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H.M.S. *CHALLENGER*, HALIFAX, AND THE REVEREND DR. HONEYMAN

I

The arrival of the British corvette *Challenger* in Halifax on May 9, 1873, was not particularly unusual in itself. But the men on board and the purpose of the voyage were unusual, because the ship as she docked brought oceanography for the first time to Nova Scotia, and in fact was establishing that branch of science as a global, coherent discipline.

The arrival of *Challenger* at Halifax was nearly an accident. At its previous stop, Bermuda, the ship's captain, G.S. Nares, had been warned that his next port of call, New York, was offering high wages and that he could expect many desertions.[1] Course was changed; the United States coast passed by the port side, and *Challenger* steamed slowly into the early spring of Halifax Harbour.

> We reached Halifax on the morning of the 9th. The weather was very fine and perfectly still, with a light mist, and as we steamed up the bay there was a most extraordinary and bewildering display of mirage. The sea and the land and the sky were hopelessly confused; all the objects along the shore drawn up out of all proportion, the white cottages standing out like pillars and light-houses, and all the low rocky islands looking as if they were crowned with battlements and towers. Low, hazy islands which had no place on the chart bounded the horizon, and faded away while one was looking at them. The little coasting vessels with their hulls drawn up looked as if they were standing on pedestals, while, above them, their inverted images on the soft gray mist were more real and definite than they were themselves. None of us had ever seen such an extreme effect before, nor have we seen anything like it since.

> Coming directly from the rich vegetation and the lovely subtropical spring weather of Bermudas, the first view of the country about Halifax was certainly by no means attractive. The low rolling hills of granite and metamorphic rocks, covered with somewhat stunted pine-woods, remind one of some of the tamer parts of Scandinavia.
>
> Early in the forenoon we were along-side of the coaling wharf. Halifax is not a pretty town. It reminds one greatly of Greenock or a second-rate English seaport, with its dull streets of square houses blackened with coal-smoke. The houses are almost all built of wood, and there is no attempt to lighten the effect by introducing color. In the centre of the town there are some rather better streets, with good shops and one or two fair public buildings.[2]

Challenger's arrival at Halifax caused a stir. Members of the Nova Scotian Institute of Science visited the ship and were given an account of its facilities and work; Alexander Agassiz, copper magnate, engineer, biologist, and an early explorer of the deep-sea, visited from the Museum of Comparative Zoology in Cambridge, Massachusetts. The members of the Institute of Science were particularly interested in seeing a large boulder, dredged south of Nova Scotia, which Dr. David Honeyman, the Provincial Geologist, identified as a block of Shelburne granite, moved offshore by the ice-sheet when Nova Scotia was glaciated.[3] A year later, *Challenger* was still intriguing the local naturalists; Honeyman reviewed for them the current knowledge of life in the oceans,[4] [5] and showed specimens left in Halifax as a gift by Wyville Thomson.[6] The *Morning Chronicle* and *Acadian Recorder* continued to print notes on the progress of *Challenger's* voyage until her return to England in 1876.

While in Halifax, Charles Wyville Thomson, civilian leader of the expedition, wrote to his son.

> ...this place is very cold and I have to roll myself up in a coat of skins sometimes and pull down a fur cap round my ears in the forests to keep out the snow. It is nearly gone now--only in showers now and then-- and the trees will they say burst out in a week and be quite green in a fortnight. The maples are scarlet already with their flower--which comes out before the leaves. All the idle men in the ship went off early in the morning with their fishing rods and come in at night loaded with trout, for the fishing here is wonderfully good in the long chains of lakes which run far into the country along the valleys among the granite hills ....The mayflower is the emblem of Nova Scotia; it is a delicious little thing-- large pale pink trusses of flowers, with a most delicious perfume like meadow-sweet, blooms among

the snow on long trailing stems. When the snow goes off they are half hidden by the moss, out of which you have to disentangle them. Our cabin is always full of flowers brought to us by admiring ladies, and the Captain and I see who gets the most flowers and I get far the most which he says is not fair. [7]....

Assistant Engineer W.J.J. Spry was impressed by Halifax.

The city, with its suburbs, extends, for over two miles in length, along the slope of a hill on the western side of a very fine harbour. To the tourist it presents varied and numerous attractions.

