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AR 142

Antarctic seals, whales and dolphins of the early twentieth century:

Marine mammals of the Australasian Antarctic Expedition 1911-14 (AAE) and the British, Australian and New Zealand Antarctic Research Expedition 1929-31 (BANZARE)

Edited by Peter D. Shaughnessy

This document was intended for publication in the *British Australian New Zealand Antarctic Research Expedition, 1929-31, Report Series B*, but that series has ceased.

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Abstract

No detailed report on marine mammals has been published previously from the Australasian Antarctic Expedition of 1911–14 (AAE) or the British, Australian and New Zealand Antarctic Research Expedition of 1929–31 (BANZARE). Five typescript reports and three manuscripts from archives of The Mawson Institute for Antarctic Research, University of Adelaide are published here. Five deal with marine mammals of the AAE and three are from the BANZARE.

Two of the AAE reports concern seals of Macquarie Island, primarily elephant seals as well as vagrant antarctic seals. One was written by H. Hamilton, biologist of the AAE party at Macquarie Island, the other by E. R. Waite, biologist on the first subantarctic cruise of *Aurora*. Two reports deal with the third antarctic cruise of *Aurora* in the summer of 1913–14. Pertinent marine mammal observations have been extracted from the biological log of J. G. Hunter, Senior Biologist of the Expedition, and cross-referenced to the narrative of that cruise by the leader of the expedition, Douglas Mawson. A report on Ross seals has also been included; its authorship is unclear, but it was written either by J. G. Hunter or by G. F. Ainsworth. Only one report from the AAE specifically concerns large cetaceans; it lists those seen near the Antarctic coast by Captain James Davis, a retired whaler on the second antarctic cruise of *Aurora* in the summer of 1912–13. The BANZARE reports are from manuscripts by Professor T. Harvey Johnston, Chief Biologist on *Discovery* during the two BANZARE cruises. Aspects of these reports are reviewed in light of current knowledge by P. D. Shaughnessy (pinniped observations, section III.A), R. A. Tedman (reproductive anatomy of pinnipeds, section III.B) and by G. J. B. Ross (cetacean observations, section III.C). In these reviews, reference is made to published AAE and BANZARE reports that refer to marine mammals, particularly those concerning food of seals.

Hamilton and Waite described harvesting methods used for elephant seals at Macquarie Island during 1911–13 and indicated the animals were still numerous. Hamilton estimated numbers ashore on the whole island during the breeding season of 1913 as 25 000, considerably fewer than the estimate of 110 000 in 1960. He reported cephalopods and, to a lesser extent, fish from stomachs of elephant seals. No fur seals were seen at Macquarie Island in 1912 and 1913, but numerous leopard seals hauled out there (Table 7). At least four

were pregnant, in contrast to the situation between 1949 and 1979 when leopard seals ashore were sexually immature. A near-term fetus was collected in early July 1913, about two to four months earlier than the reported pupping period. Stomachs of leopard seals taken at Macquarie Island contained cormorants. Two crabeater seals and one Weddell seal were sighted at Macquarie Island; since then four other Weddell seals but no other crabeater seals have been reported from the island. Hunter noted scarring on crabeater seals. He observed leopard seals chasing crabeater seals and suggested that leopard seals were the cause of scars on crabeater seals. Six Ross seals were collected by the AAE on fast ice near Haswell Island (66°S, 92°E) in January 1914. Aspects of their vocalisations, pelage, trachea and dentition, and a stomach constriction are described, and measurements are summarised in Table 2.

Whales were seen along the Antarctic coast between 90°E and 160°E in latitude 55°S to 65°S; blue, finback and killer whales were identified. Hunter reported hourglass dolphins on two successive days near 50°S, 105°E.

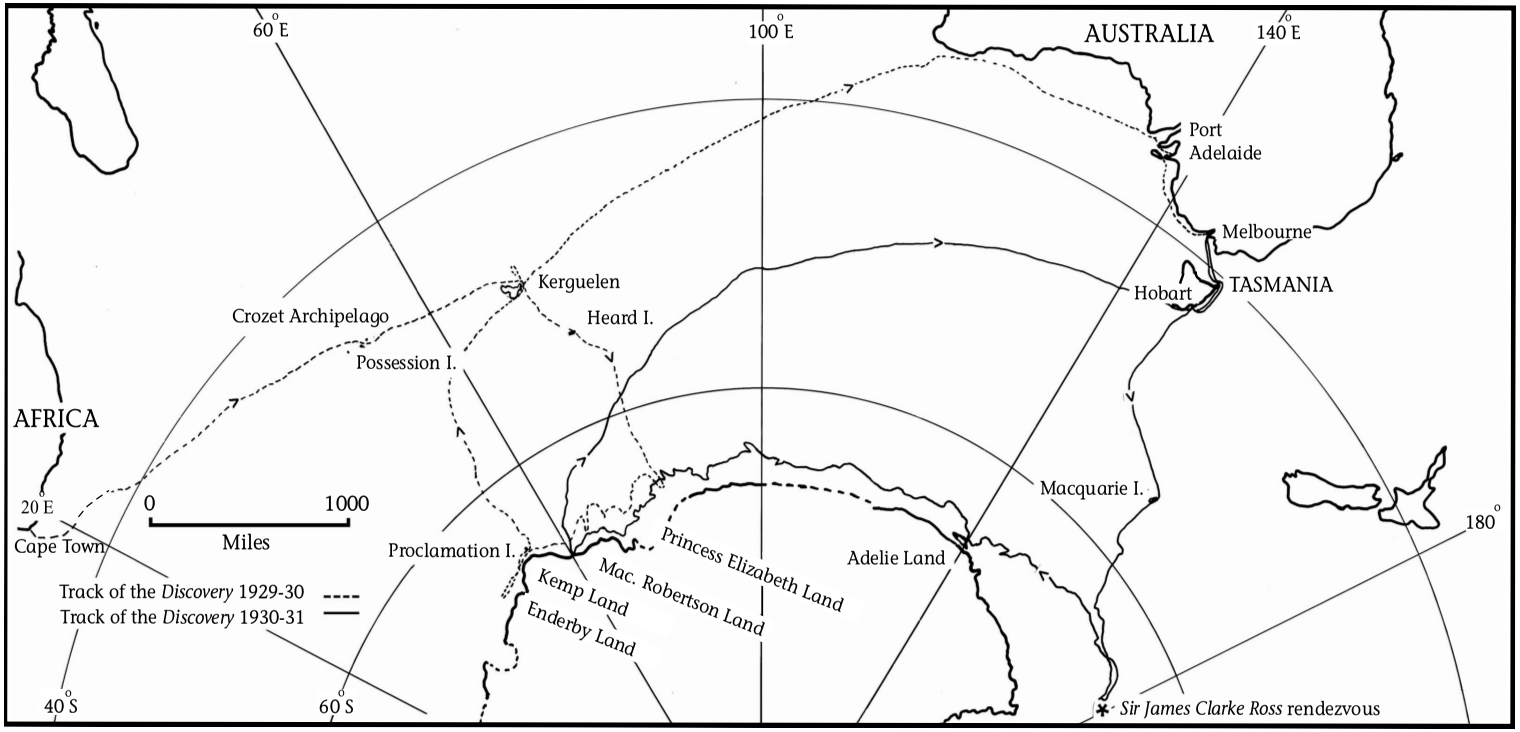
On both BANZARE voyages, T. Harvey Johnston ensured that a whale and seal logbook was maintained by scientists and deck officers. Noon positions for these voyages are provided in Table 1. Most observations were limited to daylight hours (Table 10). Distributions of crabeater seals and killer whales were similar (Table 9). Their observations are the only reasonable sightings data for whale distribution and abundance off the Australian Antarctic Territory before Antarctic pelagic whaling began in earnest. G. J. B. Ross has compared the sightings rate of large whales from BANZARE voyages with catch and effort data for the 1930s (Table 8), and compared sightings rate with sightings data from recent minke whale assessment cruises sponsored by member nations of the International Whaling Commission (Table 12). The ratio of blue:minke whales from *Discovery* in about 1930 and from cruises of the International Decade of Cetacean Research about 1980 has changed from about 2.1:1 (5.1:1 if distance is not accounted for) to 1:266, a change of at least some 550-fold, and indicative of large-scale changes in the relative population sizes of these species in the intervening 50 years (Table 11). Descriptions of the whaling fleets encountered by *Discovery* are also included. Several small cetaceans have been identified from sketches made in the logbook.

Notes on seals and whales by Harvey Johnston include descriptions and sketches of the anatomy of the reproductive tracts of male and female elephant seals. The descriptions of the external genitals, especially the perineal region, are more detailed than previous information on the topic. Harvey Johnston's descriptions of pigmentation, hairs and scales are meticulous; they are compared with recent knowledge by R. A. Tedman.

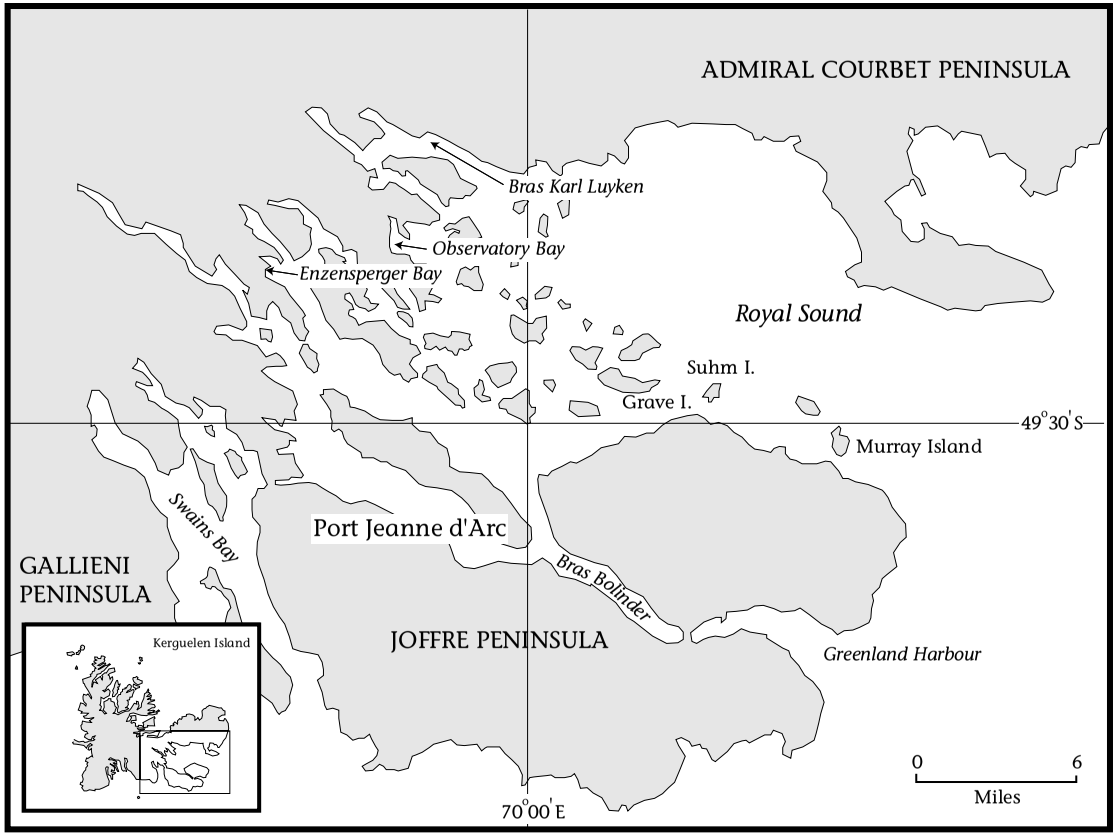
Harvey Johnston also described encounters between a killer whale and crabeater seal, encounters between a leopard seal and a crabeater seal, and the diurnal haulout pattern of crabeater seals. Measurements of several seals collected on BANZARE voyages are summarised in Tables 3 to 6. Extracts from Harvey Johnston's journal that concern marine mammals include a description of methods used to harvest elephant seals at the Crozet Archipelago in November 1929.

