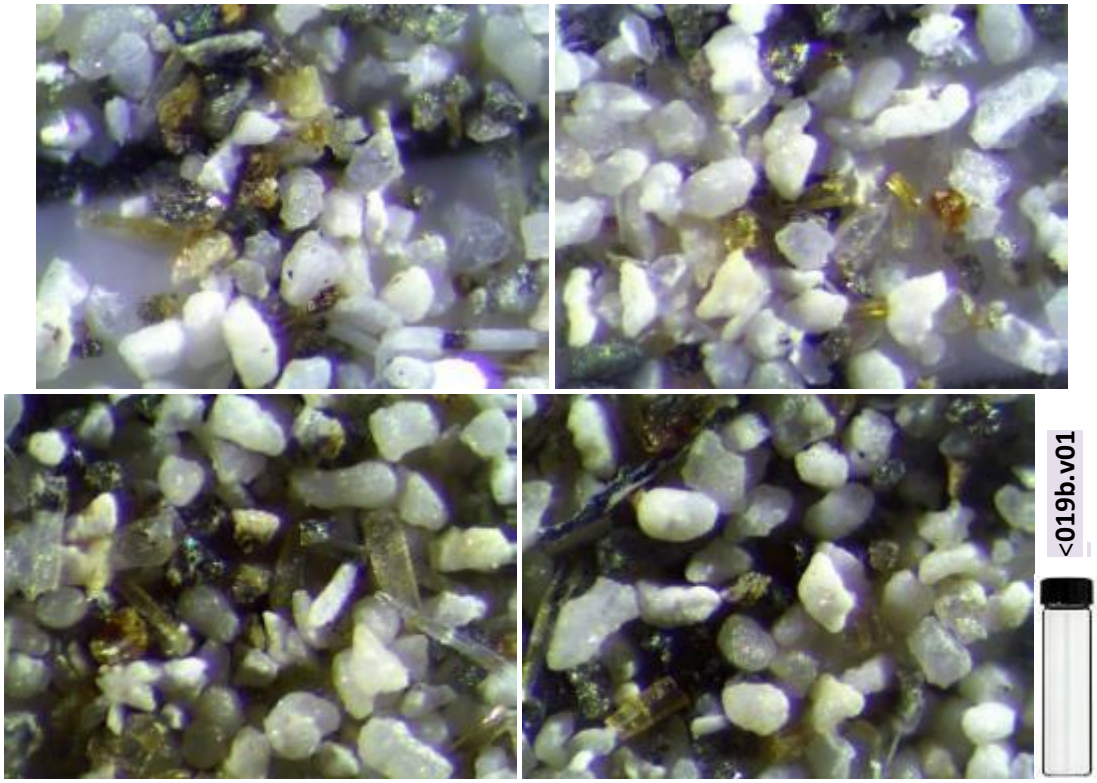
<019> SP_19 **Mekiro Island** AmScope microscope

<019b> SP_019b **Mekiro Island** Held in #250 (63 micron) sieve Canon camera

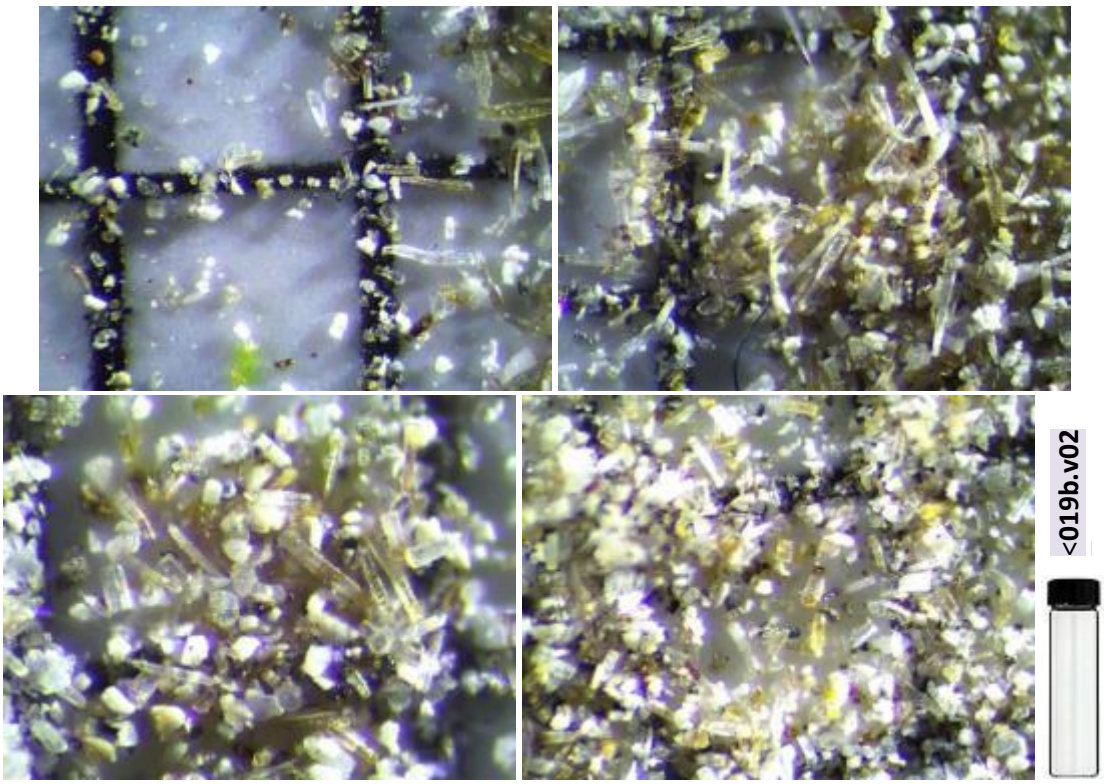


No forams were recognized in this sieving. This very fine material had a high content of glass slivers: about 20% in <019b.v01> and 50% in <19b.v02>.

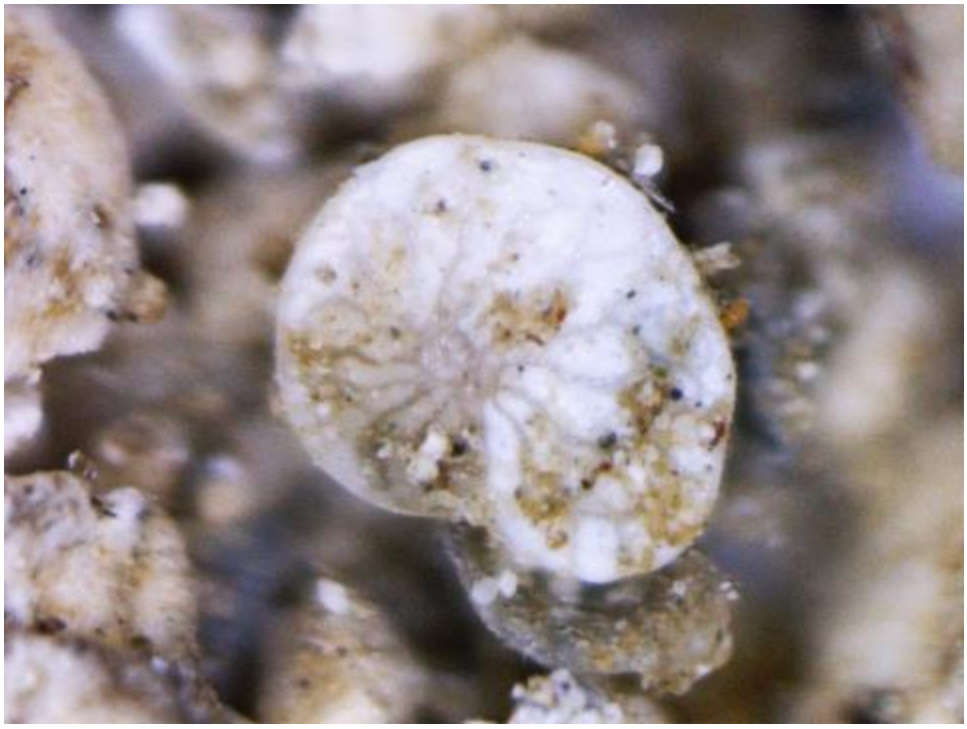
Vial <**019b.v01**> **Mekiro Island** AmScope microscope Held in 63 micron sieve



Vial <**019b.v02**> **Mekiro Island** AmScope microscope Passed thru 63 micron sieve



<009> SP_009 **Mangareva Island Main Dock #1** USB_Digital microscope



(Above and below) Unidentified forams

4

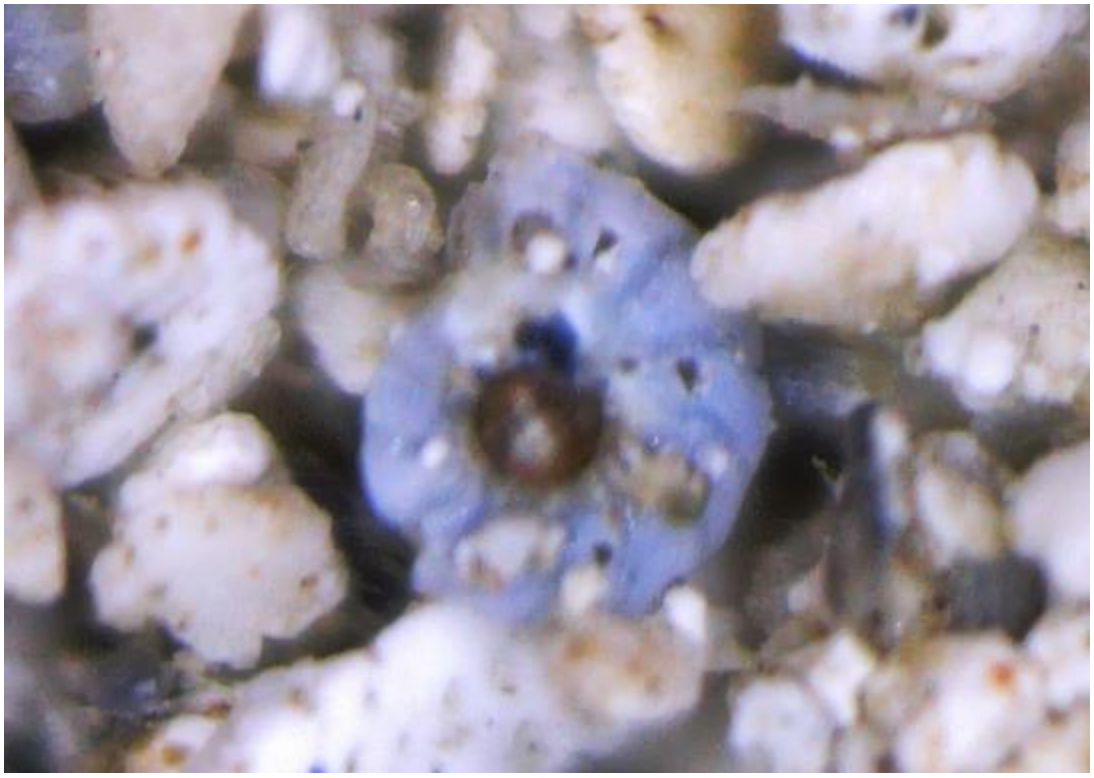
<010> SP_010 **Mangareva Island Main Dock #2** USB_Digital microscope

