

SEM Diaries - 45

Foraminifera and other creatures from the Eocene

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Fig. 1 Showing a stub of mostly forams. Left: The optical photograph of the stub, prior to sputter coating, with annotations added using Adobe Photoshop. Right: The same stub, as imaged at low magnification in the SEM.

“So, the electron microscope is for viewing subjects at a higher magnification than can be achieved using light microscopy. Right?” Well, half right, perhaps. The statement would generally apply to subjects viewed with a Transmission Electron Microscope (TEM) but this does not always apply to viewing with the SEM. In fact, there are times when I like to use a magnification of around x20, especially when searching on a stub for a particular specimen, or part of one, or attempting to image the head of a wasp, for example. In fact, the SEM is an ideal instrument for imaging subject matter such as foraminifera, which are easily appreciated even when using a low power stereo microscope.

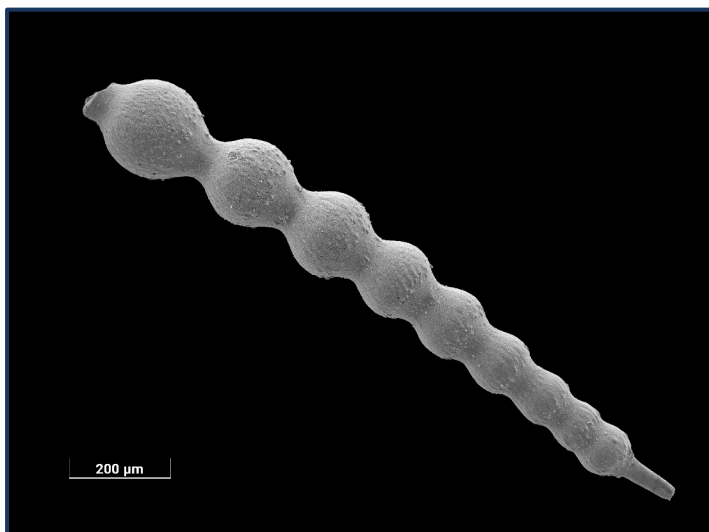
That having been said, the SEM does have advantages when studying forams. First, the maximum magnification of most stereo microscopes is in the range X40 to X64. Even at its highest magnification (x64) my Olympus SZH will by no means fill the field of view when focused on a foram such as *Elphidium crispum*.

Secondly, since forams are opaque objects, using a conventional high power microscope is not an easy option unless it has an epi-illumination fixture. Even if it were possible to light the specimen from above, the depth of field of an image would be such that only a small part of the foram would be in focus.

With the SEM it is possible to zoom in on the subject so that the image can fill the frame, and the depth of field offered by the SEM is usually more than adequate.

I was recently asked if I would like to image a collection of fossil material from the London Clay formation. This is a marine geological formation from the early Eocene epoch (c. 54 - 50 million years ago), and extends in parts to the South Coast of England and onto the Isle of Wight. It is very rich in small fossils including molluscs, foraminifera and fish, along with vegetable specimens such as seeds and pollen. Of course I said “yes”.

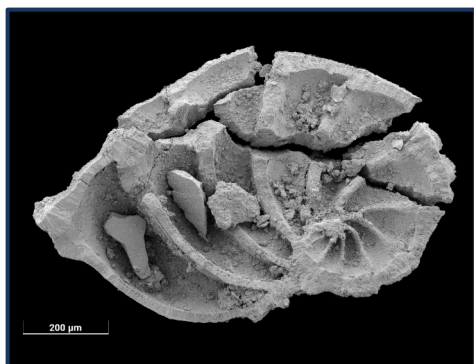
The material had been in the possession of a paleontologist at the British Museum prior to its being bequeathed to my friend who passed it to me. It had been collected from a variety of sites, which was



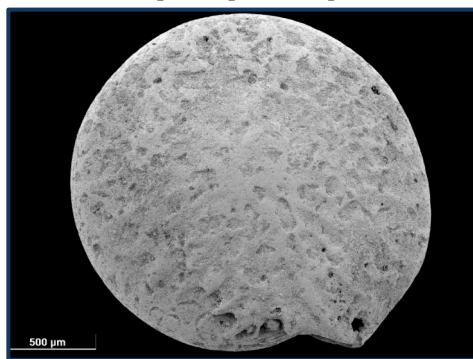
Foram *Caveastomella adolphina* (d'Orbigny 1846), collected from a building site at Imperial College, London, in 1970

reflected in the different species depending on location. Furthermore, and this was a great bonus, the samples had been sorted to leave almost pure fossil material, with an absence of sand or other “adulterating” products.

