Paper 14

Tools of Surveying and Mapping in the National Historical Collection

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ABSTRACT

This paper will provide an overview of the surveying and mapping collections within the National Historical Collection, the collection cared for by the National Museum of Australia. These number about 800 individual instruments and systems and relate primarily to the work of the Bureau of Mineral Resources, its predecessors and its successors. The collections also include instruments and systems from the Australian Survey Office, the Australian Centre for Remote Sensing and from a private surveying group. They include instruments used in a number of important exploration and mapping tasks including the work of the Imperial Geophysical Experimental Survey in 1929-30, the search for oil in south-western Queensland, Australia's pioneering work in Antarctica, the storing of Landsat images, the topographical mapping of Australia and the monitoring on underground nuclear explosions. The holdings of the National Historical Collection will be compared to those of other Australian institutions as well as selected overseas institutions.

BIOGRAPHICAL NOTE

Denis Shephard is a curator in the Australian Society and Culture section of the National Museum of Australia, where he has been involved in a wide-range of collection documentation and exhibition development projects. He has a particular interest in the technology of surveying and mapping and has been responsible for developing this part of the National Historical Collection. This interest has grown out of his 25 years experience as a survey- and engineering-draftsman during which he worked for the Victorian and Australian governments, in local government and in the mining industry.

Tools of Surveying and Mapping in the National Historical Collection

Introduction

In this paper I will quickly outline the history of the National Museum of Australia and the development of the National Historical Collection. I will then look at the place of mapping in the activities of the National Museum of Australia.

The primary focus of my paper, however, will be on the surveying and mapping equipment in the National Historical Collection.

This relates primarily to the activities of the Australian Survey Office, the Bureau of Mineral Resources and its successors and to the Australian Centre for Remote Sensing. There is also an important collection relating to the work of a government surveyor in the Goulburn district of New South Wales in the late-19th century.

The National Museum of Australia

The need for a national museum in Australia was debated from the time of Federation in 1901. It was not until a wide-ranging Government inquiry conducted by Peter Pigott, however, that the possibility of one became a reality.

The National Museum of Australia was established with bipartisan political support in 1980. It is a Commonwealth statutory authority that is currently part of the portfolio of the Department of Communications, Information Technology and the Arts.

The Museum's responsibility, as set out in the *National Museum of Australia Act 1980* is '*to develop and maintain a national collection of historical material*' that records Australia's history and culture; and, to provide access to that collection through exhibitions and other means.

It was several years, however, before a permanent exhibition space was built for the museum, on Acton Peninsula, in March 2001.

Maps and mapping activities are found in a number of places in the permanent exhibition spaces, including

i) a satellite image is used to illustrate one of the stories in the *Tangled Destinies* module illustrating;

ii) a chart of the Darling River in *Conquering Distance* module illustrating the impact of paddle steamers on Australia's socio-economic development;

iii) the 'Big Map' audio-visual installation featuring stories about Australian exploring, mapping and the environment;

iv) land, hydrographic and geophysical surveying equipment illustrating stories about the mapping and exploration of Australia, at the base of the Big Map; and,

v) the Garden of Australian Dreams is a landscape feature based on a standard topographic map of Australia and Horton's Aboriginal language map overlain with a number of three-dimensional features.

But, it is the National Museum's collecting activities that I will focus on today.

National Historical Collection

As stated earlier, the National Museum's primary task is '*to develop and maintain a national collection of historical material*'.

Collection development began with the transfer of the existing Commonwealth Government Historical Collection from the Department of Home Affairs in July 1981. The principal items in this collection were horse-drawn and motorised vehicles and several objects associated with well-known Australians. The most significant object was probably the Bean 14 motor vehicle driven from England to Australia by Francis Birtles in 1928-29 and presented to the Australian Government by the Bean Motor Company in 1929.

In the early 1980s the priority was to develop the collection as quickly as possible through donation, purchase and transfer. In 1985, for example, the Museum assumed responsibility for the Institute of Anatomy collection of biological specimens and anthropological material. In the mid-1980s a more systematic approach was taken with the adoption of an integrated collections development policy that was guided by the broad intellectual framework of

i) Australian society and its history since 1788;

ii) the interaction of people with the Australian environment; and,

iii) Aboriginal and Torres Strait Islander culture and histories.