Heterostegina depressa

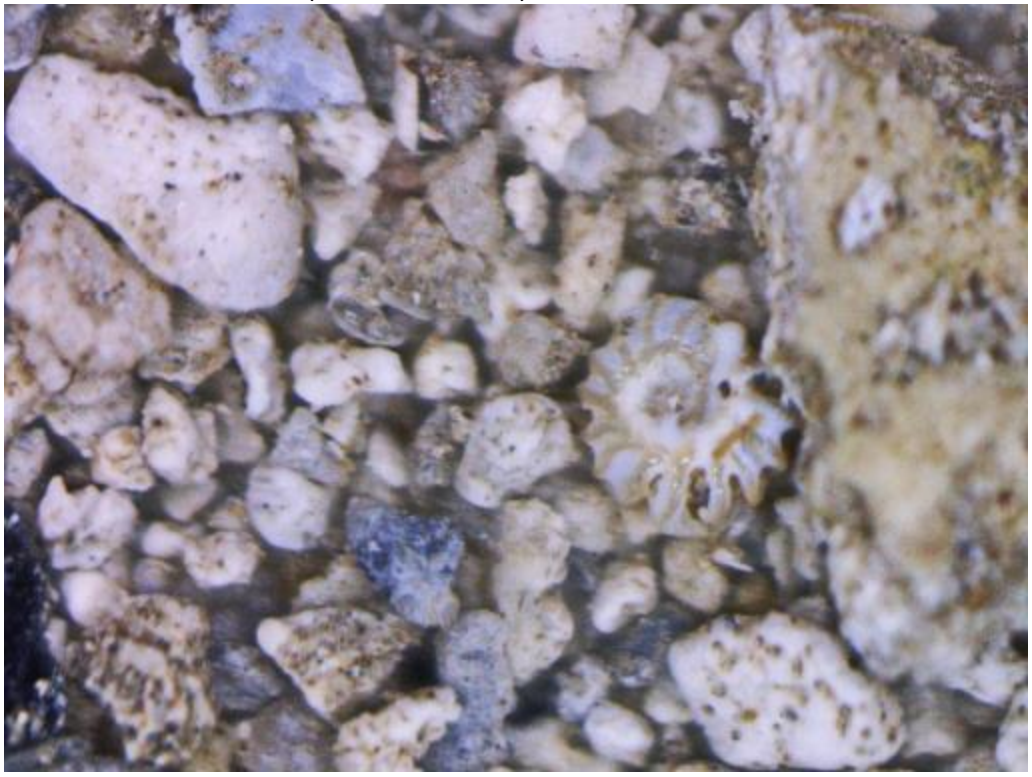
<011> SP_011 **Mangareva Island Main Dock #3** USB_Digital microscope

Amphisorus hemprichii

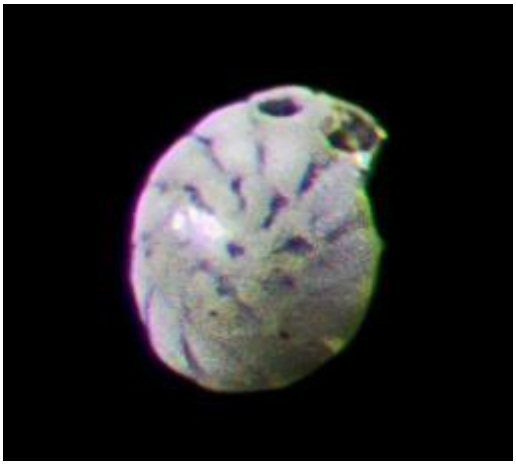
<011> SP_011 **Mangareva Island Main Dock #3** USB_Digital microscope



(above and below) Unidentified forams

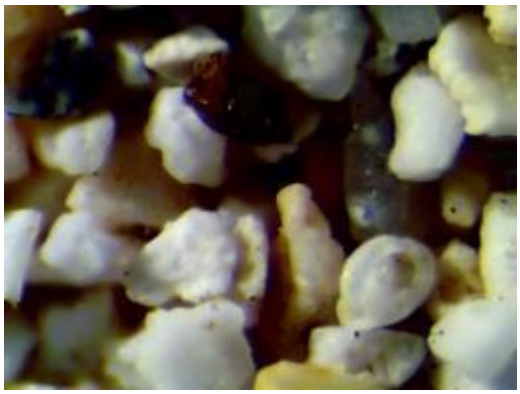


<017> SP_17 **Mangareva Island Beach 1 mi N main dock** AmScope microscope **0.5X** [Sand]

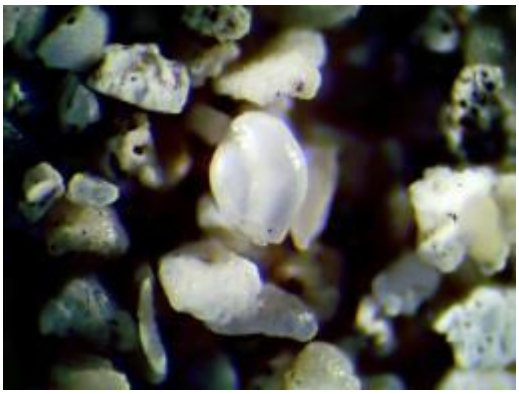


Unidentified foram

<018> SP_18 **Akamaru Island** AmScope microscope **2X**



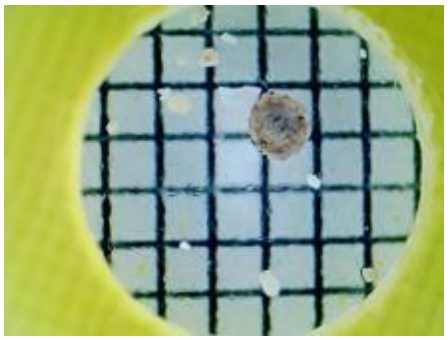
(lower right)Probably urchin spine tubercle



(center) A miliolid

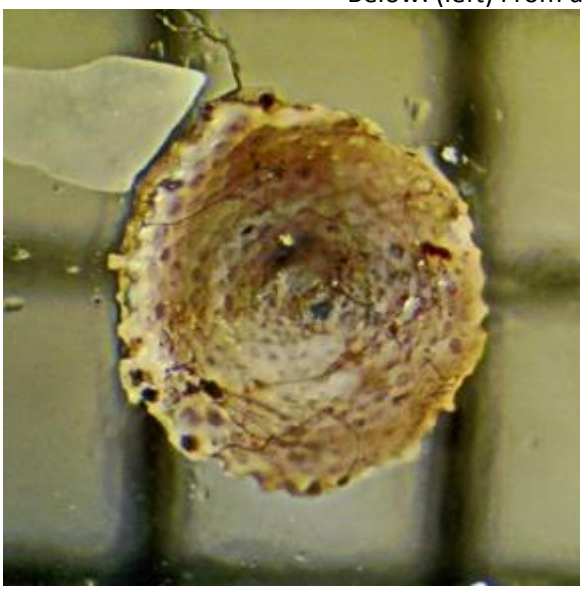
Tentative identification of Amphisorus hemprichii

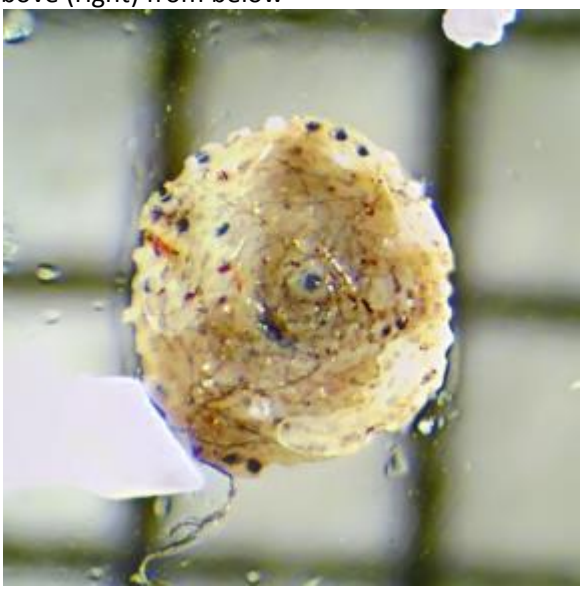
<018> SP_18 **Akamaru Island** AmScope microscope **2X**



[Slide <018.s01
Grid 1 mm

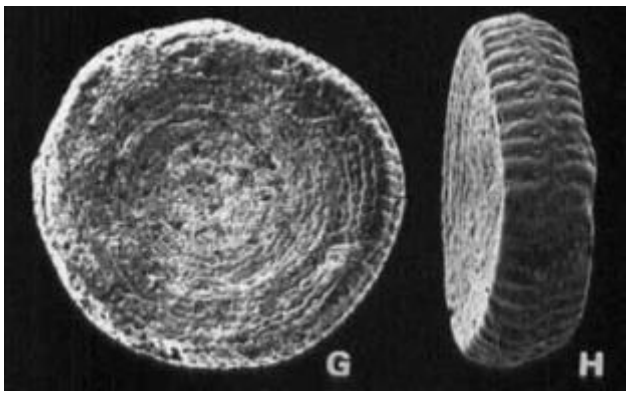
Below: (left) From above (right) from below

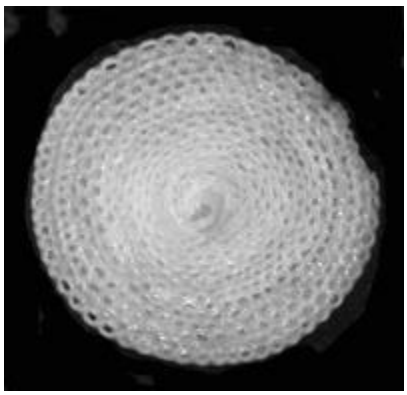




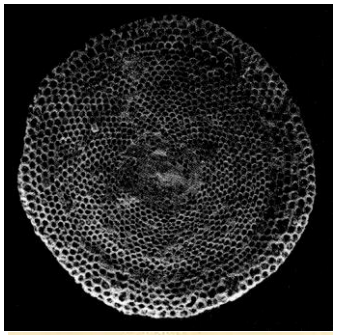
The edge structure is not obviously that of *Amphisorus,* so this specimen could be Sorites.

