



## A Brief History of 19th Century Deep Sea Sounding

Steve Ritchie

### Preface

At the 7th International Geographic Congress in Berlin in 1899 a Commission on the Nomenclature of Undersea Features was established. This did not hold its first meeting in Wiesbaden until 15th – 16th April 1903. It was attended by Prince Albert of Monaco, who took the Chair, Professor Otto Krümmel, Dr Hugh Robert Mill, Professor Alexander Supan, Professor Otto Pettersson, Professor Julien Thoulet and Enseigne de vaisseau Charles Sauerwein, Head of Prince Albert's Scientific Cabinet. Considering the amount of deep sea bathymetry available worldwide the Committee decided that it was time to prepare a General Bathymetric Chart of the Oceans (GEBCO).

I have been invited by the GEBCO Guiding Committee to write Part I of the GEBCO Centenary Volume to be published in the year 2003.

My essay will deal with the history of deep sea soundings until about 1902 when, under the supervision of Charles Sauerwein, Alphonse Tollemer, the Chief Draughtsman and his six assistants began to use this material for compiling the first edition of GEBCO.

On examining in some detail the 24 sheets of the first edition of GEBCO (1905), which is said to have been compiled with 18,400 deep soundings, the enormity of my task became clear.

Having been offered space for a paper in the 'Hydrographic Review', now to be published commercially. I decided to seize the opportunity to submit a preliminary paper on my subject. My hope is that shortcomings which may be brought to my notice by readers will enable me to eliminate such deficiencies and thus provide an essay worthy of inclusion in the GEBCO Centenary Volume.

My aims will be to identify, in roughly chronological order, the more notable deep sea surveyors in the 19th century, to describe their methods and equipment for deep sea sounding and to define their hydrographic output.

### An Early Oceanographer

Possibly the first man of science to discover that there is a continental shelf that terminates in a steep descent to the abyssal plain was Count Luigi Ferdinando Marsigli who, having studied the surface and sub-surface currents flowing in the

Bosphorus, decided to make an oceanographical study of the Gulf of Lyons, working from temporary headquarters that he established in the small port of Cassis. The local fishermen were employed in trawling for coral from small boats and were willing to take the Count to sea with his lead and line, protected thermometer and water samples.

He ran fourteen lines of soundings from different places along the shorelines across the continental shelf, from which he drew profiles. A few soundings of 100 or 150 fathoms showed him where the slope towards the abyss began.

He assumed that the continental slope would rise off the North African coast in a similar way to what he had observed off the Gulf of Lyons; he forecast in his book 'Histoire Physique de la Mer' in 1725 that the deepest part of a traverse across the abyss, could it be made, would be found in the latitude of Malta. He regretted that it was presently impossible to run such a traverse. 'Unless', he wrote 'some Prince orders special ships and adequate instruments for the purpose this will probably never be done'.

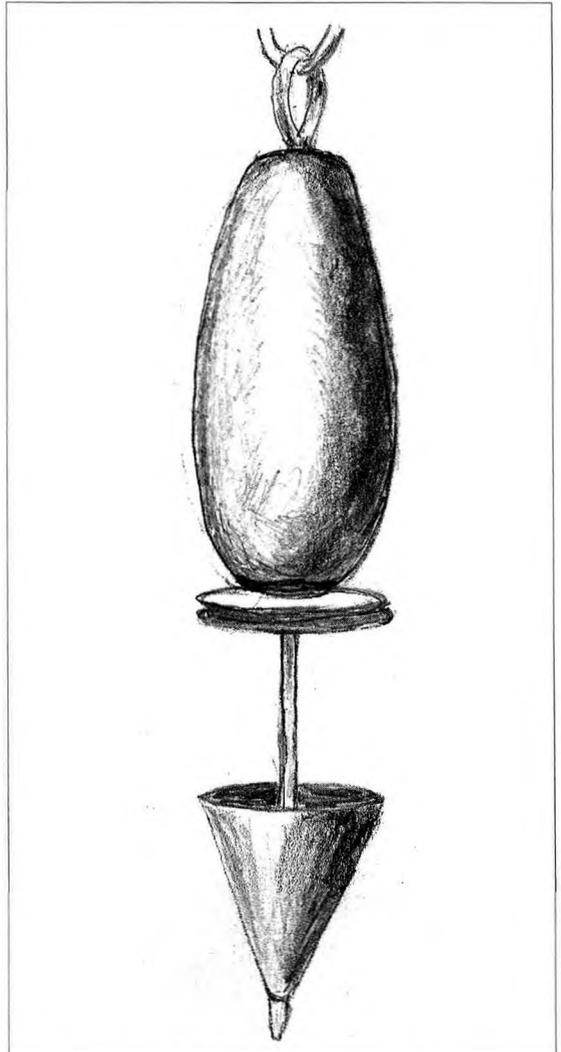
One hundred and sixty years later the Prince of Monaco took up this challenge and pursued it for over thirty years.