Forams and similar material are quite easy to mount on an SEM stub, with a sticky conducting carbon tab. “All” that is needed is to pick up the required foram



This foram fragment is undertermined, but it does show the layout of the chambers inside the foram.



Foram *Nummulites variolarius*, collected from the Sables Moyens, Isles les Melduses, France

from a small container such as a watch glass, using a paint brush with a drop of water on it, and transfer it to the stub. The surface tension of the water secures the foram to the brush until it is placed on the stub, at which point the stickiness of the carbon tab overcomes the surface tension and secures the specimen. Using a more obvious way of holding the specimen, such as with forceps, is doomed to failure, as the foram would turn to dust under the pressure of the tips of the forceps. I use two stereo microscopes, side by side, for this. One is focused on the samples in the watchglass, while the other shows the receiving stub.

It is possible to mount a significant number of forams on a single stub. This is great for economy of materials such as stubs, and gold for sputter coating, but this technique requires a way to identify each individual sample on the stub so that it is easy to locate a particular specimen and also to be able to catalogue the species. Prior to coating my stubs, I photograph them and then add a unique number adjacent to each specimen using Adobe Photoshop (Figure 1 left). Then, following coating, I place the stubs in the SEM and open a tool on my SEM called the “positioner”. Then I move my mouse pointer round the low magnification SEM

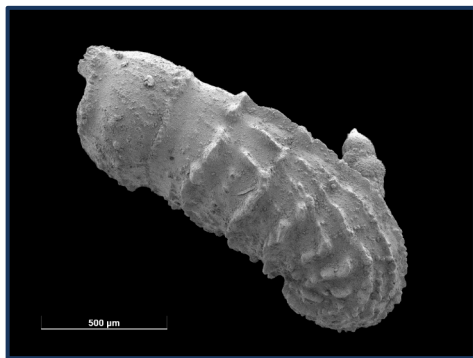
image of the stub (Figure 1 right) and click on every specimen in turn, taking care to do this in the same order as the samples are numbered. Once this is done, I can increase the magnification so that a single specimen fills the frame and image that specimen. Then I can just click on a numbered position on the positioner and the SEM will automatically move the stage to bring the particular specimen into position. There is no need to reduce the magnification again, to locate the next position.

So, having implemented my technique for mounting the wide variety of specimens imaging them more or less became a “conveyor belt” sort of operation. I was able to image six stubs with possibly a total of 100 specimens in a relatively short time, before opening the SEM chamber and replacing those stubs with the next six.

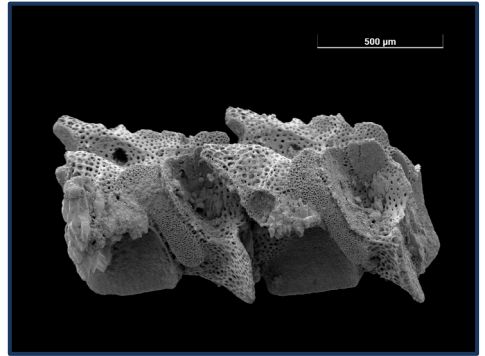
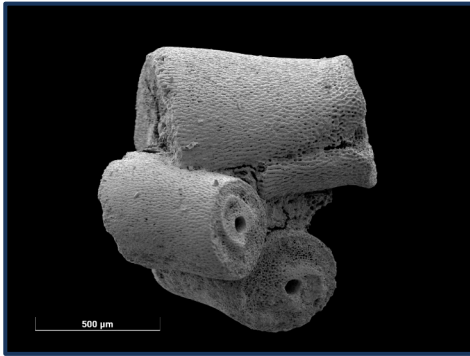
Another conveyor belt type of operation is to work on a selection of the images to mask out the distracting background (including the crazing of the carbon tab on the stub), adjust the contrast and brightness and move the scale bar from the “info bar” beneath the image into the body of the picture. I have created two Photoshop “actions” to carry out this



