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7

HEARD ISLAND

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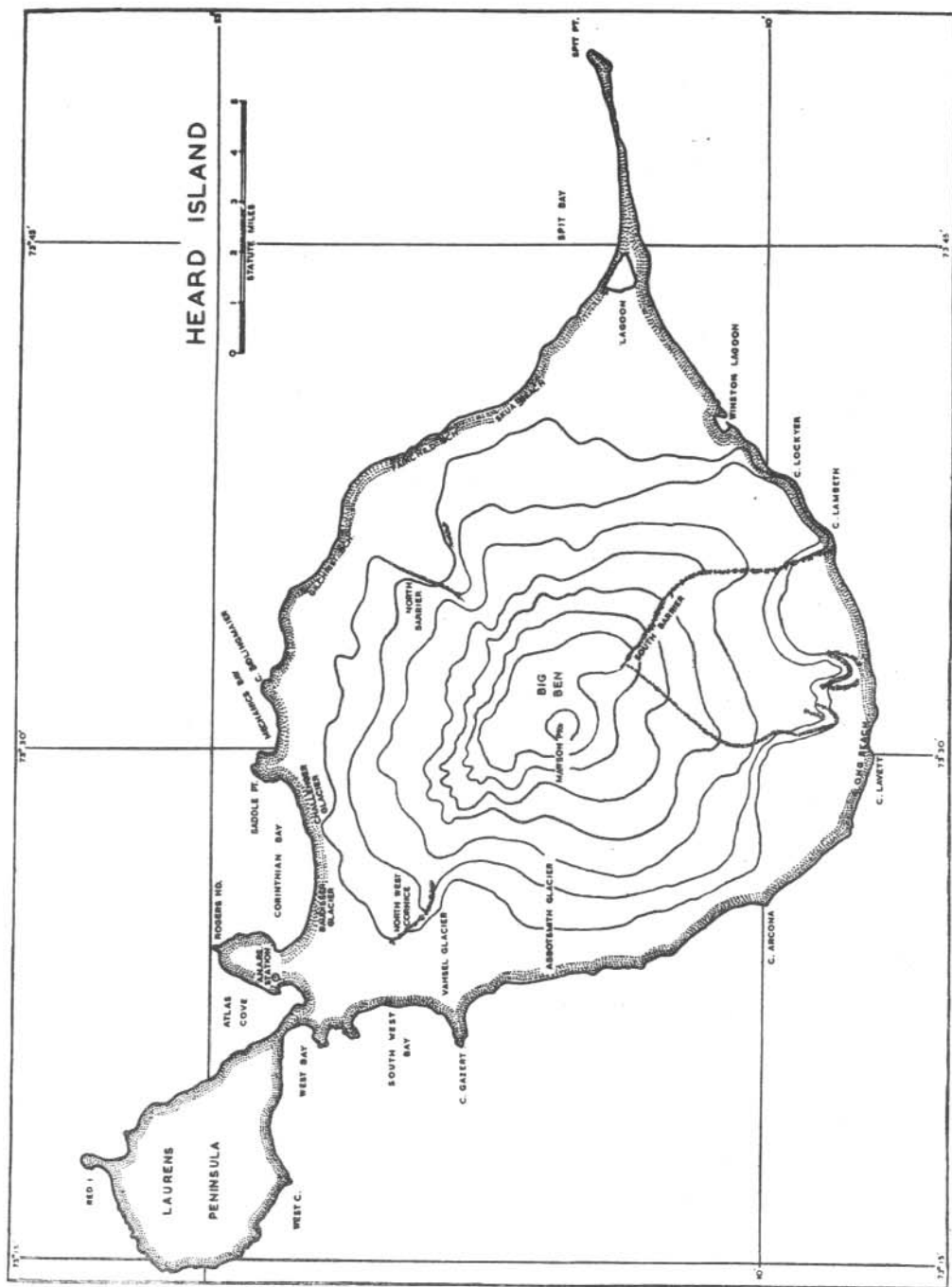


Plate 1

## INTRODUCTION

The ocean surrounding the Antarctic Continent is known as the Southern Ocean. It extends from the coast of Antarctica to the southern coasts of South America, Africa, Australia, and New Zealand; an imaginary line joining the southern coasts of these countries forms its northern boundary.

The Southern Ocean is divided into two main hydrological zones by the Antarctic Convergence, the line of demarcation at the surface of the ocean between the cold antarctic water and the warmer sub-antarctic water. These zones, the antarctic and sub-antarctic, are significant not only because they determine the distribution of marine life but also because they influence the properties of the air masses above them and consequently the meteorology of a large part of the southern hemisphere.

The Southern Ocean contains several isolated islands and groups of islands: South Georgia, the South Sandwich Islands, Bouvetoya, the Prince Edward Islands, Iles Crozet, Iles de Kerguelen, Heard Island, Macquarie Island, Campbell Island and Auckland Island. Differences in their altitudes, atmospheric circulation and ocean currents, combined with their positions relative to the Antarctic Convergence, have resulted in some of these islands being ice-covered and glaciated while others are clothed in grass and other non-artoreal vegetation. The former can be classified with the Balleny Islands, Peter I Oya, etc., as antarctic islands.

Heard Island (lat.  $53^{\circ}$  S., long.  $73\frac{1}{2}^{\circ}$  E.) which lies about 900 miles north of the western sector of Australian Antarctic Territory, is a typical ice-capped antarctic island. The recent establishment there of a research station by the Commonwealth of Australia makes it possible to provide the first comprehensive scientific information on the island's geography, geology, meteorology, flora and fauna.

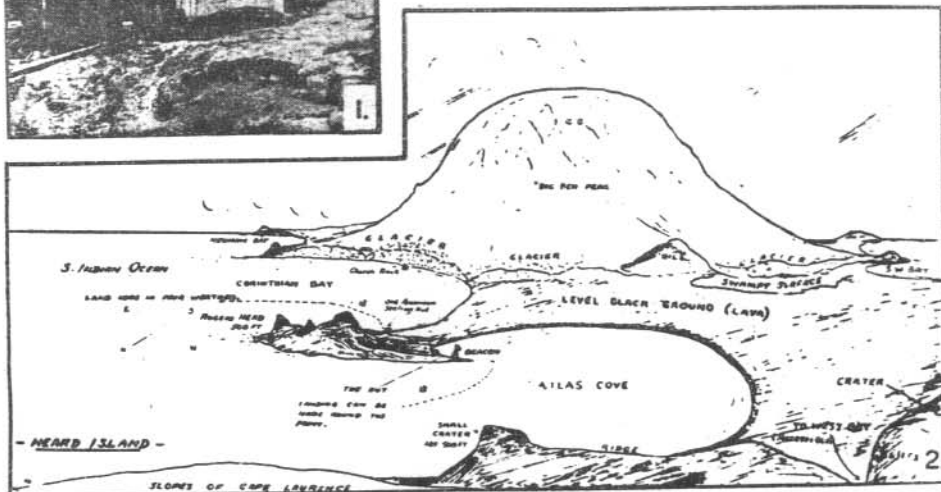
## HISTORY

Heard Island was discovered by a British sealer, Peter Kemp, who sighted the island on 27 November 1833 from the brig "Magnet" on a voyage from Iles de Kerguelen to the Antarctic. In 1849 it was rediscovered by an American whaler, Thomas Long, who reported to the owners of his ship, the "Charles Carroll",

\* This account is based on "Historical Notes on Heard and McDonald Islands" by Brian Roberts, "The Polar Record" Vol. 5, No. 40, 1950.



# EARLY HISTORICAL RECORDS OF HEARD ISLAND, 1874-1929



## Plate 2 HISTORY:

1. Flag raising ceremony, January, 1929, at Admiralty Hut, erected by crew of "Kildalkey."
2. Sketch from Laurens Peninsula, drawn by Q. H. Bullard of the "Kildalkey."
3. Earliest extant map of Heard Island published by the British Admiralty 1874 on the advice of Captain Nares of the "Challenger" Expedition. The map is probably based on an earlier map of the American sealers.
4. Old sealers' hut, Corinthian Bay.  
(1, 2 and 4 by courtesy of Commander Q. H. Bullard.)

that he had seen land from the mast head while whaling south of Iles de Kerguelen. However, neither of these discoveries was published and the credit of discovering the island went to Captain Heard, an American merchant captain of the "Oriental", who sighted the island on 25 November 1853, during a voyage from Boston to Melbourne.

The first landing on Heard Island was made in March 1855 by Captain Darwin Rogers of the "Corinthian" who was the first of a long succession of New London sealers to exploit the island's rich supplies of sea elephants. He took 400 barrels of elephant oil, advising his employers, Perkins and Smith, to despatch another vessel to this promising field. Captain Franklin E. Smith, the junior partner of the firm, fitted out the "Laurens", took command himself and sailed in September 1855 to join Captain Rogers and his tenders, the "Atlas", "Exile", "Franklin" and "Mechanic". They explored the island, naming its principal headlands and bays, and filled their vessels with 3000 barrels of elephant oil.