### Maury's Contribution

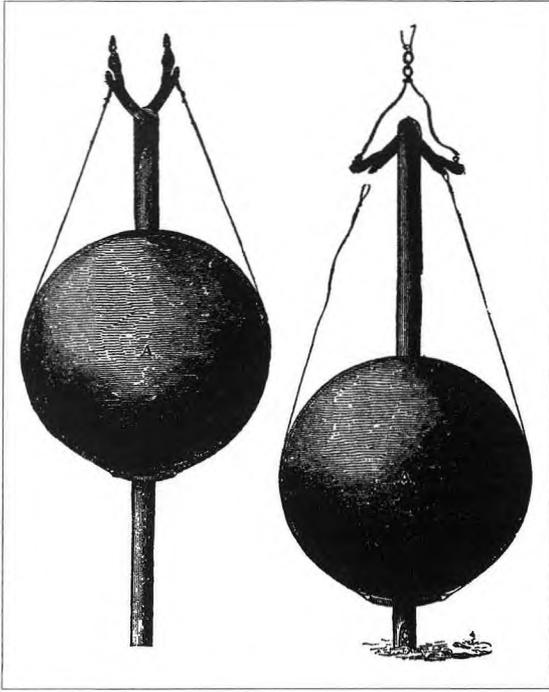
From 1850 when the tug **GOLIATH** succeeded in laying a cross Channel telegraph cable between England and France the call for the smoothest and levellest sea bed routes to be found for telegraph cables was the major stimulus for seamen to devise methods for exploring the depths of the ocean.

Matthew Fontaine Maury was the Director of the United States Navy's Depot of Charts and Instruments from 1842 to 1861 when, on the outbreak of the Civil War, he resigned and left his office to support the Southern States. He was famous for his 'Wind and Current Charts' and his 'Sailing Directions' which where so beneficial for seamen, but he had an equal interest in the depths and sea bed deposits in the North Atlantic.

He had at various times three surveying vessels under his control carrying out deep sea surveys including the brig **DOLPHIN** with an excellent surveyor in command. Using a variety of ropes, and lines stowed on reels on deck, Lieutenant Berryman took a large number of ocean soundings, from which he brought sea bed samples with either the Cup sounder invented by Henry Stellwagen in 1842 or with the Brooke sounder invented by the midshipman of that name ten



*Stellwagen's Cup Sounder*



Brooke Sounder

years later. The latter apparatus was carried to the sea bed by the considerable weight which drove a sampling tube into the sediment to be recovered onboard. By 1855 Maury had collected enough deep soundings for him to prepare a contoured chart of the North Atlantic to be included in his book 'The Physical Geography of the Sea'. Among those interested in Maury's chart was Cyrus Field, an American paper manufacturer, who formed the Atlantic Telegraph Company in 1856.

### Searching for North Atlantic Cable Routes

In June and July the following year the British Hydrographer sent Commander Joseph Dayman in **HMS CYCLOPS** to sound out a suitable cable route from the west of Ireland to Newfoundland. In August the first attempt to lay a cable along this route was made but the cable broke during the lay and a year's delay followed.

