

IMPORTANCE OF “HISTORIC SITES” ON HEARD ISLAND FOR PROTECTION OF SCIENTIFIC RESOURCES AND ENVIRONMENTAL MANAGEMENT OF A WORLD HERITAGE SITE

by Janet Hughes and Estelle Lazer

(with two tables and five plates)

HUGHES, J. & LAZER, E., 2000 (30:vi): Importance of “historic sites” on Heard Island for protection of scientific resources and environmental management of a World Heritage site. In Banks, M.R. & Brown, M.J. (Eds): *HEARD ISLAND PAPERS. Pap. Proc. R. Soc. Tasm.* 133(2): 71–77. ISSN 0080–4703. National Museum of Australia, GPO Box 1901, Canberra, ACT, Australia 2601 (JH) and Department of Archaeology, University of Sydney, NSW, Australia 2006 (EL).

Heard Island has important historic sites relating to the hunting of elephant seals and various scientific activities, which are noted in the World Heritage citation for the island. Some, especially sealing sites, are generally acknowledged to have historic value, but the value of later sites, such as the first ANARE base at Atlas Cove, is debated, due to its recent date, unattractive appearance, rapid deterioration and hazards to wildlife. The authors believe that Atlas Cove is significant to Australia’s Antarctic history, but this does not necessarily require that all elements of the site must be preserved *in situ*.

The potential historical value of this site is briefly reviewed; the value of comparative studies of historical, archaeological and materials conservation information on historic sites on other Subantarctic islands is also considered.

Documentation of these aspects of the sites is essential, certainly before any “clean up” is carried out at Atlas Cove since it will produce information to assist in environmental management and may benefit scientific research. Identification of the scientific artefacts and achievements should be an essential part of documentation of Subantarctic sites, but generally has not been given significant attention by archeologists. For development of a statement of significance for Atlas Cove, it is vital.

Key Words: historic site, sealing, ANARE, Atlas Cove, Spit Bay, scientific significance, historic significance, hazardous materials, archaeology, materials conservation.

INTRODUCTION

This paper aims to review the location, extent, characteristics and significance of historic sites on Heard Island and is based on fieldwork carried out by the authors during 1986–1987 (Lazer) and 1992 (Hughes). The purpose of the review is to examine values relating to historic buildings and associated artefacts in both the historic and scientific context and, through this, to develop significance criteria against which to consider the need for preservation of the sites. Preservation involves a consideration of materials conservation issues because of the severe, maritime conditions of Heard Island.



PLATE 1

The remains of the Admiralty Hut and adjoining ANARE Surgery at Atlas Cove (February 1992).

HISTORY OF HEARD ISLAND

Discovery and Early Exploitation of Heard Island

The date of discovery is still the subject of investigation (Allison & Keage 1986, Lazer & McGowan 1990: 9–11), since it is possible that the island was known before its recorded discovery in 1855 by Heard, an American sealer. Elephant sealing was conducted during the 19th and early 20th centuries at various sites on the island, with most activity at the Spit Bay end of the island. The sealers were predominantly American but also included significant numbers of Cape Verde Islanders (Starbuck 1878).

Early Scientific Expeditions

Scientific expeditions, such as that of HMAS *Challenger* (1872–76), the German *Arkona* (1874) and Drygalski’s *Gauss* expedition (1901–3), visited the island, usually in conjunction with oceanographic cruises (Headland 1989). The *Challenger* expedition conducted extensive oceanographic studies, including sampling the ocean floor around the island (Tizard *et al.* 1855). A microscope slide of sediment from the ocean floor in this region is displayed at the Australian National Maritime Museum in Sydney. The hexagonal “Admiralty Hut” (pl. 1) was built in 1926 by the crew of the *Kildalkey* and appears to have been used by a number of expeditioners, including Aubert de la Rue (Law & Burstall 1953: 5). The British, Australian and New Zealand Antarctic Research Expedition (BANZARE) stayed for approximately one week in the Admiralty Hut in 1929,

while carrying out a range of scientific observations (Fletcher 1984, Jacka & Jacka 1988).

