Report on the Imaging of Historic Sea-Ice Data for the Southern Ocean and Antarctica

Clive Wilkinson and Catharine Bailey

Introduction

Imaging of ships' logbooks and sea ice reports was undertaken during February and March 2013, at the British Antarctic Survey (BAS) and the Scott Polar Research Institute (SPRI), Cambridge and the National Archives (TNA), Kew, London. At the first two archives 21,000 images were produced using a Canon G12 camera affixed to a stand and using a remote device to activate the shutter. Most images were taken at a $1/30^{th}$ sec. shutter speed, using either professional studio lamps or desk top reading lamps to illuminate the documents. At the National Archives 5470 images were taken (10, 940 pages) using a Nikon D90 affixed to a stand. Studio lamps are not provided in the designated photography areas but ceiling lighting was deemed adequate. There were a variety of different sized foam supports to ensure that documents are not damaged by handling.

Document Handling and Image Quality

The number and quality of images produced is entirely dependent on two factors. The first is the availability of the material to be photographed and the time needed to deliver to the point of imaging. This will vary from archive to archive. At both BAS and SPRI, material was readily available with no delay in production. At TNA the ordering system allows a researcher to order up to 6 records in advance of their visit and then a maximum of 3 documents at any one time thereafter. Waiting times from ordering to receipt of documents can and often takes more than 40 minutes. To maximise on the number of logbooks consulted during the day, as soon as 3 documents arrived another 3 were ordered immediately.

The second factor is the handling of the documents, which is dependant on the format, binding and age of the documents themselves. Although care is taken with all historic documents irrespective of age, as a general rule, the older the document the more time is required to set up each image. Relatively recent typewritten reports and modern logbooks often of a uniform size and format require minimum handling and can be imaged quickly, up to 1K to 1.2K images per day. Older documents, many of them bound, require more time to set up using weights to flatten pages and additional care in turning pages. Under these circumstances, 500 to 900 images per day can be produced.

The binding and format of the documents can affect the quality of the image. Closely bound sets of documents cannot be fully opened or flattened and as a consequence, the writing at the inside edge of the pages can be partially or completely obscured when photographed. Little can be done in this circumstance except by examination of the original document if the image is not sufficient. During the imaging project, this problem arose very infrequently. The format of the document determined how the image was taken. When at all possible, one image per page is desirable except under the following circumstances. In the case of older logbooks the minimum

of handling is necessary to preserve the integrity of what can be a fragile document. Therefore, in these instances, imaging a double page instead of turning and adjusting an entire bound volume for each image not only reduces handling but also saves time. Furthermore, some logbooks contain data for one entire day on facing pages, and it is better to have the entire day available as one view rather than two images for the same day. One consequence of this however is that in the case of very large format documents, with facing pages on the same image, the quality of the image at the very edges can deteriorate. This is entirely due to the nature of the camera lens, even using lenses of high quality. The sharpness of the image can also be affected by the writing on the page, in particular when the writing is very faint or unclear or where logs have been written in pencil. There are instances of these problems in the image set produced by this project, for example, a number of the logbooks at TNA have been written in pencil but where writing is a little fuzzy, the writing is legible but not as clear and sharp as some of the other images.