As a consequence of all this collecting activity the National Museum now has a collection of about 200,000 artefacts, including

- an Australian Broadcasting Commission outside broadcast van
- one of the largest collections of Freemasonry regalia in an Australian public collection
- convict clothing
- 80,000 stone tools
- Australia's largest collection of bark paintings
- toys used by Aboriginal children
- cricketing memorabilia
- steam-powered equipment
- protest material from both the peace and the green movements

Most importantly, however, in today's context, there is an important and growing collection of surveying and mapping artefacts. These include

i) the Merrett Collection, comprising a wrought iron survey marker that was one of 11 made to mark the southern limits of the subdivision of Victorian Mallee country in 1884-87, by surveyor Tom Turner. As it was not needed to mark this line Turner placed it on the western boundary of the subdivision which was the boundary line between Victoria and South Australia where it remained until replaced a few years back.

ii) the Australian Centre for Remote Sensing Collection, comprising a Thorn EMI magnetic tape data recording system [1970s-2005] and a CREO Model 1003 optical tape recording system [c1988-2202] both of which were used to store the mass of remotely sensed images gathered by the Landsat satellite system from the 1970s to 2005;

iv) the CSIRO Marine Research Collection, comprising two expendable bathythermographs of the type that were used to record and map ocean temperatures from 1984 to 2002;

v) the Faithfull Family Collection of surveying and drafting equipment;

vi) the Department of Defence Collection of marine chronometers;

vii) the Bureau of Mineral Resources Collection of geophysical surveying equipment; and,

viii) the Australian Survey Office Collection of surveying and plan printing equipment.

It is the last four that I will now discuss in a little more detail.

Faithfull Family Collection

The Faithfull Family Collection comprises about 1550 artefacts from *Springfield*, a wool-growing property south of Goulburn. *Springfield* was established by William Pitt Faithfull in the late-1820s. It has remained in the family since then with the current owner, Jim Maple-Brown, being William Pitt Faithfull's great-grand-son.

The collection includes colonial era costume, a bushranger medal, a late-19th century landau, firearms and edged weapons, wool samples, Joseph Foveaux's pocket watch and bible, two protractors, a brass scale rule and a circumferentor.

The circumferentor is of the style patented by Angelo Tornaghi in 1863. Tornaghi (1831-1906) was born in Milan, Italy, and, having learned the trade of clock and instrument making whilst working for Negretti and Zambra in London, arrived in Sydney as a representative of that firm before going into business as a clock-maker and instrument-maker on his own account in the early-1860s.

Circumferentors were less expensive, more robust and easier to use than theodolites in rough country. The line of sight, for example, did not need to be as well cleared. The 1855 Commission of Inquiry into the New South Wales Survey Department made various recommendations aimed at improving surveying practices in the colony, including the gradual elimination of the circumferentor or compass by the theodolite, as an instrument for the survey of boundary lines. As late as 1886, however, the Survey Regulations still allowed circumferentors to be used in certain circumstances.

This circumferentor was used by surveyor Edgar Reginald Deane, one of two surveyors in the Faithfull family.

Edgar Reginald Deane was born in Devonshire on 3 September 1835, a son of lawyer Robert Deane. He arrived in New South Wales in early 1838, with his grandmother Ann and her three children Robert, Ann and Mary. He probably moved to *Springfield* following his aunt Mary's marriage to William Pitt Faithfull in January 1844.

Edgar Deane was appointed a licensed surveyor in New South Wales on 22 September 1859 making him eligible to perform contract surveys for the Lands

Department. He was licensed a surveyor under the provisions of the Real Property Act on 3 December 1863. From 1885 these licenses were renewed annually with Deane's last renewal being 1 January 1892. In December 1885 he was appointed a member of the Goulburn Land Board serving until at least 1890 when he was granted four months leave of absence whilst travelling overseas to England.

His field survey books and plans held at the National Library of Australia cover the period 1864 to 1879.

Many refer to use of a circumferentor as the instrument used for the survey work.

Edgar was also actively involved in horse racing and trotting. He was author of *Introduction to an Australian Trotting Register*, which was published in 1897. He appears to have settled in England with his cousin Constance Faithfull (1857-1938) in the mid-1890s.

Edgar Reginald Deane died at Torquay, England, on 4 October 1912.