These scientific visits had minimal enduring impacts, since few stayed long enough to establish buildings and they did not harvest large numbers of wildlife. Their descriptions, photographs and maps provide useful information for subsequent scientific study.

ANARE PERIOD

The Australian National Antarctic Research Expedition (ANARE) base at Atlas Cove in 1947 was the first one established by Australia during the "modern" era of Antarctic exploration. Heard Island was formally claimed at this site for the British Commonwealth. Following an "exchange of notes" between Great Britain and Australia in 1951, the sovereignty of Heard Island was transferred from Great Britain to the Australian Commonwealth (Law 1983: 44). Important scientific research was conducted during the ANARE occupation between 1947 and 1955 (pl. 2). This included geology, biology (seals, birds, parasites, insects and arachnids, fish, plankton and hydrology, botany, algae and marine fouling), meteorology and physics (cosmic rays, geomagnetism, seismology, aurorae), listed in Law & Burstall (1953).

Approximately 25 buildings were constructed at Atlas Cove to provide accommodation for expeditioners and for scientific activities (Law 1983); a full list of these is contained in Jongens (1983). The construction of the buildings reflects attempts to select materials and design features suitable for the cold climate and severe winds.

HUMAN IMPACTS OF EARLY OCCUPATIONS OF HEARD ISLAND

Introduction

Since protection of Heard Island's scientific and environmental values is a key objective for a World Heritage place, it is useful to consider the island's history in terms of past "human impacts" on the environment. This approach focuses attention on past human activities on the island to analyse their current significance, for example, depletion of wildlife by sealing and scientific activities. Wildlife exploitation had a major impact on all Subantarctic islands. Large numbers of elephant seals were killed during the 19th and early 20th centuries. It was common for whole beaches of seals to be slaughtered by sealing gangs (Fletcher 1984).

Evidence of past introductions of alien domestic species includes bones of dogs and sheep. These species were deliberately introduced to the island for various purposes (including dogs for transport and sheep for food) although fortunately none has survived. Johanson (1992) showed the high risk of introduction of alien species, especially plants, via human travel between neighbouring islands.

All of these have ongoing significance in the World Heritage context. Other past human impacts include abandoned buildings and equipment which present physical hazards. Oil, chemicals and toxic or hazardous materials are chemical contaminants which may persist in the environment. There are many rusty ANARE fuel drums at Atlas Cove (pl. 3), several of which were found to contain oil during the ANARE visit by Hughes (1992). Leakage



PLATE 2

The remains of the ANARE station at Atlas Cove (February 1992).

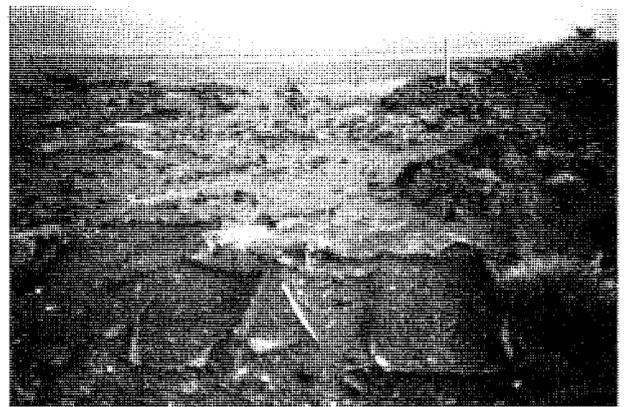


PLATE 3

Remnants of steel oil drums near the ANARE Surgery at Atlas Cove. These have been "cut off" above ground level by a combination of abrasion by scoria particles and corrosion, leaving jagged edges (February 1992).

was evident where some drums had stood. Other chemicals included anaesthetic ether (among numerous medical items in the old Surgery) and some fibrous lagging material which may contain asbestos. From their fieldwork on Heard Island, the authors have identified several types of potential scientific information which should be investigated before any "cleaning up" is attempted. Evidence of past human impacts may provide valuable information on the extent and content of buildings, the materials used and the location and context of any hazardous materials, for example, the possibility of asbestos and polychlorinated biphenyls used in electrical and heating equipment.