Its charming situation, its safe harbour and splendid scenery, are not to be surpassed on this side of the Atlantic. The sea runs up into various little bays and coves indenting the land in many directions, giving a variety of charming aspects to the entire scene, and finally ending in Bedford Basin, a broad sheet of water covering an area of nine square miles, its banks rich in all sorts of charming foliage, where cluster numerous pretty villa residences of the wealthy families.

The appearance of the city on first landing is not very prepossessing, but on reaching its centre, there are seen good broad streets, well built upon, with shops and stores of large dimensions, where all the luxuries and requirements of life are to be obtained. Amongst these, Granville and Hollis Streets take the pre-eminence, containing as they do the best of the shops, and most of the principal public buildings.

The famous Citadel, situated on the crest of the hill overlooking the town, is said to be, after Quebec, the strongest in the Dominion. From here we have a fine panoramic stretch of scenery; the picturesque abounds everywhere, and from every point there is some glimpse of nature to charm, whether it be mountain, valley, island, or lake. From this stand-point we can obtain a peep of the north-west "Arm", with the number of pretty little islands scattered over its length and breadth. The nature of the land about here, with its green slopes running clear down to the water's edge, has greatly assisted, with the many charming villas erected in the midst of the ever-green foliage, in combining art and taste, giving such charms to the surrounding scene that the most enthusiastic admirer of nature could scarcely desire more.

Then there is the eastern shore and town of Dartmouth, which has to be reached by steam-ferry. Here are many pleasant walks, and during the winter seasons its inland lakes are gay with crowds of skaters.

The public gardens, covering an area of nearly twenty acres, deserve more than a passing mention; for their loveliness and beauty can be appreciated by the ordinary observer as well as the learned.

Picnicking is one of the favourite amusements of our Haligonian cousins, which they appear to heartily enjoy; during the season everybody goes

picnicking, from the government official to the poorest member of the community, in one or other of the many beautiful little bays or coves in the harbour.

The weather had not been of the best; cold winds with occasional snow and rain, greeted us during the time at our disposal here; yet we could fain have made a longer stay amongst such kind friends, of whom it is a pleasure to speak. There was a goodness and cordiality with their hospitality and warmheartedness that can never be forgotten by those who know them.

On the 19th May, we steamed out of the harbour, and before nightfall the coast was out of sight.[8]

What was *Challenger*? Who were these men? And, in particular why were they travelling around the world?

II

It is traditional to look back to Edward Forbes (1815-1854), a Manxman who became Regius Professor of Natural History at Edinburgh[9,10], to explain the main ideas in marine biology in mid-nineteenth century. Forbes, dredging in the Mediterranean from H.M.S. *Beacon* in 1841, put forward his famous "azoic" hypothesis, based on his results in the deep ocean.

As we descend deeper and deeper in this region, its inhabitants become more and more modified, and fewer and fewer, indicating our approach to any abyss where life is either extinguished, or exhibits but a few sparks to mark its lingering presence.[11]

Forbes died before he could disprove his own hypothesis, and even as Forbes wrote, contrary evidence was available to show that life existed at great depths in the ocean. [12] But his authority was great, and the weight of opinion, up to 1868, held that the deep ocean (below about 550 meters) was lifeless.

Fortunately, Forbes' enthusiasm for marine biology, not just his azoic hypothesis, survived him. A generation of European biologists, especially in Norway and Britain, took up dredging and began to discover animals at increasingly greater depths. Michael and Georg Ossian Sars, in Norway, between 1850 and 1866 extended the limits of life in the sea to more than 800 meters. But it was in Britain that the azoic hypothesis was put most rigorously to the test.

Charles Wyville Thomson (1830-1882), then Professor of Natural History at Belfast, and William B. Carpenter (1813-1885), physiologist and administrator at the University of London, began dredging in the 1850's. Their success in finding rare species (for example, crinoids in Lamlash Bay) and the results of the Sars work inspired Thomson and Carpenter to go farther afield and to work at greater depths. With the help of the Society, they cajoled the Royal Navy into lending a surveying vessel, H.M.S. *Lightning* for dredging in the summer of 1868, and set out to the northwest of Scotland, then to the seas near Shetland and the Faeroes. Beset by bad weather and the problems of an aged vessel, they dredged to 1200 meters, took temperatures in the water column, and sampled sediments. The results were sufficiently interesting that they asked for another vessel, and in 1869 were given H.M.S. *Porcupine* for a summer's work west of Ireland and between Scotland and the Faeroes. West of Ireland, *Porcupine* dredged at 4456 meters, found animals abundant on the bottom, and finally laid Forbes' hypothesis to rest.[13,14] Between Shetland and the Faeroes they measured warm temperatures near the sea bottom to the southwest and much colder ones to the north-east, opening a controversy over ocean circulation which dominated Carpenter's thought for years to come.[15]