British Antarctic Survey

Logbooks

At the British Antarctic Survey (BAS), 130 logbooks were imaged. These were for all vessels operated by BAS and the earlier Falkland Islands Dependencies Survey (FIDS), namely the *John Biscoe* 1949-1970, *Kista Dan* (chartered) 1959-1965, the *Perla Dan* (chartered) 1966-1970, *Shackleton* 1955-1969, *Bransfield* 1970-1980 and the *John Biscoe 2* 1970-1980. The logbook AD5/7/JB2/2.04 (*John Biscoe* 2) was not imaged as this was found to be a duplicate of 2.03. The entire set of logs for each vessel and each season were imaged, even if it was clear from the nature of the vessel's movements that no ice observations would be found in the log. It was considered that it was best to image the entire log and the entire voyage rather than selectively image parts of the logbook or voyage. All of the logbooks contained pressure and temperature data, sea state, wind force and direction and weather. Sea temperatures were also present except in the earlier logbooks. Vessels commonly departed Southampton in October or November, and stopped at Montevideo before arriving at Port Stanley in the Falkland Islands in November or December. One notable exception to this was the *Bransfield* which in several seasons steamed to Maryport in Florida before steaming south to Montevideo. In the 1977-78 season, *Bransfield*, made a transit of the Panama Canal after departing Maryport, stopping at Valparaiso, then transiting the western part of the Magellan Strait before steaming to the Antarctic Peninsular. The vessels usually made several trips to the South Orkney and South Shetland Islands and to the western side of the Antarctic Peninsular as far south as Marguerite Bay either from Port Stanley or from Grytviken in South Georgia. The logbooks of the *Kista Dan* and *Perla Dan* include voyages to Halley Base. Vessels completed their season by March or April returning to Southampton via Montevideo by May or June.

The logbook images themselves are one image per day. The logbooks are either in book form with one page per day or, by the 1970s, individual log sheets bound on the left-hand side. The only exceptions are the logs of the *Kista Dan* and *Perla Dan*. These logbooks are pre-printed as the others but the column headings are in Danish, with the entries completed in English.

55

År 1963 Måned January

Skibets sted (ved middag) Southern Ocean

Kl.	Styret kurs devierende	Deviation °	Misvisning °	Afdrift	Sejlet kurs retvisende	Logvisning	Dist.	Vind Vindstyrke Sø	Vejr Barometer Termometer	Maskinen Kl.
Saturday den 26 13	Sailed in pack-ice conc. 8-10/10							of main course 180°		
14	"		"		" "	"	"	"		
15	"		"		" "	"	"	N 8	overcast	
25/16	Stopped		"					3 - ice	720 +3°	
17	"									
25 18	Sailed in close pack-ice conc. 9-10/10							main course	160°	
19	"	"		"	" conc. 6-9/10			" ENE	" overcast	
20	"	"		"	"		"	3 - ice	720°-0°	
21	"	" pack ice conc 5-8/10				main course 155°				
22	"	"		"	"	"		"		
30/23	"	"		"	"	"		N 8	overcast	
24	Stopped							3 - ice	720-+1°	
Sunday den 27 1	"									
2	"							0 S 8	Snow squalls	
4/3	Sailed in close pack-ice conc. 7-8/10					main course			175° overcast	
4	"	"	"	"	"	"	"	4 - ice	721 +1°	
5	"	"		"	"	"	"	"		
6	"	"	"	"	"	8-9/10	"	⊖	Snow squalls	
7	Sailed in pack-ice conc 5/10						"	"	150° overcast	
8	"	"	"	"	"	"	"			
9	Sailed in pack-ice conc 2-5/10						"	5 - ice	723 +1°	
10	"	"	"	"	"		"	"	160°	
11	"	"	"	"	"		"	"		
12	"	"	"	"	"		"	" ⊖	overcast	
							"	4 - ice	725 +1°	

Middagsplads:

I henhold til bestik fra Primus morn ..... 67 ° 14 ' brd. S

I henhold til observationer anstillet kl. ..... 09 ° 7 ' lgd. W

Terrestriske observa- ° ' brd.

° ' lgd.

AD5/7/KD/4 – *Kista Dan*, 26/27 January 1963, at 67°14'S, 09°07'W

In many cases the logbook has been adapted and the data recorded does not match the column headings. It is very clear however, what is being recorded, and this will present no difficulty. It should be noted however that the printed format of the logbooks of both these vessels adopt the convention of the 'nautical day', beginning and ending at noon. The nautical day is 12 hours ahead of the civil day.