Below: Amphisorus hemprichii (left) Henderson and Oeno Islands (Whittaker and Hodgkinson, 1995); (right) Clipperton Island 2013 (McGann, 2014)

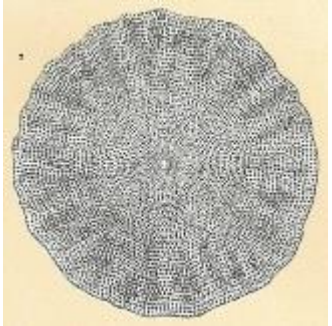




[Ref} Additional images of *Amphisorus hemprichii*



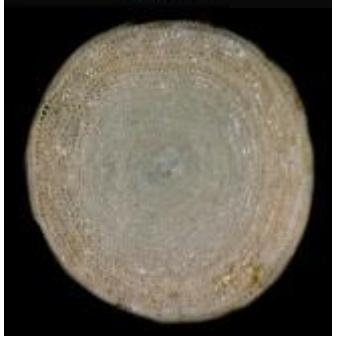
http://www.geocities.ws/rainesbk/foraminifera.html



http://www.marinespecies.org/aphia.php?p=image&tid=112822&pic=35333

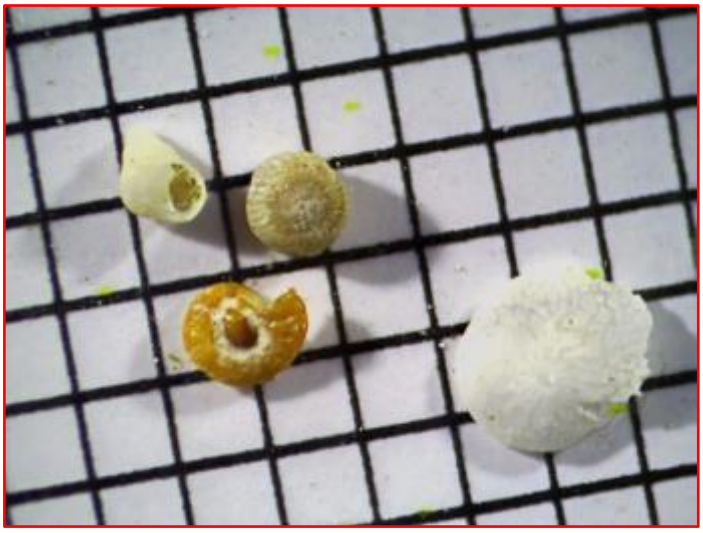
http://forambarcoding.unige.ch/specs/15-amphisorus-hemprichii

http://www.foraminifera.eu/single.php?no=1006350&aktion=suche



http://forambarcoding.unige.ch/genera/12-amphisorus/specs

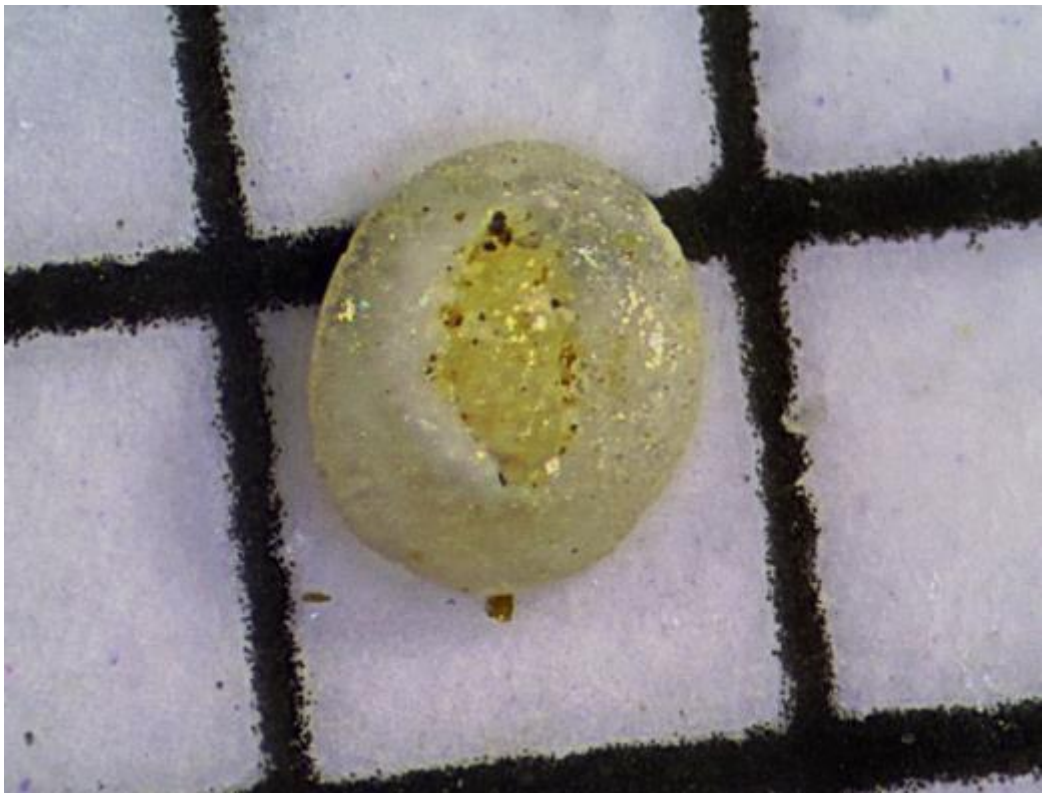
<019b#35> SP_019b.#35 **Mekiro Island** Held in #35 (500 micron) sieve AmScope microscope **1X**



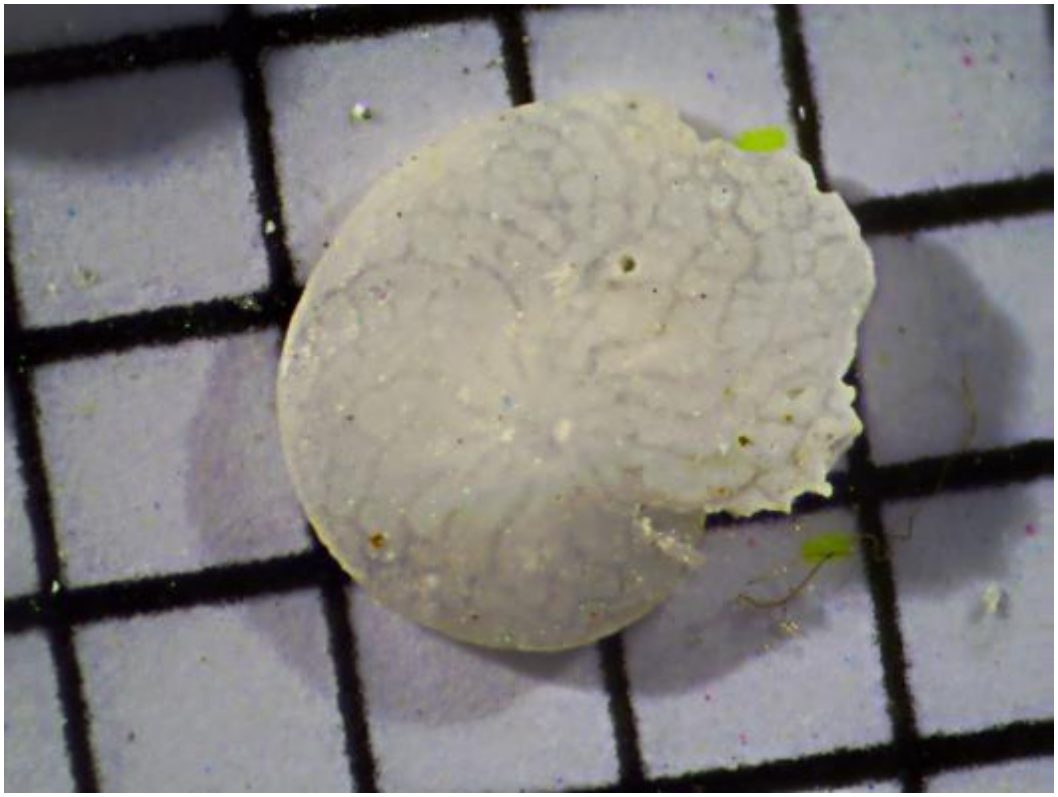
All the specimens in the 9 images on this and the next 3 pages were saved in

Vial **<019b#35.v03>**

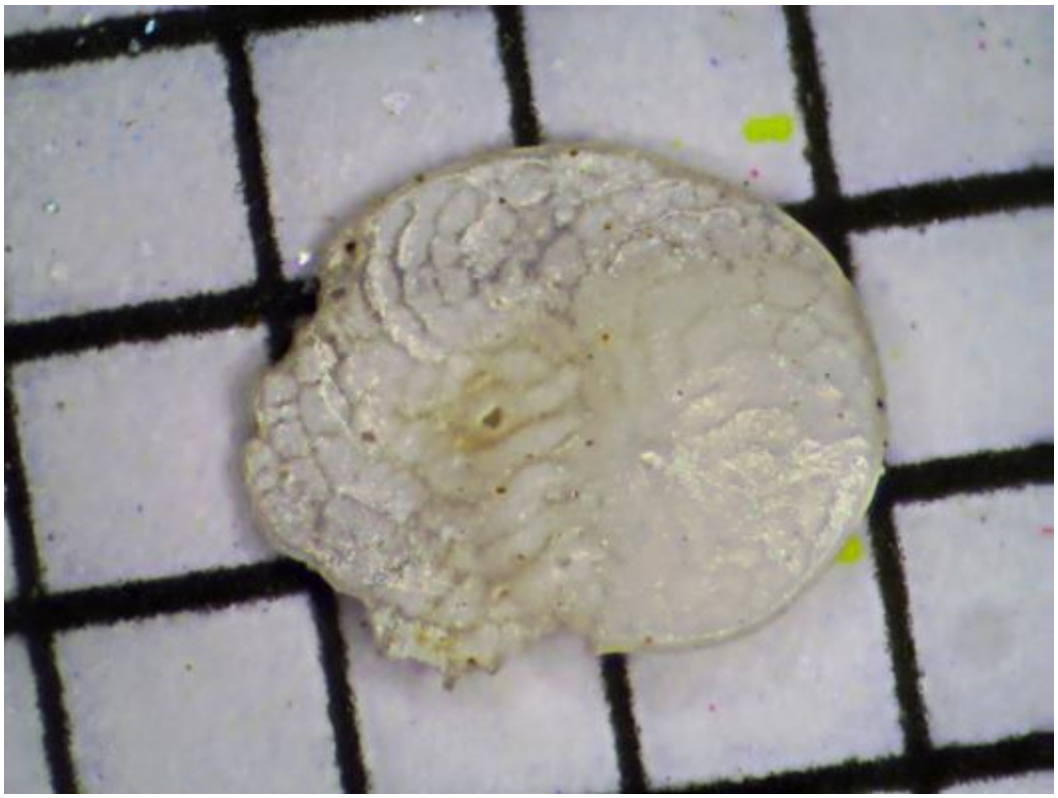
(above) *Amphisorus hemprichii (*cf., *Sorites)*



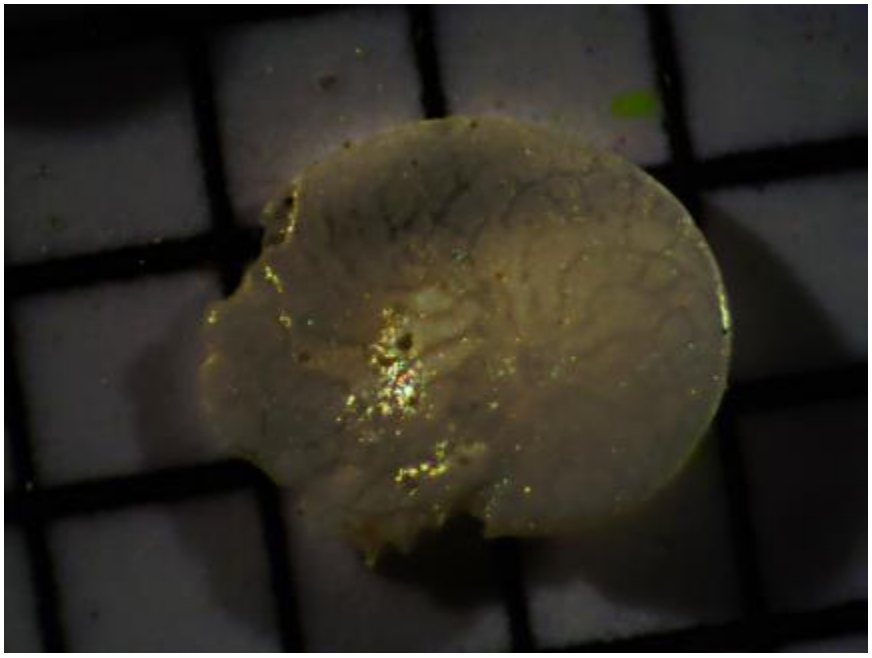
(above) Possibly a miliolid, cf., *Quinqueloculina* sp., but lacking obvious aperture

