John Packer
Larissa Paver

Money, mistakes and the birth of a science

Key words
oceanography
mid-ocean ridge
telecommunications
electromagnetism

Over two thirds of the Earth's surface is covered in sea which can reach depths of 11 000 metres. Oceanography, the modern science of the oceans, is a huge challenge and one that requires a great deal of money, time and effort. ***John Packer*** *and* ***Larissa Paver*** *explain how it has its roots in big business, a disproved theory and national pride.*

Big business: the coming of the electric telegraph

During the 17th and 18th centuries, scientific interest in the sea was largely focussed on solving the practical problems of navigation, safety and tide prediction. However, it was not until the 19th century that detailed scientific exploration of the deep oceans began, partly as a result of governments stepping in to support a new system of fast international communication – the electric telegraph (see Box 1).

From the time of the laying of the first submarine telegraph cables, the possibility of connecting continents was a powerful reason for governments and industry to gain a better knowledge of the deep sea. The electric telegraph had the potential to change politics, diplomacy, trade, news-gathering and even war for ever. But it was a massively expensive and sometimes dangerous business. The problem was that in the absence of any maps of the ocean floor, the general assumption was that it was smooth. The first undersea telegraph cables were therefore laid with little or no slack, so that they strung out between peaks in the ocean floor and soon broke. Engineers needed to know much more about seafloor conditions, including bottom topography (the 'landscape' of the sea-bed), currents and organisms that might dislodge or destroy the cables.

Box 1: The Electric Telegraph

The electric telegraph was based on the chance discovery by Hans Christian Oersted in 1820 that electricity flowing through a wire creates a magnetic field around the wire, making a compass needle move.

This principle was used in a simple circuit with batteries, a switch and very long wires, to make a needle some distance away move. Combine this with some sort of code, like Morse code, or use a machine that spells out letters of the alphabet and you have an effective and fast way of communicating over a distance. That's exactly what telegraph means – *tele* means far and *graph* means writing.

An ABC telegraph of the sort used on overland telegraph systems. Messages were spelled out using the buttons next to the letters.

The first electric telegraph in Britain was used along a railway line in 1837 and such was its impact that a telegraph network quickly spread throughout Britain. By the 1860s, anyone could go to a Telegraph Office almost anywhere in Britain, write a telegram and send a message in far less time than ever before – fast communication had arrived.

The next logical step was to connect Britain to other countries by submarine cables, or cables under the sea. The challenge of electrical insulation was solved using a type of rubber from Malaysia and steel armouring largely overcame the problems of wave action, fishing nets and sharks. In November 1851, the first functioning submarine telegraph cable was laid across the Straits of Dover.

A submarine telegraph cable lying on the sea-bed off Bermuda.

Submarine telegraph cable sections with the copper conducting wires at the centre, surrounded by insulation, waterproofing and one or two layers of protective 'armour'.

A theory disproved: life in the deep oceans

At the same time as the electric telegraph was being developed in Britain, Edward Forbes (1815-54), professor of natural history at Edinburgh University, had collected animals in the Aegean Sea. He noticed that fewer plant and animal species were caught as his nets went deeper. So, he concluded that deep-ocean waters below 600 metres must be azoic or have no life in them. For some time, this mistaken idea was widely accepted.

Forbes' azoic theory was first questioned publicly in 1861, when a telegraph cable in the Mediterranean Sea, raised for repairs from 2000 metres deep, was found to have living animals on it. Interestingly, these findings have now themselves been questioned, as depths of 2000 metres are difficult to find along the supposed route of the cable, the animals may have been misidentified (the specimens have disappeared) and the sections of deep sea and shallower water cable mixed up. Whatever the truth of the matter, the findings had tremendous impact at the time - they raised doubts about Forbes' azoic theory, helping to prompt events that led to the birth of oceanography.

To try to answer the question of whether or not life existed in the deep oceans once and for all, Charles Wyville Thomson (1830-82), also a professor of natural history at Edinburgh University, led two expeditions between 1868 and 1870. HMS Lightning and HMS Porcupine, dredging at depths of as much as 4300 metres, both found many animal life forms. However, the results of these two expeditions were limited to specific areas of the sea, so left room for doubt about whether life would be found at all depths.

Box 2: The electric telegraph and the Mid-Atlantic Ridge

Lieutenant Matthew Maury, head of the US National Observatory, was the first to attempt to map the floor of the Atlantic, based on information from a voyage of 1853. Maury found that there was a large 'plateau' with no strong currents or disturbances between much of Newfoundland and Ireland. In a letter dated 1854, Maury named it 'Telegraph Plateau'. He described it as placed there especially 'for the purpose of holding a submarine telegraph, and of keeping it out of the way'.

Using this data and data from a 1925-27 voyage of the German research vessel Meteor, scientists proposed that the 'Telegraph Plateau' was actually a continuous ridge extending the length of the Atlantic Ocean basin. Investigations which followed revealed that this was correct, and we now call this feature the Mid-Atlantic Ridge.

National pride and the *Challenger* expedition

At the time, the British Admiralty Hydrographic Office prided itself in producing the world's finest maritime charts (or maps of the sea), but now the Office was being asked questions by the submarine telegraph companies that it was unable to answer because it had not mapped the sea-bed in any detail. This was not a comfortable situation.

So it was that with business, scientific and public interest running high, the Royal Society of London was able to persuade the Admiralty to organise and pay for the most comprehensive single oceanographic expedition ever undertaken.

The Society obtained the use of the naval ship Challenger, a sailing vessel with steam power as back-up. The ship was refitted with laboratories, winches and equipment. Wyville Thomson led the expedition and the Challenger sailed from Portsmouth in December 1872. The voyage was to last nearly three-and-a half years and cover around 70 000 miles.