The conversion to the civil day is made in the log itself by having two dates on the page, as can be seen in the example above. The upper half of the page begins at 13.00 hours and ends at midnight on the 26th January. The bottom half of the page is the period from 1am to noon on the 27th January. The time and date is clear but it should be noted that the file naming convention adopted for each image from these logs uses the second of the two dates. This convention was used to preserve the noon position with the correct day and filename. This means that data for the afternoon and evening of the 27th January will be found on the image dated 1963_01_28.

Voyage and Ice Reports from Vessels

In addition to the logbooks, an ice report (AD6/2/1963/J) from the *John Biscoe* during the 1963-64 season was imaged. Similarly a dedicated journal of ice observations, kept by the officers of the watch of HMS *Protector* during the 1960-61 season, was imaged. This journal (AD6/2/1960/J) has sub-daily observations of all types of ice including negative ice-free observations.

Several additional items connected with the vessels were imaged in order to determine if the remainder would be worthy of imaging for ice observations at some future date. These consisted mainly of ice reports from ships and voyage reports from the commanding officers. It was considered that a broad report on ice conditions experienced during a season might assist in placing the daily reports within a wider context. In one particular case, this proved to be a worthwhile exercise. The document AD3/1/AS/179/1/6/A(1) contains a 'Report on ice conditions season 1958-1959' from the *John Biscoe*. The case contained other documents not imaged as this was a speculative exercise. The ice report described severe conditions with the *John Biscoe* beset in the ice. The vessel was assisted by the USCG icebreaker *Northwind,* and there was a radio dialogue between the two vessels describing the conditions experienced by each, while still at some distance from each other. This sort of information will not ordinarily be found in the logbook, making reports such as these of value. Voyage reports submitted by the commanding officer of the *John Biscoe* [AD3/1/AS/179/1/6/2(1)], for the periods 1968, 1967, Apr. 1966, Jan 1966, 1965, 1964, 1963, were imaged to determine if these reports were able to add additional context and information to the observations in the logbooks. If this should prove to be the case it is recommended that all the voyage reports corresponding to the imaged logbooks be photographed at some future date. In addition to the above, a 'Report of Proceedings' of the *John Biscoe* 1948 (AD8/1/27) was imaged as there was no logbook archived for this voyage.

Ice Reports from Bases

Sea ice reports (including some ice charts) from Deception Island 1944-1966 and Signy Island 1950-1978 were imaged on this occasion, as these bases had been omitted in previous imaging

initiatives. The station at Deception Island was abandoned after severe volcanic activity after 1966. The reports vary considerably in length and quality varying from half a page of no real value, monthly summaries with ice charts and through to very detailed daily though not continuous sea ice observations. An example of one of the best reports is that made from Signy Island in 1951. This begins with a summary of past ice conditions 1946-1950, including date of sea open to navigation, date of arrival of pack, first ice in Shallow Bay, first ice in Borge Bay, periods of fast ice joining Signy to Coronation Island, and the date of final break up of fast ice. Following this are daily but not continuous ice reports from 16 May to the 6 of December, followed by additional ice reports from nearby locations 8 December 1951 to 2 February 1952 with an additional report for the period 4 to 30 March 1951. Other reports contain remarks and notes made by the observer concerning other phenomena. The Signy Island ice report for 1961 (AD6/2H/1961/J) contains general remarks on the wind patterns experienced during the passage of depressions both to the north and south of Signy Island. The corresponding report for 1963 (AD6/2H/1963/J), has remarks on the taking of sea temperatures and the problems with different types of thermometers and buckets. The report for 1965 (AD6/2H/1965/J) notes a temperature difference of 0.3C in sea temperatures between Factory Cove and the Normanna Strait. The report from Signy island for 1976 (AD6/2H/1976/J) includes three photographs of sea ice taken from elevated positions on land.

Scott Polar Research Institute

At the Scott Polar Research Institute, 76 logbooks and 1 ice chart were imaged. Many of the logbooks are meteorological logs on permanent loan to the Institute from the Met Office and placed in the Institute's archive in 1961. The vessels and logbooks are summarized below.