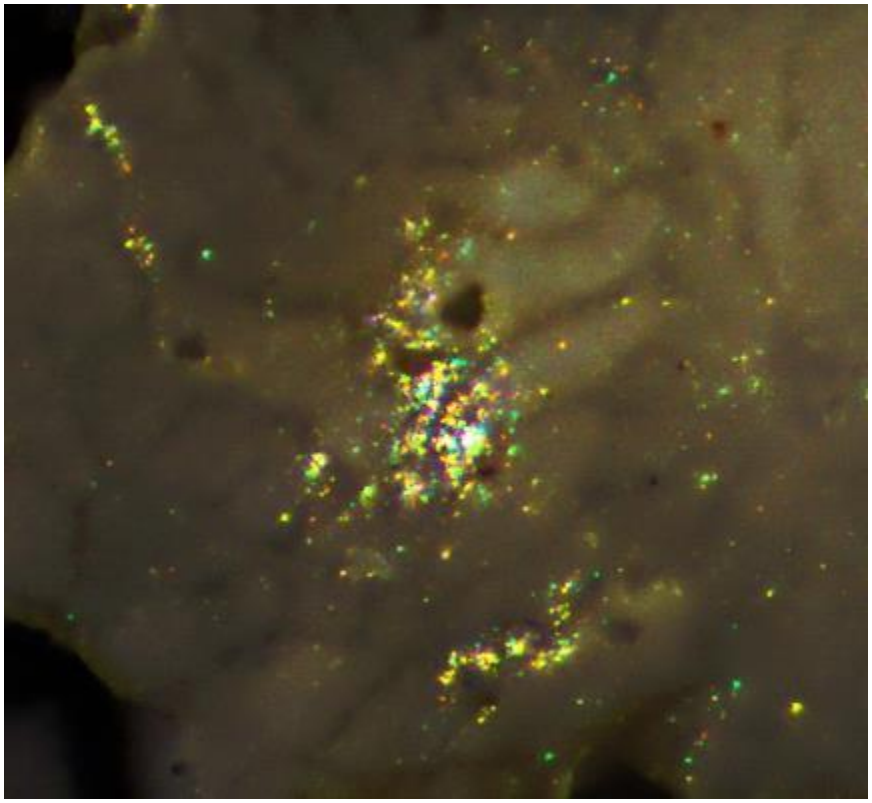


(above) *Heterostegina depressa* (dorsal side); (below) ventral side



The previous specimen seen in intense white light from left side. Close-up below.

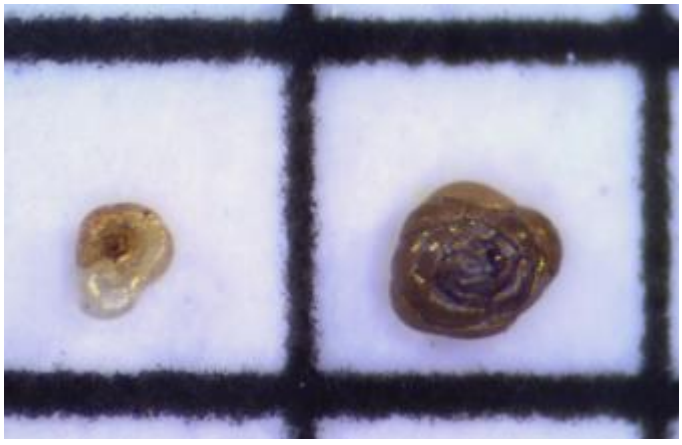


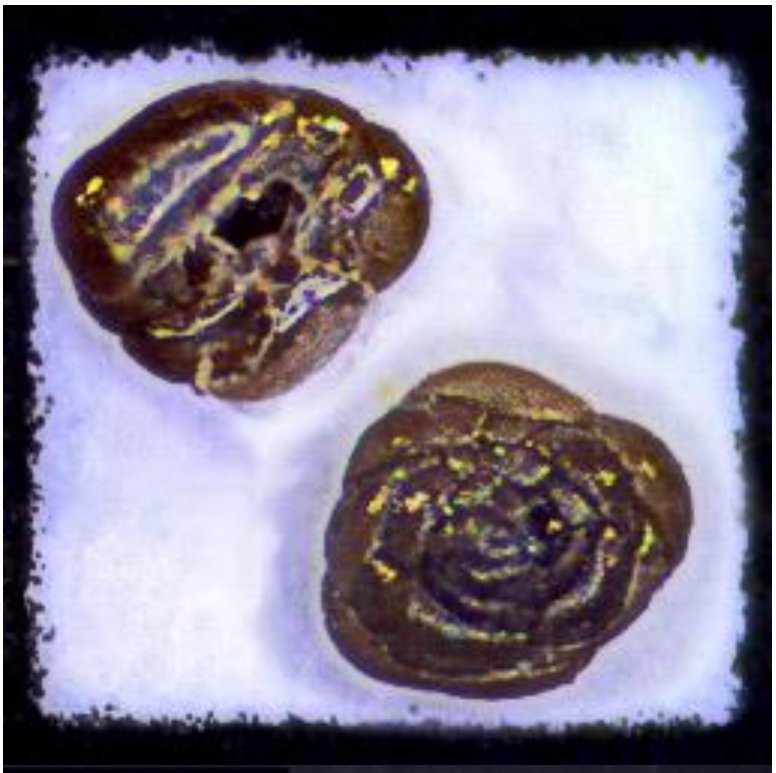


The light source was an AmScope LED-6WD dual high-intensity white spotlight about 5 cm away. When the light was from the left, the pattern above was seen. When the light was from the right, no pattern was seen. The colored spots were locked to the foram, rather than being produced by scatter in the microscope.

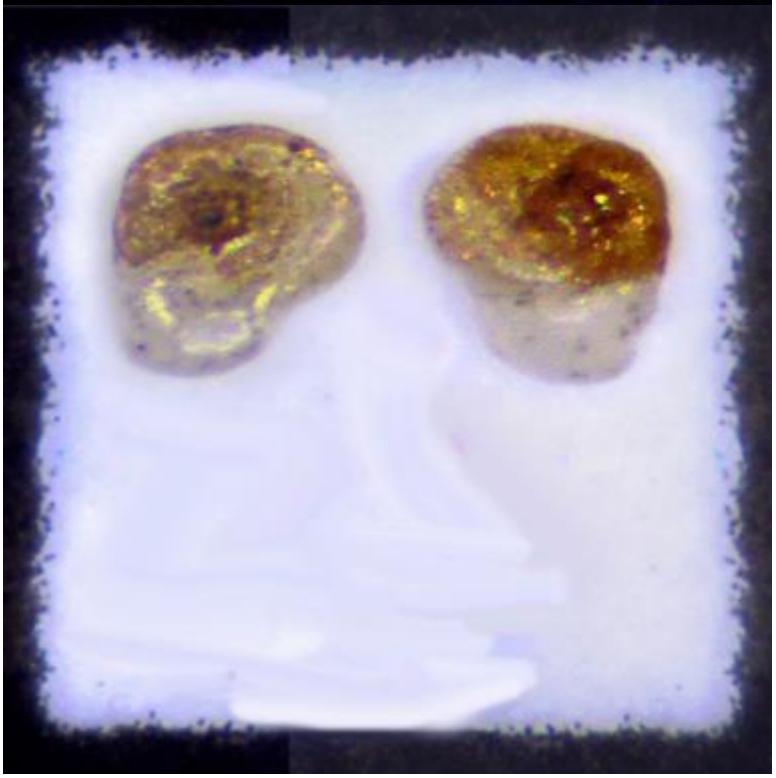
<019b#60> SP_019b.#60 **Mekiro Island** Held in #60 (250 micron) sieve AmScope microscope **1X** [Ex.#2]

<019b#60> SP_019b.#60 **Mekiro Island** Held in #60 (250 micron) sieve AmScope microscope **1X** [Ex.#2]