Clearly, said Thomson and Carpenter, a much larger expedition, better equipped, was needed to examine the scientific question of questions: what is the nature of life in the deep oceans, and what physical conditions govern life there? Carpenter, through his connections with the Royal Society and ministers of Gladstone's Liberal government, began a campaign for a grand voyage of exploration. Times were ripe for such a venture, through a combination of fiscal reform, beginnings of government support for science, and the Royal Navy's interest in surveying routes for deep-sea telegraph cables.[16] The Royal Society supported the venture and appointed a circumnavigation committee.

By February, 1872 the Cabinet and Chancellor of the Exchequer (Robert Lowe, appointed a Fellow of the Royal Society in 1871) had approved expenditure of about £100,000 for outfitting and supplying a major expedition.[17] A vessel was chosen, the rather undistinguished

corvette *Challenger*, then lying inactive, and the expedition began to take shape.

III

H.M.S. *Challenger* was a 2306 ton spar-deck corvette, 226' long, of 30' beam, built at Woolwich in 1858, and outfitted with a 234 h.p. auxiliary steam engine which was very inefficient and consequently little used. Until 1872 the ship had a relatively featureless career as a patrol vessel and had disciplined unruly natives in Fiji in 1868. When the Hydrographer of the Navy, Captain George Richards, began his search for a vessel, *Challenger* was at dockside, in commission, but not in use. Extensive renovations began.

The main deck of *Challenger* was stripped of guns (one 60-pounder was left as moral support) and rebuilt to include chemical and zoological laboratories, a darkroom, spirit stores, and accommodation for scientists and junior officers. A special preparation room (what we might now call a("wet lab") was built on the upper deck, and equipment for dredging and sounding was installed, including a raised deck for dredging, which kept the mud abhorrent to ship's officers) off the upper deck. Overall, as a scientific vessel, the ship was modern and able. We would find its equipment familiar and usable today.

IV

Challenger was provided with a naval staff of highly competent officers, experienced in surveying, hydrography and magnetic observations. Captain G. S. Nares began the expedition, but left the ship at Hong Kong in 1875 to take command of an Arctic expedition. He was replaced by Frank Tourle Thomson. The lieutenants and sub-lieutenants were experienced with thermometers, soundings, and magnetic apparatus (for determining declination of the compass all over the globe) and showed a remarkable talent with pen and brush in their private accounts of the voyage, some of which were later published. [18] Even a lowly cooper and cooper's crew, Benjamin Shepard, kept a log

of the journey in water-colour sketches which have recently been found in a Cambridge, Massachusetts bookshop and published.[19,20]

The civilian staff is worthy of particular attention, because of their importance in the success of the voyage and their role in making its results known later. Charles Wyville Thomson (1830-1882), knighted by Queen Victoria at the end of the voyage, was a Scot, who, after academic posts in Dublin and Belfast, became a successor to Edward Forbes as Regius Professor of Natural History at Edinburgh.[7] As a marine biologist he specialized in Porifera (sponges) and Echinodermata (starfish and their relatives), and with W. B. Carpenter, had made his reputation by the successful research voyages of *Lightning* and *Porcupine* . Wyville Thomson's frequent despatches to *Nature* and letters to friends kept the British scientific community in touch with the results of the voyage.

John Murray (1841-1914) was born in Canada of Scottish parents. He returned to Scotland at the age of fifteen and became a student at Edinburgh, although, like Forbes before him, he took no degree. As a partially qualified medical student, he went to the Arctic on a Dundee whaler, then returned to Edinburgh to work for the physicist P.G. Tait who recommended him to Wyville Thomson when a place became available on *Challenger* at the last moment. Murray is a figure of primary importance in marine science, because, apart from his work on the voyage, he later saw the entire results through to publication, made Edinburgh the centre of the new science, oceanography, and founded the famous Scottish Marine Biological Association. Murray was to become virtually the patron saint of marine science. In keeping with his individualistic, energetic life, he was killed in an automobile accident in 1914, at the age of 73.