Given the rapid deterioration of the old station, the need for documentation of the buildings and past human impacts is urgent. Even after the site is "cleaned up", it is important to know the former location of buildings and artefacts to account for any subsequent effects, particularly where pollutants may affect the subject of scientific studies, such as the growth rate of vegetation.

Archaeologists are the appropriate professionals to undertake excavation and documentation of the old ANARE site. They frequently work in multidisciplinary teams and

even for such a recent site as Atlas Cove, their work has the potential to provide invaluable information which will benefit future research and environmental management of the island.

Other research which indicates the potential usefulness of the examination of historic artefacts includes the work of Downes (1989) in studying logbooks of the voyages to Heard Island and measuring oil barrel staves recovered there to calculate barrel volume and, hence, volume of seal oil harvested. This information can help to estimate the economic and environmental impact of past wildlife exploitation. Smith *et al.* (1989) presented a case for collaboration between various scientists and cultural heritage specialists to study driftwood on the island. Research by Lazer & McGowan (1990) allowed documentation of sealing information over the entire island, as well as information about the killing and processing of the elephant seals. Thus, archaeological study of Atlas Cove has the potential to provide further knowledge about the extent of impact of human activities and identify which impacts may be persistent, knowledge which will assist ongoing environmental monitoring.

Archaeological and Materials Conservation Research Required Before "Clean Up"

Archaeologists and conservators have complementary roles in working together on cultural heritage sites. The archaeologist studies the physical evidence of the site, analyses the evidence of historic activities which took place at the site and interprets its historical significance. The conservator uses this analysis to decide priorities for preservation of the artefacts (which may include whole buildings) and also identifies the appropriate conservation methods.

Archaeologists' activities may include bibliographic research, a photographic survey of sites, description of significant features and recording of any excavations. Measurement of significant features and their spatial arrangement is used to determine the extent of the site and provide a site map. The data is analysed to produce a statement of the significance of the site, and the archaeologist provides key input into development of a conservation management plan.

Conservators' activities may include photographic recording and description of the condition of significant features of the site(s), identification of mechanisms and measurement of rates of deterioration, and determination of priorities for conservation. Standard conservation techniques may be used, but the severe Subantarctic conditions of Heard Island may also necessitate development of new preservation treatments or removal of items to Australia for treatment, subject to appropriate approvals.

Stabilisation of artefacts and building materials or of objects exposed during excavation is important as deterioration generally increases upon exposure. A monitoring programme is produced for sites and artefacts to determine the longer term efficacy of conservation treatments and to identify the need for any further stabilisation. The conservator joins the archaeologist in providing input into the development of a conservation management plan.

Sources of Archaeological Information on Subantarctic Islands

All Subantarctic islands share the same historical pattern of exploration of the southern oceans leading to exploitation of the seal populations. Thus, cultural heritage studies of Subantarctic sites other than those on Heard Island are relevant, since they also contain evidence of sealing activities and early scientific bases comparable with those of Heard Island. Sites on other Southern Indian Ocean islands (Marion and Prince Edward Islands, Îles Kerguelen, Îles Crozet) are particularly relevant, because of elephant sealing activities by the same ships and often the same gangs as operated on Heard Island (Cooper & Avery 1986, Downes 1996). The ANARE base on Macquarie Island was established only a few months later than Atlas Cove, and useful comparisons may be made with building design, equipment and activities undertaken by occupants. Some Arctic island sites, such as Jan Mayen, Svalbard and Franz Josef Land, may be relevant to Heard Island in considering adaptation to isolated locations with severe climates. Some similar activities took place (scientific exploration, sealing, whaling), but most of the historic sites in the Arctic are of much earlier dates, with some sites on Svalbard dating from the 17th century.