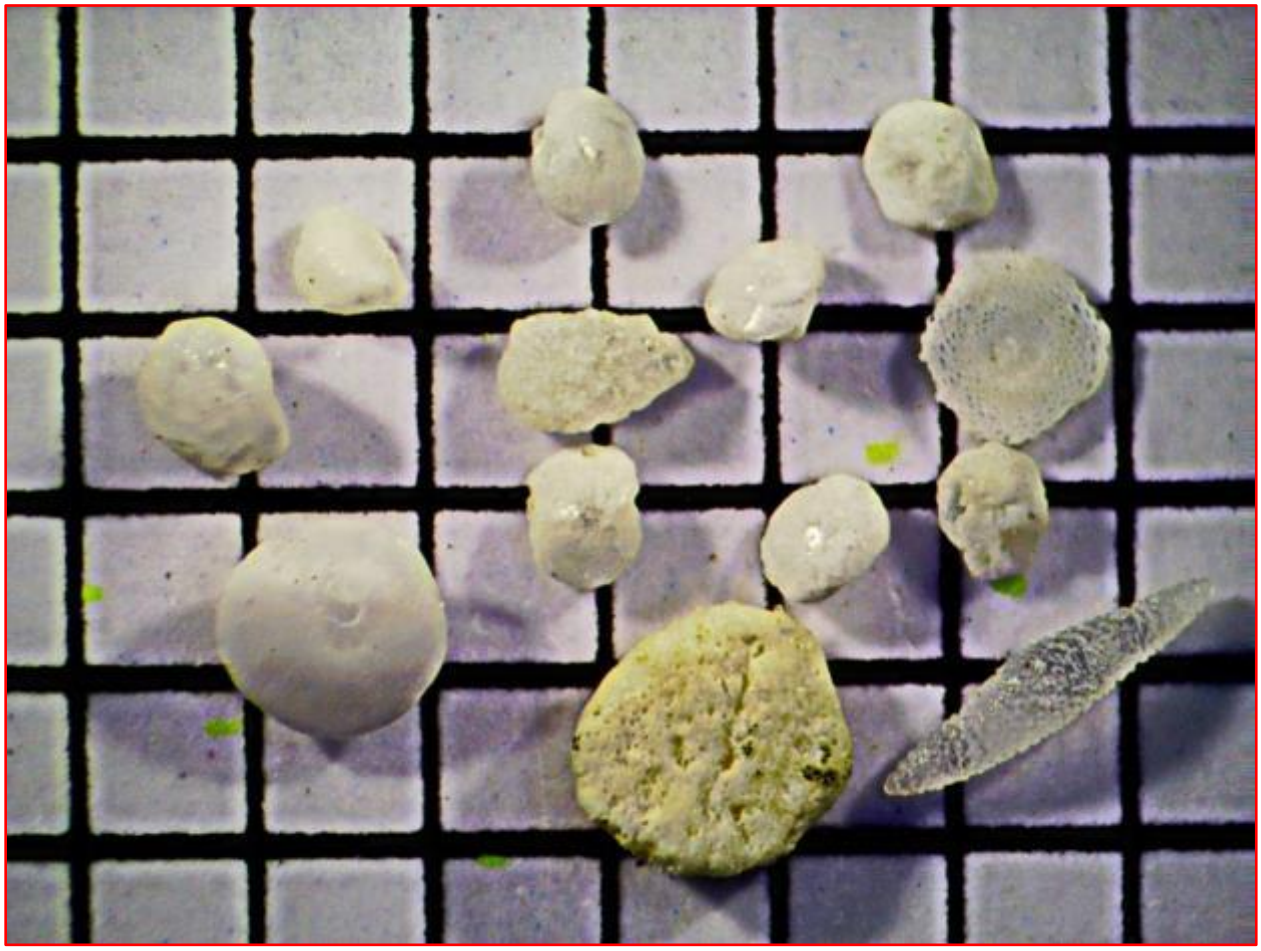


Ventral (left) and dorsal (right) sides. Frame grid 1 mm



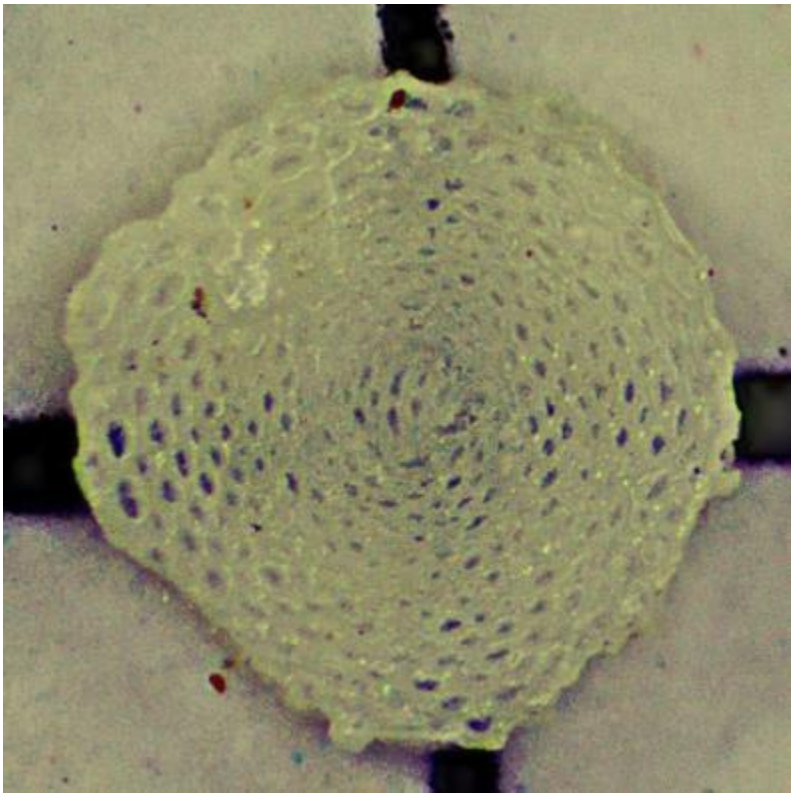
Ventral (left) and dorsal (right) sides. Frame grid 1 mm

<020b> SP_20b **Tauna Island** AmScope microscope **1X**

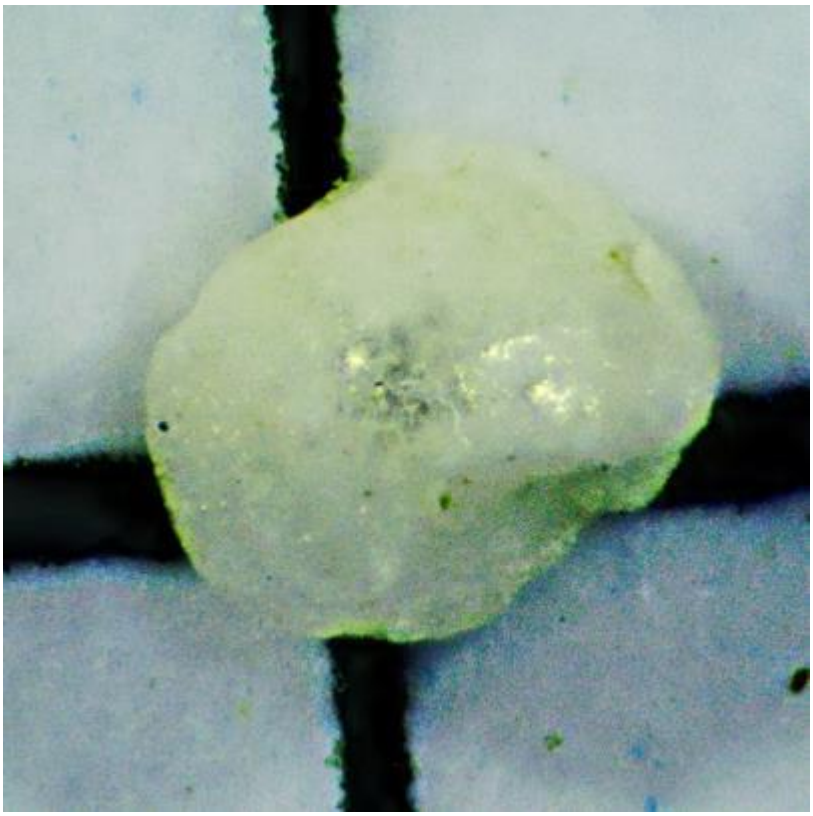


Specimens in these 3 images saved in **vial <020b.v01>**  See also non-foram specimens (below)

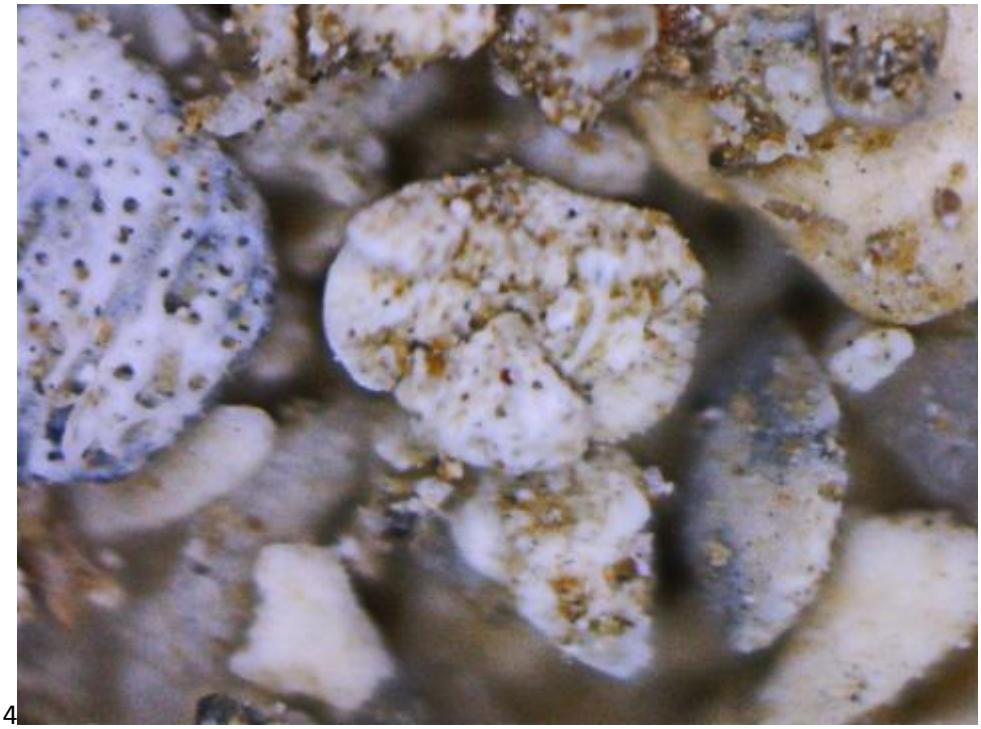
<020b> SP_20b **Tauna Island** AmScope microscope **1X (con't)**



(above) *Amphisorus hemprichii (below) Amphistegina* sp.