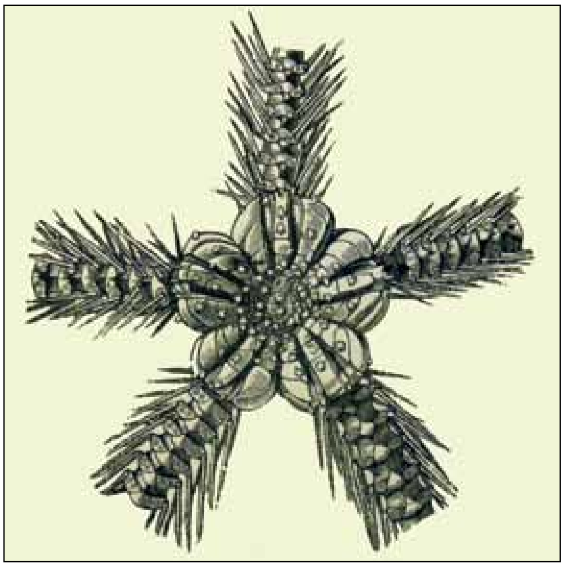
HMS Challenger, 1874, taken from the Challenger reports held at Porthcurno Telegraph Museum

The zoological laboratory aboard HMS Challenger.

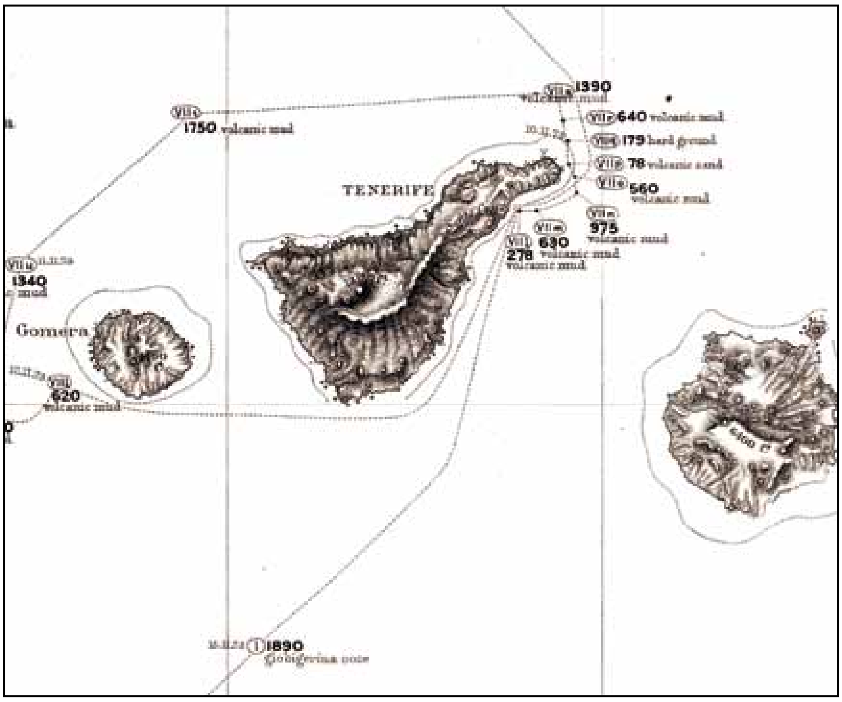
Researchers were jubilant with the scientific success of the Challenger Expedition. The crew completed more than 360 deep-sea soundings, collecting samples of sea-bed sediment at the same time. They obtained no fewer than 7000 sea-life specimens, some from as great a depth as 9000 metres. Almost 5000 new species of marine organism were. Each specimen was described, catalogued carefully, and preserved for later analysis. The findings of the Challenger crew left no doubt that organisms lived at all depths in the ocean, finally disproving Forbes' theory.

For the first time, charts that showed sea-bottom topography and the distribution of deep-sea sediments were sketched out. Needless to say, telegraph companies of the time were very interested in the findings of the Challenger Expedition and made extensive use of the expedition reports.

More than 23 years were required to analyse all of the data and specimens collected by the Challenger Expedition. These findings were published in fifty large volumes that marine researchers still consult today.



Ophiomitra chelys, *a newly discovered type of brittle star, dredged 'from a depth of over 1500 fathoms' (2700 metres) by HMS Challenger.*



A chart from the Challenger expedition. It shows the Canary Islands and gives information about depth in fathoms (a fathom is six feet, a bit less than two metres) and the nature of the seabed.

Box 3: The electric telegraph and tsunamis

On November 18th 1929, an earthquake of magnitude 7.2 occurred off the coast of Newfoundland. This 'Grand Banks Earthquake' triggered a large undersea landslide, snapped 12 telegraph cables and led to a tsunami that struck the coast of Newfoundland about 3 hours later, leaving 28 people dead and more than 10 000 homeless.

The telegraph cables were in use when the earthquake and landslide struck. Therefore the precise location and time of each of the cable breaks and sequence of breakages is known. Subsequent study of this unique set of observations has led to a greater understanding of the conditions that can lead to a tsunami.

National pride and the making of a science

Scientists in other countries used the example of the Challenger Expedition to gain government support for their work. Although their stated purpose was the scientific exploration of the sea, national prestige was also at stake. None-the-less, the Challenger Expedition and reports laid the foundation of the science of oceanography, and modern oceanography is usually dated from this time.

John Packer *is a volunteer and trustee at Porthcurno Telegraph Museum and a former telecommunications engineer & lecturer.* Larissa Paver *is the Museum's Learning Manager.*