TABLE 1
Archaeological publications on relevant Subantarctic sites

Location	Activity relevant to Heard Island	References
Heard Island	Sealing, exploration, shipwreck, ANARE base	Burton & Williams 1985, Robb 1987/88, Lazer & McGowan 1990, Downes 1996
Marion & Prince Edward Island	Sealing, 1940s scientific bases	Cooper & Avery 1986, Graham 1989
Îles Kerguelen & Îles Crozet	Sealing, exploration, shipwreck, whaling	Le Mouél 1994
Macquarie Island	Sealing, 1940s ANARE base	Davies 1982, Townrow 1988
Auckland/Campbell Island	Sealing, exploration, shipwreck	Judd 1992
South Georgia	Exploration, shipwreck, whaling	Basberg <i>et al.</i> 1996

Relevant studies of historic sites carried out on several Subantarctic islands include detailed site surveys and excavations, with those on Marion Island, Iles Kerguelen, Macquarie Island and South Georgia receiving the most detailed investigation. Sealing sites on Heard Island were studied by Burton and Williams in 1985 (Burton & Williams 1986) as a ground survey. Lazer and McGowan visited sites 1–35 (listed in Lazer & McGowan 1990) and excavated one sealing site at Oil Barrel Point (near Spit Bay). It was not possible to visit sites 36–46 near Atlas Cove. A few artefacts of particular interest were brought to Australia, including a unique blubber press, now held by the Queen Victoria Museum in Launceston.

Development of Significance Criteria for Abandoned Sites

Determination of significance criteria is a standard and essential requirement for assessment of any site of potential historic significance. They are derived from the historical context of the site. Warren (1989) proposed significance criteria for historic sites in Antarctica. The authors have adapted these, with slight variation, for abandoned Subantarctic sites:

- (1) an important event or activity took place at the site, or the site typifies a significant relevant period of activity;
- (2) a significant scientific discovery or innovation occurred;
- (3) a significant death or deaths occurred;
- (4) evidence of sovereignty is present;
- (5) there is material evidence of a unique lifestyle or response to the severe environment.

A brief and simplified example of how these criteria might be applied for Atlas Cove is given below, although detailed investigation may reveal additional information.

- (1) Atlas Cove was the site of the first ANARE station, which was a significant event in Australia's Antarctic and Subantarctic history.
- (2) Important cosmic ray studies, commenced on this site, improved knowledge of upper atmosphere physics and led to subsequent studies in Antarctica.
- (3) Two ANARE expeditioners lost their lives during the occupation of the ANARE base and they are commemorated by a small memorial.
- (4) The ANARE station is physical evidence of Australian sovereignty, by virtue of occupation during 1947–55 and scientific activities carried out on a regular basis since that time. The prior British occupation of the site is evidenced by the Admiralty Hut, later extended by ANARE.
- (5) The distinctive polygonal huts and other buildings were part of the trial of building materials and designs which was essential preparation for the founding of proposed "permanent" bases on the Antarctic continent (Scholes 1951). This is of interest in showing how Australians proposed to develop existing technology to cope with cold, remote conditions, which are largely unfamiliar in Australia.

Atlas Cove is often considered to be a site which is so recent that it cannot have historic significance, yet age alone is not a good indicator of cultural significance. The site has some potential cultural and scientific significance, although this does not necessarily require that all material comprising the site must be preserved: such an assessment should not be made until a framework for archaeological and conservation assessment has been developed and approved by relevant Australian government agencies.

Materials Conservation

While there are few sources of archaeological information for sites on Heard Island and other comparative Subantarctic islands, there are even fewer sources of conservation data or comparative research for any Subantarctic island. Observation by Hughes during a brief visit to both Atlas Cove and Spit Bay during 1992 produced some photographic records detailing condition of buildings and artefacts such as trytops (pl. 4) and oil barrels.

Deterioration processes affecting Heard Island sites

A number of factors are causing deterioration of the historic sites on Heard Island and these are particularly destructive when operating in combination. Wind has caused structural damage, particularly affecting the buildings at Atlas Cove. The low walls, which are all that remain of most of the sealing huts, do not present a large profile to the wind. Wind picks up abrasive particles that cause "corrosion" or erosion of surfaces. Water and high humidity result in frequent wetting and drying cycles, which promote swelling and cracking of wood. The maritime climate promotes corrosion, and temperatures are sufficiently high to allow biodeterioration. Salt deposition also causes "defibring" of timber, during which wood fibres separate from the surface of the timber, resulting in progressive reduction of structural strength.