The report includes a listing of the many marine mammal specimens collected by the expeditions (Tables 13 and 14). It has been prepared with museum specialists J. Dixon, L. Gibson and L. Queale from the Museum of Victoria, Australian Museum and South Australian Museum, respectively, where the specimens are housed.

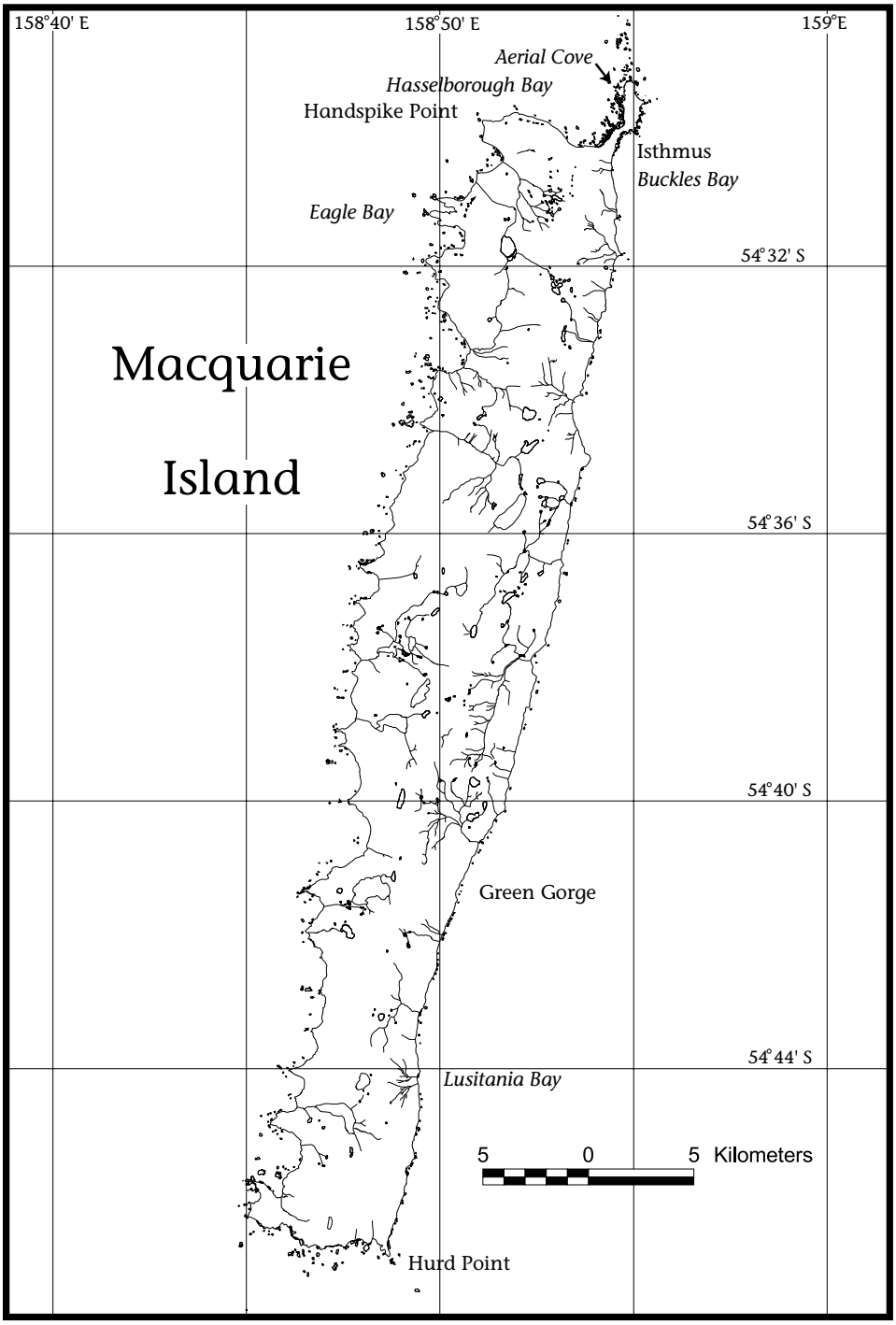
As noted by Erickson and Hofman (1974) in their review of antarctic seals, the first significant scientific contributions on the topic came from exploratory expeditions in the early 1900s. The same can be said of antarctic cetaceans. From then until the work on seals by Lindsey (1937) and Bertram (1940), there were few scientific contributions on antarctic marine mammals. Thus, at the time of the AAE (1911–14) and BANZARE (1929–31), little of substance had been written on marine mammals of antarctic waters. Scientists of the AAE and BANZARE had an opportunity to contribute to the knowledge of antarctic marine mammals when little was known of them. Contributions in this report show that useful material was collected, but little was made of the opportunity. Most of the information has been confirmed or supplemented by recent investigations. Much of it would have provided new knowledge if it had been published promptly. Nevertheless, information on many of the subjects covered here is still sparse.



Map 1. *Routes taken by 'Discovery' in 1929-30 and 1930-31 (based on Map 2 of Grenfell Price, 1962).*



Map 2. *Portion of Kerguelen visited by 'Discovery' in November 1929 and February 1930 (based on Map 3 of Grenfell Price, 1962).*



Map 3. *Macquarie Island, showing places mentioned in the text that were visited by members of the AAE in 1911–13 and of BANZARE in November-December 1930.*

I Introduction

Several brief notices announcing the publication of a report on mammals or marine mammals from collections and studies of the Australasian Antarctic Expedition 1911–14 (AAE) and the British, Australian and New Zealand Antarctic Research Expedition 1929–31 (BANZARE) appear in published reports of the expeditions. But, as several authors (e.g., King 1969) have pointed out, such a report has not been published.

The most informative notice is in Mawson's (1940) resumé of biological programs of the AAE, where he indicates that "biological reports appear as Series C of the Expedition publications… These have all been published with the exception of that dealing with Mammalia, which is in press" (p. 162). This is supported by a "List of reports dealing with the biological collections" (p. 163) where that on Mammalia is numbered 2 and attributed to "Dr. T. Harvey Johnston (Adelaide)." At the end of the list Mawson notes (p. 165) that reports on Aves and Mammalia are joint ones dealing with observations of both the AAE and the BANZARE. The joint report on "Aves" was produced by Falla (1937) as a BANZARE report entitled "Birds". A list of reports on its inside front cover included "Reports on mammals (in preparation)" as Volume III of Series B.

That a joint report on mammal studies and collections made by the AAE was to be included in the BANZARE report series was also advertised on the covers of several AAE reports. But the most recent listing of reports of the BANZARE (Koltun 1976) does not include one on mammals.

Some information on marine mammals of the AAE has been published. Mawson's (1942) geographical narrative of the Expedition refers to seals and cetaceans seen and collected by shore parties and from *Aurora*. Similarly, notes are included in the geographical report of BANZARE which was conducted from *Discovery* (Grenfell Price 1962). In both instances the information is provided chronologically. Internal parasites of marine mammals collected by the AAE and BANZARE have been described, eg by Harvey Johnston and Mawson (1945). In addition R. A. Falla reported briefly on marine mammals observed at Macquarie Island by BANZARE (in Crowther 1933). Some other publications from the expeditions that refer to marine mammals are discussed in Section III of this report.

Pertinent archival material is held at the Mawson Antarctic Collection, University of Adelaide and was formerly held at the Mawson Institute for Antarctic Research, University of Adelaide. It includes several packets containing notes, manuscripts and typescripts, and several albums containing photographs relating to marine mammals collected and observed on the AAE and BANZARE (Innes and Duff 1990).

Plate 1. *O. Bauer (sealing headsman) pointing out the best anchorage to Captain J. K. Davis on 'Aurora' at Macquarie Island (AAE, Photo: J. F. Hurley)*

There is also a report from the little-known drift through pack ice of *Aurora* on Shackleton's Imperial Trans-Antarctic Expedition, 1914–17 which has been edited and published (Shaughnessy 1990).

Section II of this report comprises the eight reports on marine mammals by expeditioners of the AAE and BANZARE. Their location in the Mawson archives is indicated in Appendix 1. Other likely topics in the subject index of the guide to Mawson's papers (Innes and Duff 1990) did not provide further material.

The most comprehensive of the AAE reports is an incomplete manuscript (12 pages) entitled "Mammalia" and a typescript (7 pages) containing most of the same material entitled "Extracts from Hamilton's notes on Plants & Animals of M.Q.I. [Macquarie Island]". Both were prepared by Harold Hamilton; there is a signed, undated note in Mawson's handwriting on the front of the manuscript stating that "These were notes which Hamilton had commenced putting together in form for publication when I took over the material from him." Hamilton was a biologist at Macquarie Island during the AAE and was one of a party of five who spent two years there. They arrived with Mawson's party on *Aurora* on 12 December 1911 (Plate 1) and departed on *Aurora* on 28 November 1913 (Mawson 1942).

The contents pages of Hamilton's manuscript indicate that he intended writing on three species of Cetacea and six of Pinnipedia, whereas only five of the latter species were covered, all from observations made at Macquarie Island. It refers primarily to the elephant seal and, presumably, was the "special study … of sea-elephants" to which Mawson (1915b) referred in summarising the achievements of the AAE. Hamilton's material reproduced here (section II.A) that concerns elephant seals and crabeater seals is from the typescript, as is most of that on leopard seals; material on the fur seal is from the manuscript. In addition, the manuscript has been consulted for clarification or to add a few details omitted from the typescript.

A second report on pinnipeds at Macquarie Island is by Dr Edgar R. Waite, then Curator of the Canterbury Museum, Christchurch, New Zealand, and later Director of the South Australian Museum, Adelaide (Jones 1992). Waite participated in the first subantarctic cruise of *Aurora* from May to July 1912. His typed report of 21 pages is entitled "Narrative of Sub-antarctic Cruises". Part of the section headed "The Vertebrate Land Fauna" refers to pinnipeds and is reproduced here (section II.B).

Waite was at Macquarie Island on two occasions. In 1912 he went ashore twice: at the northern end from 8–12 June and at Lusitania Bay from 14–17 June (Mawson 1942, p. 52). He visited the island again during the AAE, on 20 and 21 August 1913 aboard the New Zealand Government Cable Steamer *Tutanekai* on a relief voyage (Cumpston 1968, p. 261). His report of a Weddell seal encountered on that visit is included here. Waite's account of these journeys is recorded in his hand-written diaries, which are held on microfiche at the South Australian Museum (June 1912 journey on fiche number 72, August 1913 journey on fiche number 75).

Extracts are included from Dr J. G. Hunter's "Biological Log of Voyage of *Aurora* Nov. 19th 1913 to end Feb. 1914" of 40 typed pages (section II.C). His report covers the third and final antarctic cruise of *Aurora* (summer of 1913–1914). Hunter was Senior Biologist on the Expedition. As his log was cited extensively in Mawson's (1942) narrative of the voyage, it has not been included here in full, but pertinent observations of marine mammals are presented with reference to the appropriate page of Mawson's narrative.