It was not long before sealing gangs began to winter on the island. Charles Lanman, who examined the journals and log books of the New London sealers, gives a vivid account of their lives on Heard Island :-

"After building their house, which was merely a square excavated on the ground covered with boards and made airtight with moss and snow, they proceeded to business. Those who were expert with the lance did most of the killing, the coopers hammered away at their barrels and, as occasions demanded, all hands participated in skinning the huge sea elephants, or cutting off the blubber in pieces of about fifteen pounds each, and then, on their backs or on rude sledges, transporting it to the trying works, where it was turned into precious oil. Not a day was permitted to pass without "bringing to bag" a little game, and the number of elephants killed ranged from three to as high as forty.....The regularity with which rain followed snow and the fogs were blown about by high winds, was monotonous beyond conception.....Mist and snow and slaughter, the packing of oil, hard bread and bad beef, fatigue and heavy slumbers....."

The riches of Heard Island were a jealously guarded secret. In February 1858 Captain Cubin, in command of the British vessel "Caribou", passed the island and unaware of its previous discovery sent a

life boat ashore. He relates that his ship drifted in the current revealing a bay in the coastline where he was astonished to see vessels lying at anchor.

"One of the vessels got under way when I stood towards it," he reports. "It proved to be the American schooner "Oxford" of Fairhaven. They put out a boat and the Master came on board.....He seemed annoyed that my boat had landed and advised me to go and leave her behind, saying she would never return.....but whilst speaking the lookout at the masthead reported the boat in sight. He then became more communicative, and told me they were after oil; that the shores of the island swarmed with sea elephants; and that they had sent to America from the island since the discovery 25,000 barrels of oil....."

However the American monopoly of the island did not last. An Australian, W.L. Crowther, owner of one of the largest whaling fleets of Hobart, heard of the lucrative trade through an American sailor who had taken ill on Heard Island and been shipped to Melbourne. Crowther immediately fitted out two of his whalers, the "Offley" and "Elizabeth Jane". Three hundred miles from the island the "Elizabeth Jane", which was carrying most of the stores and equipment, began to leak and altered course to Mauritius where she was condemned and sold. Captain Robinson of the "Offley" then joined forces with an American schooner, the "Mary Powell", and the two ships landed their crews on Heard Island on 29 October 1858.

One of the Australian shore party describes the landing as follows :- "We were all ordered on shore on an island covered with ice and snow and without any shelter or covering for our heads or bodies and amid the most intense and bitter cold with snow dropping, having no fuel to make a fire to warm our numbed and frost-bitten limbs. At length we succeeded in finding along the beach some old portions of a wreck with which we managed to erect a place sufficiently large for us to crawl into. We were fully two days in erecting the few poles and a sail over them which was our home - in this place, you will hardly credit it, we had to exist for upwards of six months.....our fireplace was tussocks of grass and our fuel consisted of elephant blubber and penguin skins, for we could get no other."

But worse was to follow. After they had filled 400 casks with elephant oil and loaded them on to the "Mary Powell", the ship ran under the ice cliffs and was wrecked.

"But for the bravery of one young active American sailor they had all lost their lives. He took a lance warp and got out on the yard arm. When she rolled into the cliffs he jumped, held on, and with a tomahawk he cut his way to the top. When he had reached there he passed his lance warp out and hauled the lightest man up. Then these two got the next heaviest, and so on till all were rescued. They had much privation. Many lost toes, and some fingers, with frostbite, but eventually all were rescued by the "Offley". £8,000 worth of blubber and two vessels were gone".

As in the case of other islands in the Southern Ocean, there was no attempt to control the slaughter of the sea elephants, so that within twenty years they had almost been exterminated. In 1874 when Sir George Nares landed from the "Challenger", he found forty sealers scattered in parties along the coast but the industry was in decline. Lord George Campbell, a member of the expedition, observed that most of the sealers were Portuguese impressed from the Canary Islands. He describes them as "wretchedly paid" and without even the "pluck to face a penguin".

By 1880 the island was abandoned by the sealers and there is a long gap in the records until 1902 when Baron E. Von Drygalski, leader of the German "Gauss" Expedition, paid a brief call and provided the first comprehensive scientific information on the island's geology, flora and fauna.

In 1908 the British Colonial Office received an enquiry from the Norwegian Government about the sovereignty of Heard Island - a Norwegian whaling company was considering establishing a whale fishery depot there. The Colonial Office early in 1910 granted an option to the "Sandefjord Whaling Company" to take up an exclusive licence to occupy Heard Island for three years. However, the company made a private agreement with the "South African Whaling Company" at Capetown to share the licence if the South African company undertook to send a whaling reconnaissance expedition to the island. An expedition was despatched from Durban in the floating factory-ship "Mangoro"



under Captain A. Evensen, who hoisted the British flag on Heard Island on 25 March 1910. The island was apparently considered unsuitable for the establishment of a whale fishery.

In October 1926 a whaling licence was granted by the British Colonial Office to a South African firm the "Kerguelen Sealing & Whaling Company", and in January 1929 one of the company's whalers, the "Kildalkey", under the command of Captain H.O. Hansen, visited Heard Island, erected a hut and navigational beacon, and hoisted the British flag. The "Kildalkey" made six visits to the island during 1929, spending from eight to nine days there on each trip. On the first visit the French geologist, E. Aubert de la Rue, was landed to carry out geological investigations; subsequently he wrote a paper on the results of his work.

In November 1929 Sir Douglas Mawson's B.A.N.Z.A.R. Expedition called in at the island for seven days, and carried out a short programme of biological and geological research.

Early in 1947, following efforts by Sir Douglas Mawson to arouse interest in Australian antarctic possessions, the Australian Government appointed an Antarctic Planning Committee to draw up a programme for an Australian antarctic expedition. This Committee recommended that a research station be established on Macquarie Island and that a reconnaissance of the coast of the Australian sector be carried out with a view to discovering a suitable site for a permanent antarctic station. Following discussions with the United Kingdom Government, it was decided to establish a station also at Heard Island.

The Heard Island party of the Australian National Antarctic Research Expedition arrived in H.M.A.S. "Labuan" on 11 December 1947. On 26 December the Australian flag was raised and the island was formally claimed for the 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.

#### GEOGRAPHY

Heard Island lies approximately 2,400 nautical miles from Western Australia and 2,300 from South Africa. Nine hundred miles to the south is the

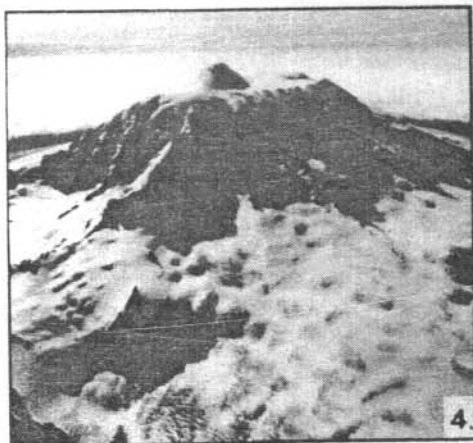
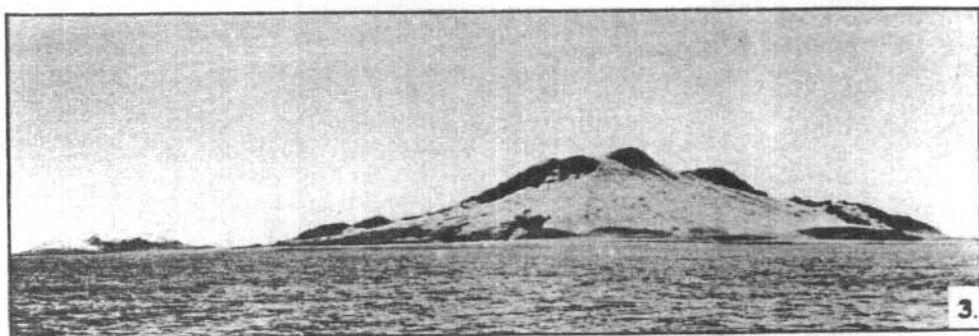
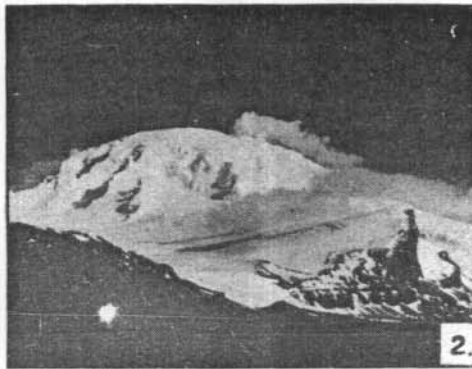
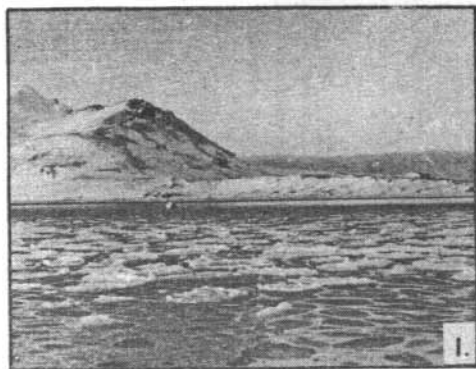


Plate 3

GEOGRAPHY:

1. Pancake ice Atlas Cove, July, 1948.
2. Volcanic activity, Big Ben.
3. Panoramic view of southwest coastline of Heard Island, Laurens Peninsula at left.
4. Mawson Peak, 9005 ft.
5. Spit Bay area.