Wallowing and rubbing by wildlife is evident in some buildings at Atlas Cove and also affects the remaining oil barrels at Oil Barrel Point. Humans have removed and relocated artefacts and buildings, particularly at Atlas Cove. While few tourists have been able to land on Heard Island, the impact of tourism is potentially significant, since the few tourists who have visited have strongly lobbied for the removal of the ANARE buildings, due to their adverse aesthetic impact. Coastal erosion is occurring rapidly, particularly along the southern and western coasts of Heard Island. The Oil Barrel Point historic site is useful for monitoring the progression of erosion of the beach (M. Mabin, James Cook University, pers. comm.).

The ANARE buildings have now severely deteriorated and fragments are being blown about the area, which is a significant breeding area for seabirds and much frequented by penguins and seals. Photographs taken during ANARE occupation in 1947–55, 1987 and 1992 show the

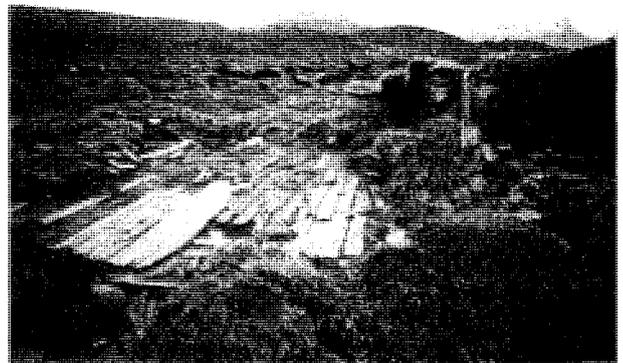


PLATE 4

A sealing site at Spit Bay with trytops in situ (February 1992).

progressive destruction of the buildings. These and additional photographic documentation by Thornton (1983), during an expedition to climb Big Ben, and by Hughes in 1992 are sufficiently detailed to allow the rate of deterioration of structures at Atlas Cove to be quantified.

Materials conservation data

Less information is available on conservation of historic sites in Subantarctic conditions than in Antarctica, where several studies on building and materials deterioration have been undertaken since the 1980s. A bibliography of relevant conservation research for both Antarctic and Subantarctic sites has been compiled by Hughes and awaits publication. Data on deterioration of materials relevant to conservation of Subantarctic sites include some corrosion-rate information and some field applications of timber preservatives applied to Stella Hut on Enderby Island in the Auckland Islands (J. Fry, pers. comm.). There are few effective, long-term preservative treatments suitable for wood in Subantarctic conditions.

Corrosion rate data

Hughes *et al.* (1996) carried out an extensive survey of corrosivity (standardised corrosion rate, measuring in microns the thickness of metal corroded per year) measurements in Antarctica and on some Subantarctic islands. This includes a methodology for the measurements using a standard low copper alloy steel (which has a corrosion rate similar to mild steel, a common building material). Data were obtained for six sites on Macquarie Island (King & Hughes 1993). Weighed metal plates of standardised size ("coupons") were sent and attached to Stevenson screens in the meteorological station at Marion Island, Signy (a British base in the South Orkney Islands) and a temporary meteorological screen at Spit Bay on Heard Island. A coupon was deployed at Atlas Cove but was lost, due to the building being torn apart by the wind.

According to the ISO Standard 9223 classification, the corrosivity of steel at Spit Bay is "very severe". The longer period of exposure of the coupon at Macquarie Island has been taken into account, and the higher corrosivity rate is probably due to a combination of high salt deposition and the erosion of the coupon surface by windborne particles. The rate measured at Spit Bay is sufficiently high to conclude that conventional corrosion protection, such as galvanising and protective coatings, would be ineffective. Corrosivity at Atlas Cove is expected to be higher than that at Spit Bay due to its more exposed location and severe weather.