Another report on pinnipeds is entitled "Ross Seals (section II.D). They were collected by the AAE on one occasion, during the third antarctic cruise (Mawson 1942, p. 93). Six animals were taken from fast ice at approximately 66° S, 92° E near Haswell Island on 21 and 22 January 1914.

The only identification of the author of the typed report of three pages on

Ross seals is the name "Ainsworth" at the top of the final page with lines drawn through it. Ainsworth was meteorologist and leader of the AAE party at Macquarie Island. He and other members of that party participated in the third antarctic cruise of *Aurora* , having joined it at Macquarie Island in early December 1913. It is possible, but seems unlikely, that Ainsworth was the author of this report, since he was not a biologist. The report is most likely to have been written by Dr Hunter. His "Biological Log …" of the third antarctic cruise (see above) refers to a report on Ross seals within the entry for 22 January. Portion of the report on Ross seals is reproduced here and some information from it is tabulated.

The only report solely on Cetacea (section II.E) was written by Captain James Davis, who participated in the AAE. He was "a whaling master, at that time lately retired and residing in Hobart" (Mawson 1942, p.61). In a letter to Mawson dated 31 May 1926 he wrote on whales seen on the second antarctic cruise (summer of 1912–1913). Those parts of the letter that concern Cetacea are included here.

Several notices in BANZARE reports suggest that Dr T. Harvey Johnston had worked on a report concerning marine mammals of that expedition. The only indications in archival material of such activity are notes on relevant literature and two manuscripts on marine mammals. One is the rough copy of "Whale and Seal Observations", and is presumably the "information regarding the occurrence of whales and seals during the voyage" referred to by Harvey Johnston (1937, p. 2). It includes sightings by biologists and deck officers, and enhances observations in the chronology presented in Grenfell Price (1962). It is included as section II.F. The second manuscript includes notes on seals at various localities, it is included as section II.G. In addition, Harvey Johnston kept a logbook: notes from it relating to marine mammals are collated in section II.H. He was Professor of Zoology at the University of Adelaide at the time of BANZARE, was Chief Biologist on that expedition, and was editor of some AAE and BANZARE scientific reports.

Details of the routes covered by various voyages of the AAE are provided by Mawson (1940, 1942). For the BANZARE voyages, information on the routes covered is summarised in the introduction to section II.F which deals with observations of marine mammals at sea. Noon positions for these voyages are provided in Table 1; they are taken from Harvey Johnston (1937).

In section III of this work, observations in the original reports are reviewed in light of current knowledge; pinnipeds in section III.A, T. Harvey Johnston's notes and sketches of the reproductive anatomy of elephant seals in section III.B, and cetacean observations in section III.C. Scientific names follow those used by Klinowska (1991) for cetaceans, King (1983) for pinnipeds and Christidis and Boles (1994) for seabirds; they are summarised in Appendix 2.

Many marine mammal specimens were collected by the expeditions. In section III.D, those that could be traced are tabulated and comments are provided on some of them. In the original reports (section II) museum specimen numbers are appended where possible in square brackets to descriptions of specimens.

Photographs to illustrate this work have been chosen from archives of the Mawson Antarctic Collection, University of Adelaide. They have been inserted into the text by the editor of this work.

Sketch maps are provided of the routes taken by the *Discovery* in 1929–30 and 1930–31 (Map 1, based on Map 2 of Grenfell Price 1962), and of Kerguelen (Map 2) and Macquarie Island (Map 3). An outline of the routes taken by *Aurora* during the AAE is shown in Fig. 2 of Mawson (1942). Since few places visited on those voyages are referred to in this work, a map showing the voyages is not included here.

As noted by Erickson and Hofman (1974) in their review of antarctic seals, the first significant scientific contributions on the topic came from exploratory expeditions in the early 1900s. The same can be said of antarctic cetaceans. Examples of detailed contributions from that era are Wilson (1907), Hepburn (1912 and other papers) and Lillie (1915). From then until the work on seals by Lindsey (1937) and Bertram (1940), there were few scientific contributions on antarctic marine mammals. Thus, at the time of the AAE (1911–14) and BANZARE (1929–31), little of substance had been written on marine mammals of antarctic waters. Thus scientists of the AAE and BANZARE had an opportunity to contribute to the knowledge of antarctic marine mammals when little was known of it.

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II Reports

Plate 2. *'Old Bill', an adult male elephant seal at Macquarie Island (AAE, Photo: H. Hamilton)*

II.A Extracts from Hamilton's notes on the Plants and Animals of M.Q.I. (Macquarie Island) H. Hamilton

II.A.1 Sea-elephant *Mirounga leonina*

(a) Occurrence of sea-elephants on Macquarie Island

For well over a century Macquarie Island has been the stronghold of the sea-elephant (Plate 2), although it is found also at the Kerguelen, Marion, Heard, Crozet and Guadalupe Islands.

Since 1820 this animal has been hunted for the oil contained in its blubber. In these early days the methods of obtaining the oil were simple and crude (Plate 3) and only in the last 20 years has any systematic seal-oiling been done (Plate 4). Notwithstanding this fact, it is evident that Macquarie Island will be the home of these seals for years to come.

The parties that work the island generally kill an average of about 400 large elephants (per year) (Plate 5), but from the inaccessible nature of parts of the coastline, there will always be safe breeding grounds for the elephants. The sealers only kill elephants that come up on The Isthmus in the vicinity of the boiling down works and probably only operate on one mile of coastline. One has only to visit the remote rookeries during the breeding season to realise the enormous numbers of these elephants.

In one rookery about ¼ mile (400 m) from the works on the west coast over 400 cows were counted. At Eagle Bay there was another large rookery of well over 500 cows. Up and down both coasts there were hundreds of other rookeries. After seeing these it is impossible to think that the sea-elephant will ever be exterminated by human agency on Macquarie Island.

A very conservative census taken during the breeding season of 1913 produced an estimated population of 25 000 animals.

(b) Seasonal

About 15 September 1912 the cow elephants started to arrive and congregate on beaches. For some days previous the bulls had been cruising round but did not venture ashore. By 22 September the cows had arrived in large numbers and the earliest arrivals had calved. Meanwhile large bulls had been selecting rookeries and waging war with intruders. The midnight was then disturbed by their bellowing. Strenuous battles were always occurring in the water near

Plate 3. *Sealers rolling barrels up the beach at The Nuggets, Macquarie Island (AAE, Photo: H. Hamilton)*

Plate 4. *Sealers landing a boiler at The Nuggets, Macquarie Island (AAE, Photo: H. Hamilton)*

rookeries and the noise was truly alarming.

Rookeries are generally formed on a large sandy or shingly beach having clear access to the sea. Large rookeries may have three or four "boss" elephants but there seem to be definite boundaries to each bull's demesne.

Eventually some old bull would establish his reputation as a fighter and no other would dare give battle. Then he would take charge of his rookery and live in comparative peace for a few weeks. Occasionally another bull would lure him into a fight to decide the question of supremacy. It was clearly a case of the survival of the fittest. As bulk is a great factor in deciding fights it is easy to see why the male elephant grows to such a large size. Only the largest and strongest elephants dominate the rookeries so that the progeny results in a large elephant.

By 12 October [almost] all the cows had given birth (Plate 6) and only a few very late arrivals produced after that date. The young "pups" are weaned in 3 weeks and during that time the bull does his duty (Plate 7). As soon as the cow has been served she leaves the island for sea to fatten up for the moulting season.

On 3 November there were very few cows left on the beaches. On 20 December at Lusitania Bay many of the elephants were on land casting their coats. This is an operation taking several weeks to accomplish and it is then that the elephants use mud baths or wallows which are generally some distance from the sea at the base of the hills. At West Point [Handspike Point] elephants were to be found lying in the tussock over ¼ mile (400 m) inland.

After taking a mud bath the elephants congregate and wait for their skins to be cast off. After this operation is complete they return to sea, probably until the next breeding season.

Meanwhile this season's pups have been at sea feeding. After March and all through winter these young ones stay near the island, coming up on the beaches for occasional spells. During February a few large bull elephants are to be found but they seldom stay on shore for more than a day or two.

(c) Size

The size of sea-elephants has often been greatly over estimated. I took particular care to measure any large ones and conclude that 20 feet (6.1 m) is an exceptional size for an adult bull. Most measured (by an accurate steel tape) from 16 to 18 feet (4.9 to 5.5 m). The cows never grow beyond 12 feet (3.7 m) and on average measure about 9 feet (2.7 m).

Plate 5. *De-blubbering an elephant seal at Macquarie Island (AAE, Photo: H. Hamilton)*

Plate 6. *Elephant seal cow and pup at Macquarie Island (AAE, Photo: H. Hamilton)*

Plate 7. *Elephant seals copulating at Macquarie Island (AAE, Photo: H. Hamilton)*

(d) Food

I was particularly anxious to find out what these elephants live on. When the first of the season came up and were killed I examined their stomachs and found hundreds of cuttlefish beaks. From subsequent observations it seems that cuttlefish is the staple food of the sea-elephant. Once however I found fish remains in the stomach. It is hard to say where the elephant obtains this cuttlefish because no specimens of this beast were ever seen on the beaches or round the rocks.

(e) Locomotion

Elephants are powerful swimmers and can move through the water with great rapidity. The tail flippers are the principal organs of propulsion, the fore flippers being used for turning and diving.

On land the fore flippers are used as levers for thrusting the enormous bulk of the elephant along. It is surprising what a rapid pace large bulls can reach especially on a slight declivity. One has to run quickly to get out of the way.

(f) Habits on land

As a rule the sea-elephant is a timid, inoffensive brute except during the breeding season. Then the bull in charge of a rookery will often attack a human being

who ventures within the rookery proper and disturbs the cows. One old wall-eyed elephant, known to the sealers as "Old Jimmy", was specially aggressive and would make towards any human intruder, uttering horrible threats in the shape of bellowings. This elephant had a special antipathy towards a cook named Jimmy who used to interrupt his loving dalliances. The bull always recognised Jimmy and used to chase him out of the rookery. Evidently the elephants have a distinguishing power.

(g) Habits in water

As would be expected an elephant shows to best advantage in the water. During the progress of the breeding season the water near a rookery is a scene of much activity. Here all the younger and disappointed bulls congregate with any eye to stealing a march on the boss of the rookery. These unattached bulls cruise about in the water and hide in the kelp, at the same time keeping a sharp eye on affairs on land. Perhaps the "boss" of the rookery may be lured into battle by some adventurous newcomer anxious to test his skill and strength. While the argument is proceeding these stray bulls will make for the shore and endeavour to break into the rookery of cows. When the "boss" settles the fight and returns there is a hurried rush for the water on the part of the intruders. It would seem that these elephants are arrant cowards and will not engage in fight unless they think they can defeat their opponent. If a bull sees a larger one approaching there is no question about fighting; rather, hurried flight is the order of the day. In fact skill counts for little in a contest as weight alone tells.

The favourite position in the water is with the nose and eyes just showing and the tail flippers waving in the air. The elephants are able to stay like this, floating in the one spot without being moved by the waves.

The wonderful nose is evidently a most useful organ to an elephant. They are able to smell out the position of a cow although she may be hidden hundreds of yards away. This mobile nose is ever being directed towards the land and worked about with a sniffing movement. I am inclined to the theory that the extraordinary development of the nose is accounted for in this way. When in the water the elephant wants to smell what is going on without exposing the rest of his body, or at least as little of it as possible. Therefore by developing nostrils that can be directed at right angles to the axis of the neck, the elephant can keep his body under water and still have them projecting above the surface. All that can be seen of a lurking elephant are eyes and nostrils.

