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***Editorial* - Looking back again**

International Congresses on the History of Oceanography, like that in Kaliningrad last month, lead to reflection.

A century ago, in 1903, several major expeditions were in progress or had just begun: the German South Polar Expedition (1901-1903) on *Gauss* under Erich von Drygalski, the British National Antarctic Expedition (1901-1904) on *Discovery* under Robert F. Scott, the Scottish National Antarctic Expedition (1902-1904) on *Scotia* under W.S. Bruce, J.B. Charcot's French Antarctic Expedition (1903-1905) on *Français*, and Roald Amundsen's assault on the North West Passage (1903-1906) in *Gjoa*. They were only examples of expeditions to many oceans, but mainly the South Atlantic, the Southern Ocean, the Indian Ocean, and the Pacific, that would completely revolutionize knowledge of the deep circulation of the oceans largely due to work in the Institut für Meereskunde in Berlin in the early 1920s.

During a period of three years beginning in 1906, the Norwegian physicist and applied mathematician V.F.K. Berknes was beginning a professional reorientation, moving from the theory of electricity to meteorology and oceanography. A few years earlier (in 1898) he had proposed a theorem useful in calculating the motions of real geophysical fluids (air and water) on the surface of the Earth. In 1903 his junior colleagues and former students Bjørn Helland-Hansen and Johan Sandström modified the theorem to allow the calculation of ocean currents using the relatively easily measured properties temperature and salinity. Their paper, *Ueber die Berechnung von Meeresströmungen*, translated into English in 1905 and widely noted, along with the appearance of Martin Knudsen's tables enabling interconversions of the properties of seawater, transformed the nature of physical oceanography and gave enormous impetus to its reorientation from a geographical field to a branch of geophysics. And the precise measurement of temperature at sea, a *sine qua non* for the new methods, was promoted by the first use of Richter reversing thermometers on the Norwegian research vessel *Michael Sars* in 1903.

1903 saw the meeting of a committee to supervise the production of the first General Bathymetric Chart of the Oceans, chaired by Albert 1er of Monaco, and the beginning of the process that led to the production of the first GEBCO in 1905. Present at that first meeting in Wiesbaden in April was the French mineralogist Julien Thoulet, the most vigorous exponent of French oceanography for decades, who, in addition to his work on and for the GEBCO committee, suggested in 1903 that various bivariate plots could be used to characterize water types - thus proposing the use of what came to be known as T-S plots thirteen years before they were proposed independently by Bjørn Helland-Hansen. Helland-Hansen himself, along with the Norwegian fisheries biologist Johan Hjort, became involved in 1903 in the first International Course in marine science, in Bergen, intended to provide a strong scientific background in all aspects of oceanography to the scientific assistants involved in the regular survey work being done by the nations involved in the newly-founded International Council for the Exploration of the Sea. Others attended them too, including senior academics from several European countries. The courses, which lasted until the beginning of the First World War, were immensely influential in spreading quantitative approaches to the sea, and in establishing the marine sciences as acceptable professional specialties.

In Germany in 1903, Karl Brandt was working on his theory of the control of the spring plankton bloom by bacteria of the nitrogen cycle, proposed first in 1899 before the University of Kiel in his famous lecture *Ueber den Stoffwechsel im Meere*. His junior associate, Rudolf Feitel, showed that there were denitrifying bacteria, essential components of Brandt's theory, in the coastal waters of the Baltic and North Seas. Farther afield, Hans Gazert, physician on Drygalski's *Gauss*, reported that he had been unable to find significant numbers of denitrifying bacteria and no evidence of denitrification in the Southern Ocean, a result similar to that of the Norwegian biologist H.H. Gran in coastal waters of Norway at the same time. In the Mediterranean, the Kiel biologist Hans Lohmann demonstrated that seemingly poor waters were actually much mo re productive than had been suspected; his very fine gauze and paper filters showed that there was a significant population of very small cells, later called nanoplankton, results that led directly to his pioneering calculation of the production of the nanoplankton in Kiel waters in 1908.