Antarctic Continent, while the Kerguelen Archipelago, 280 miles to the northwest, is the nearest significant land.

Heard Island is about 27 miles long and 13 miles wide. (See Map ). The main part of the island is roughly circular in shape and slopes steeply upward to form the impressive mountain mass of Big Ben at a general height of 8,000 feet. Rising from the breached crater-top of this extinct volcano the more recent cone of Mawson Peak reaches a height of 9,005 feet.

Subdued volcanic activity still persists and smoke and steam have frequently been noticed issuing from fissures in Mawson Peak and from a vent at about 5,000 feet on the southern side of Big Ben.

At the north-western end of the island, Laurens Peninsula and Rogers Head Peninsula are connected to the main body of the island by a low-lying sandy isthmus. Laurens Peninsula is surmounted by three peaks - Mount Dixon, Mount Anzac and Mount Olsen - each between two and three thousand feet high. At the south-eastern end of the island, a long, narrow sand-and-boulder spit terminates in a strip of shoal water extending for about five miles out to sea. Permanent ice covers nearly all of the island. Where the descending ice-sheet reaches the sea there are ice-cliffs 50 to 100 feet in height; elsewhere extensive moraines of glacial debris and ice are formed. In winter the whole of the island is covered with snow, but in summer the lower slopes of Laurens Peninsula, the immediate environs of Atlas Cove, the Rogers Head Peninsula, and the Spit are ice-free. Because of the steep terrain and the heavily-crevassed glaciers, overland journeys of more than a mile or two from the Station are considerable undertakings; but owing to the heavy surf and treacherous weather, the use of small boats as an alternative means of travel is extremely hazardous.

From the sea Heard Island presents a forbidding and desolate appearance. Sheer black rock-faces alternate with the terminal ice-cliffs of the glaciers, against which the surf breaks unceasingly. The higher slopes of the island are usually covered in clouds and are seldom visible. As the principal axis of the island lies in the direction of the prevailing north-westerly winds, and as there are no deep indentations in the coastline, no all-weather anchorages

7.

exist; Atlas Cove and Corinthian Bay are the best.

A few detached islets and rocks lie close offshore, of which Shag Island, Sail Rock, Drury Rock and Norwegian Rock are the most important. The McDonald Islands, a small group of bare rocks standing boldly out from the sea, lie 27 miles to the northwest.

The Antarctic Convergence lies more than 100 miles to the north of the island and the mean annual temperature of the sea at Atlas Cove is about 33°F. Although the antarctic pack-ice does not extend as far north as Heard Island, pancake ice has been observed to form on the surface of Atlas Cove during calm weather in winter.

#### ANARE STATION

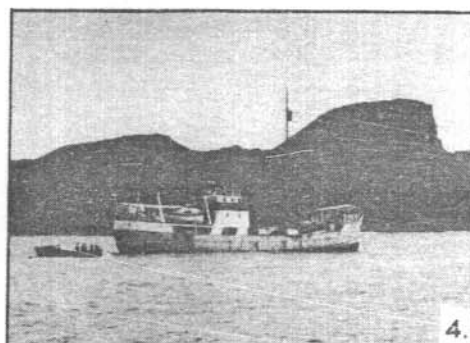
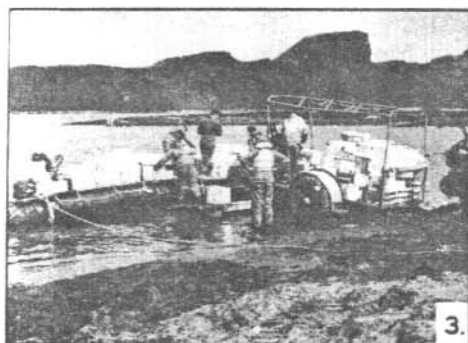
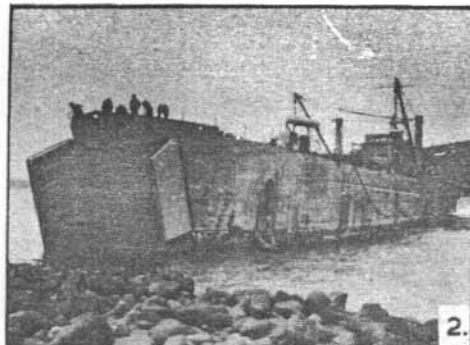
The research station at Heard Island was established on 11 December 1947 and is now in its sixth year of operation. It is manned by a party of about fourteen men who volunteer for twelve month's service, the composition of the party depending upon the scientific programme planned each year.

In 1953 the team comprised the following :-

- Officer-in-Charge
- Meteorologist
- 3 Meteorological Observers
- 3 Radio Operators
- Geophysicist
- Medical Officer and Biologist
- Engineer
- Dog Trainer
- Cook
- Storeman

No distinctions are drawn between scientific and non-scientific men; in fact, the non-scientific personnel are encouraged to take an interest in the scientific work and to assist in field work and the more routine observations.

The station is now quite an extensive establishment comprising 25 huts, including a diesel power-house which supplies 15,000 watts for heating, lighting and scientific equipment. A variety of huts has been tried out and the type of construction has now been reduced to two designs - a Nissen hut for power-houses and storerooms and a specially prefabricated



**Plate 4**    **A.N.A.R.E. STATION:**  
 1. DUKW landing equipment at Corinthian Bay during annual relief.  
 2. "Labuan" beached in Atlas Cove, December, 1947.  
 3. Off-loading stores from a rubber pontoon, Atlas Cove, 1952.  
 4. M.V. "Totian" at anchor in Atlas Cove, March, 1952.  
 5. A.N.A.R.E. Station, summer, 1952.



**Plate 5** A.N.A.R.E. STATION:  
 1. The appendix operation, October, 1951.  
 2. Interior of Radio hut.  
 3. Christmas festivities, Recreation hut.  
 4. Annual delivery of mail during relief.



heavily-insulated hut for living accommodation and scientific laboratories. The station has a fully equipped surgery, including a modern X-ray unit.

Everything possible is done for the comfort and morale of the party. Food and clothing are of the best quality. The station amenities include a library, a radiogram, a piano, table tennis, regular film screenings and free issues of cigarettes and liquor. Men are permitted a certain number of radio messages each month to and from their next-of-kin without charge.

The Heard Island station is relieved annually by ship. Amphibious DUKW's, scows and pontoons transport the year's supplies from ship to shore and when the unloading is finished the incoming party is taught the routine of the station by the retiring party.

Pending the establishment of an Australian research station on the Antarctic Continent, Heard Island serves as a testing-ground for equipment and a training-ground for antarctic personnel. Field parties have been equipped with specially designed clothing, tents and mountaineering equipment; huts and scientific apparatus of various kinds have been tested; and huskies are being bred and trained on the island.

#### \* GEOLOGY

STRATIGRAPHY. Heard Island is glaciated throughout the year and because of the scarcity and discontinuity of outcrops much reliance has been placed on collections made from moraines.

As far as is known, three formations exist, as follows :

Uppermost : Lavas.

Intermediate : Drygalski Agglomerates.

Basal : Laurens Peninsula Limestones.

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\* This account is reproduced from "A Geological Account of Heard Island" by A.J. Lambeth, Journal and Proceedings of the Royal Society of New South Wales, Vol.86, 1952.





Laurens Peninsula Limestones. The lowest formation, here called Laurens Peninsula Limestones, outcrops on both the south and north-east coasts of Laurens Peninsula, in latitude  $53^{\circ} 01'S.$ , longitude  $73^{\circ} 20'E.$  The existence of this underlying pelagic limestone was suspected by E. Phillipi, the geologist of the "Gauss" Expedition, in 1902 but these outcrops are the first observed "in situ".

The limestones are thinly bedded and intercalated with thin soft tuffaceous shales, and are folded about an E.-W. magnetic axis with north and south dips varying between  $25^{\circ}$  and  $35^{\circ}$ . The colour varies from white or grey to blue or brown, the texture being even and fine-grained with conchoidal fracture. There are abundant foraminifera which indicate a Palaeogene age.\*

The upper surface of the formation is plane and sub-horizontal, the greatest elevation being approximately 250 feet above sea level on the south coast of Laurens Peninsula. From here it dips gently southwards to below sea level. The attitude indicates that the formation is not very far below sea level throughout the north-eastern part of the island.