Department of Defence Collection

The Department of Defence Collection comprises 24 marine chronometers that were transferred to the National Museum in 1981. They had all been used on Royal Navy and Royal Australian Navy vessels. At the moment I do not know which Royal Australian Navy vessels they were carried on but, when the records I have requested from the National Archives become available, hopefully I will find out. I do know, however, that at least three were carried on vessels engaged on hydrographical surveying work along the Australian coast.

Dent 2-day marine chronometer 1604 was assembled by EJ Dent sometime about 1853/54. It was purchased by the Admiralty from Captain Hopes in February 1863 and was carried on at least six Royal Navy vessels before being transferred to the Australian Government in August 1921.

The chronometer was issued to HMS *Dart* on 27 June 1882 and returned to the Royal Observatory Greenwich seven years later. We might assume that it was carried on *Dart* for most, or at least some, of this time.

The eighth Royal Navy vessel bearing the name *Dart* was a two-gun screw-driven vessel launched as *Cruiser* at Barrow in 1882 for the Colonial Office. She was purchased by the Admiralty in March 1882 and re-named *Dart*. Originally intended as the official yacht of the Commander-in-Chief of the Australia Station she was ultimately fitted out as a survey vessel.

Dart arrived in Sydney late in 1882. She commenced survey work the following year, with HMS *Alert* and HMS *Lark*, and remained exclusively on hydrographic survey work in Australian and adjacent waters until 1903. *Dart* worked around the Great Barrier Reef, Papua New Guinea, the Solomon Islands, the New Hebrides, Tasmania and New Zealand.

Dart was lent to the New South Wales Government in 1904 for training purposes before being sold out of service at Sydney for £1010 in 1912.

Loseby 2-Day marine chronometer 109 was built by Edward Thomas Loseby of 44 Gerard Street, Islington, in London, sometime around 1843, rated at the Royal Observatory Greenwich in 1846 and purchased by the Admiralty in December 1846.

It was carried on at least five Royal navy vessels before being transferred to the Australian Government in August 1921.

The chronometer was issued to HMS *Geranium* on 4 March 1916, shortly after she was launched at Greenock in the United Kingdom. *Geranium* arrived in Australian waters in 1919 and, after clearing a minefield off Point Hicks was presented to the Australian Navy. On 1 July 1920 she was recommissioned for survey work Lieutenant Commander Vaughan-Lewis commencing work in the Napier Broome Bay area of Western Australia later that year. Over the following years *Geranium* worked in the waters of northern Australia, off the Queensland and Western Australia coasts and around Tasmania. Her last survey was at Melville Island in 1927.

It seems likely that the Loseby chronometer remained on *Geranium* for several years as it was transferred to the Australian Government whilst the vessel was still engaged on survey work. The question remains, however, did it remain on the vessel after its recommissioning in July 1920?

HMAS *Geranium* was paid off in Sydney on 10 November 1927 and, after years in reserve, was handed to Cockatoo Island Dockyard for dismantling in June 1932. The hulk was sunk off Port Jackson on 24 April 1935.

Gardner 2-day marine chronometer 5/3947 was made by R Gardner of 20 Lloyd Square in London and rated at the Royal Observatory, Greenwich, in 1895/96 before being purchased by the Admiralty in 1896 at a cost of £38. It is known to have been carried on at least four Royal Navy vessels before being transferred to the Australian Government in August 1921.

HMS *Sealark* was commissioned as a survey vessel in 1904 and arrived at Sydney in September 1907 where she replaced HMS *Dart* as the survey vessel in Australian waters. Over the next 11 years *Sealark* was used in hydrographic survey work along the Great Barrier Reef, in the Coral Sea and around the Solomon Islands.

Gardner marine chronometer 5/3947 was issued to HMS *Sealark* on 13 January 1909 and returned to Royal Observatory, Greenwich, from Sydney, on 10 July 1911. Surveys carried out in this period included work around Guadalcanal and in the Torres Strait.

HMS *Sealark* was sold out of service in September 1919.

Bureau of Mineral Resources Collection

The Bureau of Mineral Resources Collection is one of the largest and, to my mind at least, one of the most important collections in the National Historical Collection.