Type of Logbook	**Vessel**	**No. of Logs**	**Dates**
Deck Log	Penola	5	1934-1937
Meteorological Log	Penola	2	1936-1937
Deck Log	Terra Nova	2	1910-1913
Rough Log	Terra Nova	8	1910-1913
Chief Officer's Log	Fitzroy	5	1944-1947
Meteorological Log	HMS Rattlesnake	1	1850
Meteorological Log	HMS Terror	6	1839-1840
Meteorological Log	HMS Terror	28	1841-1843
Meteorological Log	HMS Erebus	10	1839-1843
Log of Proceedings	HMS Erebus	2	1841-1843
Meteorological Log	Quest	3	1921-1922
Skibsdagbog	Magga Dan	1	1956-1957

Type of Logbook	Vessel	No. of Logs	Dates
Dekksdagbok	Theron	1	1955-1956
Chief Officer's Log	Endurance	1	1914
Deck Log	Nimrod	1	1907-1908

Whereas the BAS logbooks are of just two consistent patterns and formats, the logbooks held at SPRI vary considerably and are therefore described individually below. Firstly however, from the above table there appear to be duplicate logbooks imaged. This is not the case. With regard to the *Terra Nova*, for instance, the eight rough logs were presented first for imaging, followed by the two fair copy logbooks. It was considered that the keying of the data in the fair logbook would be much easier, even though the former rough logs had already been imaged. Furthermore, the fair copy log may have omitted ice observations made in the rough logs or summarized the observations in some way. This has not been determined for certain, yet it seems best that all material connected to a voyage that is likely to contain observations should be imaged.

HMS *Terror* and HMS *Erebus*

This determination was carried forward in the imaging of the logbooks of the James Clark Ross Expedition to the Antarctic on the *Erebus* and *Terror* 1839-1843. The first six sets of meteorological logbooks of HMS *Terror* were kept by Captain Francis Crozier, and the following 28 (monthly) meteorological logbooks, were kept by Pownall Potter, the ship's sailing master or navigation officer. The logbooks and the observations were made and recorded independently, and it is likely that ice observations in particular will differ in detail in the sense that they will contribute additional information or clarify observations rather than present contradictory data. This assertion has not been tested, but is expected.

Similarly, the meteorological logbooks of the *Erebus* were imaged. Both the *Terror* and the *Erebus* were in company throughout the expedition, but again the observations were taken and recorded independently and in this instance from different vessels. Most of the *Erebus* logs contain no noon positions but these can be taken from either the logs of the *Terror* or the ADM/55 logs at the National Archives (see below). In the case of the *Erebus*, not all of the logbooks were imaged due to constraints of time and it was decided to depart from best practice, which is to image complete logs or sets of logs, and confine imaging only to those logbooks where the dates and known movements of the vessel made it certain that sea ice observations would be present.

The logbooks of both vessels are remarkable for recording hourly meteorological observations throughout the period of the expedition, even when the vessels were anchored for the winter season near Hobart, Tasmania and in the Auckland Islands. The hourly meteorological observations consist of air temperature, barometric pressure, attached thermometer and corrected pressure. The first of the logbooks of the *Terror*, MS/547/1/SL, contains notes, comments and pressure corrections made by the Met office in July 1871. Other data noted at frequent times were wind force and direction, hygrometer observations, precipitation and

weather. Oceanographic observations consist of hourly sea temperatures (continued while at anchor), and less frequently, sea state or swell, and specific gravity of seawater. Sub-surface sea temperatures were taken, and this fact along with the depth is recorded in the log, but the actual temperature measurements are not present in the logbook itself. In addition there are almost daily observations of magnetic variation, and magnetic dip, daily sightings of birds and sea mammals, observations of meteorites and aurora – and of course many detailed observations of sea ice.

Other Logbooks

The five logbooks of the *Fitzroy* 1944-1947 (MS/487/1-5) are identical in format and content to the earliest logbooks archived at the British Antarctic Survey. Unfortunately the first two logbooks contain no noon positions, but have been imaged in the hope that this information can be found elsewhere. The approximate position of any ice observations in these first two logs might be determined from the text where physical features such as islands or bases will be mentioned.