In 1858 **HMS AGAMEMNON** and **U.S.N.S.**

**NIAGARA** met in mid ocean, joined their section of cable and connected Ireland and Newfoundland successfully. There was much rejoicing and passing of congratulations along the cable from the Old World to the New, whilst Commander Dayman received the gift of a gold watch from the Mayor of New York.

The cable failed to carry signals after about a month's operation. Meanwhile Dayman, in **HMS GORGON**, was already sounding out an alternative route from Newfoundland via the Azores to the English Channel. In 1860 Sir Leopold McClintock in **HMS BULLDOG** was sounding out yet a further possible route via the Faeroes, Iceland and Greenland, perfecting the Bulldog grab sounder to the delight of Dr George Wallich, the scientist onboard, who welcomed some excellent samples.

In 1862 Mr Hoskyn, Master of **HMS PORCUPINE**, was engaged in making a close survey off the West Coast of Ireland to locate the most gradual route down the continental slope by which a cable could reach the abyssal plain. Hoskyn discovered the Porcupine Bank, which would have been a cable hazard and surveyed the extensive Rockall Bank.

So all was ready when the Civil War was over in 1865 to lay the 3,700 kilometres of cable which Cyrus Field had prepared. It was loaded into the **GREAT EASTERN**, the only vessel large enough to take it, and finally laid satisfactorily from Valencia in Ireland to Trinity Bay in Newfoundland.

### Deep Sounding by the Timed Interval Method

Dayman was already on his next task, to take a line of deep sounding from **HMS FIREBRAND** along a route for a cable to be laid from the English Channel across the Bay of Biscay, along the coast of Portugal and Spain, through the Strait of Gibraltar and the Mediterranean to Malta.

Until 1870 both American and British naval officers relied for deep sounding on lowering a weight, or apparatus for taking a bottom sample, on a line marked at every 50 fathoms. They carefully timed the inter-

vais between the passage downwards of each mark until a sudden increase of the interval denoted that the weight had reached the sea bed. Hauled taut the depth could be read from the line. A great variety of lines and ropes, each stowed on their respective reels, were used with various sinkers; the British and Americans would test the various combinations of line and sinker recording the increasing time intervals during a descent between 400 and 1,400 fathoms to familiarise themselves as to how each combination would react to sea conditions.

The business of deep sounding, which took place every 100 miles or so, or more often over an irregular sea bed, required absolute concentration as the lead continued to descend for an hour or so. It also called for patience, the ability to accept temporary failure and complete dedication to finding the correct depth at every cast. To obtain a bottom sample it was sometimes quickest to find the depth using a heavy sinker on a light twine which was not recovered, and then to send down a Cup or Brookes sounder on a stouter line recoverable with the donkey engine. When a sample was particularly desired the line might be 'walked in', a lengthy business.

Fathoms	Times			Intervals		Remarks
	h	m	s	m	s	
0	Eased down					A.M.
100	6	12	45	Let go.		
200		13	35	0	50	
300		14	35	1	0	
400		15	42	1	7	
500		16	58	1	16	
600		18	21	1	23	
700		19	52	1	31	
800		21	29	1	37	
900		23	13	1	44	
1,000		25	8	1	55	
1,100		27	37	2	29?	Checked?
1,200		29	44	2	7	
1,300		32	58	2	14	
1,400		34	12	2	14	
1,500		36	29	2	17	
1,600		38	49	2	20	
1,700		41	12	2	20	
1,800		43	39	2	27	
1,900		46	3	2	24	
2,000		48	33	2	30	
2,100		52	8	3	35	Bottom.
2,150		56	0	3	53	

Page from H.D. 14 HMS Gorgon, Commander Dayman'

Deep soundings were usually taken from the bows of the ship so that she could be kept headed into wind or sea by the judicious use of the screws. The line would pass from its reel through a block at the derrick head, an accumulator, consisting of a number of rubber ropes included in the topping lift to dampen the effects on the sounding line of the pitching of the vessel. If, because of wind and sea, the sounding line could not be kept vertical, a boat was lowered when the sea bed was reached to underrun the line until vertically was achieved and the depth recorded.