The Bureau of Mineral Resources, Geology and Geophysics was established within the Department of Supply and Shipping in 1946. Its principal task was to develop an integrated and comprehensive scientific understanding of the geology of the Australian continent, the Australian offshore area and the Australian Antarctic Territory. Until about 1980 it also functioned as a Bureau of Mines to monitor the performance of the mineral and petroleum industries. In 1992 the Bureau underwent a major functional restructure and its name was changed to the Australian Geological Survey Organisation. A further major operational restructure occurred in 2001 when the new name of Geoscience Australia was adopted.

The collection includes geophysical survey equipment which had been used until made obsolete by technical advance, plus a range of other miscellaneous 'out of service' items. The former had been collected by Bureau of Mineral Resources staff concerned that historically significant but superseded equipment was being lost through the normal stores write-off process. The primary organiser was Max Allen who collected material for a proposed earth sciences museum from the 1950s until his retirement in 1983.

In May 1977 Dr Peter Sydenham from the University of New England examined part of the collection describing it as '*the most extensive assembly of historic geophysical apparatus in Australia*'. He went on to argue that this '*significant part of Australia's technological heritage*…(should) *be made more available to the public, for it presents a significant amount of national activity in the more modern era of the earth sciences*'

Scientific prospecting techniques utilise the principles of physics, mathematics, geology and chemistry. They include electrical and electromagnetic methods, which measure either natural or artificially created electrical and/or electromagnetic fields to derive either the resistivity or the conductivity of the sub-surface. These methods are represented in the collection by several instruments including this resistivity meter that is currently on display in the recently installed 'Rocks to Riches' Module in the Nation Gallery.

Magnetic methods measure variations in the Earth's magnetic field caused by changes in the sub-surface geologic structure or by differences in the magnetic properties of near surface rocks. They have much in common with gravity methods although they are generally more complex because of the more erratic and localised nature of the magnetic field. The magnetic surveying instruments in the collection, including this Askania earth inductor and Watts variometer, illustrate the evolution of magnetic survey instruments from mechanical balances to electronic instruments.

Gravity methods involve measuring variations in the Earth's gravitational field caused by changes in the sub-surface geologic structure. They are used primarily as a reconnaissance tool in the search for oil. This method is represented in the collection by several instruments including this gradiometer that is also on display in 'Rocks to Riches'.

It is one of three that were built by Oertling of England in 1928 for use by the Imperial Geophysical Experimental Survey. This survey was a joint project between Australia and Britain to experiment with geophysical field prospecting methods from 1928 to 1929. At least two of the gradiometers were tested in the search for oil in East Gippsland and gold at Gulgong. This is the only one of the three to survive.

Radiometric methods make use of instruments that count electrical impulses generated by the discrete nuclear process. This method was first used in the late 1930s for stratigraphic correlation in oil well logging then, in the late 1940s, in the search for uranium deposits. Survey is by hand-held ratemeter, airborne detector or by well logging.

The Bureau of Mineral Resources was heavily committed to the search for uranium in the 1950s and purchased a range of equipment from Australia, the United Kingdom, Holland, Canada and the United States of America.

The wide variety of radiometric surveying instruments in the collection reflect the boom in uranium exploration in the post-WWII period and include these Phillips, Jordan and Ericcson instruments.

The Bureau of Mineral Resources Collection also includes seismic equipment, laboratory equipment and observatory equipment, including this Sun 2 computer system. Popularly known as ‘Annie’, it was installed in the Bureau of Mineral Resources’ seismological centre in Canberra in 1984 where it played a key role in the Bureau’s nuclear explosion monitoring program until being decommissioned in 2002. ‘Annie’s’ role was to retrieve and analyse data from the Alice Springs seismic array, which was jointly run with the United States of America Air Force.

Six of the 34 chronometers on the books of the Bureau of Mineral Resources in 1986 also form part of the collection. They include

i) Brockbank and Atkins chronometer 1437, dating about 1850-55, that was purchased in 1948 for use on Macquarie Island; and,

ii) Parkinson and Frodsham chronometer 1208, dating about 1823, that was purchased in 1957.

Finally we come to the Australian Survey Office Collection.

Australian Survey Office Collection

The Australian Survey Office collection comprises 43 objects that were transferred to the National Museum on two occasions.

Nine items of surveying, calculating and plan-printing equipment were transferred to the National Museum in 1980. A further 34 items of miscellaneous land surveying equipment – theodolites, steel bands, electronic distance measuring equipment - and associated documentary material was added to the National Historical Collection in 2003.