Henry Nottidge Moseley (1844-1891) was the naturalist *par excellence.* He studied medicine at Oxford, Leipzig, Vienna and London; in 1871 he went to Ceylon with a British expedition viewing an eclipse of the sun. As an indefatigable observer on the *Challenger's* voyage he wrote on botany, anthropology, zoology, and all combinations of these subjects[21]. His description of the anatomy of the peculiar arthropod- like animal *Peripatus,* made while *Challenger*

was at Cape Town, established his reputation. When he returned to England, Moseley became Professor of Human and Comparative Anatomy at Oxford, where he died early, of overwork. His unpublished albums at Oxford, containing many photographs, are a unique record of the voyage [22].

John Young Buchanan (1844-1925), one of the more enigmatic figures, was a tall, bearded, taciturn and somewhat irascible Scot, chemist to the expedition. His technical competence was very great, a distinct advantage in doing chemistry on a wooden sailing vessel, thousands of miles from equipment makers. He was responsible for measuring the specific gravity of sea water samples and determining the dissolved gases present, notably oxygen and carbon dioxide. During the voyage, Buchanan became of note in marine biology by showing that the supposedly primitive form of life, *Bathybius*, found in preserved samples from sounding ships, was actually only a precipitate of calcium sulphate caused by alcohol preservative [23]. Buchanan eventually became oceanographer of Albert Ier Prince Souverain de Monaco, and being independently wealthy, worked on oceanography from his own yacht. In his post-*Challenger* years he became greatly interested in and well known for his studies of glaciology and the physical chemistry of ice.

A tragic figure of the voyage is Rudolph Von Willimoses-Suhm (1847-1875) a young German invertebrate zoologist, educated at Munich and Kiel, who met Wyville Thomson by coincidence while visiting Edinburgh, and was asked to come on the *Challenger*. Suhm's meticulous work on invertebrate structure ended when he died of erysipelas on passage between Hawaii and Tahiti.

Finally, of the scientific staff, I must mention the Swiss artist J.J. Wild, who served as secretary to Wyville Thomson and whose drawings, as engravings, convert the *Challenger* Reports from dry scientific volumes to books of great beauty and charm.

In the navy lists, these civilian scientists were "naturalists", in the same tradition as Solander, Banks and the Forsters with Cook a hundred years before, or Goodsir with the lost Franklin Expedition of 1845. To the young officers, they were "the philosophers", grubbing

over mud, trailing peculiar nets in the water, or on hands and knees in the vegetation of remote and exotic islands, penguin- bitten, tormented by insects and totally committed to the detailed recording of scientific information. The success of the expedition, in the long run, rested with them, and they responded magnificently.

V

In preparation for the voyage, the Admiralty issued detailed instructions to *Challenger's* captain governing the routine sounding, temperature and magnetic observations to be made by the ship's officers. For their part, the civilian scientists had a list of objectives, prepared by the Circumnavigating Committee of the Royal Society. These were, 1) to "determine the physical conditions of the deep sea" - i.e., measure depth, temperature, specific gravity, light penetration and the nature of circulation. 2) to establish the chemical composition of sea water - salt, gases, organic matter in solution and suspended particles. 3) to determine and chart the nature of marine sediments and determine their sources, and 4) to study the distribution and abundance of organisms, and to determine where they had originated.

It was these aims, particularly the fourth, that the naturalists had in mind when the ship left England late in 1872. *Challenger* was moved from Sheerness, in the Thames estuary, to Portsmouth on December 7; after final farewells, celebrations and oratory, the ship headed south on December 21, into the teeth of southerly gales. According to the August pages of *Punch* the last object taken on board the ship as she departed Spithead was volume 63, for 1872, of that magazine. [23] This is a fact which, until now, has escaped historians of oceanography.

The beginning of the voyage was not auspicious, as Herbert Swire's account illustrates, dated December 27, 1872:

> ...here we have been kicking our heels about for the last six days in the chops of the channel... South-westerly gale follows south-westerly gale... and all we can do is to "lay to" and let it blow on. ... we had to hang on to our grub pretty stiffly, for everything had a tendency to make for the lee side of the place, there to revel in sublime smashery and confusion ...[18]

Later the weather improved, and *Challenger's* first year in the Atlantic began.

Punch [24] in characteristic fashion, described the voyage that was to come, under title "All around the world".