TABLE 2
Corrosivity rates at Subantarctic islands

Site	Days exposed	Corrosivity (m/yr)
Heard Island (Spit Bay)	341	55.3
Macquarie Island (Isthmus [Weather Station])	721	222
Marion Island (Weather Station)	376	31.9
Signy (Weather Station)	365	36.4

Further Archaeological and Materials Conservation Research Requirements for Heard Island

The need for documentation of the scientific values of abandoned bases of Heard Island

Since Heard Island has both scientific and cultural values, managers of the island should consider whether there may, indeed, be overlaps or conflicts between these values, and whether a study of early human impacts may also produce useful scientific information. This will have implications for the "clean up" of Atlas Cove and for coordination of the scientific programme anticipated in 1999–2000. Identified research questions, which should be investigated, include

- What elements of an abandoned site, even if not of historic significance, may have scientific value(s)?
- How can this information be identified during the archaeological and conservation documentation of the site?
- How should the information be recorded, analysed and preserved for long-term benefit?

There are many elements of abandoned sites that may have scientific significance which should be recorded and investigated. The precise location, description and source of information which could be re-used for scientific purposes must be recorded, for example, locations of meteorological screens, survey marks, gravity and magnetic stations, and scientific instruments such as tide gauges. The location should be precisely recorded, relative to a survey mark, so that variation over time since the original scientific study can be determined. This approach is being used at Cape Denison and Macquarie Island, where the Australasian Antarctic Expedition (AAE) bench-marks are being used to determine possible change in sea-level relative to tide gauge readings made by the AAE (R. Summerson, Bureau of Rural Sciences, pers. comm.).

Soil stratigraphy revealed during excavations may assist in dating characteristics of past soil and vegetation disturbance, e.g. datable artefacts may be used to identify soil horizons. Vegetation growing on areas of past disturbance allows measurement of long-term plant growth rates.

Datable animal remains (such as seal oil and bones) can help in determining baseline environmental levels of natural substances and pollutants such as heavy metals, radioactive elements and pesticides. Retention of "historic fragments", such as lichen growth on stone comprising a sealing platform, can assist in dating processes. Features such as Oil Barrel Point (pl. 5) are useful in dating coastal erosion processes (M. Mabin, James Cook University, pers. comm.).

Documentation of "rubbish" potentially provides information on the extent and type of environmental pollutants. For example, knowledge of the building construction materials used may allow identification of possible hazards such as asbestos and polychlorinated biphenyls.

Success has been achieved in utilising scientific information at a variety of cultural sites in polar regions, especially Inuit human remains at Qilakitsoq in Greenland (Hansen *et al.* 1985), whaling sites on Svalbard (Hacquebord 1988) and, to a limited extent, at Cape Denison in Antarctica (Hughes & Lazer, pers. obs.). Most of these studies have considered analysis of material recovered from the site rather than anticipating sources of information which can be recorded and integrated into long-term scientific monitoring and recording in the field. There have been few opportunities thus far to develop these research

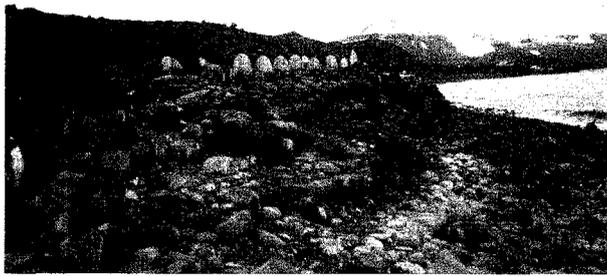


PLATE 5

Oil Barrel Point, Spit Bay, showing the weathered remains of seal oil barrels laid on their sides. The site is rapidly being eroded by the sea (February 1992).

opportunities and to integrate these studies into conservation management plans for historic sites.