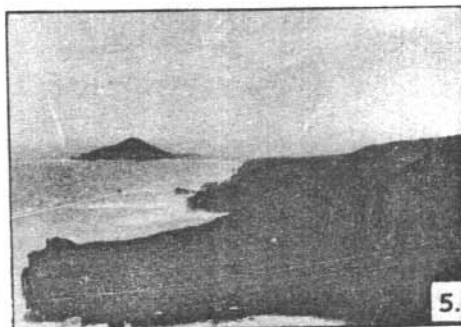
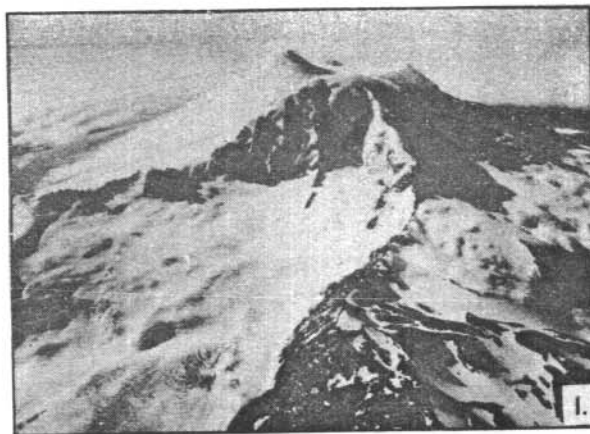
On the south coast of Laurens Peninsula the formation has been intruded, prior to folding, by concordant sills of fine-grained, non-porphyrific, holocrystalline trachybasalt, varying in thickness from a few inches to five feet. These are the only igneous rocks observed.

Drygalski Agglomerates. These were first reported by Phillipi from the flanks of Mt. Drygalski near Atlas Cove, and as the widespread nature was not realized the occurrence was described as a crater ruin. They occur over most of Laurens Peninsula and the east and south coasts of the island. Their three-fold nature is apparent at Mt. Drygalski and the southern and north-eastern parts of Laurens Peninsula, which may be taken as the type area. (Mt. Drygalski, lat.  $53^{\circ} 02'S.$ , long.  $73^{\circ} 23'E.$ )

The agglomerates are sub-horizontal in attitude, overlying the Laurens Peninsula Limestones with an angular unconformity of approximately  $35^{\circ}$ , the maximum thickness on the Laurens Peninsula being 1100-1200 feet.

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\* Globigerina sp. and Gumbelina sp. were contained in it.



**Plate 7 GEOLOGY:**

1. Mawson Peak surmounting the plateau-like top of Big Ben range suggesting a cone-in-cone structure.  
The rib-like outcrops are of high lavas.
2. AA-AA lava, west coast, Laurens Peninsula.
3. Dikes at Corinthian Head.
4. Rogers Head.
5. Coast lavas. Macey Cove in foreground and Red Island in distance.

Their lower division consists largely of agglomerates, but near the top of the division local thinly-bedded tuffaceous shales are developed. Volcanic bombs are recognizable, while the variable-sized, angular to sub-angular, and rounded agglomerate pebbles are mainly porphyritic olivine-basalt, limburgite and limburgitic scoriae. The bond is tuffaceous, shaly, palagonite and occasionally calcareous. Much of the material was deposited under water. Locally there is little sorting, but broadly there are significant differences in grainsize, the grainsize diminishing towards the top. The maximum thickness of this division on the Laurens Peninsula is about 350 feet.

The igneous rocks are of three types : Minor gabbroic stocks and bosses, contemporaneous trachytic necks, and the feeder dykes of the middle division.

The middle division overlies the lowest on an approximately even erosional surface, some of the trachytic necks being truncated. It is entirely igneous and, unlike the other divisions, is not continuous but is a series of volcanic outpourings within the Drygalski Agglomerate. Thin flows emanating from small dykes have produced local thicknesses of up to 300 feet. Columnar structure is common, the rock types being olivine-basalts and feldspar-basalts.

The upper division, thickness approximately 400 feet shows a return to the agglomeratic facies of the lowest, with a finer grainsize in the agglomeratic particles, whilst tuffaceous shales and grits are more common than elsewhere. Their presence assists in the differentiation of the lower and upper divisions, where the middle is not developed. Contemporaneous brecciated plugs are the only igneous rocks.

The upper surface of the Drygalski Agglomerates is roughly plane, conforming to the general attitude of the formation.

Lavas. These are known mainly from moraines, although those near sea level can be examined in detail. Geographically, the lavas fall into three groups; these, however, are not necessarily in sequence and may be contemporaneous.

- (1) The Mt.Olsen Lavas: Situated on the heights of Laurens Peninsula.

(ii) The Coast Lavas: Parasitic cones adjacent to sea level.

(iii) The High Lavas: Situated on the main mass of the island.

(i) The Mt.Olsen Lavas. These are situated on the heights of Laurens Peninsula about Mt.Olsen and Mt.Anzac, and are mostly glaciated (Mt.Olsen, lat.  $53^{\circ} 01'S.$ , long.  $73^{\circ} 20'E.$ ). They overlies the Drygalski Agglomerates with disconformity, and stratigraphically are in a situation similar to the high lavas, although they may not be contemporaneous.

The basal beds are trachyandesites, approximately 100 feet maximum thickness, with traces of columnar structure, overlain by an accumulation of trachyte, up to 1300 feet thick, which forms the various peaks. Moraine material does not suggest that any other rock type is present.

(ii) The Coast Lavas. These are diverse. The limburgite of Rogers Headland is noteworthy. This is a crater floor-relic, remnants of the sides occurring in the limburgitic tuff relics of Rogers Head, portion of Corinth Head and Church Rock. This cavernous lava issued from many centres in the floor and is similar to occurrences at Saddle Point, Cape Bidlingmaier, Scarlet Hill, Red Island and Mt.Macey. At these places, Mt.Macey and Cape Bidlingmaier excepted, the containing walls are absent. They all show pa-hoe-hoe structure, and columnar structure on a small scale, while tumuli are common. The conspicuous and almost linear scoria-cones developed at these places with their abundant lapilli ejecta, are of an earlier date than the surrounding limburgites.

The lavas on the northern and western coasts of Laurens Peninsula centre about Mt.Dixon. This mould-like structure is completely glaciated and outcrops can be seen only at the base. They are trachyte, overlain by massive basalts, followed by vesicular aa-aa basalts. The accumulation of cinders probably represents the final outburst.

The Cave Bay trachytes with the overlying scoriaceous lavas appear to be allied to this Mt.Dixon suite, both forming part of a former widespread occurrence extending to the islands (e.g. Pulpit Rock) lying off Cape Gazert, where the aa-aa type overlies a massive basalt.

(iii) The High Lavas. The high lavas appear to extend upwards from the top of the Drygalski Agglomerate to the culminating peak Mt. Mawson. Consequently they represent a piling up of nearly 8000 feet of volcanic material. They are known almost entirely from moraines, as those few outcrops which do exist are either difficult of access or unapproachable.

The lavas appear to have built up Big Ben Range by emanating from vents situated about the centre of the island. Seen from the air, the plateau-like upper surface of this mass resembles an infilled crater, in which case Mt. Mawson is a cone-in-cone structure, a feature commonly developed in the vents of the Laurens Peninsula coast lavas. The great height of this mountain mass developed in the narrow island area suggests lavas of high viscosity. In the samples collected limburgites, olivine-augite-basalts and trachybasalts predominate, with some subordinate plagioclase-basalts and trachytes, whilst more coarsely grained olivine-augite-types probably represent local intrusions into the lavas.

TECTONICS AND STRUCTURE. Three distinct formations are superimposed in a simple structure. The elevation and folding of the Laurens Peninsula Limestones indicates movements of great magnitude and, since these sediments are Palaeogene in age, the movement may have been contemporaneous with the Alpine of the Northern Hemisphere. Only minor trachybasalt sills occur.

After a period of erosion, widespread explosive volcanic activity occurred from many centres, the ejecta being mostly limburgite and basalt, but some trachyte necks were formed. These formed the lowest division of the Drygalski Agglomerate. A hiatus followed during which thin fissure basalts formed discontinuous local accumulations. Explosive vulcanism followed, the average grainsize of the ejecta being finer than previously.

So far there was no sign of glaciation, it being inferred that the glacial epochs of the Pleistocene had not yet intervened. Consequently the Drygalski Agglomerates are probably late Tertiary, when this formation was undoubtedly of much greater extent than at present.

During the break in deposition which followed, the upper surface of the Drygalski Agglomerates was

eroded to a roughly plane surface.