(h) Offence and defence

The extraordinary development of the canine teeth of a sea-elephant is undoubtedly the result of a high degree of specialisation. Both the upper and lower canines are larger than other teeth. They are embedded in bone for five-sixths of their length, to withstand the tremendous blows received during a fight.

A battle between two large bulls is an impressive sight. Recognised preliminaries precede a battle. Take, for instance, the settling of a dispute as to who bosses a rookery. A bull has established himself in charge of a rookery and is challenged to come out and fight by some bold knight errant. The challenger (usually in the water) metaphorically "throws down the glove" by bellowing forth that he is anxious to meet the "boss" in mortal combat. This usually awakens the "boss" and if he thinks the foeman is worthy of his steel, he bellows forth his answer. Then for some time a purely wordy warfare is carried on, the combatants at the same time making towards one another. The elephants have certainly some means of gauging their opponents' strength by means of their bellow. Many fights are settled by roaring, without the contestants meeting.

Most battles take place on the beach or in shallow water. If neither challenger nor challenged give way, they rush to meet one another, rearing up as high as they can to gain an advantage.

Suddenly one elephant will throw back his head and make a terrific lunge at his opponent. Back goes the head of the one struck at and the blow is met on the thick hide below the chin. The other fellow has his turn at striking and so on, the object being to tear one another with the powerful tusk [canine tooth]. Frequently they both strike at once and the resulting impact is terrific. Jaws get interlocked and there is a wrestle to throw one another to the ground. Should one be unfortunate enough to overbalance and come to the ground the other fellow is down like a ton of bricks, ripping and tearing away with his tusks. Although the skin is very tough and the teeth blunt, I have seen ghastly wounds caused by fighting and many elephants have at least one eye knocked out. Fights seldom last long, as the holder of a rookery is generally an old and seasoned fighter. Back goes the winner to his cows and all is quiet again (literally). We saw many fights for the possession of cows, but seldom was the reigning monarch deposed.

(i) Vocal

The elephant has a wonderful vocal organ judging by the noise he can make. Newly born pups make a barking noise accompanied by whinings, similar to those of a young dog. The cow makes weird noises, sharp short barks and curious whinings that seem to indicate maternal solicitude. When a young pup barks the

mother immediately answers in a key that the young one can recognise.

In a rookery of several hundred cows the noise is wonderful. When annoyed by a human being, elephants of both sexes make a choking, belching sort of noise probably with the idea of intimidation. Loudest of all is the roaring of militant bulls. At night the sound carries wonderfully and can be heard a mile away from the centre of emission. This is the battle cry that warns off intruders.

(j) Sleep

Elephants are sound sleepers and often lie in the same position for days, possibly asleep all the time.

(k) Senses

Elephants have a keen sense of sight but apparently not over great distances. The sense of smell is highly perfect and is probably the most used of all their senses. They do not seem to be quick of hearing — the ears being small and ill-developed.

Young elephants (pups) have a very sensitive skin and are always scratching themselves. They dearly love to be tickled under the fore flipper — a place they cannot reach themselves. If taken young, I think the elephants would become tame easily and would be intelligent enough to perform tricks, etc. Pups up to a month old can be handled with ease and seldom object to being stroked.

(l) Pups

It is rather anomalous that the progeny of bull and cow sea-elephants would be called a "pup". The sealers always refer to them as such and I have adhered to the name. From their habit of barking they certainly remind one of a dog pup. On 4 October 1913 a young pup 55 inches (1.4 m) long weighed 102 pounds (46.4 kg).

(m) Birth

I never actually saw the process of pupping but understand that the navel cord is broken by the mother moving away from the pup. The placenta comes away an hour or two after birth. A pup is over 5 feet (1.5 m) long at birth and covered with thick black fur. The eyes are open when it is born. Suckling is carried on at the two teats of the mother for 3 weeks and then weaning by desertion takes place. During these 3 weeks the pup grows at an amazing rate and gets to be nearly as broad as long. A deposit of blubber about 3 inches (7 cm) thick forms under the skin and shows that the milk must be of exceptional nutritive value. After about a fortnight

Plate 8. *A leopard seal at Macquarie Island (AAE, Photo: C. A. Sandell)*

the black fur begins to lose its colour and gradually a new skin of bluish grey hair on the back and whitish on the belly is formed.

(n) Body temperature

Body temperature (°F) was measured in three animals in the heart with the following results: 98.2, 100.1 (animal had been moving), 98.2 (shot while asleep).

II.A.2 Fur Seal *Arctocephalus* sp.

Although many hundreds of thousands of fur seals have been taken from Macquarie Island, it is sad to record that none was seen during our two year stay on the island.

II.A.3 Sea Leopard *Hydrurga leptonyx*

The sea leopard (or tiger) does not breed on Macquarie Island, but occasionally visits the shores (Plate 8). During winter (May, June and July) these seals are most abundant, generally coming up in pairs to rest on the sand. The first sighting of the season was in Aerial Cove on 4 May 1913. The largest specimen I saw was about 12 feet (3.7 m) long, the average size being about 8 feet (2.4 m). We often

saw them swimming about the rocks on the look out for food. Occasionally we saw these seals capture and eat cormorants and penguins. They have a curious habit of following the boat, coming within a yard or two of the stern and sniffing around. Although the sea leopard on land appears savage and irritable, they are really timid and always flee from human intrusion.

I examined the stomach and intestines of many beasts and always found parasitic worms. Remains of penguins, shags and fish were often found in the stomach. On 8 July 1913 an animal 6 feet (1.8 m) long was killed that had been eating kelp [specimen not located].

A female sea leopard 10 feet (3.0 m) long killed on 9 July 1913 contained a young *in utero*, apparently within a few days of birth. It was cut out and placed on the beach while the mother was skinned. The young was covered with long fur of a tawny yellow colour. It was so far developed that it made off down the beach and was about to enter the sea when recaptured [possibly Aust-M2499 and 2500, skins].

On 11 July 1913, a leopard seal 11 feet (3.4 m) long was killed on the beach near "1st creek" [Buckles Bay] and skinned [specimen not located]. On 13 July 1913, two leopard seals were observed at "the cove" [Buckles Bay or Garden Cove].

On 21 November [1913] a sea leopard with young *in utero* was killed at North End [The Isthmus]. As no sea leopards were seen or known to have their young on land, it is suspected that they are born in the sea [possibly Aust-M2499 and 2500, skins].

The body temperature of one animal was measured in the heart at 99.7°F.

II.A.4 Crab-eating Seal *Lobodon carcinophagus*

This common Antarctic seal occasionally strays as far as Macquarie Island. Two specimens were taken, one at Green Point [Green Gorge?] on 22 August 1913 (skin preserved in formalin), the other on 10 September 1913 at North End [The Isthmus; specimens not located].

II.B Narrative of Sub-antarctic Cruises; the Vertebrate Land Fauna E. R. Waite

Mr Hamilton, who spent two years on the island, is writing on this subject, but some independent notes in narrative form may be of interest.

II.B.1 Sea-elephant *Mirounga leonina*

On landing through the surf, my attention was first attracted by sea-elephants which, on account of their superior size, demand notice. Several visits to the subantarctic islands of New Zealand had familiarised me with the smaller sea lion (*Phocarctos hookeri* Gray).

It has recently been stated that in consequence of the operations conducted in connection with the oil industry, the sea-elephant at Macquarie Island is on the verge of extinction. I was pleased to find that, although I did not get more than a mile distant in any direction from the hut of the party at North-east [Buckles] Bay, I was among literally hundreds of the animals. I was fortunate in being on the island during the season the animals pass on land. The creatures are so ponderous and their blubber so thick and heavy that it is not possible to carry much at once; consequently the men engaged in the industry derive most benefit from animals which come ashore near the digesting plant. Beaches in the vicinity are piled high with bones, and the bogs and sward above high water are strewn with putrefying carcasses. With the exception of the blubber, the animals are left to decay where they are killed. Although there is no immediate prospect of the sea-elephant at Macquarie Island being exterminated, one is led to inquire why the Tasmanian Government should permit such terrible slaughter in the interests of one man who avers that he makes very little profit from the industry.

A mere statement of the maximum length of the animal gives no adequate idea of its size, although I fancy that in this respect there has been considerable exaggeration. I have read that an old bull attains a length of 30 feet (9.1 m), but the sealers place the maximum at 26 feet (7.9 m). This includes the hind flippers which extend considerably beyond the body. The largest animal I measured totalled 17 feet (5.2 m) in length and 13 feet (4.0 m) in girth, although it certainly was not the largest seen.

Sea-elephants are met with on beaches, in pools among rocks, among tussocks or in evil smelling bogs, sometimes packed closely together to the number of thirty or more. They remind one of so many large pigs or perhaps a herd of hippopotami under similar conditions. Only a few individuals were swimming in the sea at this season, although it is in the water that their food is obtained.

An enormous quantity of food must be required to supply the demands of such a colony of large animals. Mr Hamilton tells me that cuttlefish enter largely into the composition of their food. At the Auckland Islands I found that sea lions were also feeding upon cephalopods, a subject to be again referred to.

The stomachs of sea-elephants that I examined contained no food but each held several pounds of small shingle. As the practice of swallowing shingle is indulged by seals generally, I formed the opinion that it is taken to aid digestion, much in the same way that birds swallow grit. It appears strange that an animal having no gizzard should swallow stones for digestive purposes, although it appeared to me that this was the only explanation of the practice. It has been suggested however, that pebbles are gathered up inadvertently and swallowed with the food. Dogs and other animals often pick up undesirable matter with their food, but appear to shake it off before feeding, and it is scarcely conceivable that the seals swallow pebbles from mere accident. Sealers on the island believe that stones are swallowed with the object of increasing the weight of the animal to enable it to descend deeper in search of food, and that it possibly empties its stomach of stones to ascend to the surface. This extraordinary suggestion is somewhat discounted by the fact that, as later mentioned, I have found masses of stomach stones disgorged by seals on land.

Stones taken from the stomach of one of our southern sea lions (*P. hookeri*) may constitute a double handful. But I have not seen individual stones much larger than a filbert. On the basis of analogy, it is likely that sea elephants swallow larger stones.

The stomachs of three hair seals (*Arctocephalus forsteri* Lesson), taken off the coast of South Australia were found to contain few stones, but of extraordinary size. These are preserved in the South Australian Museum. Three stones obtained from the stomach of one individual together weigh 814 g. Stomachs of another two hair seals each contained two stones; each pair of stones weighed approximately 335 g.

This surely disposes of the suggestion that the stones are swallowed by accident. The fact that all or nearly all seals obtained by man are taken on land and that it is in the stomachs of such specimens that stones are found, must equally dispel the ballast theory. It is scarcely conceivable that such large stones can be of much use for reducing food in the stomach. The food is largely fish and cephalopods which would be more easily digested than the red flesh eaten by land carnivores, which do not swallow stones.

As seals live largely upon fish, it is not unreasonable to suppose that occasionally one may experience the trouble of a bone in its gullet. Human beings are

advised to swallow some large hard object, such as a piece of potato in similar circumstances. The seal therefore might seize upon a pebble with the object of removing the obstruction. If only large and few stones were invariably swallowed, the hazard might be seriously entertained, but seeing that considerable quantities of small pebbles are more usually found in seals' stomachs, this suggestion must likewise be dismissed.