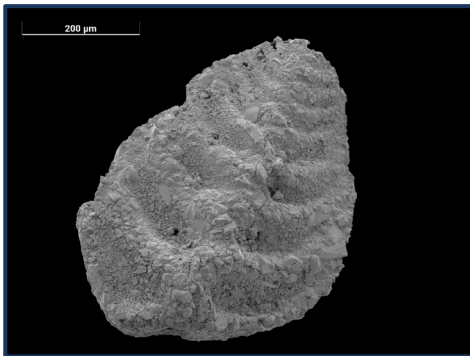
Possibly foram *Planorbulina ammonoides*, collected from a building site at Imperial College, London, in 1970



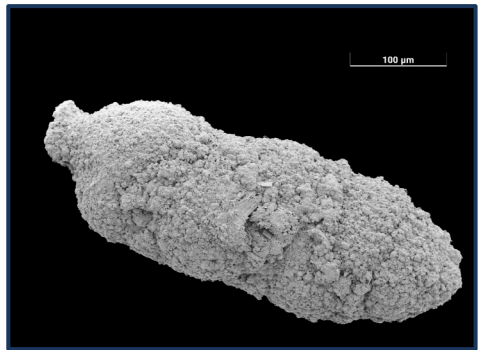
Possibly foram *Marinolina* sp. collected from a building site at Imperial College, London, in 1970



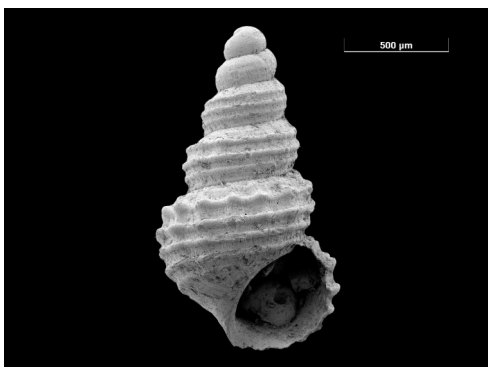
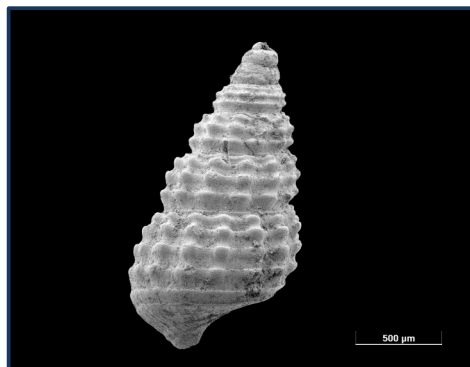
Two images of fossilised fish bones Collected from the “bed of bones”, on the shore, Bognor Regis



Foram *Vulvulina capreolus* d'Orbigny, 1826, collected from a building site at Imperial College, London in 1970



This, at first, seemed to be a bit of debris, but the neck on the left suggests it could be a foram. Collected from a building site at Imperial College, London in 1970



Two gastropods, collected from the Sables Moyens, Ver, France

process in not much more than the time it takes to create the next SEM image.

I am not the most capable at determining the species of forams, or any other creature. This is not helped by the fact that taxonomists do not feel they are doing their job properly unless they continuously re-classify a species. (I jest, in case any taxonomists are reading this!)

References:

Having received and imaged the specimens, I did a bit of research to find if there were any references on-line. This turned up an interesting site:

www.london-clay.com

This deals with the fossil flora and fauna found in the London Clay Formation, and has illustrated sections on various types. It also includes a ge0ological map of Great

Britain, showing the various beds colour coded according to Epoch. Interestingly, the section of the website on Foraminifera consists of pages from the Proceedings of the Royal Microscopical Society, October 1886. I used this article when attempting to identify the specimens that I imaged, but with limited success. As is often the case, some of the species (such as *Planorbulina ammonoides*) have been re-named by taxonomists since that paper was published.

I also found this article, incorporating the three plates from the RMS paper mentioned above, which rather supports my comments on taxonomy, though discusses a much wider variety of species types:

<http://www.microscopy-uk.org.uk/mag/artnov07/rh-british2.html>