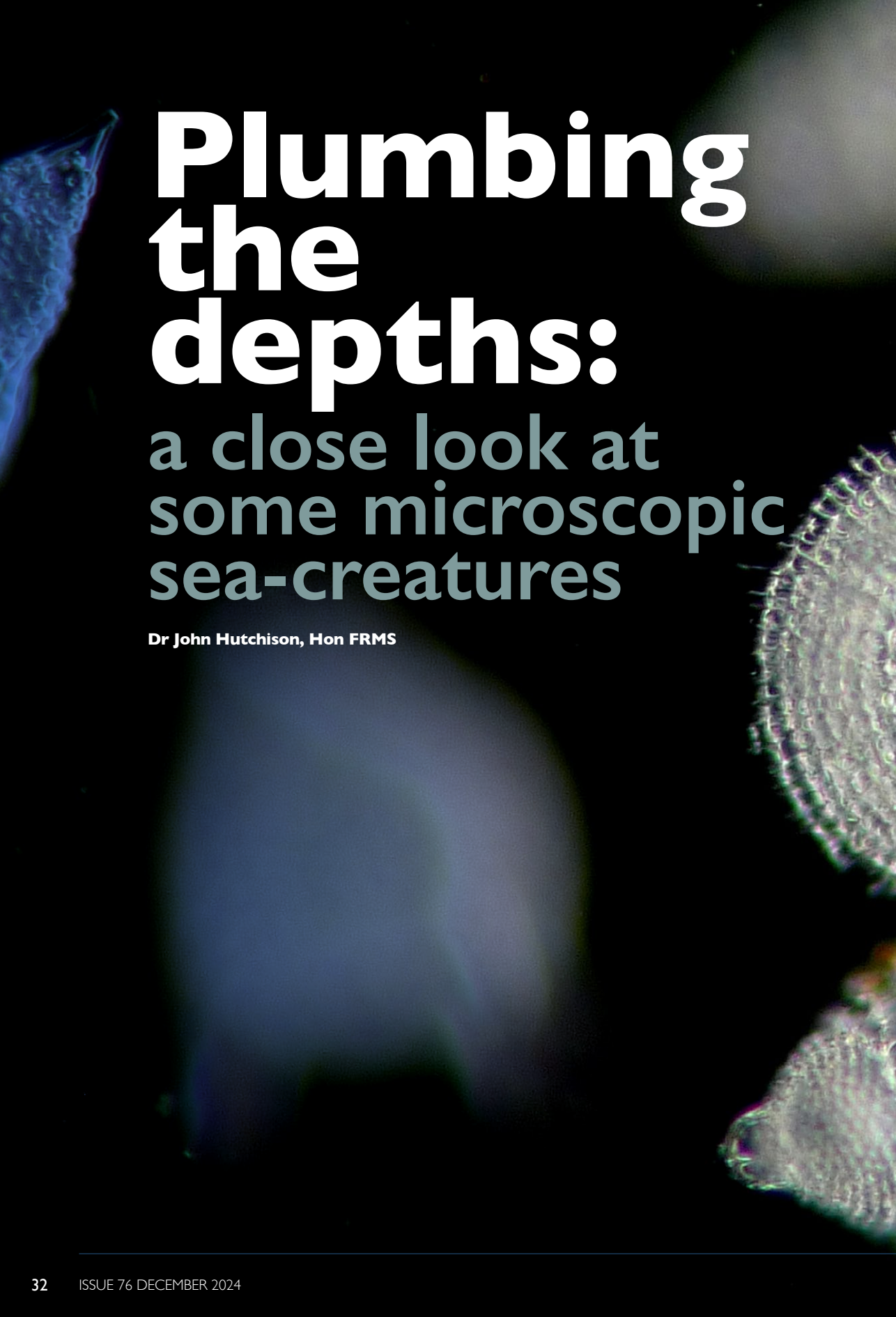


Plumbing the depths:

a close look at some microscopic sea-creatures

Dr John Hutchison, Hon FRMS



In a previous article (infocus 70 pp. 4 - 15) I described some amazing structures produced by single-cell amoeba known as diatoms. Their sub-microscopic, silica shells became very popular microscope specimens in the 19th Century, and a large number of carefully mounted slides survive today, some of which are keenly sought-after. Another class of unicellular creatures occurs, foraminifera, that are found from the bottom of the deepest oceans right up to intertidal zones. They also occur as prolific micro-fossils in chalk and limestone. The huge chalk cliffs in Southern England are made up almost entirely of foraminifera shells, known as tests, which consist mainly of calcium carbonate. They are also important indicators in oil exploration, where careful study of rock cores can reveal likely oil deposits. In contrast to the microscopic diatoms, most foraminifera tests are in the range 20 to ~ 200 micrometers in size, although some, found in the deepest ocean depths and also as fossils, may be up to several cm in size. And remember, these are the homes of single-cell organisms!

Foraminifera were first 'discovered' about 2000 years ago! The pyramids in Gizeh, Egypt, are in part built out of a Palaeogene limestone which contains huge numbers of *Nummulites gizehensis*, a large, disc-shaped foraminifera species that grew up to several centimetres across.



Figure 1. An example of a nummulites fossil from the limestone chips at Gheza. This one is just over 2 cm in diameter. The term derives from Latin ("nummulus", meaning "coin") as they were thought to have been used by the Egyptians as coins.

The geographer and philosopher Strabo (64 BC - AD 25), who came from Asia Minor but lived most of his life in Greece, wrote about these fossils, although he did not of course realise what they were. He described them as follows:

"One extraordinary thing which I saw at the pyramids must not be omitted. Heaps of stones from the quarries lie in front of the pyramids. Among these are found pieces which in shape resemble lentils. Some contain substances like grains half peeled. These, it is said, are the remnants of the workmen's food converted into stone; which is not improbable".

Although these fossils appear on the outside to be simple, disc-shaped pieces of rock, when cut as sections they reveal a remarkable internal arrangement of linked chambers, as shown in Figure 3. These chambers often contain crude oil – hence their value in oil exploration. In addition, the appearance of particular species in rock samples may also indicate likely oil deposits.

Now fast-forward several hundred million years, to the mid-19th Century.

With diatom slides gaining in popularity with Victorian microscopists who were also keen to see other wonders, and as samples of foraminifera



*Figure 2. Typical nummulites fossils showing the range of sizes. Image credit: Wilson44191_*