Igneous activity on a grand scale then commenced, localized about Big Ben. Other centres probably existed and may be represented by the various neighbouring islands. Lavas of high viscosity rapidly built up the mass of Big Ben. The main island fault may have had its beginnings here, providing a fissure through which the lavas were extruded. Most of the vulcanism appears to have finished before the Pleistocene glaciation, but its recurring and diminishing nature is clearly indicated in the numerous cone-in-cone structures. Some of the more recent flows overwhelmed the eroded edges of the Drygalski Agglomerates, indicating a general erosion of this formation. Fumaroles and hot springs do not occur on Heard Island.

The main island fault appears to have been most active after glaciation. It has truncated and destroyed the old trunk glacier flowing down Atlas Cove, as well as the headlands of the Jacka Glacier. The downthrow side was on the south-west and the throw could not be determined. Evidence of its existence is the non-occurrence of the Drygalski Agglomerates on the downthrow side either "in situ" or in moraines, as well as the truncation of the glaciers. It is represented physiographically by the escarpments of South Barrier and North West Cornice, which appear to represent the eroded scarps, at the latter place slickensided pebbles being found. The movement of the fault was associated in the Laurens area with trachytic vulcanism followed by basalts of increasing viscosity, culminating in aa-aa lavas, ashes and cinders.

The east coast may have been influenced by faulting. The almost linear arrangement of centres of eruption of limburgitic tuff, limburgite with pa-hoe-hoe structure, and scoriae, extending from Mt. Macey to Scarlet Hill is significant. The tuff of Rogers Head contains fragments which, judging from their "in situ" position in the Drygalski Agglomerate and the attitude of this formation, could not have been brought from below if this area were not down-faulted. No other evidence was apparent, but the existence of such a fault would account for the absence of the eastern wall of the old Atlas Cove Glacier, which would have been downfaulted. The island appears to have had its origin in a tectogene in the early Tertiary, and is now a horst with downthrows to the north-east and south-west.



BIOLOGY

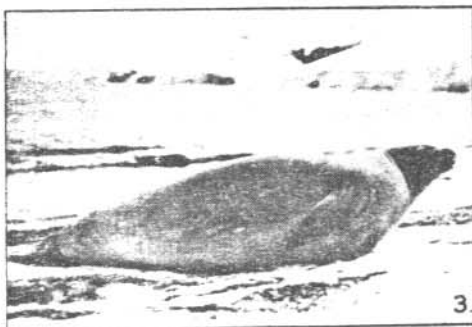
SEALS. Five species of seals have been recorded from Heard Island in the last three years - four species of true seals (Phocidae) and one eared seal, (Otariidae). Only one of these is known to breed on the island.

The Elephant Seal (Macrorhinus proboscideus, Peron and Lesueur) is by far the most abundant at Heard Island. Counts taken during the breeding season in 1949, 1950 and 1951 have revealed the presence of about 40,000 animals. The most highly populated region is the five-mile Spit at the eastern end of the island. Of the 40,000 counted in 1949, approximately 37,000 were found in this area. In the region of the "Four Bays" (South West Bay, West Bay, Corinthian Bay and Atlas Cove) the count was about three thousand. Apart from these areas, smaller groups are to be found wherever there is sufficient beach to permit a landing.

The breeding season reaches a peak in late October but the population declines throughout November with the exodus of the impregnated cows. In January there is another population rise when adult and adolescent seals return to the island to moult, and this is followed by a gradual decline which reaches a minimum at the end of August. In late September there is a sharp rise when the breeding females come ashore and by late October the breeding peak is again reached.

Elephant seals feed chiefly on squid which must be present in huge numbers in the waters around Heard Island.

The Leopard Seal (Hydrurga leptonyx, de Blainville). It is probable that there is a greater concentration of leopard seals on Heard Island in winter than anywhere else in the world (Gwynn, 1953a), although their numbers are not comparable with those of the elephant seals. During the summer, from November to March, not many come ashore, but with the onset of winter their numbers progressively increase until in August it is common to see more than a hundred animals on the beach at Corinthian Bay. The maximum number seen on this beach was 162 on 30 September 1950. The total population in the Heard Island region is estimated at approximately 900.



**Plate 8** BIOLOGY: (Seals)

1. Bull fur seal, Red Island.
2. Head of leopard seal.
3. Crabeater seal.
4. Bull elephant seal with harem.
5. Branding elephant seal yearlings.



Heard Island seems to be a popular resort for female leopard seals during late pregnancy. Several that were killed in August and September were carrying almost full-term fetuses. A premature pup was born at Heard Island on 27 September 1950 but in that case it was a miscarriage by a badly injured animal and did not survive. In 1951 a pregnant female was caged on the island and the pup was born on 14 November (Brown, 1952). Unfortunately the young animal was born dead. However this provided valuable data concerning the size of the new full-term sea leopard. It is believed that as the time for parturition approaches the females migrate to the pack ice, some three hundred miles south. Copulation may take place in the waters around Heard Island in January since at this time of the year breeding-size males are frequent visitors and females have been seen bearing fresh scars in the genital region.

The chief area for leopard seal haul-outs is in the Four Bays area, especially on the beach at Corinthian Bay where the surf is seldom severe.

Because of the presence of large penguin rookeries, Heard Island is an excellent feeding ground for the leopard seal.

The Weddell Seal (Leoptonychotes weddelli, Lesson). Heard Island is at the extreme northern limit of the Weddell seal distribution. Only solitary animals have been seen and they appear very rarely.

There is only one record of a Weddell pup at Heard Island (November 1950). When observed, the pup had already left its mother.

The Crabeater Seal (Lobodon carcinophagus, Jacquinot and Pucheran), like the Weddell seal, is a rare visitor to Heard Island, appearing singly on the beaches from July to January. There is no record of a pup having been born on the island.

The Fur Seal (Arctocephalus cf. gazella, Peters) is the only eared seal seen on Heard Island. In March 1951 a group of 31 animals were observed on Red Island. However, no breeding places have been discovered and it is presumed that the fur seals are wanderers from breeding grounds on Iles de Kerguelen. (Gwynn, 1953b).

A programme of seal marking was initiated in 1949 to investigate migrations, growth rates and changes within the harems during the breeding season. (Chittleborough and Ealey, 1951). Hot iron brands were most generally used. Over 1,000 elephant seals have been branded, the majority of which were branded as pups. Of the leopard seals more than 100 have been branded. A small percentage of the branded elephant seals have been sighted again whilst most of the branded leopard seals have returned many times.

As well as life cycles and population studies of the elephant and leopard seals some work of a physiological nature has also been carried out and data concerning pulse and respiration rates has been obtained. In the case of elephant seals histological examination of various glands and organs has been made.

Blubber samples from all seals except fur seals have been analysed and the nature of the oils determined. (Winter and Nunn, 1950a, 1950b, 1950c).

BIRDS. The bird population of Heard Island is typically antarctic. Of the 18 resident species the distribution of seven is generally confined to latitudes south of the Antarctic Convergence and that of eight is spread over both the antarctic and subantarctic zones of surface waters. Only two species are typically sub-antarctic.

Because of the extent of glaciation, only small areas of Heard Island are suitable for breeding. The northern end, comprising Laurens Peninsula, Cape Gazert, the South West Bay area and Rogers Head Peninsula, forms the most prolific breeding ground but the Spit Bay and Long Beach areas also support huge bird populations.

Of the penguins the macaroni penguin, Eudyptes chrysolophus (Brandt) is the most numerous, forming dense rookeries on the scree slopes of the Laurens Peninsula, Rogers Head Peninsula and at Long Beach. The rockhopper penguin, Eudyptes chrysocome (Forster) is often found in association with the macaronis or nesting in caves formed by lava folds. Gentoo penguins, Pygoscelis papua (Forster) nest on grassy flats and slopes behind all the larger beaches and on rare occasions ring penguins, Pygoscelis antarctica (Forster) have been found nesting among them. A very small colony of king penguins, Aptenodytes patagonica, Miller existed at South West Bay until 1949.