Non-foraminiferal specimens



4

(above and below) Unidentified

4

<011> SP_011 **Mangareva Island Main Dock #3** USB_Digital microscope

(above and below) unidentified organisms

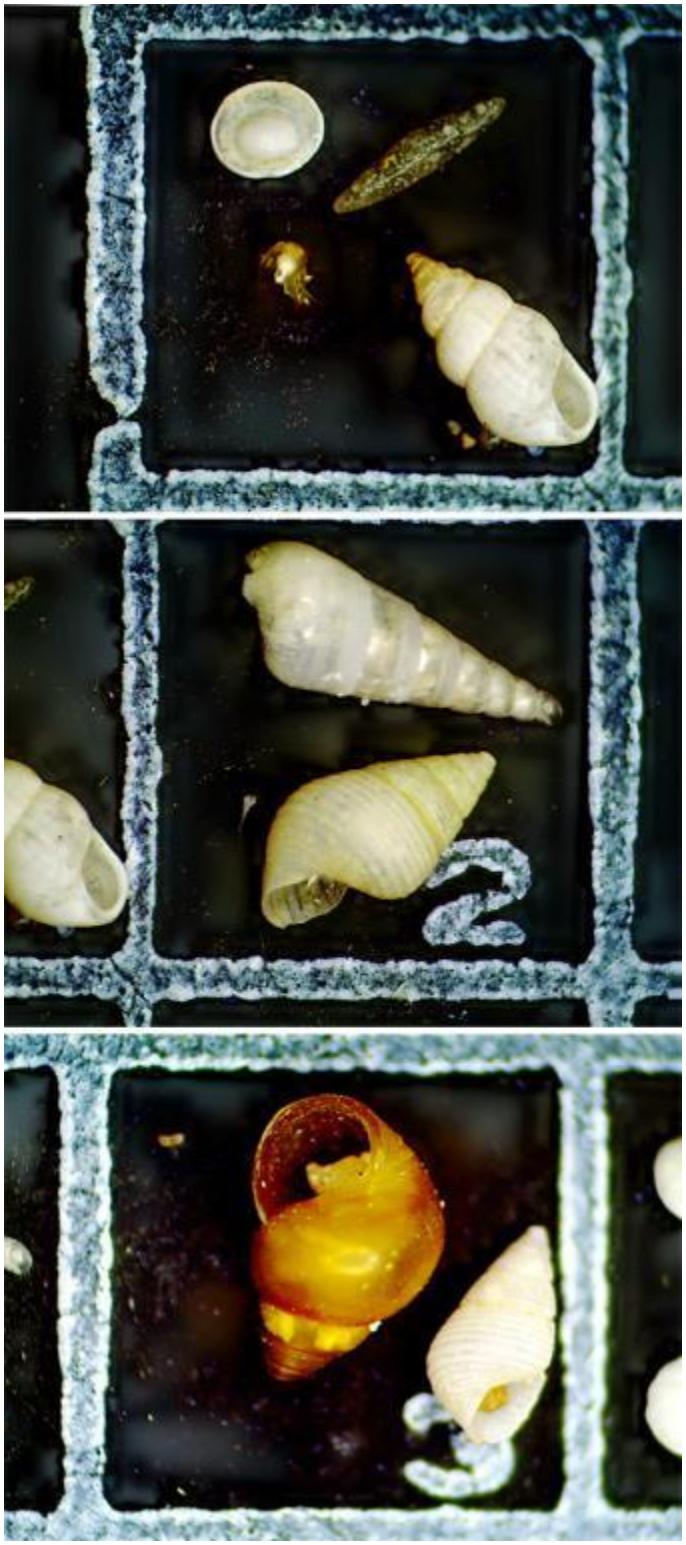
4

<013> SP_013 **Mangareva Island Main Dock #4** USB_Digital microscope

<013> SP_013 **Mangareva Island Main Dock #4** USB_Digital microscope

Probably a mollusk

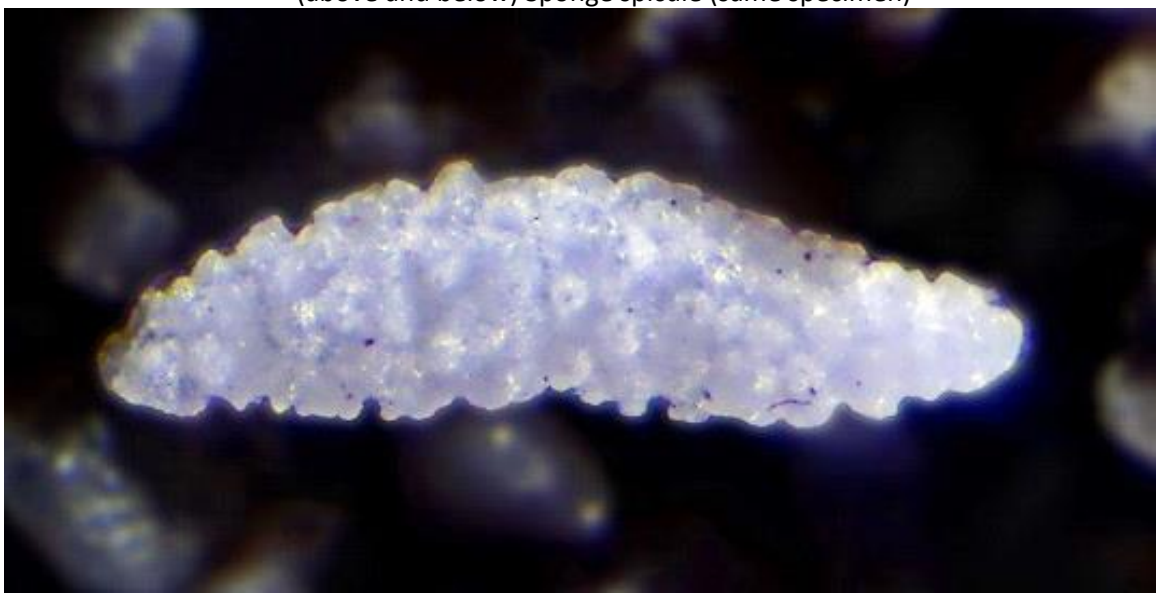
<013> SP_013 **Mangareva Island Main Dock #4** Amscope microscope 1X



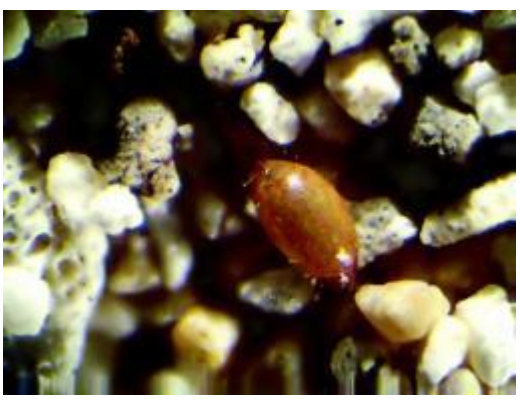
Grid scale 3.8 mm

<018> SP_18 **Akamaru Island** AmScope microscope **2X**

(above and below) Sponge spicule (same specimen)

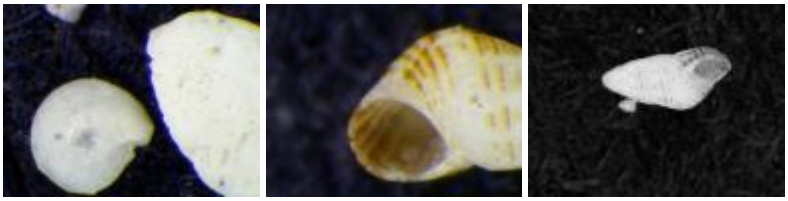


<018> SP_18 **Akamaru Island** AmScope microscope **2X**



Unidentified organism. Photos below are actual color. Specimen was lost.

<019> SP_19 **Mekiro Island** AmScope microscope



<019a> SP_019a **Mekiro Island** AmScope microscope **0.5X**

Gastropod [ca. 10 mm LOA]

<019b.v00> SP_019b.v00 Mekiro Island

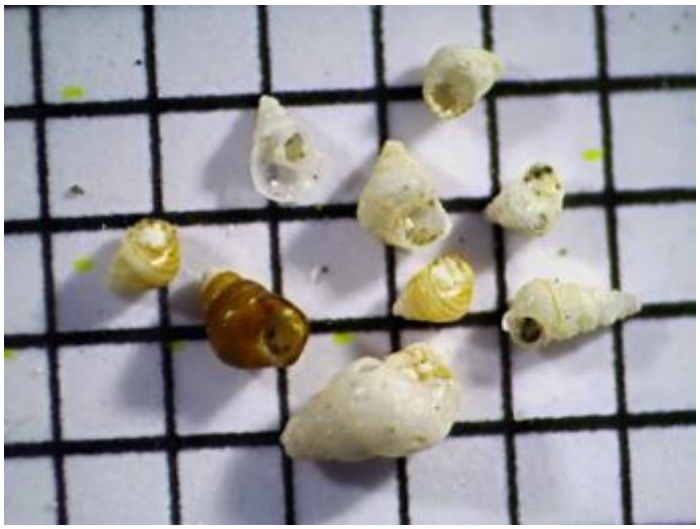
Unsorted vial of very fine sand

Vial <**019b.v00**>

<019b#10> SP_019b.#10 **Mekiro Island** Held in #10 (2000 micron) sieve AmScope microscope **1X [Ex.#2]**

Coralline algae

<019b#35> SP_019b.#35 **Mekiro Island** Held in #35 (500 micron) sieve AmScope microscope **1X**

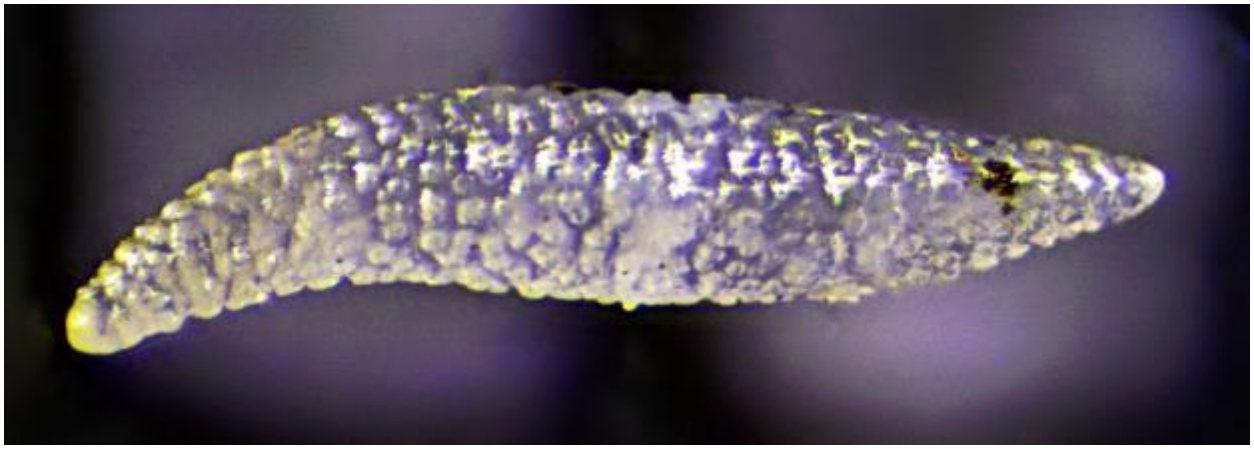


Gastropods

Sponge spicules

<020b> SP_20b **Tauna Island** AmScope microscope **2X**

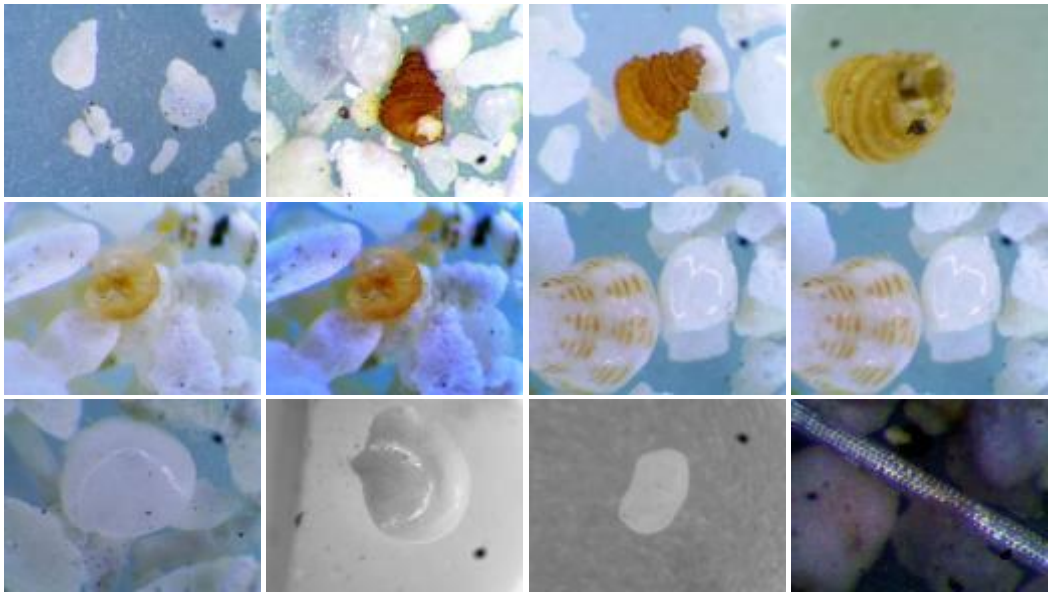
[Slide <020b.s01
Grid 1 mm



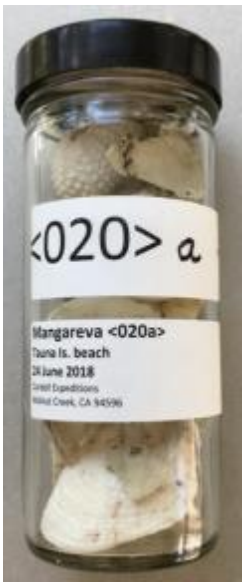
<021> SP_21 **Mangareva Island Beach 1 mi N main dock**

