Article

Three Hydrographic Quantum Leaps

By Steve Ritchie

This paper was planned for presentation at the Femme Conference in Dublin in 2005 but was not due to the ill health of the author.

These days providers of hydrographic instrumentation reveal new systems year by year; since side scan, AUVs (Automated Unmanned Vehicles) and GPS (Global Positioning System) came onto the scene in a period of continuing innovation. It has not always been so. In the past we can discern three major breakthroughs separated by periods of inventive tranquillity.

In the 18th Century the sea north of Scotland provided the access for European shipping to the Atlantic. But across this passage lay the uncharted Orkney Islands with their off lying reefs and raging tidal streams.

In 1740 a major disaster had highlighted these dangers when the Swedish East Indiaman *Svecia*, homeward bound from Bombay and heavily laden, was wrecked on reefs off the northern Orkneys, with a loss of sixty lives.

James Douglas, Laird of the Orkneys, was entitled to a major share of any shipwrecks on his shores, nevertheless he approached Professor Colin Maclaurin of Edinburgh University to recommend someone who would chart the islands and the surrounding waters. Maclaurin suggested a former student of his, an Orkney man named Murdoch Mackenzie as suitable to undertake a 'geometrical survey'. The Professor had been telling his students about the triangulation of France being carried out by Jacques Cassini.

So Mackenzie began his survey by measuring a baseline on a frozen loch from which he extended a triangulation network to include fixed marks placed along the coastlines.

Using these marks he was able to fix boats anchored in close vicinity of hidden reefs by observing horizontal sextant angles referenced to these shore marks. When taking soundings from a boat only the magnetic compass was available for taking bearings of the marks.

After the charts were published in the handsome atlas 'Orcades' Murdock Mackenzie wrote an early hydrographic manual entitled 'A Treatise on Maritim Surveying' wherein he describes how an instrument could be devised for plotting a vessel's position using two horizontal sextant angles taken simultaneously onboard between three fixed marks, which might, he wrote, be termed a 'station pointer'.

In 1774 Murdoch Mackenzie's nephew of the same name, together with his cousin Graeme Spence, were surveying for the Admiralty a newly found channel into the Thames Estuary. Recalling the suggestion in Mackenzie's Treatise, they constructed a prototype station pointer; the abundance of their well placed soundings on their survey provided evidence of its effectiveness.

The Admiralty was impressed and ordered a number of such instruments to be made to Graeme Spence's design from the London Instrument Maker Edward Troughton.

The station pointer was widely accepted and remained in use by sea surveyors of many nationalities for about 150 years.

Shortly before World War I patents for finding the depth of water were obtained by scientists of Germany, France and the United States; but underwater acoustics were only used during the war in attempts to locate submarines and obstructions such as mines.

After the war the three countries mentioned, together with the UK and Italy all turned their attention to the development of depth sounding equipment.

Various sound sources were adopted by the different inventors – an explosive cartridge, an electric oscillator or blows on the hull of a vessel.

Nearly all the systems had their successes during the post war decade, but only slowly did the manufacturer's machines come into general use by surveyors.

The author became involved in 1936 when serving as an Acting 4th Class Assistant Surveyor, referred to as the lowest form of hydrographic life, he was aboard the ancient coal-burning ship *Herald* at work in the South China Sea.

For everyday coastal ship sounding the ship was fitted with the British Admiralty Pattern echo sounding machine made by Henry Hughes and Son of London. This machine resulted from the work of a scientist named A.B. Brown who had been working during World War I for the British Admiralty to find a sonic method of detecting submarines. When peace came he turned his attention to devising a depth echo-sounding machine.

A sonic signal was created three times per second by the striking of an electrically controlled hammer within the transmitter welded on one side of the ship's hull. The returning echoes from the seabed were accepted by the receiver on the other side of the keel whence they were transferred to a timing switch which controlled a measuring wheel graduated to reveal the depth of water.

The operator, wearing earphones, sat beside the apparatus on the bridge rotating the measuring wheel to and fro until he heard the loudest signal when he called out the depth.