A world away in 1903, the University of Washington biologist Trevor Kincaid proposed that the university locate a new marine biological station in Friday Harbor, on the San Juan Islands (it opened in 1904), establishing the site occupied to this day. And in San Diego, at the invitation of the local physician Fred Baker, the Berkeley zoologist William E. Ritter spent his first summer of marine biological study in that city, using the boathouse of the El Coronado Hotel. From that grew the Laboratory of the Marine Biological Association of San Diego, the Scripps Institution for Biological Research, and eventually the Scripps Institution of Oceanography, which in 2003 has a full year of centenary celebrations underway, well advertised at http://scripps100.ucsd.edu. And so we move from 1903 to 2003!

Eric Mills

RÉMI CHAZALLON - A FORGOTTEN "INGÉNIEUR HYDROGRAPHE"

Last year, in January 2002, occurred unheralded the bicentenary of the birth of Antoine-Marie Rémi Chazallon

(1802-1872), a worthy French expert on tides. In the history of tidal science, Chazallon was overshadowed by his British contemporaries, Airy, Lubbock and Whewell, while the practical methods of analysis introduced by him were later superseded by William Thomson's (later Lord Kelvin) harmonic theory. However, for many years Chazallon was the only person to develop and improve the methods of analysis initiated by the great mathematician, Pierre Simon Laplace.

Born in the small market town of Désaignes (in the Ardèche) - where he later died - Rémi Chazallon received a first class education in the mathematical sciences at the famous *Ecole polytechnique* of Paris. On graduation, he entered the *Service hydrographique de la Marine* in 1824 as "ingénieur hydrographe," which he made his sole career.[i] The "ingénieurs hydrographes" were given responsible assignments then, as now, but they did not necessarily have the liberty to pursue individual scientific research as academics did, unless closely related to the subject of duty. However,
Chazallon's principal assignment was to improve tidal data and predictions for all the major ports of France, including on the Mediterranean; this necessitated a good deal of organisation, ingenuity and research.

Before the mid-nineteenth century, all tidal data were restricted to records of the times and heights of High and Low Waters. Chazallon saw that much more could be learned from a time-series of sea levels at intermediate times, as would be given by an autonomous recorder. Through the support and influence of Academician François Arago, Chazallon obtained funds to design his own tide recorders and had them installed at the principal ports, starting with Brest, where Laplace had initiated a famous series of visual tidal readings.[ii] With the aid of his new instruments, he pioneered a form of harmonic analysis based on a set of 32 equally spaced ordinates per lunar day, and discovered that the tide profiles were greatly improved by the addition of harmonics at 1/4, 1/6,and 1/8 of a lunar day as well as those at 1, 1/2 and 1/3 formulated by Laplace. This discovery pre-dated by at least two years the discovery of a "quarto-diurnal" tide by G.B. Airy on the east coast of Ireland, and by 26 years the introduction of "overtides" by Thomson (Kelvin) in his rigorous harmonic tide analysis.[iii]

Another innovation by Chazallon was to extract the solar tide from the lunar tide for individual analysis. This he did by the simple procedure of averaging sea levels at the same solar hour over a span of 59 days (nearly two complete lunations). He applied this surprisingly effective method to study sea levels from Brest, and from Akaroa Bay, New Zealand, where the solar tide is usually attenuated.[iv] He noted incidentally that the record from Akaroa did not support Whewell's hypothesis (now known to be false) of the Southern Ocean being the source of all tides.

Chazallon amply fulfilled his national obligation by creating in 1839 a series of annual booklets, the *Annuaires des marées*, said to be the first of their kind in the world. They included the best available tide tables for all French ports, many produced by his new methods of analysis,, together with a discourse on the behaviour of tides and tidal currents in general and how they might be assessed in other parts of the ocean. A port of special interest was Le Havre, whose refurbishment in 1853-1856 was under Chazallon's direction. Contrary to the advice of leading hydraulic engineers, Chazallon correctly insisted the the long stand of High Water at Le Havre had nothing to do with the mouth of the River Seine, but was an effect propagated along the English Channel in the open sea and therefore was independent of the shape of the estuary.

Chazallon retired from the *Service hydrographique* in 1860, and lived for further 12 years in his native Ardèche. In 1869 he was honoured by election as *Membre correspondent de l'Académie des sciences* in the general area of geography and navigation. In 1871 he was made *Officier de la Légion d'honneur*. His published works are hard to find now. Apart from his many entries in the *Annuaire des marées* from 1839 to 1861 and his monograph on spectral

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[i] 1.For general accounts of the *Service hydrographique de la Marine*, see "150 ans d'Annales hydrographiques, 1848-1998 in *Annales hydrographiques* (5e série) 22 (769) (1998), especially papers by Bourguin, pp. 35-90, and by le Gouic, pp. 179-212. Comolet-Tirman, pp. 113-131, lists all the "ingénieurs hydrographes" with dates and recounts some of their careers, but makes only brief mention of Chazallon.