Contents: algae in alcohol

<020> SP_20 **Tauna Island** AmScope microscope

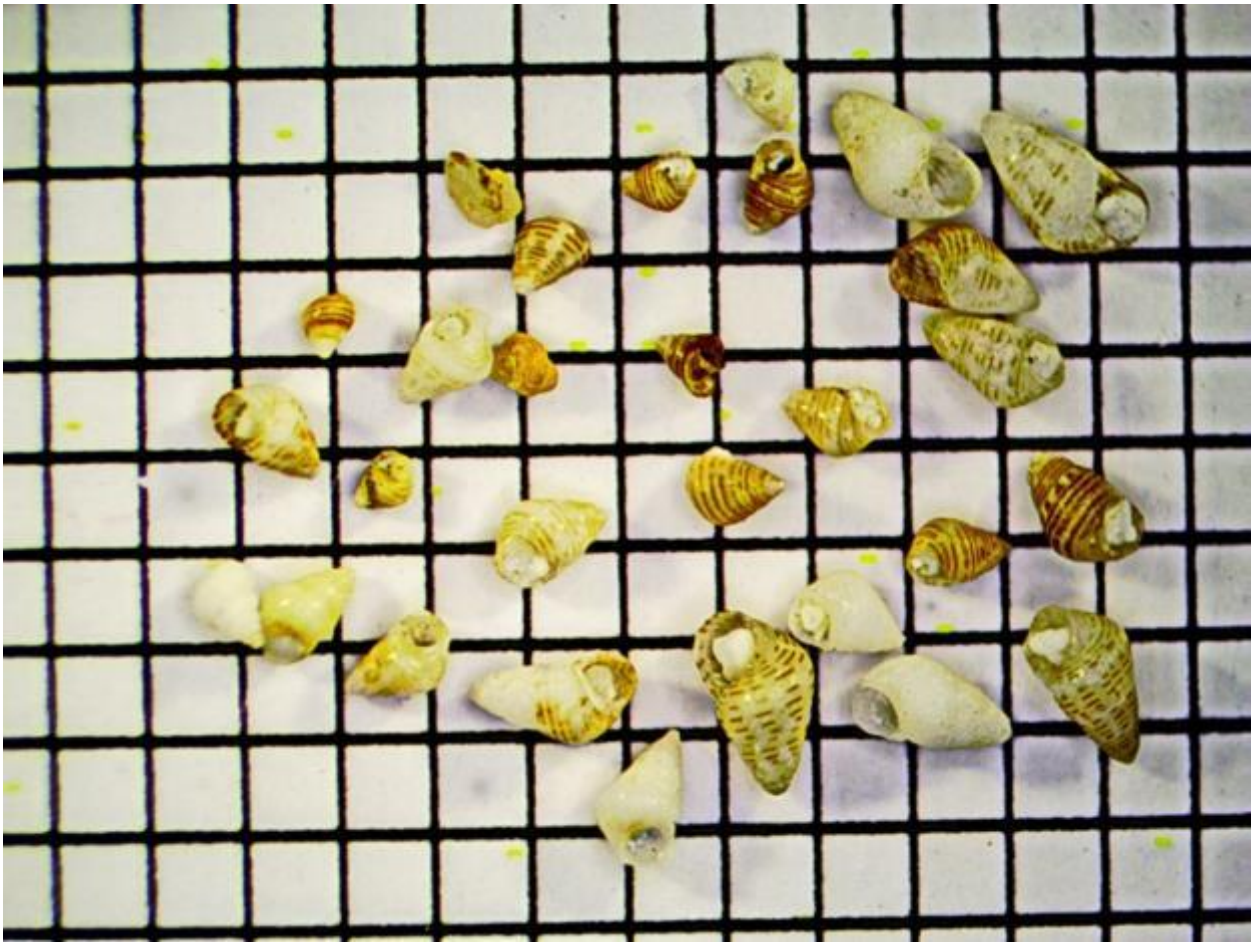


<020a> SP_20a **Tauna Island**



Contents: large mollusk shells

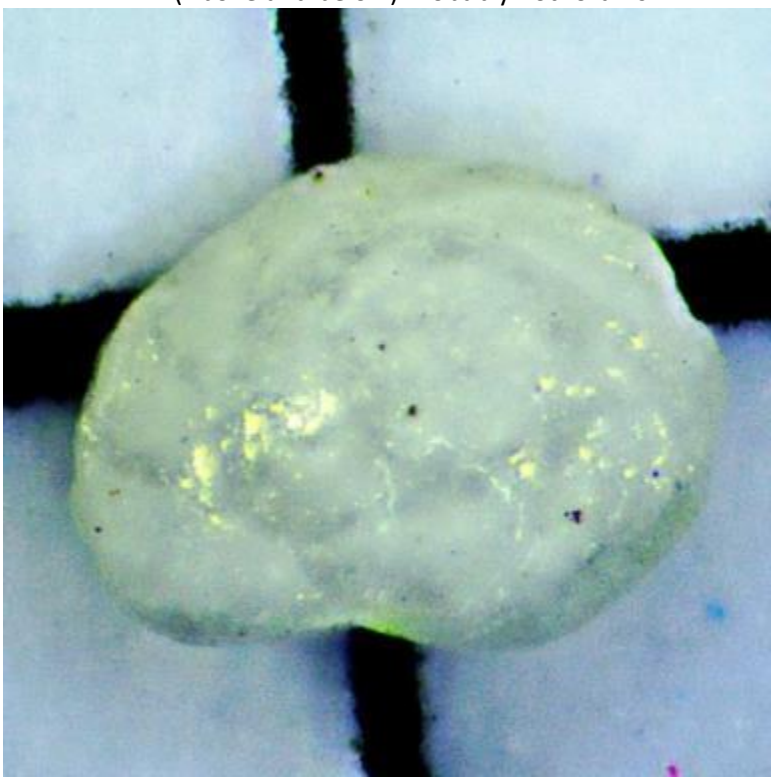
<020b> SP_20b **Tauna Island** AmScope microscope **1X**



Specimens in these 3 images saved in **vial <020b.v01>**  See also foram specimens (above)

<020b> SP_20b **Tauna Island** AmScope microscope **1X (con't)**

(Above and below) Probably not forams



Summaries

Slides

Table 4 lists the microscope slides prepared form some of the specimens. This will be an ongoing work in progress as more are examined. The slides will be numbered sequentially for each collection, i.e., <0nm.pq>–><0nm.pq+1>. Example: <019b.v01>, <019b.v02>, etc.

Table 4 - Slides

Slide #	Island	Contents
<001.s01>	Pitcairn	7 forams
<002b.s01>	Pitcairn	6 forams
<003.s01>	Pitcairn	5 forams
<004.s01>	Pitcairn	9 forams, 1 gastropod
<006.s01>	Pitcairn	1 miliolid
<006.sa01.01-03>	Mangareva	gastropods (2-4 ea sq.)
<006.sa01.04-012>	Pitcairn	forams (4-5 ea sq.)
<016.s01>	Pitcairn	13 forams
<018.s01>	Akamaru	*Amphisorus hemprichii*
<020.s01>	Tauna	sponge spicules 1.8 mm

Vials

Table 5 lists vials of specimens.

Table 5 - Vials

Vial #	Island	Contents
<003.v01>.	Pitcairn	22 forams, 3 gastropods, other
<006.v01>	Pitcairn	ca. 40 forams (loose)
<006.v02>	Pitcairn	Subcollection completely picked 9/12/18
<014.v01>	Pitcairn	1 foram
<019b.v00>	Mekiro	Unsorted fines from <019b>
<019b.v01>	Mekiro	Held in 63 micron sieve
<019b.v02>	Mekiro	Passed by 63 micron sieve
<019b.v03>	Mekiro	Held in 500 micron sieve
<020b.v01>	Tauna	ca. 30 gastropods, 12 forams.

<019b#35> SP_019b.#35 **Mekiro Island** Held in #35 (500 micron) sieve AmScope microscope **1X**

Species

Species from all collections

In **Table 6** we list all the foram species identified as of this writing.

Table 6 – Foraminifera observed (this work)

Species	Island	Collection	Slide/Vial	Page
Amphisorus hemprichii	Mangareva	<011>	–	55
"	Akamaru	<018>	<019.s01>	65
"	Mekiro	<019>	<019b.v03>	69
"	Tauna	<020>	<020b.v01>	76
Amphistegina sp.	Pitcairn	<001>	<001.s01>	16
"	Pitcairn	<002>	<002b.s01	19
"	Pitcairn	<003>	<003.s01>	20
"	Pitcairn	<003>	<003.v01>	22
"	Pitcairn	<003>	<003.v01>	23
"	Pitcairn	<014>	–	38
"	Pitcairn	<016>	–	44
"	Tauna	<020>	<020b.v01>	76
Borealis melo?	Pitcairn	<003>	<003.v01>	21
Cymbaloporetta sp.?	Pitcairn	<014>	<014.v01>	36
Heterostegina depressa	Pitcairn	<001>	<001.s01>	17
"	Pitcairn	<003>	<003.v01>	21
"	Pitcairn	<016>	–	45
"	Mangareva	<010>	–	54
"	Mekiro	<019>	<019b.v03>	70
Miliolid 1	Pitcairn	<006>	<006.s01>	31
Miliolid 2	Mekiro	<019>	<019b.v03>	69

It might be noted that *Amphisorus hemprichii* was found only on all four Gambier Islands where collections were made, but not on Pitcairn. *Amphistogina* sp. and *Heterostegina depressa* were found on both Pitcairn Island and the Gambier Islands.

Species identified on Pitcairn Island

The only description of the foraminifera of the Pitcairn Islands is that of Whittaker and Hodgkinson (1995), who give identifications of forams from the collections of the 1991-92 Sir Peter Scott Commemorative Expedition. The list from that publication is from Whittaker and Hodgkinson (1995), and was included in the "Project Description" document [Schmieder, Belton, and McGann, 2018].

In **Table 7** we list the foram species known from the Pitcairn Islands. The observations marked "X" are taken from Whittaker and Hodgkinson. Observations from the present work are marked with a red Wingding (✶). Changes in the summaries (No. species, etc.) are indicated by N**+M**, where **+M** is colored red.

Table 7 - Foraminifera of the Pitcairn Islands

Species	Henderson	Oeno	Ducie	Pitcairn
Acervulina	X			X
Amphisorus hemprichii	X	X		✶
Amphistegina lessonii	X	X		X
Amphistegina lobifera	X	X		X
Anomalinoides	X			
Bolivina				X
Chrysalidinella	X			
Cymbaloporetta	X	X		✶
Fischerinella	X			
Hauerina	X	X		
Homotrema rubrum		X		
Heterostegina depressa	X			X✶
Marginopora vertebralis	X	X		
Miliolinella	X			X
Peneroplis	X			X
Pseudolachlanella	X			
Pyrgo	X			
Quinqueloculina	X			
Rugobolivinella	X			
Schlumbergerina	X			
Scutuloris	X			
Sorites marginalis	X	X		
Sphaerogypsina globula	X	X		
Spririllina				X
Sprioloculina	X	X		
No. Species	22	10	0	8+2
Area (km^2)	37.3	16.7	3.9	4.6
Size (km)	10	1.6	2.2	3.5

Species identified on the Gambier Islands

In **Table 8** we list the foram species observed in the collections from the Gambier Islands.

Table 8 - Foraminifera of the Gambier Islands

Species	Mangareva	Akamaru	Mekiro	Tauna
Amphisorus hemprichii	✶	✶	✶	✶
Amphistegina sp.				✶
Heterostegina depressa	✶		✶	
No. Species	0+2	0+1	0+2	0+2
Area (km^2)	15.4	2.6	0.1	0.01
Size (km)	10	1	0.5	0.2

No forams have previously been documented from the Gambier Islands.

Comments

A very rough look at the photographs suggests that there are probably 20-30 different forams in the collections presented in this document. For Pitcairn, we believe there will be perhaps 10 species that have not yet been reported (i.e., not in Whittaker and Hodgkinson). For the Gambier Islands (Mangareva, Akamaru, Mekiro, and Tauna), there are no known publications on forams, so the present identifications probably represent new records.

The collections presented here probably do not lend themselves to abundance analysis. On Pitcairn, only one collection <006> was made at depth (28 m); the others were from shoreline, which was generally pounding surf. A small amount of algae was collected, but as of this date this material has not been processed to extract forams.

Finally, it is clear that another set of collections is critical to understanding the populations on these islands, including both sampling at depth and in the water column. Furthermore, the at–depth samples should be taken in the top few cm of the bottom. If done with a grab, selection of the grab will be important. If done by divers, proper instructions for the collections will be essential. The importance of the procedures for collecting, preserving, and identifying forams is emphasized by McGann and others.

Appendices

Waypoints

The location of most of the collections was recorded with a Garmin GPSmap 62s. The waypoints were assigned sequential numbers and brief descriptive locations. Waypoints WP_0Xn had to be measured from the known map positions, as no GPS waypoint was saved.

Table 9 lists the waypoints and their locations.