> In Australia, or the neighborhood, the *Challenger* will remain for some time, in order to take on board a supply of tinned meats and kangaroo soup...
>
> The Coral Sea will be the next attraction, and the friends and relatives of all on board may confidently look for handsome presents of bracelets, brooches, necklets, studs, and sleeve-links.
>
> Calling at Japan to renew the stock of tea-trays....
>
> We have now endeavoured to trace the career of the good ship - it may be with one or two trifling inaccuracies of detail....
>
> ...not the least important results of the Expedition may be the acquisition of a Sea Serpent and the capture of a live mermaid. It is understood that the authorities at the Zoological Gardens have agreed to give a sum for the possession of these interesting and long-sought creatures which would enable the CHANCELLOR OF THE EXCHEQUER to announce a surplus in his next annual Budget....[23]

In the three and a quarter years that Challenger was away from England, from December 21, 1872 to May 24, 1876, the ship steamed 68,890 nautical miles and made 362 day-long stations, spaced roughly at 200-mile intervals. The route was a complex one: the last few days of 1872 weathering gales offthe Bay of Biscay; 1873 between Lisbon and the Crozet Islands, with stops at Madeira, The Canaries, St. Thomas, Bermuda, Halifax, the Azores, Cape Verdes, St. Paul's Rock, Fernando de Noronha, Bahia, Tristan da Dunha, Cape town and Prince Edward Island. In 1874 the ship visited Kerguelen Island, entered the Antarctic ice at about 81E, then went on eastward to Melbourne, Sydney, Wellington, The Kermadecs, Tonga, Fiji, the New Hebrides, Cape York, Arru, Ambonia, the Phillipines and Hong Kong. At Hong Kong, Captain Nares left, to the regret of all on board, to be replaced by Captain Thomson, who, in 1875 carried on to the Phillipines again, then to New Guinea, Yokohama, the Hawaiian Islands, Tahiti: Valparaiso and a New Year passage through the grim darkly-forested channels of Magellanic South America. The four months of 1876 in the Atlantic seem almost rushed in the published accounts. Perhaps we can imagine that they

seemed, interminably long to men away from family and homeland for so long, as they visited the Falkland Islands and Montevideo, before making a long swing through the whole central Atlantic between February 25 and May 24.

The ports sounded exotic, but perhaps much of the flavour of the voyage is given in statistics compiled recently by Professor D. M. Merriman of Yale University from the surgeon's report and other documents.[7] Challenger sailed with 243 men. Of these, 61 deserted, most of them at the Cape (where the diamond fields beckoned from the Transvaal) or in Australia. Seven men died and 26 were hospitalized, due, in the main, to malaria, syphilis and tuberculosis. About 60% of the crew were abroad for the whole voyage, a figure which seems remarkable in this day of rotating leaves from research vessels. Of the 3 ¾ years away from England, 40% was spent in port, for repairs, provisioning, scientific work ashore, and for what we now call "R and R", that is, rest and relaxation. With the advent of efficient steel ships, such long port stops are a thing of the past, and although our efficiency as at-sea scientists is increased, there has naturally been a reduction in the romance and cultural appeal of long voyages.

Romance, cultural appeal, life below decks, and the diseases of sailors aside, the major job of *Challenger* lay in its dreary routing of scientific stations, repeated 361 times after the initial full station on February 15, 1873 in the North Atlantic.

Upon arriving on station, the ship's bow was put into the wind and a sounding began, using a special sounding device (the Baillie sounding machine) at the end of the rope, plus two or three maximum-minimum recording thermometers (Miller-Casella theramometers[25]) and a water-sampling device. After the sounding established the depth, the ship was turned down-wind and the dredge or trawl was put over. When a long length of dredge rope was out, a heavy weight was put on the line to sink the gear. As the dredge sank, the ship turned into the wind and put over a line with a long series of thermometers to establish "serial temperatures" from the ocean surface to the bottom. When the thermometers were all safely aboard, the ship drifted broadside to the wind, dredging or trawling,

for about two more hours. As the dredge or trawl was recovered the ship steamed towards it, to reduce strain on the line. When the gear was emptied on deck, the contents had to be sieved and sorted, a job that often had to wait until first light of the next morning. At first the dredging was a source of widespread entertainment and amazement, but as the voyage progressed it became repetitious and boring, except perhaps to one or two of the naturalists. Dredging became "drudging" and evoked this comment from a young officer, Lord George Campbell:

> The mud! Yegods imagine a cart full of whitish mud, filled with minutest shells, poured all wet and sticky and slimy on to some clean planks, and then you may have some faint idea of what globigerina mud is like. In this the naturalists paddle and wade about...

and later,

> Dredging, I may say without fear of contradiction, was our - the naval officers' - *bete noir.*[18]

But the boring exercises were fruitful, and from their repetition came the fifty volumes of the *Challenger* reports and the information that founded the science of oceanography. For my story in particular, the dredging results excited the interest of David Honeyman (1817-1889), provincial geologist of Nova Scotia and Curator of the newly opened Provincial Museum.