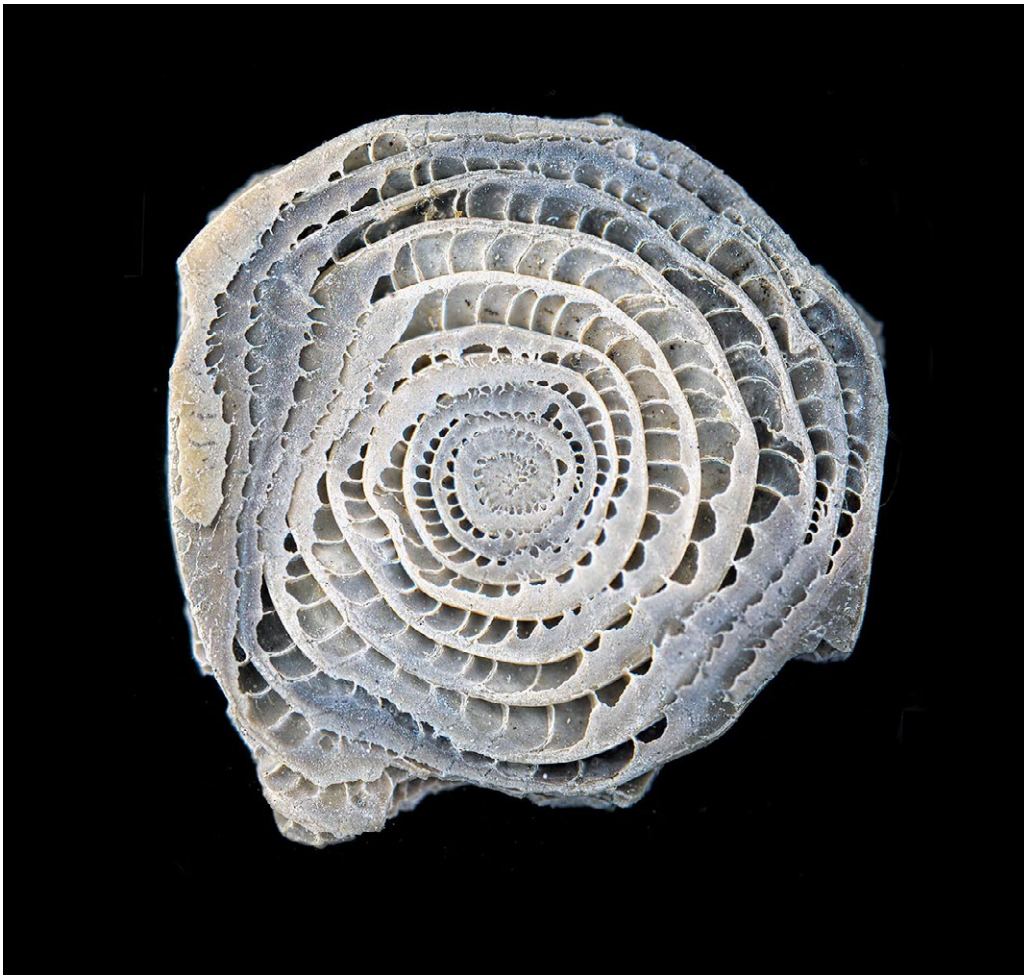


Figure 3. Nummulite fossil viewed in cross section. Image credit: Cactusdave.



Figure 4. Foraminifera tests from "the coast of Australia" and "North Pacific".



Figure 5. Three examples of a single species, Pulvinicula elegans (first identified in 1826) neatly arranged in a row. Again, no indication of where they were found, nor the mounter's name, were added.



Figure 6. Four groups of foraminifera, arranged this time as separate species, illustrating the variety of forms.







Figure 7. Other arrangements are more carefully planned, as shown here.



Figure 8. Firth has selected a variety of species and arranged them carefully in a circular pattern. In this case they came from a relatively shallow (15-17 fathoms) seabed off Rathlin Island, N. Ireland.





Figure 9. In this example Firth has assembled a wide variety of tests to illustrate the variety of shapes. Again, the location is indicated.

became available, mounted specimens became popular objects for study. Unlike diatoms which are mainly transparent silica, foraminifera tests are opaque and often white. Consequently, for microscope slides they were usually mounted on black supports, for viewing with incident illumination. Many of the earliest examples simply showed random arrays of tests, often indicating only very approximately where they were found, as in Figure 4. Note that where the following illustrations show complete slides, these are all the standard RMS 3 x 1 inch in size.

In this example no attempt has been made to separate them into individual tests, or arrange them.

In other examples considerable efforts were made to arrange the tests.

William Firth (of diatom fame, see infocus **70** p4) was a well-known mounter, and some of his work shows his skill in selecting and mounting a wide variety of foraminifera tests, as shown in Figures 8, 9, 11 and 12.

The historic expedition of HMS Challenger (1872 -76) explored many of the world's oceans and produced a rich harvest of new data, as well as many hitherto unknown organisms including foraminifera, see Figure 10.

From off the coast of Japan samples were brought up from 1850 fathoms (11,100 ft.) which included many new species. Foraminifera from this location are shown in Figure 11, prepared by Firth with his characteristic skill.

Firth also displayed his skill in creating spectacular slides as shown in Figure 12. Here various *Lagena* species are arranged symmetrically to form an attractive pattern.