The need for analysis of the sites

The comprehensive and accurate analysis of the potential scientific and historic resources of Heard Island sealing sites and at Atlas Cove require priority support. Such analysis requires

- appropriately trained cultural heritage professionals, preferably with a strong background in the history and philosophy of science relating to Subantarctic history and the experience and ability to work in a multidisciplinary team with scientists;
- adequate time to assemble past ANARE records for Atlas Cove;
- strong interaction with “clean up” teams (record process, location of test points, types of materials expected); and
- adequate assistance for GPS, aerial photography, surveying.

CONCLUSIONS AND RECOMMENDATIONS

- Archaeological and materials conservation data are valuable, and indeed essential, for the environmental management of this World Heritage island.
- Professional assessment of historic/scientific significance is important for all historic sites on the island including the first ANARE base at Atlas Cove (despite its recent age).
- Significance criteria for the site should be developed and agreed with the appropriate agencies.
- Scientific resources of abandoned human occupations should be investigated on all Subantarctic islands, including Heard Island.
- Removal to Australia of any artefacts revealed by archaeological investigation of sites should be carefully planned, since on site stabilisation is important to prevent damage. An appropriate institution should be sought to curate and preserve artefacts before their removal from the island.

ACKNOWLEDGEMENTS

George King and David O'Brien of CSIRO Division of Building Construction and Engineering were co-researchers with Ms Hughes in an ASAC-funded project on measurement of corrosion rates in Antarctic and Subantarctic regions. Steve Reeve, Dr Erwin Erb and Dr Ken Green of ANARE assisted with fieldwork and observations. Angie McGowan, archaeologist, has been a long-term colleague in archaeological research on Heard Island and helped generate many ideas in this paper. Dr Mike Pearson, formerly of the Australian Heritage Commission gave generous professional support and assisted in gaining ASAC support. Dr Simon Hayman, Department of Architectural and Design Science, provided advice on built structures and assisted in publishing reports.

REFERENCES

Access to information on Heard Island historic sites is, in many cases, difficult, since much is unpublished (such as reports or theses) or printed in journals of limited circulation. The references cited below cover all known, relevant information on historic sites; many (marked by an asterisk) are held at the Antarctic Division Library at Kingston, Tasmania. Copies of the other unpublished reports and theses are held by J. Hughes.

- ALLISON, I. & KEAGE, P., 1986: Recent changes in the glaciers at Heard Island. *Polar Rec.* 23 (144): 255–271.
- BASBERG, B.L., NAEVESTAD, D. & ROSSNES, G., 1996: Industrial archaeology at South Georgia. *Polar Rec.* 32 (180): 51–66.
- BURTON, H.R. & WILLIAMS, D.L., 1986: Heard Island ANARE 1985 Report. Rep to Aust. Antarct. Div. (unpublished draft*).
- COOPER, J. & AVERY, G., 1986: *HISTORICAL SITES AT THE PRINCE EDWARD ISLANDS*. *S. Afr. Natl. Sci. Prog. Rep.* 128. Council for Scientific and Industrial Research, Pretoria, South Africa (*).
- DAVIES, M., 1982: Macquarie Island: archaeological report. Unpubl. rep. Tasm. Parks Wildl. Serv., Hobart (*).
- DOWNES, M., 1989: Conservation and study of sealers' oil barrels at Heard Island, 1987/88. Unpubl. rep. Austr. Antarct. Div., Hobart (*).
- DOWNES, M., 1996: *INDEXING SEALER'S LOGBOOKS FROM HEARD ISLAND*. ANARE Res. Notes 97. Australian Antarctic Division, Kingston, Tasmania.
- FLETCHER, H., 1984: *ANTARCTIC DAYS WITH MAWSON*. Angus and Robertson, Sydney.
- GRAHAM, T., 1989: Cultural resource management of the Prince Edward Islands. Unpubl. thesis, Univ. Cape Town, Cape Town, South Africa.
- HACQUEBORD, L., 1988: Three 17th century whaling stations in southeastern Svalbard: an archaeological missing link. *Polar Rec.* 24(149): 125–128.
- HANSEN, J., MELDGAARD, J. & NORDQUIST, J., 1985: The mummies of Qilakitsoq, Greenland's 500 year old mummies. *Natl Geogr.* 164 (2): 191–207 (Feb. 1985).
- HEADLAND, R.K., 1989: *CHRONOLOGICAL LIST OF ANTARCTIC EXPEDITIONS AND RELATED HISTORICAL EVENTS*. Cambridge University Press, Cambridge.
- HUGHES, J.D., 1992: Report on Heard Island for Permit 91/7 issued by the [Australian] Antarctic Division. Inspection of historic sites. Unpubl. rep. (*).