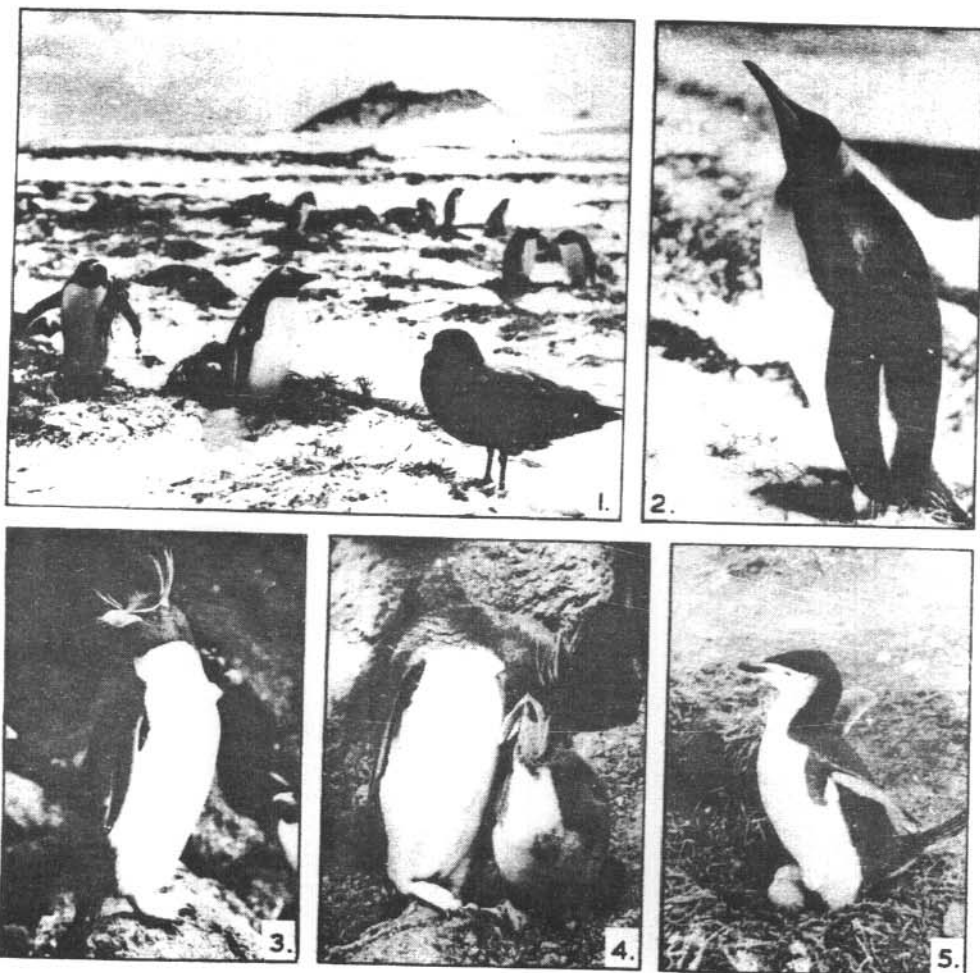


Plate 9

BIOLOGY: (Penguins)

1. Gentoo penguins building nests. Skua in foreground.
2. King penguin.
3. Rockhopper penguin.
4. Macaroni penguin feeding chick.
5. Ringed penguin.

The most numerous bird on the island is probably the dove prion, Pachyptila desolata (Gmelin), a petrel which digs its nesting burrows in grassy slopes or Azorella hummocks. The fulmar billed fairy prion, Pachyptila crassirostris (Mathews) does not compete with the dove prion for nesting sites as it nests wherever suitable holes occur in the lava cliffs facing the sea. The South Georgia diving petrel, Pelecanoides georgicus, Murphy and Harper whose burrows are to be found in most of the sandy or stony flats is much more numerous than the Kerguelen diving petrel, Pelecanoides urinatrix exul, Salvin which burrows in grassy slopes which face the sea. The cape pigeon, Daption capensis (Linne) nests on all suitable cliffs below about a thousand feet while Wilson's storm petrel Oceanites oceanicus (Kuhl) makes a crude nest under flat rocks, sometimes as far inland as one mile. Large numbers of giant petrels, Macronectes giganteus, Gmelin have rookeries at Cape Gazert, on certain areas of Laurens Peninsula and at Long Beach.

Two species of albatross breed at Heard Island. A rookery of black-browed mollymawks Diomedea melanophris, Temminck is located four to six hundred feet above the beach at Jacka Valley while occasional pairs of light-mantled sooty albatrosses, Phoebastria palpebrata, (Forster) are found on ledges of most of the cliffs.

Isolated nests of the dominican gull, Larus dominicanus, Lichtenstein occur on the tops of hummocks, on coastal rocks and among glacial moraine. This species is by no means as plentiful as the southern skua, Stercorarius skua lonnbergi (Mathews) which nests in the same regions as the dove prion on which it preys.

The antarctic tern, Sterna vittata, Gmelin has a probable breeding population of less than 20 pairs. Except in one case the small breeding colonies have been found on glacial moraine.

Two rookeries of the Heard Island cormorant, Phalacrocorax atriceps nivalis, Falla are known, one at Saddle Point at the edge of a small cliff and the other on a large rock in Sydney Cove.

The Heard Island sheathbill, Chionis minor nasicornis, Reichenow nests in macaroni penguin



Plate 10

BIOLOGY: (Birds)

1. Black-browed albatross.
2. Skuas.
3. Shearwaters.
4. Giant petrel.
5. Light-mantled sooty albatross with chick.

rookeries under large rocks, feeding its chick on the penguin eggs during the breeding season and scavenging during the rest of the year.

Other species of birds which have been observed to visit Heard Island during the last three years are :-

The Adelie penguin, Pygoscelis adeliae, (Hombron and Jacquinot); the snow petrel, Pagadroma nivea (Forster); the silver-grey petrel, Fulmarus glacialis (Smith); the antarctic petrel, Thalassoica antarctica (Gmelin); the blue petrel, Halobaena caerulea (Gmelin); the black-bellied storm petrel, Fregetta tropica (Gould); and the arctic tern, Sterna macrura, Naumann.

Life histories of the resident species have been studied, particular attention being directed to the sheathbills, fairy prions, skuas, giant petrels and penguins.

Bird marking has been carried out since 1949 (Chittleborough and Ealey, 1950) and over 4,000 birds have been banded. Experimental tattooing of penguins has also been done. The species banded are giant petrels, both species of prions, sheathbills, cape pigeons, black-browed albatrosses, diving petrels, skuas and penguins. Ringed giant petrels have already been recovered at South Africa, Australia, New Zealand, Chile and South Georgia.

PARASITES. All species of birds found on Heard Island have been examined for ectoparasites. (de Meillon, 1952; Zumpt, 1952). Ticks and lice occur on most birds and fleas often appear in their nests or plumage. A species of louse is found on the elephant seals and endoparasites have been collected from the intestines, stomachs, trachea and lungs of most animals that have been killed. Several species of cestoda, nematoda, and acanthocephala are represented and have been examined in detail.

INSECTS AND ARACHNIDS. Heard Island possesses two species of wingless fly (Anatolanta aptera, Calcopteyx moseleyi) and one fly with reduced wings (Amylonteyx martina). There are about a dozen species of beetles including Canopsis serviceus, Edemnorhinius crozetensis, E. gracilipes, E. viridis and a number of undescribed species. The Coleoptera are most plentiful



around the roots of Kerguelen cabbage and all have a yearly life cycle. Spring tails (Collembola) are numerous, three species having already been described. A moth (Lepidoptera) with reduced wings is common in January. The life histories of all the insects have been investigated and all developmental stages collected. Behaviour and physiological research has also been carried out on C. moseleyi. This includes thermal tolerance of eggs and adults, larval growth rate, colour preference etc. A full report on the insects of Heard Island is now being prepared.

Large collections of spiders and mites have been made, but as yet the species have not been described. There appear to be 4 or 5 different spiders and about 20 types of mite.

FISH. The fish of Heard Island are typically antarctic both in type and abundance. They are coastal fish and bottom dwellers.

Of the four species so far taken, three have been species of Notothenia (N. coriiceps, N. cyanobranchia, and N. rossii), and one of Chaenichthys (C. rhinoceratus).

Little is known of their feeding or breeding habits except that one nototheniid caught was found to have in its stomach about six large and complete limpet-like molluscs while the stomach contents of others included several species of algae. Eggs and larvae of a nototheniid were found in plankton hauls during the summer months of 1949-50.

PLANKTON AND HYDROLOGY. Heard Island is strategically situated near the Antarctic Convergence and the salinity of the surrounding sea is typical of antarctic surface water. Two hydrological and planktological stations have been maintained for the past three years and although values have been affected by the freshwater run-off from glaciers and melting snow, interesting seasonal fluctuations of the phosphate, nitrate, salinity and oxygen content of the sea have been recorded.

Plankton data so far collected reveals a cycle with a major increase of the phytoplankton in November dominated by Chaetoceros spp. and Rhizosolenia spp. The zooplankton increase in the summer is dominated by developing copepods (Drepanopus pectinatus) which breed in the region of Heard and Kerguelen Islands. The oceanic calanids, typical of antarctic waters, occur

at times in considerable numbers though not as abundantly as in the open ocean. Winter values are low as many species sink to deeper water in this period.

FLOWERING PLANTS, MOSSES AND LICHENS. The identification of the flora of Heard Island is not yet completed so that only a tentative account of it can be given. The following is a list of plants known to be present at Heard Island.