[ii] 2. (Author anonymous), "Observations des marées dans le port de Brest, 1807-1835." *Bureau des longitudes,* Paris, 1843 (the contents were almost certainly prepared and written by Chazallon).

[iii] 3. Chazallon, R. 1852. "Détermination des diverses ondes dont l'ensemble constitue la marée." *Annales hydrographiques* 7: 163-176 and 315-338. (It is stated in the text that the first part of this paper was presented to the Institut on 7 March 1842). Airy's remarks are in the *Comptes rendus de l'Académie des sciences*, 19: 562 (1844).

[iv] 4. *Comptes rendus de l'Académie des sciences,* 20: 1780-1782 (1848) and 38: 1149-1153 (1854).

analysis cited in Note (3), most of his research results are summarised in his occasional reports to the *Académie des sciences.*[v] These publications were listed eventually in the International Association of Physical Oceanography *Bibliography on Tides* (Publ. Sci. no. 15, 1955), except that IAPO consistently misrepresented Chazallon's first initial as "B" instead of "R."

Some four years after Rémi Chazallon's death in 1872, a later "ingénieur hydrographe," Gabriel Héraud (1839-1914), wrote that "... it is only proper to cite after these famous names [Newton, Bernoulli, Laplace, Airy] that of the learned 'ingénieur' who was for 30 years almost the only French representative of the science of tides, and the promoter of tidal studies along our coasts - Chazallon."[vi] **William Saville-Kent** (1845-1908) was employed at

[v] 5. *Comptes rendus de l'Académie des sciences* 14, 15 (1842); 18, 19 (1844); 20 (1848); 38, 39 (1854); 42 (1856).

[vi] 6. G. Héraud, 1877. "Onde diurne des marées." Paris, *Congrès international des Science géographiques* 1: 111-115.

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MARINE SCIENTISTS IN THE NEW *OXFORD DICTIONARY OF NATIONAL BIOGRAPHY*

A great reference work, the British Dictionary of National Biography, *known to all simply as "*the DNB*" is about to be replaced. The* DNB*'s 63 volumes were published between 1885 and 1900 (with later supplements bringing coverage into our own times) under the editorship of Leslie Stephen (the father of Virginia Woolf and Vanessa Bell). Its aim was to provide biographical information on Britons "from the earliest times to 1900" and it has served just that function for generations of historians, including historians of the marine sciences, who have gone to its pages for thoroughly-researched biographical essays on many of the founders of marine biology and oceanography in the United Kingdom. Here, Anita McConnell, one of the new project's editors, describes some of the contents of the* DNB*'s successor (one can hardly say "replacement" of such a seminal and invaluable work), the* Oxford Dictionary of National Biography, *due to be published next year [Editor]*

The *Oxford Dictionary of National Biography,* due for publication in 2004, has some 50,000 articles, ranging in length from a few hundred to 37,000 words. As some of these articles deal with families or business partnerships, around 60,000 persons are described. The 35,000 *Old DNB* articles have been revised or rewritten, often at far greater length; the new subjects include a generous proportion of men and women overlooked in previous times, notably scientists and craftsmen. These brief notes are but a sample of the new articles relating to marine physics, chemistry and biology, and the invention and manufacture of instruments and apparatus for this purpose. The complete dictionary, which will be available on line by subscription or in 60 volumes, includes sources and, in some instances, portraits

Robert Ball (1802-1857), Irish naturalist, was in *Old DNB* but is included here because the previous article failed to mention his invention of the naturalists' dredge which bears his name. We have now added details on his sisters, Anne Elizabeth Ball (1808-1872) who was a successful algologist, and her sister Mary Ball (1812-1898), collector of shells and other marine invertebrates.

Charles William Baillie (1844-1899) was a Royal Navy navigating officer and inventor of the Baillie sounder which managed to plumb the great depths of the Pacific and for which he later received a reward of 30 guineas (£31.10s). From 1873 to 1879 he taught at the Imperial Naval College in Hokei, Japan. On return to England he worked in the marine department of the Meteorological Council, collecting and charting ocean sea temperatures and currents, as sent in by ship's captains.