VI

The Reverend Dr. David Honeyman[26] came to Nova Scotia in 1851, at the age of thirty four. He was born in Dundee and educated at St. Andrews, long a stronghold of marine biologists, in oriental languages and natural science, where he may have come to know Charles Wyville Thomson. At first Honeyman was heavily occupied as a Professor of Hebrew at the Free Church College in Halifax; later he was a clergyman at Shubenacadie and Antigonish. His interest in Nova Scotian geology seems to have begun about 1855, and by 1862 he was so expert that the provincial government commissioned him to collect minerals for the great exhibition at London, and to be superintendent of the provincial exhibit. He represented the province at four other major exhibitions between 1865 and 1883.[27]

Geology was Honeyman's main focus in life; he had surveyed Antigonish County for the Geological Survey of Canada, and his conclusion, from another study, that Cape Breton Island had been glaciated by a great ice sheet moving from the north stirred controversy among more conversative geologists. But in 1868 he took on the job of Curator of the newly-established Provincial Museum, which he had helped to found. As secretary of the Nova Scotian Institute of Natural Science for eighteen years his educational influence was extended to an even wider circle of educated and apparently enthusiastic Nova Scotians.

An account of an Institute of Natural Science meeting on February 12, 1874, will give the flavour of the times. Dr. Honeyman was to speak on "The Ocean". [28] A crowd of 150,including the Governor, gathered at the new Provincial Building, where, before the evening's main proceedings, they were entertained by displays. After the Governor's introduction, Dr. Honeyman gave his address, "profusely illustrated by specimens from the museum", [29] and was followed by a dissertation on a fossil whale found in New Brunswick, then a lecture on the chemistry of heat.

> Governor Archibald then made a few remarks, and announced that there was to be "a feast" and "a flow" upstairs. Thither the company adjourned, through the post office hall, causing parties waiting for their letters to gaze with astonishment at the gay throng passing by them. A tea table had been laid out, presided over by fair hands, dispensing liquids and solids to the guests. All being refreshed, the company gradually thinned; and by half past ten o'clock the rooms were empty. Thus came to an end a really agreeable social and instructive meeting.

Honeyman on "The Ocean" was remarkably up to date. He discussed the background to Edward Forbes' "azoic hypothesis" and showed how it had been abandoned on a variety of evidence, the best known being the recovery of deep-sea animals by the Scottish engineer Flemming Jenkin on a telegraph cable raised from the floor of the Mediterranean at 2200 meters. A shark fishery, also, he said, had long existed off the coast of Portugal, bringing to the surface fish from as deep as 900 meters. Here was evidence for adaption to life at great depths and increased pressure, since the sharks could not survive the trip to the surface. With increasing depth, the eyes of invertebrate animals became more and more reduced, until in the deepest living

animals known, the sense of touch was enhanced and replaced sight.

Honeyman reviewed for his audience the discoveries by the Sars, father and son, of animals at increasingly greater depts off the coast of Norway, then the role of H.M.S.S. *Lighting* and *Porcupine* in furthering knowledge of deep-sea animals and in leading to the *Challenger* Expedition. *Challenger,* in keeping with the discoveries of the Sars and Thomson and Carpenter, had even dredged a crinoid north of St. Thomas in the West Indies and on LaHave Bank, off the Nova Scotian coast.[30] He was impressed by the small size of the animals *Challenger* was collecting, and speculated that the small size and apparent carnivorous habits[31] were adaptions to a meagre food supply. Deep sea animals were "cannibal Gullivers in the kingdom of Lilliput", and "in the great depths life appears to be scarcely possible or enjoyable, except by creatures of the lowest subkingdom of life, such as *foraminifera* and sponges."