In an article on the food of the northern fur seals, F. A. Lucas (The Fur Seals and Fur-Seal Islands of the North Pacific Ocean, Washington, 1899, iii, p.66) mentions that stones and shells etc. are frequently found in stomachs of seals, and writes: "we really don't know why seals swallow hard substances".

The sealers told me that the elephants resort to the shore at two periods of the year, one for breeding purposes and the other for moulting. I had thought that moulting of seals was similar to that of horses and other land animals, but was told that not only is the hair cast, but the skin also. It comes away in large pieces leaving the new hair underneath and entirely rejuvenating the appearance of the animal. I obtained pieces of the slough; in fact they could be picked up among the tussocks or rocks. An examination indicates that the epidermis is cast with the hairs and their roots. The roots are almost as long as the free portion, so that the inner part of the slough appears to be as well clothed as the outer, although the covering is somewhat stiffer in texture. The many scars which mar the coats of bull elephants are not obliterated by sloughing and are carried for life.

As presently conducted the sea-elephant industry is most wasteful, neither the skin, flesh nor bones being utilised; the oil, as previously stated, being the only product. This is derived from the blubber which underlies the skin to the depth of 5 to 8 or 9 inches (13 to 23 cm). The yield of oil from one animal is half to three-quarters of a ton (500 to 750 kg), the value being about £21 per ton. It is used for a variety of purposes and is not greatly dissimilar to whale oil. The blubber is rendered down in steam digesters fed with the residue from previous operations. The animals nearest the oil works were naturally the first to be slaughtered. Apart from stray specimens, operations have to be conducted further afield and this means laborious carrying. The blubber is removed from the dead elephant, placed in sacks and carried by men on their backs, sometimes as far as two miles over rough country or loose beaches. Above high water mark the beaches are piled high with bones of elephants and penguins, representing the remains of millions of victims dating back many years. The present lessee of the island boils down over 750 000 penguins annually.

The habits of sea-elephants are of such absorbing interest that one is greatly tempted to set down personal experiences. As Mr Hamilton is in a far better position to deal with this subject, I merely mention that I was desirous of securing

a large, good example for the Canterbury Museum. In this selection several factors had to be considered. The first was accessibility. Four men were employed in carrying the skin of the animal secured from the tussocks to the whale boat. The specimen included skull and limb bones [possibly FMa221, articulated skeleton]. Operations had to be carried on rapidly, for Captain Davis was anxious lest a change of wind should prevent the whale boat getting back to the ship. I naturally wished to obtain as large a specimen as convenient and at the same time secure one as little disfigured as possible. Bull elephants when adult are very much larger than cows and are so scarred and disfigured with fighting that it would be impossible to obtain an approximately perfect example, while a well-scarred animal of course constitutes a natural example.

A study of the habits of the calves or pups, as the young ones are generally designated, would indicate that combativeness is first developed as playfulness, the young thus acquiring practice for their fierce battles of later life. The actual fighting between rival bulls is very ponderous but intensely earnest. It is continued to the accompaniment of loud bellowings and grunting, until one of the combatants has had sufficient for the time being. One sees long gaping, bleeding wounds or great scars in their sides; these are the result of previous conflicts. The damage may be much more serious. I saw several animals with but one eye, and felt inclined to end the sufferings of one poor brute, the eyeless socket of which was a festering cavity. A moderately young bull had lost most of its lower jaw, and I saw another with the greater part of one of its paddles torn off.

The sea-elephant is most tolerant of man, evincing little interest in him until he begins to make himself a nuisance. They may be roused by throwing sticks or stones, but it takes quite a lot of forcible persuasion before the beast can be driven into the water. So uneducated are these animals that when one is hit by a stone, an attempt is made to catch it; apparently the seal does not realise that the thrower and not the stone is the real aggressor. The expression of the animals is rather sad, perhaps due to their large round eyes.

The hind limbs have no forward movement so that the creature is ill-fitted for progress on land; it is indeed almost painful to see a large animal floundering among the rocks in the surf and kelp in its efforts to reach the sea. There it is perfectly at home and as rapid and graceful in its motions as it is slow and lumbering on land.

Young animals are more interested than their elders and try to warn off intruders by aggressive tactics. These seldom amount to more than an excessive opening of the mouth, with spasmodic barkings, developed from the throat alone, in which neither jaws nor tongue take part.

Sometimes a bull will assume offensive tactics and it is then advisable to keep in front of it, for it is surprising how rapidly such an unwieldy animal can turn on its own axis. By throwing its weight forward, a bull balances its body on the paddles, and a stroke from the uplifted flippers would inevitably land one into a most noxious puddle among the tussocks, if not on the back of another elephant.

In colour the bulls are dark grey or brown; the cows are much paler and the young are of very light hue. As a result of staining influences such as peat and decaying seaweed, sea-elephants of all shades of red and brown are seen.

II.B.2 Sea Leopard *Hydrurga leptonyx*

Many sea leopards came ashore during our visit, apparently to rest. When disturbed they raise the whole fore part of the body and exhibit their wonderful array of tricuspid teeth (Plate 8). They do not appear to utter sounds like the sea-elephants and sea lions. They are long bodied and of sparse habit. On land they progress with a sinuous, almost snake-like movement. Like these reptiles they are very flexible and bend the body quickly, but when I held one by the hind flippers, its object was escape rather than attack.

It is believed that the sea leopard breeds at sea, because no newborn young have been seen on land and full bodied females slip away to sea at breeding time. In further support of this, the animal is incapable of using its hind limbs after the manner of terrestrial animals, having them permanently directed backwards. This seal is therefore peculiarly adapted for aquatic existence and may therefore be said to approach more nearly in habit the truly aquatic mammals, namely whales: whales breed at sea, why not therefore the sea leopard?

II.B.3 Weddell Seal *Leptonychotes weddelli*

[On Waite's second visit to the island he was put ashore on 20 August 1913 at The Nuggets and walked to The Isthmus (Cumpston 1968, p. 261)]. The tussle against the wind was relieved by finding a Weddell seal lying at the foot of the tussocks on the beach. It evinced no uneasiness at our approach. Mr Leslie Hinge photographed it for me. On reaching the hut I reported the seal and believe Messrs Hamilton and Blake went to secure it [SAM-M310, skin]. They had not recognised the species on the island, and I am unaware if further examples were met with later.

A reference to my notes made as soon as we got under cover, and a comparison of the photograph with other illustrations and preserved specimens confirms the identification of the species.

Reference

Cumpston, J. S. 1968. Macquarie Island. *Australian National Antarctic Research Expedition, Scientific Reports Series A*(1): 1–380.

II.C Extracts from "Biological Log of Voyage of *Aurora* Nov. 19th 1913 to end Feb. 1914" J. G. Hunter

Hunter's Biological Log was cited extensively in Mawson's (1942) narrative of the voyage; it does not appear to have been published in its entirety. Extracts with pertinent observations of marine mammals are presented here. Page numbers in this section refer to Mawson (1942); geographical positions are from Hunter's Log and from Mawson (1942).

11 December 1913.
A large sea elephant sighted on pack ice. Noon position 64°56'S, 147°17'E (p.78).

3 January 1914.
Tonight about two miles (3.2 km) away there was a large whale coming well out of the water. It showed a prominent dorsal fin, almost triangular in shape with an anterior border that appeared to be darker than the remainder of the fin. It appeared to be attacked by killer whales, at least there was some disturbance going on (p.85). Edge of pack ice; noon position 64°39'S, 134°36'E.

4 January 1914.
Whales again common, but only one close, which I did not see. Some members said it was a right whale as they could see no fin, but very often finner whales do not show their fin when they come to the surface (p.85). In pack ice; noon position 64°18'S, 132°24'E.

8 January 1914.
We killed a crabeater seal this afternoon. It was 7 feet 5 inches (2.3 m) from snout to tail and 8 feet 3½ in (2.5 m) from snout to end of hind flipper [MV-C7396, skin, skull, incomplete skeleton]. An ectoparasite was obtained from its axilla and a nematode from its stomach. Its stomach and small intestine were empty, but its large intestine was filled with reddish faeces. Its skin was a creamy yellow colour and slightly scarred (p.87). In pack ice; noon position 65°02'S, 123°12'E.

16 January 1914.
We entered the pack ice to ice the ship and obtained two crabeater seals for specimens, one a female measuring 8 feet ½ inches (2.45 m) and a male measuring 7 feet 6 inches (2.29 m) [Aust-M2502 and M2501, respectively, both are skin and skull]. Both were scarred — evidently they had been attacked by killer whales. Examined one for parasites but found nothing; its stomach and intestines were empty. What do these seals feed on? Their stomachs are always empty — even of parasites, yet they are an active species and one would expect to find fish

***Plate 9**. A Ross seal (AAE, Photo: J. F. Hurley)*

or cuttlefish in their stomachs (p.90). Noon position 62°59'S, 95°47'E.

21 January 1914.
[In the evening the ship made fast to fast ice about 8 miles from "Rookery" (= Haswell) Island. Nearby a Ross seal was found.] Its short head, small mouth and feeble dentition distinguished it from other seals. On our approach it puffed out its neck in characteristic fashion and uttered a most peculiar noise, holding its head erect and emitting a gurgling sound. It was a male specimen and moulting; olive brown above becoming paler laterally and still paler ventrally. The Ross seal is apparently not confined to pack ice; this fast ice is quite distinct from pack ice and some distance from it (p.90). Ship's position 66°28'S, 92°27'E.

22 January 1914.
Our search for Ross seals was magnificently rewarded; we obtained five more specimens, two females and three males [five of the six are Aust-M2505 and M2506, Aust-S1360, MV-C7298, SAM-M306; see Table 2]. Three of the skins were in good condition, one fair and one not good as a result of moulting (see later notes on colour, dentition, claws). From a male I obtained a single ectoparasite whilst McLean found nematodes and small tapeworms in stomachs, and larger

tapeworms in duodenums and intestines. There were no traces of any food. Hurley obtained some photographs of Ross seals (Plate 9) (p.90). Noon position 66°28'S, 92°42'E.

29 January 1914.
Tonight a leopard seal was chasing three crabeater seals. As soon as the latter came into deep water the leopard was after them and he kept them for a long time in water just above the ice foot which was too shallow for him. The leopard seal was about 12 feet (2.7 m) long. Do they scar the crabeater seals? (p.97). Anchored to fast ice. Noon position 65°05'S, 96°00'E.

6 February 1914.
In pack ice we saw numerous crabeater seals and a few leopard seals. Crabeater seals were often in pairs. Most were silvery white, although a number of them were dark brown dorsally passing to silvery white ventrally. Leopard seals sighted were single (p.101). Noon position 65°20'S, 90°16'E.

14 February 1914.
A dolphin (piebald coloured with a white band in front and behind its foreflipper) swam alongside and dived under the ship for most of the morning. The first mate also saw one yesterday (pp. 102 and 88). Open sea; noon position 51°25'S, 103°35'E.

15 February 1914.
Four dolphins (same as yesterday) were alongside this morning. Open sea; noon position 49°48'S, 107°06'E.

Reference

Mawson, D. 1942. Geographical narrative and cartography. *Australasian Antarctic Expedition 1911–14 Scientific Reports, Series A*, 1: 1–364.

II.D Ross Seals
G. F. Ainsworth or J. G. Hunter (?)

This seal elevates its head almost vertically and distends its throat wherein apparently is situated a resonance chamber. A successive booming sound (rather high pitched) issues as the animal opens its mouth. Residual air is finally expelled through the nostrils with a whistling noise, after which the head is lowered.

