Climate change in holes

Paul Merchant, Project Interviewer, National Life Stories

"When one of the teachers in the primary school...one of them asked, I think it was Robert, 'and what does your Daddy do?' He said 'he washes mud,' which is his impression of what I spent my life doing."
(Russell Coope C1379/63 track 3 1:14:32 – 1:15:11)

This article considers the role of holes in the production of scientific knowledge about past climates, and climate change. We'll start with holes at the bottom of the sea.

Commission a drilling ship and you can drill a hole into the ocean bed and pull up the contents of the hole – a cylinder of oozy sediment called an 'ocean core'. If you rinse this ooze through a sieve, you are likely to find tiny shells of sea creatures called foraminifera (forams for short). Shells from the top of the core were made by forams that lived in the ocean recently. Shells from deeper in the core were made by forams that lived longer ago, perhaps (at the bottom of the core) a million years ago. The detailed chemistry of the shells is affected by the global climate at the time of their formation; shells from colder periods are chemically 'heavier'. Interviewee Mike Hall has spent most of his working life using instruments called 'mass spectrometers' to encourage foram shells to tell a chemical story of ice ages and warmer interludes:

"We started at the top of the core and were gradually working down it so we would do the first ten measurements and you could see that these were probably fairly flat being a sort of interglacial period and then you would find, do the next two or three measurements and they would be getting heavier and therefore you would
be going down into a glacial and then at the bottom of that you'd find, the next day you'd do a few more measurements and be coming up to another interglacial and you'd be going back in cycles between glacial and interglacial periods and it was interesting to see how many glacial cycles there were."
(C1379/59 track 21 39:54 – 40:42)

A hole in the ocean floor becomes the focus for a conversation with a curious mix of timescales – the lifetime, the career, geological time, the working day:

"I think one of the most exciting times was certainly in the late sixties, early seventies where we produced...data from the longest core, which was V28/238 and it went...through up to about a million years.

...How long did it take you to work all the way down from the top to the bottom of the core?

Oh goodness! [laughs] I think it was a number of years because at that time we were probably only doing maybe ten samples a day. So, it was...certainly it was quite some time to produce that.

So over a week, if you were doing ten samples a day... how far would you move in terms of time down the core, roughly?

Oh goodness me! [laughs] I would probably say that with this core maybe we were going maybe forty or fifty thousand years a...week I should think, something of that order I think. I can't really remember. I think that was probably one sample maybe every 1000 years, at that time." (C1379/59 track 21 35:49 – 41:23)

All this was going on in Cambridge in the 1960s and 1970s. Meanwhile, in Africa, interviewee Dick Grove was seeking out other holes in the ground to answer questions about climate change. It was known that at times in the past African lakes had been bigger – suggesting wetter climates. But when? For how long? How much bigger? The ground could answer these questions. In places deep gullies (ditch like channels) cut open the ground, offering views of layers of sediment that had once accumulated under water, under bigger lakes of the past:

"We had some air photographs I believe and it was – it was really a matter of locating oneself on the air photographs and then following gullies in the slopes which revealed the sedimentary succession on the slopes which would have been laid down by the lakes when they were much bigger than they are now. ...We were pretty clear that we would find shelly material that would be datable. ...So it was largely a matter of grubbing around in – in gullies and where there had been landslips or anything of that kind."
(C1379/12 track 13 26:44 – 28:16)

Britain is not affected by gully erosion. The ground is not opened up in this way. Here, if you are a scientist concerned with past climates, it is often necessary to wait for someone else to dig a hole. Interviewee Richard West has been able to reconstruct the effect on the East Anglian landscape of past ice ages by examining the content of holes made by farmers in west Norfolk. For example, a sand pit near the village of Beachamwell (pictured) contains layers of sand and silt deposited in a lake that formed when rivers were blocked by glaciers. And nearby:

"I found another place by walking around in the Gadder Valley...where a farmer, Mr Knights, who is a great dealer in carrots, in fact I think he was 'Mr Carrot of East Anglia', had dug some pits for washing the carrots.... And this pit is on the edge of this lake, it turns out, and you can see how stuff has slumped into the lake in the section beautifully, it's an amazing experience. It was pure luck really. And so I'm able

Quaternary geologist/botanist Richard West in the field with videographer Matt Casswell and interviewer Paul Merchant. Photo: Sue Pennell

to construct a really good story about the origins of the Breckland sands, the origin of these dry valleys and the whole landscape history, the formation of this lake". (C1379/34 track 13 1:06:19 – 1:07:20)

In earlier work brickworks and sewage works provided useful holes for the collection of fossil pollen, indicating vegetation supported by past climates.

Similarly, from the 1950s the late Russell Coope (characterised by his son at the beginning of this article) made use of holes dug by others, especially gravel quarries, motorway cuttings and building foundations. Samples of fossil beetles (pictured on the front cover) from these holes included, at different levels, species currently living in the arctic, and in the tropics. Material had to be collected before the holes were deepened, or filled in:

"I remember one occasion when collecting samples, this was in a road cutting, because again motorways cut great swathes through the country, I started, in the morning, in the bottom of a hole, and finished up, in the afternoon, on a plinth, them having removed all the sediments from around me except the bit I was sitting on. So, you have to be very, very quick indeed to be in, to collect, to assess, to make a record of things before the developers, who'd revealed the stuff in the first place, destroyed it in the second." (C1379/63 track 5 21:44 – 22:18)

When foundations were dug for the Ugandan Embassy, at Trafalgar Square, London, hippopotamus, elephant and lion bones were found; Russell was alerted to the possible presence of beetle fossils in the sediments around the bones:

"And so we went and collected the material whilst they were just about to, to fill the hole in. And I was at the bottom of the hole when there was a hopper of liquid concrete suspended over my head, dribbling concrete all the time, so that I finished up looking like one of these monsters from out of space, being totally encased in sort of semi-congealed concrete, but I collected the stuff – in big bags – and fished the bags out and as I came out of the excavation they pulled the chain on the hopper and the whole thing filled with liquid concrete."
(C1379/63 track 7 1:15 – 1:55)

Future interviews for **An Oral History of British Science** will consider 'cleaner' holes for climate change science, those made in ice.

As a postscript, a warning to the inexperienced hoping to explore past climates by examining the contents of holes in the ground: be sure that you have not uncovered a buried museum:

"But while he [Lancelot Hogben] was in zoology [University of Birmingham]...he was fed up with the zoological museum, which had a whole lot of skeletons of animals in it and he ordered the chief technician to take the things and throw them away and he took them and buried them in a site just north of the university, which happened to be the site which later became designated for the university library, with the result that when they started the excavations for the university library, they ran into these rather unusual skeletal remains and of course called somebody and a poor unfortunate research student from geology went up to look at them and his impression was, oh, woolly rhinoceros [laughs] and so he ran to Shotton [his Professor] with this news that they had discovered important palaeontological remains on the site of the library!"
(John Glen C1379/26 track 9 13:33 – 14:42)