### Searching for Cable Routes Worldwide

Telegraph cable laying far beyond the North Atlantic was now gathering pace and with Admiral George Richards as Hydrographer of the British Navy a number of his ships were actively searching out the smoothest sea bed routes for prospective cables. Such voyages by HM ships included:

- **VALOROUS**, supply ship for the Arctic Expedition, Captain Loftus Jones, from the English Channel to and from Davis Strait
- **MEDINA** – Captain Spratt, Malta to Alexandria
- **HYDRA** – Captain Mansell, Alexandria to the Aegean
- **HYDRA** – Captain Shortland, Bombay to Aden and other Indian Ocean profiles
- **EGERIA** – Captain Aldrich – Several profiles in the Indian Ocean and S.W. Pacific

All these lists of deep sea soundings were published, each with an HD number, by the Hydrographic Officer at the price of one shilling.

The Service Hydrographique de la Marine was active from 1855 searching for suitable cable routes from Southern France to Tunisia via Corsica and Sardinia and to Algeria via the Balearic Islands, under the

direction of ingénieur de 1er classe Delmarche who published his manual 'Elements de telegraphie sous marine'. In 1884 La Porte, Sous-Ingenieur, assisted in laying a cable from France to Senegal via the Canaries.

### **The Advent of Wire Sounding**

Sir William Thomson, the Scot who later became Lord Kelvin, had been greatly involved with the construction of sea bed cables and had witnessed the somewhat inefficient way of deep sounding by timing the intervals between marking on a hempen line during the descent. He saw the advantage of piano wire and once he had found a manufacturer who could supply extended lengths he devised a compact sounding machine incorporating 5,000 fathoms of wire on a powered drum, an internal accumulator and a measuring wheel. When the load came off the accumulator as the lead reached the sea bed the brake was applied to the drum and the depth read off from the wheel.

Commander Sigsbee U.S.N. in **BLAKE** was the first of a number of seamen to see the value of Thomson's revolutionary wire sounding device. He fitted such a machine in **BLAKE** and began to make his own modifications. Carl Bamberg of Berlin began to produce a more compact version, resulting in a Bamberg sounding machine being supplied to Commander Belknap U.S.N. in **U.S.S. TUSCARORA** for use in the Pacific during 1873-74 for the survey of a prospective cable run from California to Japan. Belknap was well pleased with Bamberg's machine with which he made 483 successful deep sea casts.

### **Telegraph Cable Companies Takeover**

**TUSCARORA**, which made several more profiles across the North Pacific, was really the last government survey ship to sound out routes for telegraph cables. By 1878 telegraph companies were being widely established, employing their own vessels for pioneering cable routes and for recovering defective cables from the sea bed for repair.