These conclusions could later be modified in the light of *Challenger's* continuing work, but Honeyman's ideas, and indeed those of Wyville Thomas and John Murray following him, could not be fully evaluated until well past the middle of our own century.

VII

Honeyman's tiny sample from the deep-sea, along with hundreds of other dredgings by *Challenger* over the next twenty-six months, eventually showed that Forbes' hypothesis could be firmly, even emphatically, laid to rest. Animals occurred in the oceans to at least 5500 meters and were very widely distributed. According to Murray's summary of the zoological results,[32] the deep-sea fauna showed signs of being highly diverse, that is, of being composed of many species. But no living fossils were found, to the disappointment of many.

In truth, *Challenger* sampled the deep-sea biota very inefficiently because of the large mesh of its trawls and dredges which allowed animals to be washed out during the long recovery of the gear from the bottom.[33] This delayed discovery of some of the truly fascinating problems of deep-sea biology - namely the origin of very high species diversity, and the nature of food supply to the deep-sea - until the 1960's.

Honeyman had come very close to one of the main ecological problems of our era when he speculated that food was hard to come by in the deep-sea, and that the organisms must of necessity, be small and carnivorous. He had no way of knowing that, a hundred years later, his remarks to a lay audience in holiday mood might still bear on problems which keenly excite oceanographers in many parts of the world, including Nova Scotia, and even now elude solution.

NOTES

1. Letter from Harris B. Stewart, Atlantic Oceanographic Research Laboratories, Miami, 25 October 1972.

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3. Gossip, W. 1873. The *Challenger* scientific expedition. Visit to Halifax. Trans. Nova Scotian Inst. Sci., 3: 335-337.

4. Honeyman, D. 1874. Appendix. Trans. Nova Scotian Inst. Sci., 3: 439.

5. Honeyman, D. 1874. The ocean (account of a public lecture). Acadian Recorder, Sat. Feb. 14.

6. Davis, D. S. 1973. Notes on a collection of specimens made by the Challenger Expedition 1873. Nova Scotia Museum, Curatorial Rpt. No.9, 9 pp. figs.

7. MacLean, G. 1885. Appendix IV. Report on the health of the crew of H.M.S. Challenger, during the years 1873-76. Rept. Sci. Res. Voy. H.M.S. Challenger. Narrative, 2(1): 1027-1031. Merriman, D. 1972. Challengers of Neptune: The "Philosophers." Proc. Roy. Soc. Edinburgh, B. 72: 15-45.

8. Spry, W.J.J. 1878. The cruise of Her Majesty's ship "Challenger", Voyages over many seas, scenes in many lands. St. John, B. B., R. A. H. Morrow.

9. Merriman, D. 1965. Edward Forbes - Mansman. Progr. Oceanogr. 3: 191-206.

10. Ritchie, J. 1956. A double centenary - two notable naturalists, Robert Jameson and Edward Forbes. Proc. Roy. Soc. Edinburgh, B, 66: 29-58.

11. Spratt, T.A. B. and E. Forbes. 1847. Travels in Lycia, Milyas, the Cibyratis. London. 2 Vols.

12. Sir John Ross, in Baffin Bay in 1818 with H.M.S. "Isabella" had collected animals from 1800 meters, and James Clark Ross, with H.M. S. "Erebus" and "Terror" in the Antarctic, 1841, had found life to more than 700 meters. In 1845 the naturalist Harry Goodsir, on Sir John Franklin's ill-fated Arctic expedition also collected deep water animals. After Forbes, records continued to accumulate, but they were ignored or summarily rejected in most cases until the Sars' discoveries, and until in 1860 Flemming Jenkin, a Scottish engineer, recovered a telegraph cable from the Mediterranean floor at 2200 meters and found animals attached. For a summary, see Thomson, Charles Wyville. 1873. The Depths of the sea. London, Macmillan.

13. Bailey, H.S., Jr. 1972. The background of the *Challenger* expedition. Amer. Sci., 60: 550-560.
Merriman, D. 1968. Speculation on life at the depths: a XIXth century prelude. Bull. Inst. Oceanogr. Monaco, No. Sepcial, 2: 377-384.

14. Deacon, M. 1971. Scientists and the sea 1650-1900. A study of marine science. London, Academic Press. See esp. ch. 14.