When depths were rapidly shoaling it was possible for the operator to miss a vital sounding. So when operating in less than eleven fathoms the prudent Captain would order the Somerville sounding gear to be brought into action.

By means of a steam winch on the quarterdeck the sounding lead was hauled forward to the outer end of a boom, rigged out abreast the bridge, for each cast. The leadsman was situated in the chains near the winch from where he gently 'felt' the depth on the marked leadline as it passed vertically past him; a trailing counterweight kept the leadline nicely taut throughout the operation.

This veritable cat's cradle was remarkably efficient; invented by Captain Somerville, a surveying officer shortly before World War I.

For deep water sounding, which was always carried out on passage, another Hughes creation was used, their super sonic sounder which relied upon much louder bangs on the ships hull and was expected to display the soundings by means of a stylus marking them on a moving roll of sensitised paper.

This machine imposed upon the Officer of the Watch at night a veritable ordeal for the Captain's Night Order Book stated that if the echo trace was lost he was to be called.

As the wavy line of soundings came and went amid a plethora of other noises being received it was difficult to know when to call the Captain. On his

arrival on the bridge inevitably the fading trace would reappear.

However by 1939 the echo sounding breakthrough was complete with ships of every nation using echo sounding machines. With the onset of war many scientists turned their attention to discovering radar and asdic.

During the planning of the invasion of NW Europe in 1944 it was clear that there would be major minesweeping commitment along the intended routes across the English Channel and onto the beaches. Much of this would be out of sight of land and beset with strong tidal streams so that a completely new type of ship location would be required.

It was indeed fortunate therefore that there were two Americans in Britain who could solve this difficulty. W.J. O'Brien had been working on a system for locating aircraft using hyperbolic position lines generated by low frequency continuous wave transmissions from two or more fixed stations. He was joined in London by Harvey Schwartz who was working there as Chief Engineer of the Decca Record Company.

The Admiralty were greatly interested in developing O'Brien's system which was given the code name 'QM'. Secret trials were carried out off North Wales and in the Moray Firth.

For the D Day operations a master and two slave stations were established and co-ordinated in positions which would give coverage by hyperbolic lattices over the vital invasion area.

QM was activated for the minesweepers on 5 June, the eve of the invasion. O'Brien and Schwartz who had a decometer in their London flat noted that the pointers which had been meandering suddenly took up stable readings. So these two civilian scientists were the first unbriefed civilians to realise that the invasion was imminent.

The author was the First Lieutenant of HM survey ship *Scott* anchored in the Solent awaiting D Day when two secretive officials were admitted onboard to place a decometer on the bridge and connect it by a simple aerial to the lower yard and to explain its uses to the Captain and Navigator.

Their first task on D day morning was to lay small navigation light buoys along the centre of the swept channels leading towards the invasion beaches. As the ship entered the Bay of Seine the Navigator called the author from the forecastle, from where he had been laying the buoys, to the bridge. He showed him how he was using two pairs of numbers read from the decometer to fix his position by the intersection of red and green hyperbolic lattice lines overprinted in his top secret chart. To the author that morning this was pure magic. The 6 June 1944 can be considered the birthday of electronic methods of ship fixing – and bringing in the third quantum leap.

Two range Decca, lane identification, and many more advanced systems were in the ascendancy for fifty years until GPS took over.

To conclude, the author has a story to show how the oldest hydrographic survey tool was used together with the newest one to accomplish a vital survey.

A surveying officer onboard *HMS Chatham*, assisting with the aftermath of the tsunami in Sri Lanka, used a leadline and a hand-held GPS to chart a safe channel for sending relief supplies into a devastated harbour.

Biography of the Author

Rear Admiral Steve Ritchie was educated at Dartmouth Royal Naval College in England, going to sea as a midshipman in 1932. Five years later he joined the Surveying Branch of the Royal Navy in which he served for 35 years. He commanded four H.M. Survey Ships and served as Hydrographer of the Navy from 1966-71. Thereafter he was elected President of the Directing Committee of the International Hydrographic Burea in 1972 and in 1977 for five year terms of office. He now lives in the family house in N.E. Scotland where he writes on hydrographic history.

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