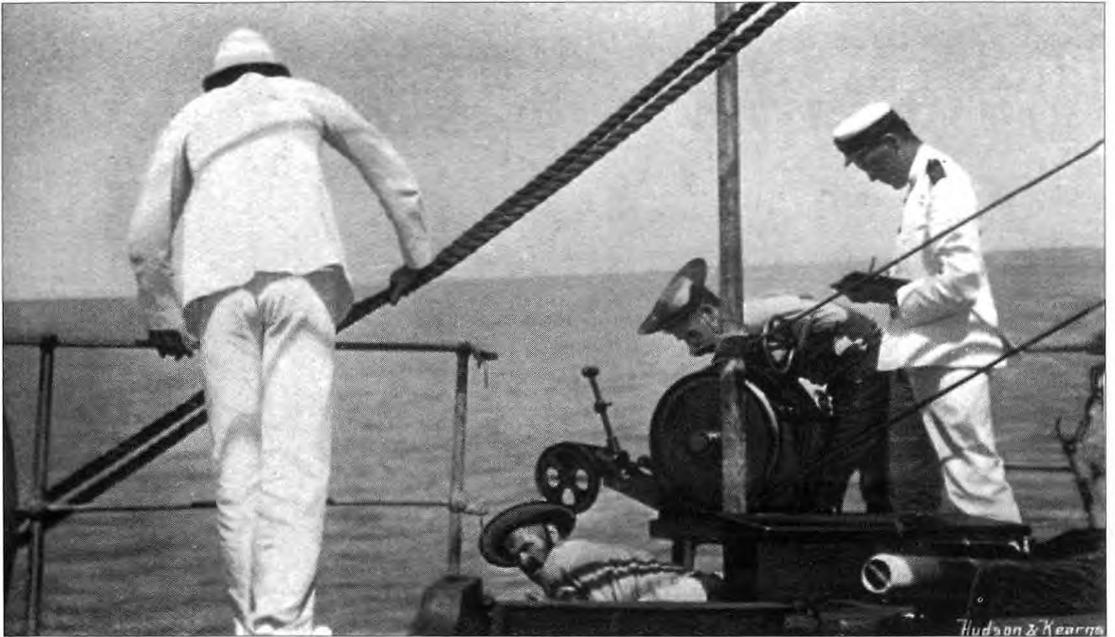
Many commercial sounded lines may be recognised on the first edition of GEBCO as double lines for such vessels proceeded sounding on a zigzag course to cover a wide swathe of ocean bed. Searching for cables for repair often provided quite a gathering of deep soundings as repeated operations with a grapnel tended to be protracted.

By the end of the century there were about a dozen telegraph companies worldwide employing about double that number of newly built or converted vessels. It is understood that Prince Albert enjoyed close cooperation with some of these companies if only to avoid newly laid cables when trawling from his vessels, and may have received deep sea data from them.

Although British surveying vessels were no longer involved in searching out telegraph cable routes the Hydrographer began to produce annually an HD publication entitled 'List of Oceanic Depths and Serial Temperature Observations received at the Admiralty during the year from HM Surveying Ships, India Marine Survey and British Submarine Telegraph Companies'.

### **The Lucas Sounding Machine Invented**

In 1874 Admiral Richards retired as Hydrographer of the Navy to become a Director of the Telegraph Construction and Maintenance Company, the Chief Engineer of which was Francis Lucas who, with Admiral Richards' encouragement, invented and patented a compact and highly efficient wire sounding machine which bore his name. It was to take over as the most widely used machine by naval and commer-



*Deep sea sounding, with the Lucas Machine HMS Egeria 1897*

cial ships seeking to sound great depths and recover ocean bed samples therefrom for fifty years to come.

It consisted of a drum from which piano wire ran out to measuring sheave held between two double arms. The weight of the sinker and wire during the descent depressed the double arms against the pressure of two spiral springs. When the weight on the double arms was removed on the sinker reaching the sea bed the two springs raised the double arm and applied the brake to the drum. The depth could then be read off on the face of the measuring sheave. The drum was power driven when used onboard and there was a smaller hand operated model for use in boats.

### Ship Names on the Façade of the Musée Océanographique

Prince Albert completed the building of his remarkable Musée Océanographique on the face of the Rocher at Monaco in 1910. On the façade of the building on the shore side appear the names of 23 vessels fitted for oceanographic research. They include the four yachts owned between 1873 and 1914 by Prince Albert, and three yachts named **AMELIA** owned by King Carlos I of Portugal. Of the remaining 17 vessels named, something of their oceanographic work must have been known to Prince Albert for him to have honoured them in such a way.

The first of these vessels must be **HMS CHALLENGER**. Her world voyage of 1872-76, with Professor Wyville Thomson as senior scientist, was devoted to the scientific exploration of the great ocean basins, and, when the fifty volumes of the Challenger Reports had been published the findings formed the foundation upon which all subsequent oceanographical research has developed. As regards her deep sea soundings, from 1874-1876 six reports on **CHALLENGER'S** ocean soundings were published by the Hydrographer as H.D. publications as they came to hand from her Captain. It is strange that despite having embarked a Thomson wire sounding machine it remained unused below decks throughout the voyage. Deep soundings, of which there were a great many, continued to be made by the timed interval method for which purpose 140,000 fathoms of various lines were carried.