Edith Berkeley (1875-1963) spent her childhood abroad then studied science in University College, London where she developed an interest in marine zoology. She spent her early married life in India before she and her husband moved to British Columbia where she was employed in the University. They then moved to the Pacific Biological Station at Nanaimo, on Vancouver Island, where Edith was able to make use of her expertise with the Polychaeta, a class of marine worms. She was the leading author on the thirty-four joint papers written with her husband, describing the new genera, species and varieties which they established.

John Young Buchanan FRS (1844-1925), son of a prosperous Glasgow merchant, studied in Scotland, France and Germany before returning to Edinburgh where he was recruited as chemist on HMS *Challenger*, 1872-76. He continued working on problems in oceanography and related sciences, teaching briefly at Cambridge and going on

London's British Museum when in 1870 he received a Royal Society grant to survey for sponges and coral off the Portuguese coast, a task which inspired him to study living marine fauna. He subsequently held posts in aquaria around the English coast, but his ambition to found a marine laboratory failed and in 1884 he took an appointment as superintendent of fisheries in Tasmania. During his twenty years in Australia, Saville-Kent occupied s

I am grateful to Jacqueline Carpine-Lancre for much advice on French sources of literature on this subject.

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scientific cruises with Prince Albert of Monaco and with submarine cable companies. He was an active member of various societies and worked closely with Prince Albert in Monaco. But in 1914, depressed by the onset of war, he went to North America. His final years as a recluse in London may account for his omission from *Old DNB*.

Louis Pascal Casella (1812-97) was the first of his line to manufacture scientific instruments; he initially specialised in glasswork: his registering and deep sea thermometers were taken on many expeditions. His son Charles Frederick (1852-1916) had a good technical education in Britain, France and Germany but lacked business ability. Trade declined until the business recruited competent management in 1910, after which it recovered. The elder son, Louis Marino (1842-1923), worked with his father until the old man's death, when he moved to another engineering company.

Henry Charnock (1920-97) trained as a chemist and came into marine meteorology during the war. He then joined the National Institute of Oceanography, where he took part in John Swallow's pioneering measurement of deep ocean currents, before spending three years at NATO's marine unit at La Spezia, Italy. In 1996 he was appointed professor of physical oceanography at Southampton University. He was recalled to NIO as director in 1971, an administrative post he did not really enjoy. In 1978 he took the opportunity to return to his chair at Southampton. Charnock was largely responsible for overhauling the state of marine technology in Britain; he was elected FRS in 1976 and was president of the Royal Meteorological Society in 1982-4.

George Herbert Fowler (1861-1940) studied zoology at Oxford and obtained his PhD for research on coral. He then taught zoology, with a brief interlude at the Plymouth Laboratory of the Marine Biological Association. His interest in plankton led him to design a self-closing plankton net which he tested on cruises in the survey ship *Research* in 1896-97 and 1900. With R. Norris Wolfenden he founded the Challenger Society, whose centenary is being celebrated this year, and he edited its influential *Science of the Sea* (1912). Retiring to Bedfordshire, he devoted much of his time to local history.

Thomas Wemyss Fulton (formerly Wemyss Alexander Thomas Fulton) (1855-1929) was a fisheries authority and oceans law publicist. Born at Edinburgh, he studied natural history under Wyville Thomson, and after travelling to India, served on the Challenger Commission under Sir John Murray. He joined the Fishery Board for Scotland in 1888 as superintendent of scientific investigations, a post he held for thirty-four years, during which time he supervised the tagging of many thousands of fish. He is best known today for his book of legal and historical value, *The Sovereignty of the Sea*.

Sir Richard John Harrison (1920-1999), made a successful career as professor of anatomy. His parallel interest, which followed from his early interest in natural history, was in comparative mammalian reproduction, and especially in the biology of marine mammals, on which he published widely.

Thomas John Hart (1907-1970) grew up in a family with natural history and maritime interests; he studied zoology and immediately after graduating joined the *Discovery* investigations. He spent many seasons in the southern oceans, continuing Sir Alister Hardy's work on phytoplankton and using the newly developed technique of colorimetric estimation of chlorophyll as a measure of total phytoplankton. In 1949 he moved with the *Discovery* investigations to the National Institute of Oceanography, where he remained until his death.