As a whole the collection represents some of the activities of the Australian Survey Office from the 1940s to the 1980s. Survey equipment associated specifically with the work of the Australian Survey Office in the Australian Capital Territory is held by the Canberra Museum and Gallery.

Of particular interest and importance in the collection are the geodimeter, the tellurometers and the Kullberg chronometer.

This Model 4B Geodimeter was purchased in January 1964. Unfortunately, at this time, we do not know anything about its use. It is, however, a very good representative example of the type of electronic measuring instrument used in land surveying from the late-1950s.

Geodimeters utilise light waves to measure distance. The instrument sends out flashes of light from a transmitter to a reflector from where it is returned to a receiver built into the instrument. A reading is made which depends on the time taken by the light flash to cover the journey.

The geodimeter was invented by geodesist Dr Erik Bergstrand of the Geographic Survey Office of Sweden and then developed and manufactured by the AGA Company of Sweden. The first laboratory model was constructed in 1947 with the first commercial model appearing in 1953. The first geodimeter received in Australia arrived in May 1954. It was field tested, by authorised surveyor CK Waller of the Photogrammetric Survey Section of the National Mapping Office, at Doncaster and on the Mt Akinson-Green Hill first order triangulation, both just outside Melbourne.

Following a further 18-months of field testing in New South Wales, Victoria, South Australia and Queensland, he concluded that '*the Geodimeter is definitely a surveyor's instrument of outstanding accuracy and consistency, and not just a laboratory curiosity*.'

The first three models were large bulky pieces of equipment. The fourth model, however, was lighter, more compact and reasonably portable. The Survey Branch of the Department of Interior took delivery of a Model 4 geodimeter in April 1959. The Model 4B, produced from 1960 to 1964, was similar to the Model 4 but with improved daylight performance.

The Australian Survey Office Collection includes four tellurometers. Again, we know little about the specific use of these instruments.

The first successful electronic distance measuring instrument utilising microwaves was invented by Colonel Harry A Baumann of the South African Trigonometrical Survey, developed by Trevor Lloyd Wadley of the Telecommunications Research Laboratory of the South African Council for Scientific and Industrial Research, and manufactured by Tellurometer Pty. Ltd. in Cape Town. The Tellurometer was designed to produce geodetic accuracy over geodetic distances, but it was also useful for second order work, especially in areas where the terrain was rough and/or the temperatures extreme. The original tellurometer was known as the Micro-Distancer MRA 1.

The Division of National Mapping in the Department of National Mapping acquired one of the first tellurometers manufactured. It arrived in Canberra during the last week of April 1957 and immediately underwent trials on the Mount Ainslie-Mount Stromlo line in the Australian Capital Territory. Further tests were carried out in Queensland and Victoria with the results proving more than satisfactory.

Like the original Tellurometer Micro-Distancer, the CA1000 is a microwave EDM. Advertised as early as March 1972, the CA 1000 was said to be 'the smallest, lightest, most flexible and widest performance EDM equipment yet produced.' It was also said to have been 'designed by surveyors for surveyors'.

The Tellurometer company became a part of the British electronics firm Plessy Group, in about 1967.

The Australian Survey Office Collection also includes one chronometer. Kullberg marine chronometer1332 was assembled by Victor Kullberg, sometime about 1867. Kullberg has been described as '*one of the most brilliant and successful horologists of the 19th century*'. He won many awards with his chronometers including medals at Besançon, Greenwich, Sydney, Paris, Le Havre, Philadelphia and London.

Unfortunately, at this point in time, we know nothing of this particular chronometer's history either in its use as a marine chronometer or of its use in the Australian Survey Office. Nevertheless, it is an important example of Kullberg's work and is one of the 31 chronometers in the National Historical Collection, the largest collection of chronometers in any Australian public collecting institution.

CONCLUSION

In today's paper I have given a sampling of the surveying and mapping collections cared for by the National Museum of Australia.

I have attempted to illustrate the diversity of the equipment and to give some idea of its importance both technologically and historically.

I believe it is an important collection but that it needs further development to make it a truly great collection reflecting the full range of the work of surveyors, geophysicist, hydrographers, scientists, navigators, draftsmen and cartographers over time. I am committed to achieving this.