At sea the same time as **CHALLENGER** was the German ship **GAZELLE**, first making investigations in the

South Pacific before encircling the world.

**BLAKE** was the U.S.C. & G. research vessel in which the scientist Alexander Agassiz sailed on three cruises in the Gulf of Mexico, the Caribbean and the North Atlantic. The captain was the Charles Sigsbee who had modified the new Thomson wire sounding machine.

The Danish vessel **INGULF** under L.A. Mourier and later Knudsen and Wandel had obtained deep soundings in the North Atlantic, Iceland and Greenland.

A.E. Nordenskjöld sailed through the N.W. Passage in **VEGA** in 1878-79.

In the early 1880s the French research vessels **TALISMAN** and **TRAVAILLEUR** made three oceanographic cruises in the Eastern Atlantic under the direction of Milne-Edwards.

Captain, later Admiral, Magnaghi, the Italian Hydrographer, made a number of oceanographic voyages in the survey ship **WASHINGTON** in the 1880s. He was particularly interested in the deep areas of the Mediterranean and in 1887 found his deepest sounding of 4,067 metres at 18°E., on the latitude of Malta as Marsigli had forecast.

In 1882-83 Conte Wilesek in the Austrian ship **POLA** made a remarkable voyage of exploration to Jan Mayen.

The Telegraph Construction and Maintenance Company owned *Buccaneer* onboard which the scientist J.Y. Buchanan, formerly of **HMS CHALLENGER**, was able to arrange a sounding voyage from Cape Verde to Ascension during which a very deep area was found.

In the years 1890 to 1896 Natterer in the Austrian vessel **POLA** made a number of oceanographic cruises in the eastern Mediterranean and in the Red Sea.

From 1892 to 1897 Prince Albert onboard **PRINCESSE ALICE I** made six cruises, the first three to the Mediterranean and coasts of Portugal and North Africa, the second three to the Azores. In six years he had made 222 deep soundings including one of 5,530 metres south west of Madeira. In the vessel he employed a modified Thibaudier machine similar to one installed in the French research vessel **TALISMAN** in 1883.

From 1893-96 the specially built **FRAM** was taking part in the great Arctic drift expedition under the direction of Fridtjof Nansen.

In 1894-95 Admiral Makaroff was making a scientific voyage round the world in the Russian ship **VITIAZ**.

In 1899 Professor Weber was depth sounding in the Flores sea where depths of 1,700 fathoms were to be found.

### Other Sounding Voyages

It is perhaps surprising that the name of **U.S.S. ENTERPRISE** does not appear on the Musée building in Monaco. Under Captain A.S. Barker U.S.N. this ship carried out a world circling deep sea sounding cruise during the years 1883-86. A brief account of the work, together with three excellent charts showing the soundings obtained during the voyage, was published in 1892. Soundings were taken every hundred miles or so, more frequently in complex areas. A number of different cup sounders, modified by both Sigsbee and Belknap, each weighing about 60lbs. were used to provide a sea bed sample at nearly every cast, the deepest being brown ooze at a depth of 4,529 fathoms close north of Puerto Rico.

Captain R.F. Scott in **DISCOVERY** spent two winters in the Antarctic. On his way south from New Zealand to the Ross sea in 1902 he took some deep soundings and again, after leaving New Zealand in June 1904

on his way to the Magellan Strait and home, he took a number of deep soundings close to the 60°S. parallel of a roughly uniform depth of 2,000 fathoms. A deep sounding of 2,738 fathoms was found at 106°W. On the way to England **DISCOVERY** met **PRINCESSE ALICE**, Prince Albert's yacht, in the Azores in August 1904. One must assume that Captain Scott passed his sounding data to the Prince who ensured that they appeared on GEBCO 1905.