15. See the essay later in this series, "H.M.S. *Challenger* and the controversy about how the oceans circulate."

16. Burstyn, H.L. 1968. Science and government in the nineteenth century: the Challenger expedition and its report. Bull. Inst. oceanogr. Monaco, No. special 2, 2: 603-613.
Burstyn, H.L. 1972. Pioneering in large-scale scientific organisation: the *Challenger* Expedition and its report. I. Launching the expedition. Proc. Roy. Edinburgh, B, 72: 47-61.

17. Lowe pointed out in Parliament that sending *Challenger* around the world cost no more than keeping her in commission at dockside. "Punch" (Dec. 14, 1872) asked Lowe, rhetorically, can "nothing of nothing come?", but apart from this rather mild comment, the preparation of *Challenger* caused little comment from anyone, including politicians, and may have been almost unknown to the public at large.

18. Aldrich, P. Journal of the voyage of H.M.S. Challenger. Archives, Royal Geographical Society, London. Unpublished manuscript. Campbell, Lord George. 1876. Log-letters from the *Challenger*. London Macmillan. 448 pp.
Spry, W.J.J. 1878. The cruise of Her Majesty's Ship H.M.S. "Challenger" St. John, N.B., R.A.H. Morrow.
Swire, Herbert. 1937. The voyage of the *Challenger*. Limited edition, 2 vols. London, Golden Cockerel Press.

19. Henderson, J.W. and H.B. Stewart. 1972. A recently discovered *Challenger* sketchbook. Proc. Roy. Soc. Edinburgh, B, 72: 223-229.

20. Stewart, H.B. and J.W. Henderson. 1972. *Challenger* sketchbook. B. Shepard's sketchbook of the H.M.S. Challenger Expedition 1872-1874. Philadelphia, Phila. Maritime Museum.

21. Moseley, H.N. 1880. Notes by a naturalist on the *"Challenger"*. London.

22. Professor H.N. Moseley's albums, in Department in Zoology, Oxford University.

23. A full account of the debunking of *Bathybius* is given by Margaret Deacon (see reference 14, pp. 352-353). This story has become part of the anecdote armament of most marine biologists.

24. Punch, Dec. 21, 1872.

25. Punch, Dec. 28, 1872.

26. Gray, F.W. 1945. Pioneer geologists of Nova Scotia. The Men and their Times. Collections N.S. Hist. Soc., 26: 153-172.

27. Honeyman's scrapbook collection of photographs,clippings, letters and other memorabilia is 213 Exhibition memoranda of the Rev. David Honeyman, D.C.L, F.C.S., in the Provincial Archives of Nova Scotia.

28. My account is taken from the *Acadian Recorder* for Saturday February 14, 1874. It was the custom of the scientists on H.M.S. *Challenger* to leave a small representative collection of animals at each port that had an active museum or natural history society.

29. Some of these can be identified today. See the comments by D.S. Davis, 1973. Notes on a collection of specimens made by the *Challenger* Expedition 1873. Nova Scotia Museum, Curatorial Rpt. No. 9, p.7.

30. See. D. S. Davis, 1972, p.6 & Figs. 1,4. A crinoid specimen, now missing from the museum collection, was labelled by Harry Piers "Or. Branchiata Rhizocrinus lofotensis Sars (Cup [calyx 3, etc., of) Costa Rica, Col. H.M.S. *Challenger.* Occurs in depths of 100-1000 ft." This peculiar note (since *Challenger* never came within 1500 miles of Costa Rica) may refer to a crinoid taken off St. Thomas, B.W.I. This specim could be one mentioned in Honeyman's address.

31. Honeyman appears to have recognized that virtually all the specimens left by *Challenger* in Halifax were Foraminifera (protozoan organisms which secrete complex shells), but some he apparently misidentified as canivorous molluscs (cephalopoda), judging by the account in the *Acadian Recorder.* Thus his conclusion that deep-sea animals were largely carnivorous may have been based in part on errors in identification.

32. Murray, J. 1895. General observations on the distribution of marine organisms. Rept. Sci. Res. Voy. H. M. S. *Challenger,* Summary Sci. Res., 2: 1431-1462.

33. Mills, E.L. 1972. T.R.R. Stebbing, the *Challenger,* and knowledge of deep-sea Amphipoda, Proc. Roy. Soc. Edinburgh, B,72: 69-87.

34. For a brief review of these subjects, see the concluding discussion in Mills, E. L. 1972. Proc. Roy. Soc. Edinburgh, B,72: 69-87.