Carefully prepared thin sections of chalk and limestone also show fossilised foraminifera, as shown in Figure 13. In this slide several examples of *Alveolina* are visible. This variety of foraminifera are elliptical or spherical – the largest one here, shown in cross-section, being ~5 mm in length.

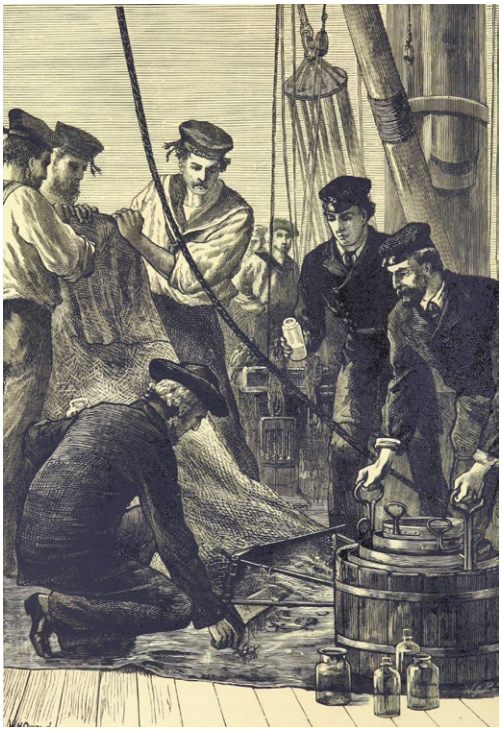


Fig 10. Collecting the material dredged from the bottom of the ocean. Firth has assembled a wide variety of tests to illustrate the variety of shapes.

The Society's own, direct links with the world of foraminifera are with a former President – Edward Heron-Allen, a lawyer who retired from his family's law firm at the age of 50 and moved to Selsey where he embarked on a lengthy study of the foraminifera that abounded on the intertidal zone of its sandy beaches. An interesting character, he was originally named Heron Allen, but later called himself "Heron-Allen", perhaps to add some cachet! He was a true polymath with an astonishing range of interests, and published many books on archaeology, Buddhist philosophy, violin-making, Persian – he translated the entire *Omar Kyayyam* poem into English - and chiromancy (palmistry). He also wrote a book on how to grow good asparagus! Along with Arthur Earland he published numerous papers in the *Journal of the Royal Microscopical Society* (now the Journal of Microscopy) as in **1915** p 547**; 1917** pp 1 – 104 and **1930** pp 359-365. He was elected President of the RMS in 1916, followed by Fellowship of the



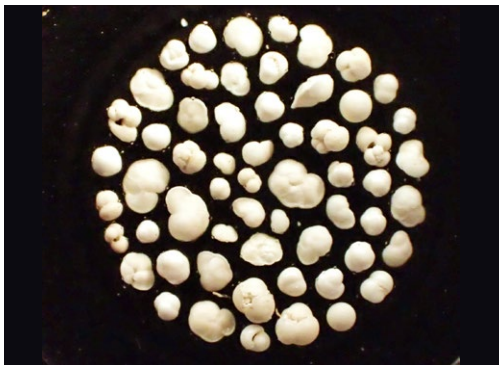


Figure 11. Foraminifera from the Challenger Expedition.



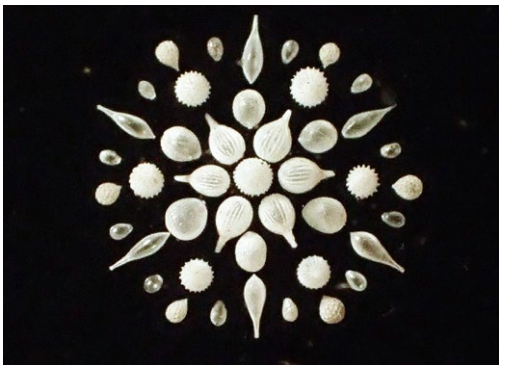


Figure 12. Various species of the Lagena genus, arranged symmetrically.