The general pelage coloration is very dark brown dorsally, becoming paler laterally to grey brown, and passing to a silvery grey ventrally. One form, however, shows a greenish yellow tint laterally passing to dark greenish brown dorsally and yellowish grey ventrally. The lower lip and under side of head is dark and upper lip pale grey. A pale ventral band extends underneath the fore flipper to margins of the hind flippers, the dorsal digit being dark, others paler. The pale band stops short of the lower chin. There are pale narrow markings extending from shoulder almost to hind flippers. They are most prominent just behind the shoulder and are slightly oblique; further behind they are not so well marked and are more nearly parallel to the length of the body. The markings extend just on to flippers.

The upper part of trachea is wider than the lower part and the posterior area with no cartilage is very wide. The stomach in all specimens showed a well marked constriction dividing it into two parts. No specimens had any food contents.

[Information on sex, body length, nails and teeth of six specimens collected on 21 and 22 January 1914 at 66°S, 93°E near Haswell Island is summarised in Table 2 or is set out below.]

No. 1 [Aust-M2505] Incisors are fairly well developed. Premolars and molars are regular. Two premolars in the upper jaw on left side posterior have fairly rudimentary cusps.

No. 2 [Aust-M2506] Incisors on the lower jaw are small. In the upper jaw four premolars and one molar are very small, as are cusps of the premolars. In the lower jaw on left side there are four premolars and one molar; their cusps are very small, except on the second premolar. On right side of lower jaw there are five premolars and one molar; the first two premolars are small, especially the second with very feeble cusps; the third and fourth have well-marked cusps; and the fifth has rudimentary cusps.

No. 3 [MV-C7298] The canines are small but the incisors are fairly well developed. On the left upper side there is a premolar, then a wide space without any signs of teeth or previous teeth, then two premolars and lastly a molar. They all have feeble cusps. On the right upper side there is a premolar, then a

wide space as before, two premolars with cusps, a molar, then a very small, apparently post-molar. It is conical and has no cusps. The first premolar has very rudimentary cusps; the second and third premolars have three normal cusps; and the molar has a simple posterior cusp.

On the lower jaw, molars and premolars have cusps. First premolars have a central notched cusp and other rudimentary cusps; the other premolars are markedly tricuspid. The molar has a posterior cusp.

No. 4 [SAM-M306] The lower incisors are fairly small; the upper ones are larger. Teeth of upper jaw have extremely rudimentary cusps which are almost absent. Teeth in the lower jaw have better formed cusps, excepting the first and second which are rudimentary.

No. 5 (for skeleton) [Aust-S1360] This is apparently a very old specimen, the teeth being very worn. Incisors and canines on both jaws are worn away leaving fragments only.

In the upper jaw there are four premolars and one molar. On the right side the first three are represented by very small particles only, probably having worn away; on left side the first two are also worn away. On both sides the fourth premolar is markedly cleft, each part being rounded and looking like two separate teeth. In the lower jaw there are apparently only three premolars and a molar; the first premolar on either side has disappeared.

No. 6 The dentition is good; all teeth are fairly well developed. There was no foetus in the uterus. The stomach contained nothing but nematodes.

II.E Whales
Captain James Davis

I joined *Aurora* and sailed from Hobart on 26 December 1912 on a voyage to the Antarctic to report on the species of whales seen on the previous voyage, such whales having been reported to be "Right" or Black whales [*Eubalaena australis*], known also as Arctic whales.

On 10 January 1913, we saw the first whales, position 65°S, 147°E; we also saw whales on 12 January, position 66°S, 144°E. These were "Sulphur Bottom" or Blue Whales [*Balaenoptera musculus*].

On 13 January, *Aurora* anchored in Commonwealth Bay (Main Base at 67°00'S, 142°40'E), and remained in the vicinity until 20 January. The ship then proceeded east along the Barrier to within 150 to 200 miles (240 to 320 km) of the Balleny Islands, returning to Commonwealth Bay on 1 February 1913. Whales were seen in large numbers whilst steaming along the Barrier, but only an occasional one could be seen in the offing.

On 8 February the ship left Commonwealth Bay and proceeded west along edge of the pack to Wild's Base (on Shackleton Ice Shelf at 66°18'S, 95°00'E). A large number of whales was seen almost every day during this voyage. We passed close to them, the whales being in schools of 25 to 30 and at other times in twos and threes.

We reached Wild's Base on 23 February and sailed again the same evening. Whales were numerous until 26 or 27 February, position 55°S, 98°E. We saw nothing more of whales during the remainder of voyage from Wild's Base to Hobart, except two or three "Fin-backs" [*B. physalus*].

Whales were seen from about 150 miles (240 km) east of Main Base, right along west and south to Wild's Base, but such whales were "Sulphur Bottom" or Blue Whales. "Killer" whales [*Orcinus orca*] were plentiful, but no "Right" or Sperm whales [*Physeter catodon*] were seen in the above mentioned localities.

II.F Whale and Seal Observations 1929-30 and 1930-31 T. Harvey Johnston

Introduction

The following is an expanded and edited version of brief notes kept as a deck log of marine mammal sightings made during BANZARE voyages aboard *Discovery* in two successive summers. A sketch map of the journeys (Map 1) is based on Map 2 of Grenfell Price (1962, pp. 22-23). Harvey Johnston (1937, p. 2) noted that he "recorded information regarding the occurrence of whales and seals during the voyage".

The first voyage began in Cape Town on 19 October 1929 and ended in Port Adelaide on 1 April 1930. The second voyage began in Hobart on 22 November 1930 and ended there on 19 March 1931. Details of the routes are provided by Mawson (1930, 1932), Harvey Johnston (1937) and Grenfell Price (1962). Briefly, the first voyage covered the coast of Antarctica from longitude 80°E, westward to longitude 45°E. The second voyage worked from longitude 180° westward to 60°E.

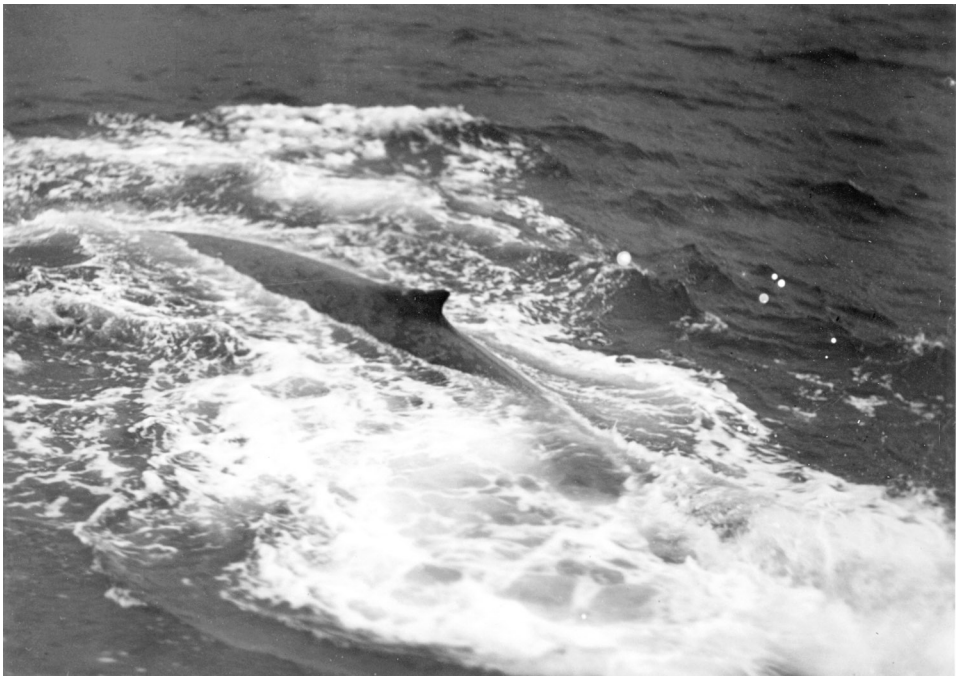

Plate 10. *A blue whale breaks the surface (AAE, Photo: unattributed)*

The geographical headings added here as a guide generally follow those of Grenfell Price (1962). Noon positions in Table 1 are from Harvey Johnston (1937), as are the positions of stations.

In addition, the vessel visited several subantarctic islands during the two voyages: Crozet Archipelago, Kerguelen and Heard Island (November 1929), Kerguelen (February 1930) and Macquarie Island (November-December 1930). A sketch map of Kerguelen showing sites visited by the expedition is at Map 2; it is based on that provided by Mawson (1934) and reproduced by Grenfell Price (1962, Map 3, pp. 38–39).

The dorsal fins of several small cetaceans were sketched by scientists on *Discovery* and included in the deck log. Some of the sketches are reproduced here (Figure 1); they have assisted Dr G. J. B. Ross with identifications (section III.C). The *Discovery* scientists also identified large whales in the deck log, but only one of these can be identified from photographs (e.g. Plates 10–12).

Observers

Scientists aboard *Discovery* who made observations frequently are referred to by their initials, as follows: RAF, Falla; THJ, Harvey Johnston; FH, Hurley; JWSM, Marr; DM, Mawson. In addition, other expeditioners and several deck officers contributed to the log, including Mr Child, Mr Colbeck and Mr (later Captain) MacKenzie. Unless otherwise noted, remarks in the deck log appear to have been written by T. Harvey Johnston.

Observations 1929-30

Cape Town to Crozet Archipelago

Table Bay, South Africa
19 October 1929
11h00 Three porpoises were sighted; they were probably *Delphinus delphis* [common dolphins] (THJ).

20 October 1929
Whales were sighted by the officer of the watch.

21 October 1929
17h30 One fin whale was idling close to the ship.Two porpoises (probably *Delphinus delphis*) were sighted (THJ).