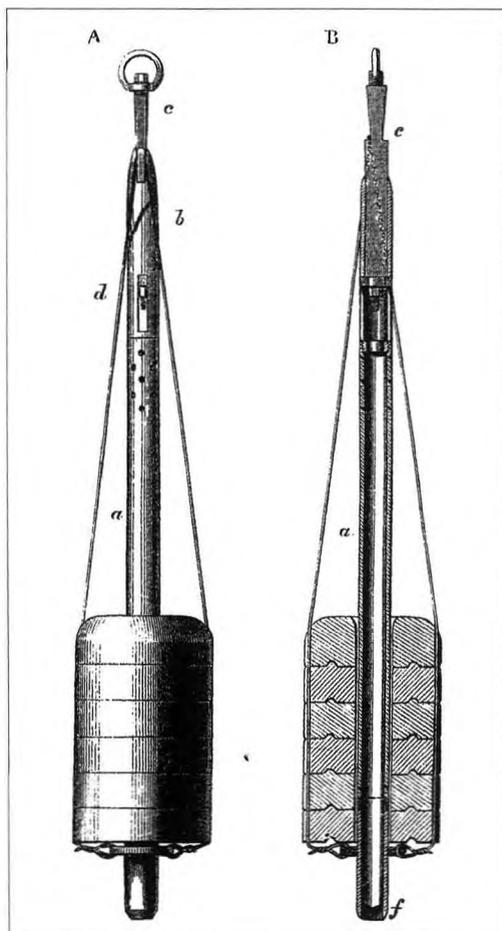
During the Scottish National Antarctic Expedition of 1902-04 William Bruce in his ship **SCOTIA** took a number of deep soundings with the Lucas machine in the Weddell Sea, and between the South Orkney islands and the Falklands. He also disproved James Clark Ross' 1840 soundings of 'no bottom' at 4,600 fathoms by finding a sounding of 2,660 fathoms two miles north of Ross' position in 68°32'S. 12°49'W.

### The Situation at the End of 19th C.

At the end of the 19th century deep sea sounding in the oceans was proceeding apace. Naval surveying vessels, a few research vessels and cable company ships were all busy. The crews would have been using either the Lucas, or modified Thomson, wire sounding machines. As for bottom sampling apparatus the Americans were employing refashioned Brooke sounders, and the British either Hydra or Baillie sounders; both the latter used ring weights to drive the sounding tube into the sediment before being released to remain on the ocean floor.

It was a further twenty years before the first experimental echo sounding machines came on the scene.

Sir John Murray, who had sailed as Sir Wyville Thomson's chief assistant on the Challenger Expedition and had completed the editing of the fifty volumes of the Challenger Reports in 1895, served as President of the Geographical Section of the British Association Meeting at Ipswich in 1899. As President of his Section it was not surprising that during his address he reviewed the current worldwide situation as regards ocean soundings – 'The soundings over the water-surface of the globe have accumulated at a rapid rate during the past fifty years. In the shallow water, where it is necessary to know the depth for purposes of navigation, the soundings may now be spoken of as innumerable; the 100 fathom line surrounding the land can therefore often be drawn in with much exactness. Compared with the shallow-water region, the soundings in deep water beyond the 100 fathom line are much less numerous: each year, however, there are large additions to our knowledge. Within the last decade over ten thousand deep soundings have been taken by British ships alone. The deep soundings are scattered over the different ocean-basins in varying proportions, being now most numerous in the North Atlantic and the South-West Pacific, and in these two regions the contour-lines of depth may be drawn in with greater confidence than in other divisions of the great ocean basins'.



*The Baillie Sounder*

## **Biography**

Rear Admiral Ritchie was Hydrographer of the Navy (U.K.) from 1966-1971 and President of the International Hydrographic Bureau, Monaco, from 1972 to 1982. A New Edition of his book "The Admiralty Chart – British Naval Hydrography in the Nineteenth Century" was published in 1995, the Bicentenary Year of the British Hydrographic Office.

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