- HUGHES, J.D., KING, G.A. & O'BRIEN, D.J., 1996: Corrosivity map of Antarctica — revelations on the nature of corrosion in the world's coldest, driest, highest and purest continent. *INTERNATIONAL CORROSION COUNCIL 23TH INTERNATIONAL CORROSION CONFERENCE* 25-29 November 1996, Melbourne. Australasian Corrosion Associate CD-ROM publication, paper 24.
- JACKA, F. & JACKA, E., 1988: *MAWSON'S ANTARCTIC DIARIES*. Allen and Unwin Australia, Adelaide, South Australia.
- JOHANSON, J., 1992: Quarantine procedures for Southern Ocean islands. Unpubl. Hons thesis, Inst. Antarct. South. Ocean Stud., Univ. Tasm. (*).
- JONGENS, S., 1983: Status of buildings at Heard Island. Unpubl. MS, Austr. Antarct. Div., Kingston, Tasmania (*).
- JUDD, N., 1992: *CAMPBELL ISLAND HISTORIC SITE INSPECTION 1990*. Privately published, Auckland, NZ.
- KING, G.A. & HUGHES, J.D., 1993: Measurement of atmospheric corrosion using standard coupons and ATCORR units, and its application in the preservation of outdoor cultural material. *Bull. Aust. Inst. Conserv. Cult. Mat.* 8 (3 & 4): 25-43.
- LAW, P.G., 1983: *ANTARCTIC ODYSSEY*. Heinemann, Melbourne.
- LAW, P.G. & BURSTALL, T., 1953: *HEARD ISLAND. ANARE Interim Reps 7*. Antarctic Division, Melbourne.
- LAZER, E. & MCGOWAN, A., 1990: *HEARD ISLAND ARCHAEOLOGICAL SURVEY (1986-1987)*. Rev. 2nd edn. Department of Architectural and Design Science, University of Sydney (*).
- LE MOUËL, J.F., 1994: *RAPPORT DE LA MISSION DU PATRIMOINE AUX ILES KERGUELEN (1994)*. Terres Australes et Antarctiques Françaises, Paris, France.
- ROBB, A., 1988: *TREATY EXCHANGE INFORMATION FOR ANARE. Initial Report*. Australian Antarctic Division, Hobart, Tasmania (*).
- SCHOLES, A., 1951: *FOURTEEN MEN*. George Allen and Unwin, London.
- SMITH, J.M.B., RUDALL, P. & KEAGE, P.L., 1989: Driftwood on Heard Island. *Polar Rec.* 25(154): 223-228.
- STARBUCK, A., 1878: History of the American whale fishery from its earliest inception of the year 1876. *US Senate Misc. Doc.* 107, Washington, D.C.
- THORNTON, M., 1983: *HEARD ISLAND EXPEDITION 1983*. Spirit of Adventure Pty Ltd, Sydney.
- TIZARD, T.H., MOSLEY, H.N., BUCHANAN, J.Y. & MURRAY, J., 1855: *REPORT ON THE SCIENTIFIC RESULTS OF THE VOYAGE OF THE HMS CHALLENGER DURING THE YEARS 1873-76*. Her Majesty's Stationery Office, London.
- TOWNROW, K., 1988: Sealing sites on Macquarie Island: an archaeological survey. *Pap. Proc. R. Soc. Tasm.* 122(1): 15-25.
- WARREN, P., 1989: A proposal for the designation and protection of Antarctic historic resources submitted to the Antarctic Treaty Consultative Parties. Unpubl. Masters thesis, Univ. Washington, Seattle.

(accepted 6 September 1999)