17h30 Several (at least four) small whales were idling on the surface. Their dorsal fins were rather low; they were probably *Balaenoptera acutorostrata* [minke whales]. They were playing on the surface approximately 300 to 800 yards

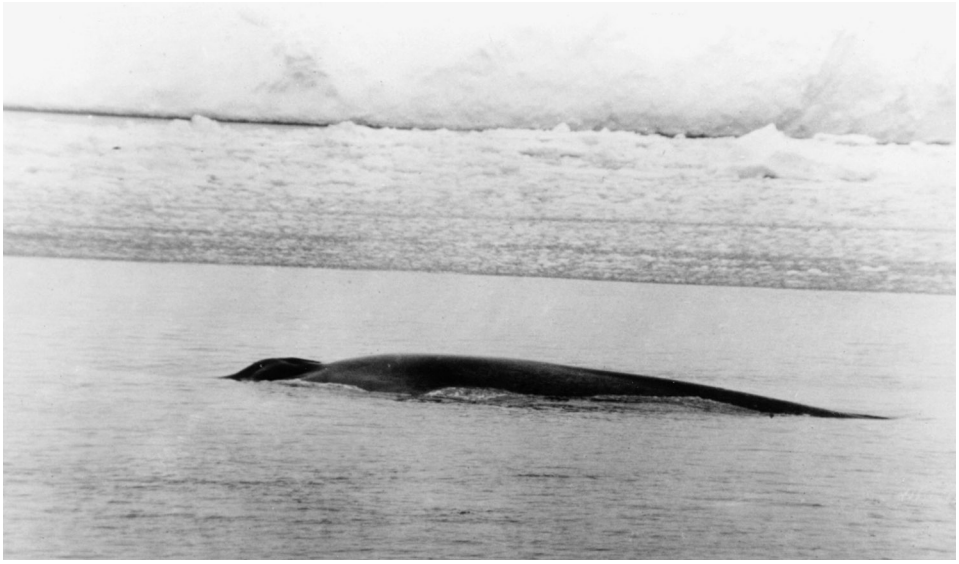

Plate 11. *A rorqual basking on the surface at the pack-ice edge (AAE, Photo: D. Mawson)*

Plate 12. *A rorqual basking (AAE, Photo: J. F. Hurley)*

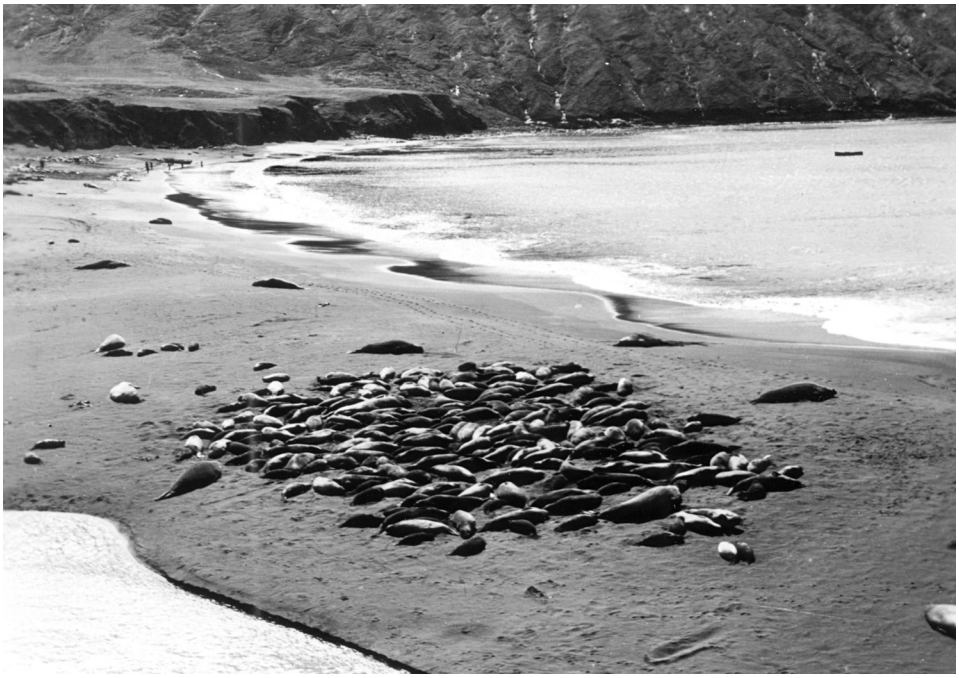

Plate 13. *An elephant seal harem on the beach at American Bay, Crozet Archipelago (BANZARE, Photo: J. F. Hurley)*

(270-730 m) off the port quarter and probably moving south-easterly (THJ).

26 October 1929
08h30 About 12 *Globicephalus melas* [long-finned pilot whales] were sighted near the port quarter. They travelled with the ship for about 5 minutes (RAF).

13h30 One finner was sighted on the starboard side about half a mile (800 m) away. Five (at least) were on the port side for about 15 minutes. One swam close to ship after doubling on its course and came within about 100 yards (90 m). Some were perhaps two miles (3.2 km) away. Their dorsal fins were showing clearly and they were identified as fin whales (THJ).

30 October 1929
07h30 A school of *Globicephalus* sp. appeared from the port quarter and approached to within 20 yards (18 m) of the ship. They travelled near the ship on the port quarter for 15-20 minutes. The wind and following sea were approximately force 5 and it was raining. There were 40 or 50 in the school. Their colouring was brown-black with a white marking or streak on the visible shoulder behind the dorsal fin [Fig. 1a]. They were approximately 12 to 15 feet

(3.6 to 4.5 m) long, although we did not observe their tails break the surface. The whales dropped astern at approximately 08h00. They were probably the same species as that shot by G. W. Rayner off the South African coast in R.R.S. *William Scoreseby* (JWSM).

16h00 A whale was seen by the Chief and Second Officers close to the ship's bow.

Crozet Archipelago

2 November 1929
Two killer whales were seen during the afternoon as the ship approached anchorage at American Bay, Possession Island (Plate 13).

3 November 1929
19h00 Two killer whales were seen while the ship was at anchor.

Crozet Archipelago to Kerguelen

8 November 1929 (47°59'S, 67°31'E)
11h00 A very large whale on the starboard bow produced several spouts (DM).

13h00 Two large blue whales were about 200 yards (180 m) from the starboard bow. They produced vigorous blows, had a low dorsal fin and were travelling west. Whalebirds [prions; *Pachyptila* spp.] were associated with the whales (THJ, RAF).

18h00 A whale was reported by the Third Officer some miles away on the starboard bow.

Kerguelen

12 November 1929
Five minke whales were close to the ship (2, 1, 1, 1) soon after entering Royal Sound. They had a falcate fin, with a light coloured patch on either side of it. They were rolling leisurely in quiet water. Four were on the starboard bow and one was in front of the ship. They had a low blow.

16 November 1929
A killer whale was sighted in Royal Sound about 3 miles from [Port] Jeanne d'Arc. The Master of *Kilfinora* informed me that humpback whales were caught earlier in the season off the north end of Kerguelen. Blue whales were caught later and are the only kind at present being caught and treated by *Radioleine*. Parasites (*Penella*) are not observed here by him. Fin and sei whales are taken occasionally; they do not utilise minke whales.

23 November 1929
Part of the skeletons (comprising part of the skull and vertebrae) of blue whales (?) and a number of small whales were found washed up on Graves Island.

Heard Island

[26 November–3 December 1929]
Sperm whale jaws and vertebrae were found in Atlas Cove and on neighbouring beaches. Part of the heads of two small dolphins were also found [specimens not located].

Heard Island to Mac. Robertson Land

5 December 1929
12h00 The Third Officer saw a large fin whale.

7 December 1929

06h30 A large whale (probably a fin whale) was close to the ship's bows and heading north-east (Chief Officer, JWSM, DM, RAF).

18h00 Three large whales (probably blue) were sighted from the masthead (FH).

19h30 A whale blowing at intervals of 3-5 minutes passed from ahead to the port side in an east-north-easterly direction ½ mile (800 m) away. It was too distant for identification, but from the blow it was probably a fin whale (JWSM).

8 December 1929
09h00 A large whale (?blue) with its dorsal fin showing was blowing frequently and idling near the surface close to the port beam (THJ).

10 December 1929
The ship passed an unidentified seal on the pack ice during the morning and a crabeater seal at 04h30 (DM).

More crabeater seals and an emperor penguin were passed later in the afternoon. A whale was seen during the late afternoon.

11 December 1929
The Chief Officer noticed six seals on the pack ice during the 04h00 and 08h00 watch. One (unidentified) had a pup.

Several crabeater seals and emperor penguins were seen between 08h00 and 09h00.

Unidentified seals and crabeater seals were seen at intervals during the day on pack ice. One was in the water and then climbed on to low ice.

18h30 A high, vertical whale spout was seen in the distance amongst loose pack ice. The whale blew three times at intervals of ½ minute and then sounded (RAF).

20h15 High vertical spouts from a large whale (probably a blue) were sighted on the starboard beam for several minutes in the pack ice. The whale was travelling

more or less west (THJ).

21h00 A blue whale with a low dorsal fin blew close to the starboard side of the ship and then sounded. Crabeater seals were near the ship on ice (THJ).

12 December 1929
Several crabeater seals were on the pack ice. Most were alone, but two were on one floe; one of the seals was male (THJ).

11h00 A blue whale with a high spout was seen not far from the ship.

11h35 Two whales were blowing high more or less simultaneously, at about one minute intervals for many minutes. They were about two miles off the port beam amongst pack ice (THJ).

17h00 Two high blows were sighted frequently. They were near each other and some distance off the starboard bow amongst pack ice (THJ).

13 December 1929
03h00 A large blue whale about one mile (1.6 km) north-west was seen by the officer on watch.

03h30 Two adult crabeater seals and a young one were on a floe close to the ship (THJ).

14 December 1929
10h30 Two tall blows were seen during the morning in the pack ice (blue whales). Several crabeater seals were seen lying on the ice during the morning and afternoon (THJ).

15 December 1929
17h00 At least nine blue whales were one to four miles (6.4 km) away and mostly south of the ship in small openings within the pack ice (DM). Several crabeaters were seen near the ship (THJ).

20h30 A whale with high spouts was sighted a few miles off the starboard quarter. Its blows were timed at around every 14 seconds (THJ).

22h30 A blue whale was blowing on the port side (DM).

16 December 1929
The following sightings were made today.

10h00 A leopard seal near the ship on pack ice (DM). Three crabeater seals during the morning (DM).

17h00 Two blue whales astern.

17h00 Minke whales playing and blowing beside the ship in a small patch of open

water. They crossed below the ship.

17h30 Four blue whales together some distance off the port beam. Two had very high blows.

19h30 Two blue whales with dorsal fins showing were about ½ mile (800 m) off the port beam.

20h30 A minke whale rose several times and blew close to the starboard beam. A large blue whale rose close to the starboard bow and blew twice. It sounded below an ice floe and came up about seven minutes later some distance off directly ahead in an open lead. It blew two or three times, sounded and then came up further ahead (THJ).

17 December 1929
06h00 A small whale was seen by the Chief Officer close to ship. His account indicates it was a killer whale.

11h00 A large blue whale was near the ship (DM).

11h20 A large blue whale and a small whale about 25 feet (8 m) long were very close to the ship. The later was possibly a young blue whale or perhaps a minke whale.

11h20 An unidentified seal (apparently a crabeater) dived under the ship.

15h30 A large blue whale close to the ship crossed its bows (Mr Colbeck). Four whales (blue) were seen at intervals during the afternoon; one was very close to the ship and crossed its bow.

16h20 A minke whale was idling close to the starboard beam. A large whale with a large dorsal fin was seen in the distance (probably a fin whale).

18h30 Blue whales were about ⅓ mile (530 m) off the starboard beam.

19h00 A small blue whale was idling and blowing with its dorsal fin exposed on the starboard quarter.

23h45 A minke whale was close to the ship on the starboard beam and another was close to the stern from 23h45 to 23h55 (THJ).

18 December 1929
09h00 A crabeater seal was lying on a floe.

A female leopard seal and a well grown pup were on a floe beside the ship. The female was at least 12 feet (3.6 m) long and the pup about 7 feet (2.1 m) long (DM).

22h00 A minke whale was travelling slowly close to the starboard side of the ship and parallel with it (THJ).

19 December 1929
04h15 A killer whale dived under the ship and swam near it (Mr MacKenzie).

12h00 An adult blue whale surfaced on the port bow three times and crossed the bows slowly in a westerly direction. It disappeared after the third blow.

12h30 Some killer whales were on the starboard beam (JWSM).

18h00 Two adult fin whales surfaced several times on the port hand forward. One had a large triangular pale patch on its right side near the dorsal fin (JWSM).

19h30 An unidentified seal was on a floe near the ship.

19h40 Two minke whales were blowing on either side of the bows for several minutes (THJ).