Table 9 - Waypoints of the collections

Island	Waypoint	Latitude	Longitude	Name	Collections
Pitcairn	**WP_014**	-25.062532	-130.115955	014 Tedside New Dock	<001>
Pitcairn	**WP_015**	-25.064795	-130.119971	015 Down Cabin	<002>
Pitcairn	**WP_017**	-25.075189	-130.088732	017 St Paul's Pool	<003>, <008>
Pitcairn	**WP_020**	-25.068654	-130.09613	020 Bounty Bay Landing	<004>, <014>, <015>
Pitcairn	**WP_022**	-25.065729	-130.121438	022 Sandy Harbor	<005>, <007>
Mangareva	**WP_037**	-23.108017	-134.963049	037 Beach	<017>, <021>
Akamaru	**WP_042**	-23.179664	-134.914203	042 Akamaru Island	<018>
Mekiro	**WP_043**	-23.175918	-134.920554	043 Mekiro Island	<019>
Tauna	**WP_045**	-23.147952	-134.851485	045 Tauna Island	<020>
Pitcairn	**WP_0X1**	-25.064467	-130.099961	0X1 Down Isaacs	<016>
Pitcairn	**WP_0X2**	-25.064653	-130.090858	0X2 Claymore anchor	<006>
Mangareva	**WP_0X3**	-23.1175361	-134.968888	0X3 Main dock #1	<009>
Mangareva	**WP_0X4**	-23.118161	-134.968611	0X4 Main dock #2	<010>
Mangareva	**WP_0X5**	-23.117717	-134.968888	0X5 Main dock #3	<011>
Mangareva	**WP_0X6**	-23.117719	-134.968888	0X6 Main dock #4	<013>

USB_Digital microscope files

Some (but not all) images were taken on Pitcairn Island with the USB_Digital microscope by saving the image as a .jpg file. Most of these are shown in this document (1" high")

Table 10 lists all the files saved from the USB_Digital microscope.

Table 10 – Images of specimens recorded while on Pitcairn Island

Collection	Location	Filename [.jpg]	Size [byte]	Image DateTime
<002>	**Pitcairn Down Cabin**	18531125755127	2,790,576	5/30/2018 12:57
<002>		18531131327548	3,044,763	5/30/2018 13:13
<002>		18531132537308	3,046,951	5/30/2018 13:25
<004>	**Pitcairn Bounty Bay Landing**	18531154016563	2,950,403	5/30/2018 15:40
<004>		18531161341441	3,378,878	5/30/2018 16:13
<004>		18531161554108	3,534,188	5/30/2018 16:15
<004>		18531162137879	3,126,512	5/30/2018 16:21
<004>		18531163324940	2,906,691	5/30/2018 16:33
<004>		18531163737645	2,771,508	5/30/2018 16:37
<004>		18531164716884	2,863,790	5/30/2018 16:47
<009>	**Mangareva Main Dock #1**	186355539532	880,493	6/2/20178 5:55
<009>		1863557566	871,606	6/2/2018 5:57
<009>		186355659822	862,410	6/2/2018 5:57
<009>		186355922619	856,130	6/2/2018 5:59
<009>		1863613435	757,538	6/2/2018 6:01
<009>		18636738700	802,494	6/2/2018 6:07
<009>		186361410931	924,918	6/2/2018 6:14
<009>		186361530908	775,526	6/2/2018 6:15
<009>		186362020654	813,558	6/2/2018 6:20
<009>		186362135901	808,061	6/2/2018 6:21
<009>		186362521783	928,455	6/2/2018 6:25
<009>		186362825590	776,165	6/2/2018 6:28
<009>		18636305190	792,962	6/2/2018 6:30
<009>		186363255973	760,903	6/2/2018 6:32
<010>	**Mangareva Main Dock #2**	186217589407	3,233,247	6/1/2018 17:58
<010>		186218054181	3,526,597	6/1/2018 18:00
<010>		186218312352	3,407,949	6/1/2018 18:03
<010>		1862185051	3,410,228	6/1/2018 18:05
<010>		18621882453	3,366,432	6/1/2018 18:08
<010>		186218943222	3,476,137	6/1/2018 18:09
<010>		1862181351845	3,311,540	6/1/2018 18:13
<010>		1862181624485	3,463,907	6/1/2018 18:16
<010>		1862181859300	3,693,026	6/1/2018 18:19
<010>		1862182115973	3,529,439	6/1/2018 18:21
<010>		1862182517221	2,245,166	6/1/2018 18:25
<011>	**Mangareva Main Dock #3**	186216343227	3,231,222	6/1/2018 16:03
<011>		186216646672	3,192,788	6/1/2018 16:06
<011>		1862161014820	3,265,421	6/1/2018 16:10
<011>		1862161628880	3,134,999	6/1/2018 16:16
<011>		1862162125252	2,948,288	6/1/2018 16:21
<011>		1862162314596	3,236,079	6/1/2018 16:23
<011>		18621729307	3,239,513	6/1/2018 17:02
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<011>		1862172422626	3,126,420	6/1/2018 17:24
<011>		1862172933594	3,521,914	6/1/2018 17:29
<011>		1862173220723	3,212,099	6/1/2018 17:32
<011>		1862173531514	3,430,679	6/1/2018 17:35
<011>		1862173824235	3,414,613	6/1/2018 17:38
<011>		18621740373	3,360,292	6/1/2018 17:40
<011>		1862174157675	3,196,855	6/1/2018 17:42
<013>	**Mangareva Main Dock #4**	1862104136544	709,553	6/1/2018 10:41
<013>		1862104345621	768,628	6/1/2018 10:43
<013>		186210568854	785,742	6/1/2018 10:56
<013>		186211034965	704,040	6/1/2018 11:00
<013>		186211425238	619,832	6/1/2018 11:04

<013>		186211820950	678,143	6/1/2018 11:08
<013>		186211125829	675,148	6/1/2018 11:12
<013>		1862111346515	659,677	6/1/2018 11:13
<013>		1862111549932	676,547	6/1/2018 11:15
<013>		1862111953228	799,884	6/1/2018 11:19
<013>		1862112216359	712,570	6/1/2018 11:22
<013>		1862112513189	790,273	6/1/2018 11:25
<013>		186211304893	729,963	6/1/2018 11:30
<013>		1862114211132	726,182	6/1/2018 11:42
<013>		1862114930668	719,188	6/1/2018 11:49
<013>		1862115243805	682,342	6/1/2018 11:52
<013>		186211557531	684,645	6/1/2018 11:55
<014>	**Pitcairn Bounty Bay Pier**	1853145821680	483,038	5/30/2018 4:58
<014>		1853151848817	794,883	5/30/2018 5:18
<014>		1853153031360	770,067	5/30/2018 5:30
<014>		1853153128338	3,237,133	5/30/2018 5:31
<014>		1853154112940	3,129,124	5/30/2018 5:41
<014>		1853154627137	3,327,577	5/30/2018 5:46
<014>		1853155218769	3,151,201	5/30/2018 5:52
<014>		18531655632	3,419,798	5/30/2018 6:05
<014>		18531695361	3,298,552	5/30/2018 6:09
<014>		185316133627	3,209,123	5/30/2018 6:13
<014>		1853161621829	3,585,510	5/30/2018 6:16
<014>		1853162335795	2,985,804	5/30/2018 6:23
<014>		1853163227133	3,506,139	5/30/2018 6:32
<014>		1853163556436	3,300,210	5/30/2018 6:36
<014>		1853163839643	3,265,343	5/30/2018 6:38
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<014>		1853172917570	3,358,137	5/30/2018 7:29
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<014>		1853173942530	3,531,677	5/30/2018 7:39
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<014>		185317478577	3,274,659	5/30/2018 7:47
<014>		1853174820377	3,211,654	5/30/2018 7:48
<014>		1853174939580	3,134,926	5/30/2018 7:49
<014>		185317573281	3,412,938	5/30/2018 7:57
<014>		185317584260	3,520,768	5/30/2018 7:58
<014>		185318022812	3,287,004	5/30/2018 8:00
<014>		185318024824	3,285,892	5/30/2018 8:00
<014>		18531826301	3,289,757	5/30/2018 8:02
<014>		185318431644	3,393,847	5/30/2018 8:04
<014>		185318625180	3,340,565	5/30/2018 8:06
<014>		1853192423884	2,694,586	5/30/2018 9:24
<014>		185319274574	2,766,788	5/30/2018 9:27
<014>		1853193110194	2,779,771	5/30/2018 9:31
<014>		185319342273	2,978,509	5/30/2018 9:34
<014>		1853193942706	2,602,972	5/30/2018 9:39
<016>	**Pitcairn Down Isaacs**	186335455982	881,173	6/1/2018 3:54
<016>		18634632164	778,156	6/1/2018 4:06

Collecting permit

GOVERNMENT OF PITCAIRN, HENDERSON, DUCIE AND OENO ISLANDS
Adamstown
PCRN 1ZZ
PITCAIRN ISLAND

3rd June 2018

RE: Permission granted by the Government of Pitcairn Islands.

Doctor Robert W. Schmieder conducted a research study on marine foraminifera whilst on Pitcairn Island. Permission has been granted for the collection of marine sand samples including transportation to the United States of America (USA) for further microscopic study. The research study and data gained is important to the Government of Pitcairn Islands.

Please don't hesitate to contact me if you require further information.

Kind regards

Michele Christian

Division Manager
Environmental, Conservation & Natural Resources
Government of Pitcairn Islands
South Pacific

Email: dmnature@pitcairn.gov.pn
Phone: +64 9 984 0153

Kind regards

Michele Christian

Appreciations

We sincerely thank our hosts and supporters on Pitcairn Island. Steve and Olive Christian opened their home for most of the two weeks we were there, and they made it possible to secure the collections on Pitcairn; Steve himself personally made some of these collections. We thank Kevin Young for assistance in processing the collections on Pitcairn and Michelle Christian for providing guidance for the project and the permit reproduced above.

We express our very sincere appreciation to Neil Broughton and the crew of the Claymore II for their significant contributions to this project. Among other favors, they used the Peterson Grab to recover five collections from Pitcairn and Mangareva Islands. Crewmen Spock and D'Arcy took primary responsibility for this operation. We especially thank Andrew Fagan for the loan of his laptop computer in the face of having lost our computer at the airport.

Literature

R. Irving and T. Dawson, The Marine Environment of the Pitcairn Islands, The Pew Environment Group, Dundee University Press, 2012. http://www.octassociation.org/IMG/pdf/dupreport11lo.pdf

> [p. 19]: FORAMS19 In 1991 a number of sediment and seaweed samples, collected by Richard Preece of the Sir Peter Scott Commemorative Expedition, were later analysed for Foraminifera (forams) by John Whittaker and Richard Hodgkinson of the Natural History Museum, London (Whittaker & Hodgkinson, 1995). Note that no Foraminifera were found in the sediment samples taken. A total of 11 species of Foraminifera have been recorded from Pitcairn, although this is by no means a complete record (see Appendix 5).

M. McGann, "USGS Scientist Examines Foraminifera Collected from Remote Clipperton Island," USGS Sound Waves, https://soundwaves/usgs.goc/2014.02/research4.html .

M. McGann, "Foraminiferida," in: *Intertidal Invertebrates of Central California to Oregon (The Light and Smith Manual)*, 4th Edition, Univ. Calif. Press, Berkeley, (2007), pp. 46-68.

Palomares, M.L.D., Chaitanya, D., Harper, S., Zeller, D. & Pauly, D. (eds.) 2011. The Marine Biodiversity and Fisheries Catches of the Pitcairn Islands, 42 pp. A report prepared for the Global Ocean Legacy project of the Pew Environment Group. The Sea Around Us Project, Fisheries Centre, UBC, Vancouver, Canada. [Referenced in Irving and Dawson]

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