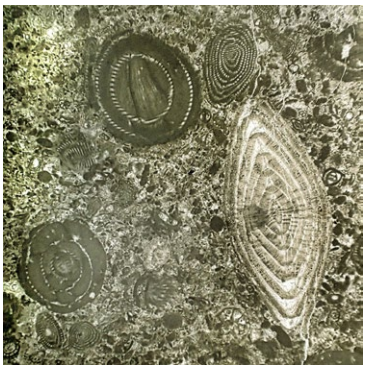


Figure 13. Thin section of chalk from near Trieste.

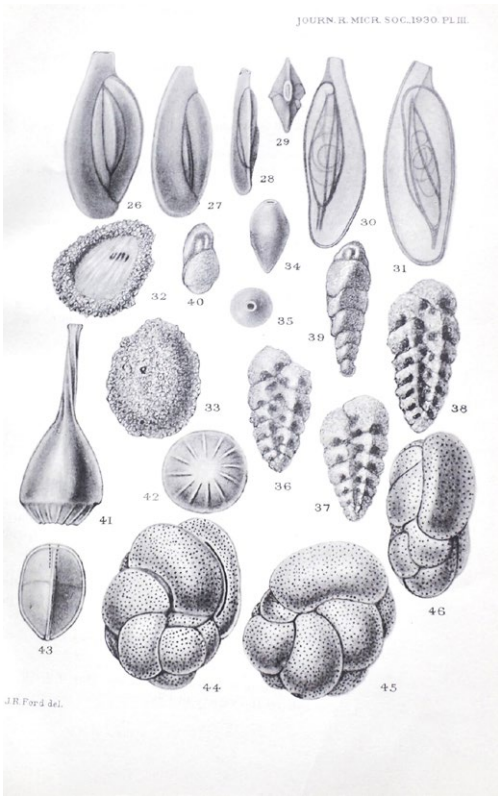


Figure 14. Illustration of some of Heron-Allen's foraminifera published in our Journal in 1930.



Figure 15. Edward Heron-Allen's work is still recognised by a Blue Plaque and also by the Eward Heron-Allen Society – a group of enthusiasts who still hold regular symposia where they discuss some of the more esoteric aspects of his work.



Figure 16. "Christmas greetings" slides from 1909 and 1912, now in the Natural History Museum.

Royal Society two years later in recognition of his seminal work on foraminifera.

He and Earland identified and classified huge numbers of different species, showing the wide range of shapes and sizes.



Figure 17. Examples of Ernest Heath's work, now in the Museum of Wales. a) Slide prepared in 1908 and b) details of an elaborate arrangement.

Heron-Allen - perhaps surprisingly – did have a sense of fun, and rather than send Christmas greeting cards to his friends, his collaborator Arthur Earland often made slides for him containing "seasonal" arrangements of foraminifera as shown in Figure 16.

The letters and numbers in these arrangements are made of foraminifera tests. The particular species that lived in these tubes, having 'selected' fine sand grains and glued them together to form tubules of varying lengths and curvatures in which they could live safe from predators.

One of our early Fellows, Ernest Heath,(1860 – 1942) also produced a wonderful collection of arranged slides in the early 20th century, now held in the Museum of Wales, Cardiff. Although he donated much of his collection to the museum, they note that:

"We don't know much about him, apart from that he was a fellow of the Royal Microscopical Society, somehow got hold of deep-sea mud from around the world, and must have had a lot of time on his hands!"

He was a Fellow in 1909, and most of his output was from that period.

Just like the diatom slides in my previous article (infocus 70) these foraminifera tests provide a wonderful window into the past, attesting to the considerable skills, insatiable curiosities and perhaps even the eccentricities of those who created them.

Some of these beautiful objects are highly sought-after collectors' items, and it is not difficult to understand why. Looking down the microscope more than 100 years after their creation, I suspect the sense of wonder for today's viewers remains every bit as powerful.

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