The logbook of HMS *Rattlesnake* 1850 (MS/540/SL), records 3-hourly (daytime only) meteorological observations and sea temperatures but apparently no ice observations that could be seen on a brief perusal of the logbook. The log commences at the position 40S, 201E, in the South Pacific in June and the vessel sails then to the Drake Passage and then the Falkland Islands.

The logbook of the *Penola* 1934-1937 (MS/71/SL-78SL) consist of five standard deck logbooks, pattern S322, with 4-hourly meteorological observations with 4-hourly sea and swell observations (Douglas Scale) with some sea temperatures and current observations, and ice observations. Two of the logbooks are Form 915, Air Ministry Met Office meteorological logs with a wider range of observations. MS/74/SL has a sighting of HMS *Ajax* on 18 January 1937, where a comparison of observations between the logs of the two vessels may be made. The log of the *Ajax* was imaged at Kew. The logs of the *Terra Nova* employ almost the same pattern (S321) as the *Penola* with much the same data recorded. The first three *Terra Nova* logs (MS/280/12/1/SL-3/SL) note the type and exposure of the instruments and the first log contains a running survey of the ice barrier.

The three logbooks of the *Quest* 1921-1922 (MS/609/1/SL-3/SL) are Form 131 meteorological logbooks with 4-hourly meteorological observations, sea state, sea temperature, with specific gravity of seawater at times. The first logbook in the set contains a Met Office form 104, form for testing logs, instrument metadata and the index error of barometer. At the end of the logbook is a three page ice report and six page current report with sea temperatures.

The logbooks of the *Magga Dan* and the *Theron* 1955-1957 (MS/1222/1/SL-2/SL are printed in Danish and completed in English and are similar to the logs of the *Kista Dan* and *Perla Dan* archived at BAS and illustrated above with the example page from the *Kista Dan.* The format is nautical day and the same file naming convention used for the BAS logs is adopted with these logbooks. The *Theron* recorded sub-daily positions usually in association with ice observations.

The logbook of the *Endurance* 1914-15 (MS/1439/SL) is a photocopy of the original which is too fragile to be produced. Some of the pages of the original are only partial yet on most pages a date, a position and observations can be seen consisting of 4-hourly meteorological observations, some sea temperatures and ice observations

The log of the *Nimrod* 1907-8 (MS/1592/SL) was one of the few imaged in this project apart from the *Terra Nova*, *Erebus* and *Terror* to visit the Ross Sea and McMurdo Sound. There are 4-hourly meteorological and sea surface temperatures with additional observations of magnetic variation.

Manuscripts not imaged

Several logbooks that could have been imaged were not produced, usually due to copyright issues or the need for permission from the owner. Many of the documents archived at SPRI are not owned by the Institute but are on permanent loan. The log of the *Tula* and the journal extracts are copies of documents at the Royal Geographical Society and the British Library, and permission to image these must be sought from those institutions. The extracts of Ross going through the ice pack 1841-2 (MS/366/14/11:ER) are owned by the Scott family and permission is required. Permission is also required for the logbooks of the *Aurora,* and the 'Observations of birds in the Southern Ocean … including ice and meteorological conditions' (MS/881/1-6:BJ). The latter set of manuscripts is an extraordinary set of documents with different sets data set out in a grid on individual pages.

The documents relating to the whalers operated by the Compañia Argentina de Pesca, proved disappointing. Of those examined, there were no positions recorded, and if ice data was present, the text was in Norwegian. Under these circumstances, it was thought best to designate the collection as low priority and move on. However each of the logbooks should be examined in more detail at some future date as the factory ships from which the whalers operated often cruised in the area east of the Weddell Sea where historical observations are particularly sparse.

National Archives

Logbooks

At TNA 131 logbooks were imaged. The earliest logs are for *HMS Chanticleer*, which began its voyage in 1827 arriving in South Shetland towards the end of 1828, and for the British Relief Expedition ship the *Morning* (1902-1903) and the *Terra Nova* (1903-1904). A few logs date from the 1930s and 1940s but the majority of logs date from 1950s and 1960s with the most recent being 1970 (HMS *Protector*).