Azorella selago Hook f. which is circumpolar in distribution covers most of the snow-free areas of the island often forming several acres of pure stands or mixed associations with Poa grass. It has the widest range of any plant on the island. Poa cookii Hook, f, a short grass found only at Heard and Kerguelen Islands, occurs most commonly on the lower slopes of hills. Colobanthus kerguelensis Hook f. forms into small tufts, often in association with Festuca kerguelensis Hook f. It grows usually on stony ground near the coast. Callitriche antarctica Engelm ex Hegelm, a small circumpolar species, is fairly common, appearing in damp hollows between the Azorella hummocks or submerged in fresh-water pools. Acaena adscendens Vahl is found only in the Spit Bay area. It is not abundant, usually occurring in small isolated patches among the Azorella. Pringlea antiscorbutica R. Br. ex Hook f. (Kerguelen cabbage) has a wide range all over the island and can be found on the most barren windswept ridges or the lushest grassy slopes. It seldom forms large communities.

The following mosses (Clifford, 1953) have been collected from the island :

Amblystegium serpens B. et S; Bartramia papillata H.f. et W; Bartramia diminutiva C.M (Probably a synonym of Bartramia papillata); Bartramia robusta H.f. et W) C.M.; Blindia contecta (H.f. et W) C.M.; Brachythecium c.f. salebrosum B. et S; Ceratodon purpureus Brid.; Dicranoloma billardieri (Schwaeg) Par; Dicranoweisia grimmiae (C.M.) Broth (Probably a synonym of Blindia contecta); Ditrichum subaustrale Broth; Drepanocladus uncinatus (Hedw.) Warnst; Grimmia insularis Mitt; Pogonatum alpinum (Hedw.) Mitt; Rhacomitrium crispulum (H.f. et W) H.f. et W.; Rhacomitrium nigritum (C.M.) Jaeg (probably a synonym of Rhacomitrium crispulum); and Tortula robusta Hk. et Grev.



Several species of lichen have been collected from snow-free rocks during the summer months and are being examined in detail.

ALGAE AND MARINE FOULING. The marine algae so far recorded include eight Chlorophyta, five Phaeophyta and twenty-six Rhodophyta. Four species of fresh-water Chlorophyta have been collected.

On most of the coast of Heard Island, Durvillea antarctica dominates the upper sublittoral zone, the fronds of the uppermost plants lying on the surface at low tide. Above this giant fucoid occur several distinct littoral zones, dominated (from below) by Desmarestia rosii; Rhodymeria, Plumariopsis eatoni and Curdiea; Iridaea spp. (replaced by Rhodymeria on the open coast); Porphyra columbina; and the highest zone by Enteromorpha brilbosa especially on open cliffs where wave-splash is strong.

In the marine fouling the following succession was observed :-

After one month, a thick diatom growth, mainly of Gomphonema charcotii made up the primary fouling. After three months the algae especially Chaetomorpha sp. and the diatoms Amphipleura rutilans and Navicula glaciei became more important, Chaetomorpha sp. dominating the three-month growth in winter. However, after two months in summer this had passed its peak and Amphipleura rutilans and Navicula glaciei became the dominant organisms. After three months Monostroma gradually increased in importance and by six months covered the other plants, followed by red and brown algae, including Porphyra (two species), Ilea fascia, Punctaria sp., Desmarestia cf. ligulata with some Durvillea antarctica growing away from these.

METEOROLOGY.

The geographical situation of Heard Island is such that its meteorological reports are of particular interest. (Gibbs, Gotley and Martin, 1950, 1951, 1952). Generally speaking, mean sea surface isotherms over the Southern Ocean are aligned in a west-east direction, but converging ocean currents lead to concentrations and deformations of isotherms in certain areas. Probably the most pronounced instance of this occurs roughly along the 45th parallel of latitude in the Marion Island-Heard Island region.

Heard Island is therefore in an area where, with an appropriate deformation field of temperature, major frontogenesis is likely to occur and reports from the island provide valuable data for the study of developing cyclones, which pass near to it early in their life history. The sequences of weather experienced are of fundamental value and interest, both practically and theoretically.

As experience develops and data accumulate it becomes possible to prepare weather charts embracing the whole of the area from Heard Island to Australia with greater confidence. Analyses of these charts provide opportunities of foreseeing unexpected weather developments over Australia itself, particularly outbursts from high latitudes of cold air.

Since January 1948, three-hourly weather observations have been taken at Heard Island. Daily radiosonde flights are made and it is planned to instal rawind apparatus in 1953. The meteorological station on the island also acts as a collector and distributor of weather data, receiving regular reports from Cape Town, Marion Island, Iles de Kerguelen and Ile Amsterdam, and transmitting them to Australia.

The main features of the Heard Island climate can be seen from Tables 1 to 7.

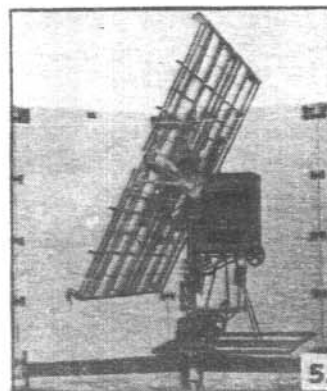
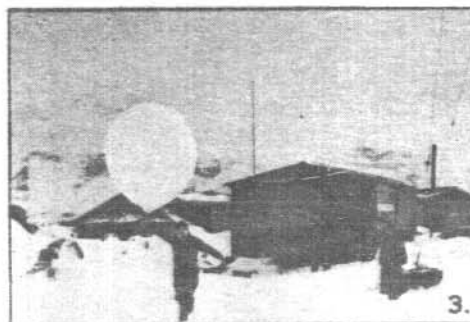
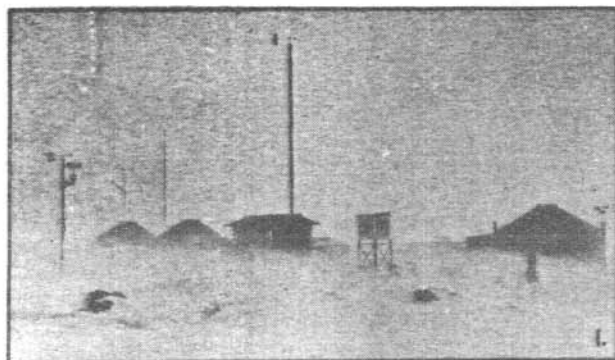


Plate 11 METEOROLOGY:

1. Meteorological installations at A.N.A.R.E. Station.
2. Lenticular cloud over Big Ben.
3. Releasing a Radiosonde balloon.
4. Preparing for Pilot balloon flight.
5. Rawin apparatus.

23.

TABLE I  
MEAN PRESSURE (MSL)

IN MBS. AT HEARD ISLAND

MONTH	1948	1949	1950
January	-	991.7	994.3
February	994.3	1004.7	996.2
March	992.0	1001.8	995.4
April	996.1	997.3	1001.1
May	991.4	992.8	995.2
June	994.1	987.4	988.0
July	990.7	998.6	990.7
August	983.7	992.3	994.3
September	998.8	990.2	990.6
October	989.2	994.3	995.7
November	990.9	985.8	995.7
December	997.1	988.9	997.7
Year	992.6	993.8	994.6
3-Year Period		993.7	

TABLE 2

MEAN DRY-BULB AND DEWPOINT TEMPERATURES  
AT HEARD ISLAND

MONTH	DRY-BULB			DEWPOINT		
	48	49	50	48	49	50
January	-	37.8	38.3	-	34.5	34.0
February	36.5	39.5	38.0	33.1	35.5	33.0
March	36.4	37.7	36.4	32.2	35.0	32.6
April	33.9	37.1	35.3	30.3	32.0	30.5
May	32.7	34.4	34.1	28.4	28.5	29.2
June	31.6	29.4	30.8	26.5	26.0	26.1
July	30.8	27.7	31.4	25.9	24.5	26.7
August	27.8	29.4	29.4	22.8	25.7	24.7
September	28.3	29.1	29.5	22.9	24.0	24.6
October	29.9	31.5	31.6	24.7	27.0	28.0
November	31.5	32.5	33.2	28.2	28.3	29.0
December	35.6	35.8	36.5	32.5	34.0	32.6
Year	32.3	33.5	33.7	28.0	29.6	29.3
3-Year Period		33.2			29.0	

25.

