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Digitisation of unlikely pioneer's collection answers key questions in evolution and helps

train future scientists | Digital Collections Programme

Henry Buckley (1939-2002) is a relatively unknown pioneer in the world of Foraminifera. Buckley was discouraged from publicising his collection, up until recently this collection wasn't well known in the micropalaeontological community but all that is changing.

The Buckley collection has been digitised and today is helping Museum PhD students to answer questions on evolution. Yale University also plan to use this collection to train new generations of scientists to identify modern planktonic foraminifera and to help develop automatic recognition software in the future.

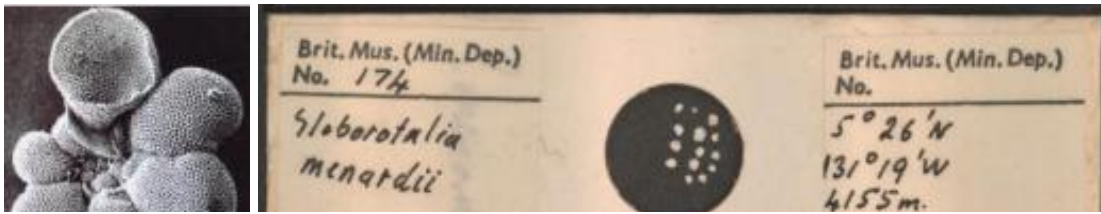
Foraminifera and why they are important



Ernst Haeckel via Wikimedia Commons

Foraminifera are very small (less than a millimetre) shells, the remains of a single celled organism, from several hundred million years ago to the present day. Their complex shells can be extracted from rocks or sediments and mounted on microscope slides.

Planktonic foraminifera are important because they form their shells from calcium carbonate dissolved in the seawater in which they lived. Subsequent studies of their isotopic composition can tell us a lot about the climatic conditions in which their shells formed and we can use them to study how climate changed through time. Calcium carbonate is susceptible to dissolution in acidic conditions, so foraminifera are particularly affected by ocean acidification.



Henry Buckley

Buckley was the curator of the Museum's vast collection of Ocean Bottom Deposits, in the former Mineralogy department. From this collection he amassed, sometimes against the wishes of his managers, a vast collection of foraminifera.

Buckley became interested in Foraminifera through the encouragement of his first manager at the museum, Dr Wiseman. Buckley amassed a large collection of slides and created a library of Scanning electron microscope photomicrographs for each species that he could recognise morphologically. Most of Buckley's collection was taken from sediments in the Ocean Bottom Deposit Collection.



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Henry Buckley working on the Ocean Bottom Deposit collection in 1986

The OBD collection today consists of samples from 40,000 geographical locations worldwide and is the most comprehensive British collection of seabed samples with all of the world's oceans represented. The collection includes the HMS Challenger samples (1872-76), material from the British Royal Navy's survey ships and the John Murray

Expedition to the Indian Ocean (1933-34). The OBD collection offers a fantastic geographical spread and the historical perspective needed for scientists to study Foraminifera in relation to global temperature cycles.

It was Buckley's lifelong ambition to produce an *Atlas of Modern Planktonic Foraminifera*. However, as he had a degree in Geology and Zoology, his subsequent managers after Dr Wiseman felt that he was not trained in micropalaeontology and did not allow him to proceed with his atlas. Despite the fact that he was actively discouraged, Buckley amassed over 1500 slides of individual species of planktonic foraminifera extracted from over 200 samples from the OBD collection.

Buckley was one of the first to use a Scanning Electron Microscope to look at foraminiferal wall structure and published pioneering papers on isotopic interpretation of oceanographic and climatic change. He also described a new species *Globototalia oveyi*. However, because Buckley was discouraged from studying micropalaeontology by his managers, for a long time his collection remained under used and Buckley relatively unknown amongst foraminiferal micropalaeontologists.

Current use of the collection



Southampton and Natural History Museum PhD student, Marina Rillo

Marina Rillo has been using the Buckley collection to study the evolution of planktonic

foraminifera for her PhD. Marina started her research at the Museum by taking close-up images of all specimens on each slide. These were then segmented to produce around 16,000 images of individual specimens that could be sent for identification/verification. She has publicised her use and finding from this collection at various conferences and published a paper describing the collection and its potential.

Marina has been resampling and reprocessing samples from the OBD collection that Buckley worked on to assess biases that could have been introduced by Buckley to the slide collection. The resampling showed that Buckley could identify the foraminifera species very well. However, there is a size bias in the collection, meaning that Buckley picked larger individuals of each species.

Resampling also showed that seafloor samples collected 100-150 years ago (for example by the HMS *Challenger*) represent modern but pre-industrial samples, and can therefore be used to study human impact on the deep ocean during the past century.

“The Buckley Collection enabled us to investigate how individuals of a species can have different body sizes in different parts of the world. Our results show that there is a huge size variation within each species across the world, much more than we can explain with our current knowledge.” Marina Rillo

Inspiring future scientists and innovative technology

Researchers at Yale University have assembled a large set of experts, including Marina, to verify the identification of Foraminifera in their collections using the crowdsourcing platform Notes from Nature. Marina suggested that the Buckley dataset should be added to what will be ‘the largest set of images of modern planktonic foraminifera.’

The crowd of experts have recently completed their classification work. Each image in the dataset had to be classified four times before it was marked as complete. Yale presented their results so far at the International conference on Foraminifera in June 2018 at the University of Edinburgh.

The main aims of the Yale project are for the collection of images to be used as a teaching dataset for the scientists of the future. The specimens classified by the experts can also provide example specimens to develop automatic recognition software.



Slide from the Henry (Alexander) Buckley collection, where he formed his initials from specimens.

The Buckley collection dataset is openly available on the [Museum's Data Portal](#) both as a list of slides and as records of individually imaged specimens. Yale will also be releasing a collaborative data paper with the participants of their crowdsourcing classification work and will make their dataset and learning publically available to the world.

Ironically even though Buckley didn't achieve his dreams of producing an *Atlas of Modern Planktonic Foraminifera* during his lifetime, images and data from his collection are now contributing to the largest set of images of modern planktonic foraminifera ever compiled. This goes a long way to realising Henry Buckley's dreams in the digital age.

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