A catalogue compiled by Clive Wilkinson of Royal Navy ships operating in Antarctic waters was used as the basis for identifying suitable logbooks for imaging. Whilst it was known that all of these ships had at some point during the voyage operated in the far Southern Ocean, detailed

shipping movements were not available for each individual logbook and so a systematic checking of all the logbooks in the catalogue was required.

The majority of the logbooks from the 1950s and 1960s follow a similar printed format. One logbook covers one month at sea and/or ports and contains data for one entire day on facing pages. For this reason it was considered better to have the entire day available as one view rather than two images for the same day. The logbooks are set out in the standard way with navigational (course, magnetic variation, latitude and longitude), meteorological (true wind direction and force, air pressure, dry bulb and wet bulb temperatures) and oceanographic observations (wave direction and height and sea surface temperatures) recorded on the left hand page and remarks on the right hand facing page.

The logbooks from the 1950s and 1960s are almost entirely written in pencil. The writing, whilst legible, is faint in places and thus the reader will need to zoom into the images to read the handwriting.

The earlier logs exhibit a range of formats. The log of HMS *Chanticleer* follows the 'nautical day' and whilst in port each page covers several days and contains only basic information such as 'AM fresh breezes and cloudy', PM Moderate and fair. This changes however to one page per day ,once at sea, and contains more frequent observations of the wind and weather, although there are no instrumental readings.

The logs of the *Morning* follow the 'civil day' and consist of 1 day per page. The log contains the usual positional data, wind and weather together with ice and 4 hourly air pressure and temperature observations.

The *Terra Nova* is similar in format to the *Morning* using the 'civil day' and contains positional data, wind and weather, ice and 4 hourly barometric and air temperatures.

Workflow and QA

At the National Archives, each logbook was consulted to determine the location of the ship. The main geographical focus was Antarctica or far South Atlantic waters but given the acknowledged usefulness of meteorological observations at sea for other regions, it was decided initially that once ships had entered the South Atlantic, the logbooks should be imaged. It soon became clear however, that due to the volume of logbooks needed to be checked, combined with the sometimes slow production of documents that it would not be possible to get through all the

logbooks in the time scale (25 days). Thus, priority had to be given to those logbooks which contained observations recorded in the far South Atlantic/Antarctic regions.

QA was undertaken at several stages during the scanning stage following the processes below.

Imaging the logbook:

- Checking all of the logbook was in view of the camera
- Spot checks to ensure camera was in focus
- Checks to ensure that pages were not photographed twice

Transferring images from camera to computer:

- The images were copied into the correct folder
- The number of images tallied with the number of logbook pages

Batch file renaming and cropping of images

- The correct images were renamed
- Where images were cropped that no part of the logbook was removed from view

Image files were batch renamed using a program called Irfanview following the file naming convention set out below:

The file naming conventions for naming folders and files are as follows:

- Folders: department _division _piece reference_name of vessel
- Image files: department _division _piece reference_image number

Each logbook has its own folder, for example ADM_53_127623_Bigbury Bay and contained within each folder are the individual images of the logbook pages named, for example: ADM_53_127623_001, ADM_53_127623_002 etc.

There were some instances where cropping of the images was required, either to remove excess borders around the logbook or to remove weights used to keep tightly bound documents as flat as possible without causing any damage.

Image specifications

In line with the National Archives advice on image specifications for digitisation projects (http://www.nationalarchives.gov.uk/documents/information-management/digitisation-image-specification.pdf), the logbooks were photographed at a resolution of 300dpi, 24 bit RGB colour as RAW files and subsequently saved in uncompressed Tiff format. Whilst these specifications are deemed suitable for long term preservation of digital records the files can be very large and slow to open, so with this is mind a complete set of jpegs was also created. These take up less memory space and are quicker to open and view.