TABLE 3

MEAN MAXIMUM AND MINIMUM TEMPERATURES  
AT HEARD ISLAND

MONTH	MAXIMUM			MINIMUM		
	48	49	50	48	49	50
January	-	40.4	40.9	-	34.0	34.1
February	39.5	42.9	40.5	33.5	35.4	34.3
March	39.6	41.8	38.6	33.1	34.2	33.2
April	37.0	41.0	37.3	30.6	33.1	33.1
May	34.8	37.6	36.6	29.3	30.5	30.8
June	35.0	33.2	33.0	27.2	25.1	26.7
July	33.8	31.7	34.1	25.7	23.1	27.3
August	30.3	32.7	33.0	23.8	25.2	25.4
September	31.7	32.1	33.0	24.2	23.8	25.6
October	33.0	34.3	33.7	25.5	27.6	28.3
November	35.3	34.5	35.4	29.7	28.9	30.3
December	39.0	37.5	39.7	32.7	32.5	33.6
Year	35.4	36.6	36.3	28.7	29.5	30.2
3-Year Period		36.1			29.5	

TABLE 4

EXTREMES OF TEMPERATURE  
AT HEARD ISLAND

MONTH	HIGHEST			LOWEST		
	48	49	50	48	49	50
January	-	46.3	44.6	-	31.9	32.2
February	47.7	51.2	46.1	31.0	29.6	30.5
March	44.6	52.2	50.7	30.2	28.5	29.6
April	44.8	57.2	43.0	24.1	26.1	30.0
May	40.7	45.5	45.0	24.0	22.1	23.5
June	44.0	42.8	37.5	19.3	16.7	19.0
July	39.0	41.4	40.7	20.0	15.7	22.7
August	36.5	43.0	38.5	16.0	13.0	17.5
September	39.2	36.8	36.9	16.0	16.2	20.5
October	42.4	38.9	38.1	16.5	18.9	21.6
November	39.3	40.1	42.0	24.0	25.7	27.5
December	44.2	44.8	49.5	29.6	28.8	29.9
Year	47.7	57.2	50.7	16.0	13.0	17.5
3-Year Period		57.2			13.0	

TABLE 5

PRECIPITATION AT HEARD ISLAND

MONTH	TOTAL POINTS			NO. OF DAYS		
	48	49	50	48	49	50
January	-	665	617	-	28	26
February	507	483	596	28	23	23
March	660	646	519	28	28	28
April	567	715	568	29	28	27
May	375	642	551	26	30	24
June	300	258	285	28	25	21
July	302	211	290	27	23	16
August	73	193	227	25	29	21
September	257	150	276	23	21	24
October	301	414	170	25	17	21
November	319	404	313	28	23	21
December	442	381	678	26	25	27
Year	4103 <sup>*</sup>	5162	5090	293 <sup>*</sup>	300	279
3-Year Period		4940			300	

\* Totals for 11 months only.



TABLE 6

MEAN SUNSHINE  
DURATION  
AT HEARD ISLAND

in hours per 24 hours

MONTH	48	49	50
January	-	1.9	2.5
February	-	2.4	1.4
March	1.6	2.1	0.9
April	1.7	1.3	1.4
May	1.0	1.3	1.1
June	0.8	0.9	1.1
July	0.5	1.4	1.1
August	1.5	0.8	1.3
September	2.1	1.9	1.1
October	2.2	2.6	1.9
November	3.0	3.2	2.4
December	2.4	1.6	1.3
Year	1.7	1.8	1.5
3-Year Period		1.7	

TABLE 7

MEAN RUN OF WIND  
AT HEARD ISLAND

in miles per 24 hours

48	49	50
-	313	308
-	304	359
310	352	369
347	348	369
343	404	352
396	444	366
442	369	464
396	430	505
425	457	482
419	442	403
365	408	413
335	302	390
378	381	398
	386	

PHYSICS

GEOMAGNETISM. Prior to the establishment of the ANARE Station no magnetic measurements had been made at Heard Island. In 1947 an absolute magnetic station was established on the pebble flat near West Bay ( $53^{\circ} 01.9'S.$ ,  $73^{\circ} 21.9'E.$ ) after a preliminary variometer survey. Measurements were made at this station in December 1947 and February 1950. These are summarised in the following table :

<u>Date</u>	<u>Declination</u> (Mean of Day)	<u>Inclination</u> (Mean of Day)	<u>Horizontal</u> <u>Intensity</u> (Mean of Day)
23.12.47		$68^{\circ} 36.9'$	0.18360 Gauss
24.12.47	$48^{\circ} 43.5'$		
20. 2.50		$68^{\circ} 37.5'$	0.18414 Gauss
22. 2.50	$49^{\circ} 22.4'$		

A detailed variometer survey was made in February 1950 with a view to establishing a permanent magnetic observatory. This observatory was established in February 1951. Since then absolute measurements have been carried out periodically, and since August 1951 La Cour recording variometers have been in continuous operation. (Jacka, 1953).

SEISMOLOGY. In February 1951 a seismic observatory, equipped with a two-component Wood-Anderson type seismograph, was established on Heard Island. Some experiments were carried out with a long period mass but these proved unsatisfactory and since then both components have been adjusted to a period of 0.75 seconds.

One earthquake only was recorded during 1951.

COSMIC RAYS. Continuous measurements were made of the intensity of cosmic radiation at Heard Island over a period of 10 months during 1948. The apparatus used consisted of one narrow-angle and one wide-angle vertically-directed Geiger counter telescope measuring the total intensity, and a narrow-angle

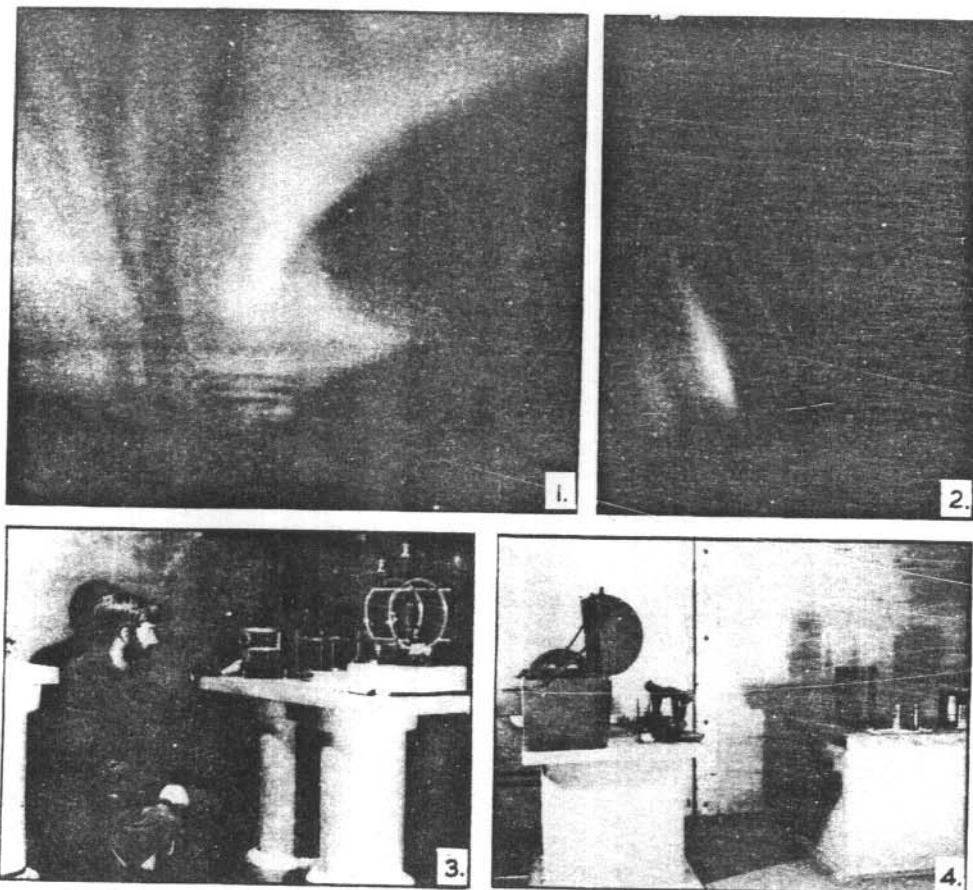


Plate 12    PHYSICS:  
 1. and 2. Aurora Australia.  
 3. Geophysicist adjusting La Cour Magnetograph.  
 4. Seismograph.

vertically-directed telescope carrying 10 cm. thickness of lead absorber measuring the hard component intensity. The output from the coincidence detectors following each telescope was fed to binary type scaling units and thence to standard Swiss telephone message registers which were automatically photographed once per hour.

A study has been made of the dependence of these measures of cosmic ray intensity on atmospheric structure. The work suggests that the region of meson formation is centred at about the 100 millibar level or higher, that the mu-mesons are mainly formed by decay of pi-mesons and that the probability for capture before decay of pi-mesons increases with increase of density or decrease of temperature (Cf. Duperier, 1949 Proc. Phys. Soc. 62, 684). Further work involving a different approach to the problem is at present being undertaken.

AURORAE. Systematic visual observations of the Aurora Australis have been made at Heard Island since February 1951 with a view to studying its spatial and temporal distribution. Preliminary examination of these records does not suggest any departure from what might be expected in the region of Heard Island.

The aurora is observed on 30 to 50 nights per year. It probably occurs much more frequently but is masked by cloud cover which is especially marked in the sector southwest to southeast of the Station in the region of Big Ben.

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