20 December 1929
11h30 A large crabeater seal was on a floe near the ship.

18h00 One blue whale was sighted on the starboard bow distant approximately one mile (1.6 km) moving in an easterly direction and blowing frequently. It then sounded and did not reappear for approximately 10 minutes during which time it had crossed our bows well ahead. It appeared again on the port bow distant approximately ½ mile (800 m) blowing frequently and moving in an easterly direction. It almost looked as if the whale had tried to avoid us.

21 December 1929
07h30 A minke whale was sighted off the starboard beam. A much larger whale off the starboard beam blew twice before sounding. It was estimated to be 50 feet (15 m) long, with a markedly falcate fin [the log contains a small sketch]. The description suggests a sei whale (FH).

10h30 A small whale (fin or minke) blew several times astern. It looked like a fin whale (JWSM).

A covered dart (number 3410) fired at a range of approximately 80 yards (73 m), fell very short and missed (Plate 14). Covered darts seem to be useless; the cover probably bursts in air. Several covered darts were fired later and all fell very short in the same way (JWSM).

23 December 1929
19h30 A minke whale blew several times close to the starboard beam. It sounded, came up near the ship, blew twice, went down again and then blew on the port side some minutes later (THJ).

Plate 14. *R. A. Falla on the deck of 'Discovery' with the whale-darting gun (BANZARE, Photo: J. F. Hurley)*

26 December 1929
Crabeater seals were seen on floes during the morning. Three were seen during the afternoon on one floe by the officer of the watch.

28 December 1929
A whale with a falcate fin was seen by the Third Officer during the early morning (THJ).

12h30 A killer whale was on the port beam.

29 December 1929
17h00 Two adult sei whales were swimming near the ship for several minutes. Two marking shots were fired; both shots missed. The whale's dorsal fin [the log contains a small sketch] was rather like that of a minke whale, but the whale was much larger. They had a rather diffuse blow, but the wind was strong. A killer whale was associated with them (JWSM and THJ).

30 December 1929
15h30 A large blue whale about 200 yards (180 m) (or less) off the starboard beam blew twice and sounded. It had a typical dorsal fin.

15h30 A very pale crabeater was seen by the officer of the watch.

Mac. Robertson, Kemp and Enderby Lands

4 January 1930
20h30 Two large blue whales blew four times on the port beam about 400 yards (360 m) from the ship and sounded. Their backs showed plainly but the dorsal fin was not recognised at that distance (THJ).

Falla from the barrel reports that there were two large and one small blue whales in the group. All were idling close to loose pack ice and swimming for some distance with backs exposed. They were on view from 20h30 to 20h55 and travelling leisurely towards the south-west (THJ).

5 January 1930
19h30 Several crabeater seals were swimming and feeding beside floes close to the ship. A leopard seal was also swimming near the ship (THJ).

7 January 1930
16h15 A minke whale was close to the ship's bows (THJ).

8 January 1930
07h30 Fifteen killer whales were seen by the Chief Officer close to the ship. Colour markings were recognised from Wilson's sketch [presumably Wilson (1907)] (THJ).

11 January 1930
Two Ross seals and several crabeater seals were seen during the morning (DM).

22h30 A school of a dozen or more killer whales was near the ship on the port side. Some had a very high narrow fin as illustrated by Wilson. The Third Officer estimated there were about 40 in the school (THJ).

12 January 1930
Sightings of marine mammals made today were as follows.

04h30 Four blue whales with very large spouts were on the port side, two between the ship and pack ice and two in the pack ice (Simmers and the Chief Officer).

09h00 A large blue whale was on the port quarter, about ¾ mile (1200 m) away.

09h00 A minke whale was on the port beam near the ship.

09h15 Two minke whales were about 200 yards (180 m) from the port bow (THJ).

11h00 A fin whale was seen during the morning. Also two whales with a low blow were near the edge of the pack ice between noon and 12h30 (DM).

12h15 Two crabeater seals were on a floe (THJ).

13h15 Three blue whales were just inside the pack ice (DM).

13h20 A blue whale was on the port beam about ¼ mile (400 m) away (THJ).

13h30 A minke whale was 50 yards (45 m) from the port quarter.

14h30 A blue whale on the port beam was swimming near the pack ice.

15h00 Two seals (most probably Weddell seals), one leopard seal (DM) and some crabeater seals were on pack ice near the ice edge (THJ).

13 January 1930 Possession Island [Proclamation Island]

A Ross seal, many crabeater seals and Weddell seals were on the pack ice. The last named were on pancake ice alongside the shore.

21h00 Two blue whales were blowing close to the pack ice inshore (RAF).

14 January 1930

The following sightings were made on this day.

08h00 There were several high blows on the starboard quarter. Approximately five whales, possibly fin whales were seen. A fin whale was approximately ½ mile (800 m) distant on the port side near the edge of the pack ice (JWSM).

10h50 Three whales with high spouts were at varying distances from the ship on the starboard bow, distant 2 to 5 miles (3.2 to 8 km) or more (THJ).

11h00 A large whale 200 yds (180 m) from the ship on the starboard side was travelling in the opposite direction. It blew twice and sounded, and then blew three times and sounded. Its spout was not very high. It was probably a fin whale (THJ).

11h40 A blue whale close to the port quarter travelled astern and westwards toward the starboard quarter. It blew many times (THJ).

13h00 A blue whale with a very high spout was 2 miles (3.2 km) or more ahead and close to the pack ice.

14h30 Two blue whales were close to the ship and near the pack ice: one was on

the port side and one on the starboard side.

14h50 A blue whale on the starboard side with a very high blow was some miles off.

Four whales seen between 14h30 and 14h45 include two of those recorded above (FH).

A whale (blue) was seen soon after lunch (DM).

16h40 Two blue whales were on the port beam near the pack ice and one was on the port quarter. An unidentified whale (with a smaller blow) was on the port bow. All were distinct animals (RAF).

17h00 The last mentioned crossed the ship's bows and travelled on the starboard beam in the opposite direction to the ship. It blew four times, but did not expose much dorsal surface and no fin was seen. It was apparently a fin whale. Its blow was not as high as that of a blue whale and was more diffuse (THJ).

20h20 Two blue whales were close to the starboard beam.

15 January 1930
08h30 Three blue whales were on the port side (bow, beam and quarter) close to the pack ice (THJ).

11h00 Of five blue whales, two were about 1 mile (1.6 km) ahead. The two closest to the ship were on the port side and others were seen by the Third Officer just previously; some of them obviously had spotted bodies (? finners). All were alongside the pack ice. [Blue whales rather than fin whales have spotted or flecked bodies].

11h30 A blue whale was sighted ahead in brash ice (THJ).

Many high blows were observed throughout the forenoon north of the pack ice and also at the pack-ice edge. Blue whales were close to the ship on seven occasions but were shy.

16h50 A high blow was seen near the pack ice.

16 January 1930 (skirting pack ice)
03h00 Mr Colbeck reported seeing a blue whale being attacked by two killer whales. One killer whale was holding on near the tail while attacking.

08h30 A blue whale was seen on the port beam a considerable distance off with very high blows.

13h00 A blue whale was on the port beam with very high blows.

15h00 Two other blue whales were seen (RAF).

15h15 Two blue whales near the ship and close to pack-ice edge were travelling

east at about 5 knots (FH).

17 January 1930
18h00 Two blue whales were seen travelling south-west (Mr Child).

18 January 1930
Williams observed (for 5 minutes) a killer whale attacking a large whale near the ship.

19 January 1930
A leopard seal swam towards the ship in very rough seas (high gale).

20 January 1930
A fin whale swam very close to the ship (JWSM).

21 January 1930
10h30 A whale bumped the ship (Mr Child). Simmers working on the forecastle head felt the bump. The whale was close to the ship and had dived, but not deep enough to miss it.

20h15 Two blue whales on the starboard bow were travelling east in company. Two others also in company were further off to starboard. All four had very high blows and were blowing at about the same time.

22 January 1930
Many whales were seen during the day.

Three killer whales were chasing a seal which was close to the ship and well away from the pack ice. The seal was captured after it turned and twisted quickly. The killer whales cut off the seal's retreat and made repeated dives at the seal before the latter was killed.

At least six blue whales were seen during the afternoon travelling very slowly east.

21h30 One killer whale was travelling east along the pack-ice edge at about 4 knots (RAF).

23 January 1930
Two blue whales were seen during the early morning (DM).

Proclamation Island

24 January 1930
Weddell seals were seen on the pack ice. One swam beside the ship.

25 January 1930
Seals (Weddell and Ross) were observed on the pack ice. Two Weddell seals were collected [presumably SAM-M8683 and SAM-M14893].

26 January 1930
Minke whales were feeding near the ship along the edge of brash ice. Weddell seals and one crabeater seal (?) were also seen.

The return

27 January 1930
08h30 Mr Child reported seeing six whales (as three pairs) travelling west by north on the port beam. Two were fin whales (dorsal fin seen) close to the ship and the other four made high blows. They were seen also by RAF and THJ.

Twelve more whales were sighted in the next half hour by Mr Child, who saw more later in the evening.

28 January 1930
A few whales (blue) were seen by the ship's officer.

29 January 1930
A blue whale seen by Simmers during the early morning was almost leaping from the water.

Kerguelen

18 February 1930
Simmers and others saw a small porpoise twice in Enzensperger Bay (Observatory Bay trip).

19 February 1930
Marr made notes on small porpoises seen near Observatory Bay.

Station 56 Bras Karl Luyken [Gulf of Morbihan]

20 February 1930, 11h00
Weather: blowing, heavy rain squalls off high cliffs with intermittent sunshine. A school of approximately 8 to 12 small porpoises approached the shore from the middle of the Arm (observer ashore). They came quickly to within 3 yards (3 m) of rocks in the deep water there, approaching almost in line abreast. They followed a course parallel to the rocks and then disappeared around a jutting place.

Movement: A quick porpoising movement, arching the back steeply. The head and dorsal fin were generally showing, but not the tail.

Length: 4 to 5 feet (1.2 to 1.5 m).

Colour: Generally black — a sort of dun black, with a hint of brown. There was a very distinct grey patch laterally from the head region to abaft the dorsal fin. In one animal this patch was much paler, and was almost white. The soft grey colour in the others was most striking and distinct. A sharp, clear line of demarcation separated the grey forward from the general black of the rest of the body [Fig. 1b].

Dorsal fin: Small and blunt.

Snout: Blunt. The snout and head were generally coloured dun black. The observer had a general impression of plumpness and shortness. It was very difficult to sketch this accurately as the porpoises moved quickly. But the observer clearly noted the distinct grey patch and the striking line of demarcation between grey and dark forward.

Blow hole: Fairly large (JWSM).

22 February 1930
Two minke whales were seen near Murray Island.

25 February 1930
A very large leopard seal came up near DM near Suhm Island [in Royal Sound]. After sighting him, it dived. A male elephant seal skull was taken back to the ship [specimen not located]. A number of carcasses were seen there and on Murray Island on 24 February.

1 March 1930
An elephant seal (a male, nearly adult) was seen amongst vegetation well above the beach on the mainland opposite Murray Island. A number of skeletons (male, female and young) were along the beach; they were from the last [harvesting] season and preceding seasons.

Kerguelen to Port Adelaide

15 March 1930 (Noon position 39°40'S, 106°18.5'E)
16h30 [Three] schools of porpoises were seen. One lot (about 10) was alongside the ship; another lot was some distance off the port bow, and another lot was some distance off the starboard bow. There were probably about 30 in total. They leaped well out of the water; they were evidently feeding on a school of fish and seemed to be hunting in line. Those at the ship's bows soon fell behind, feeding. Their characteristics were distinctly noted by Falla and Fletcher. They were seen

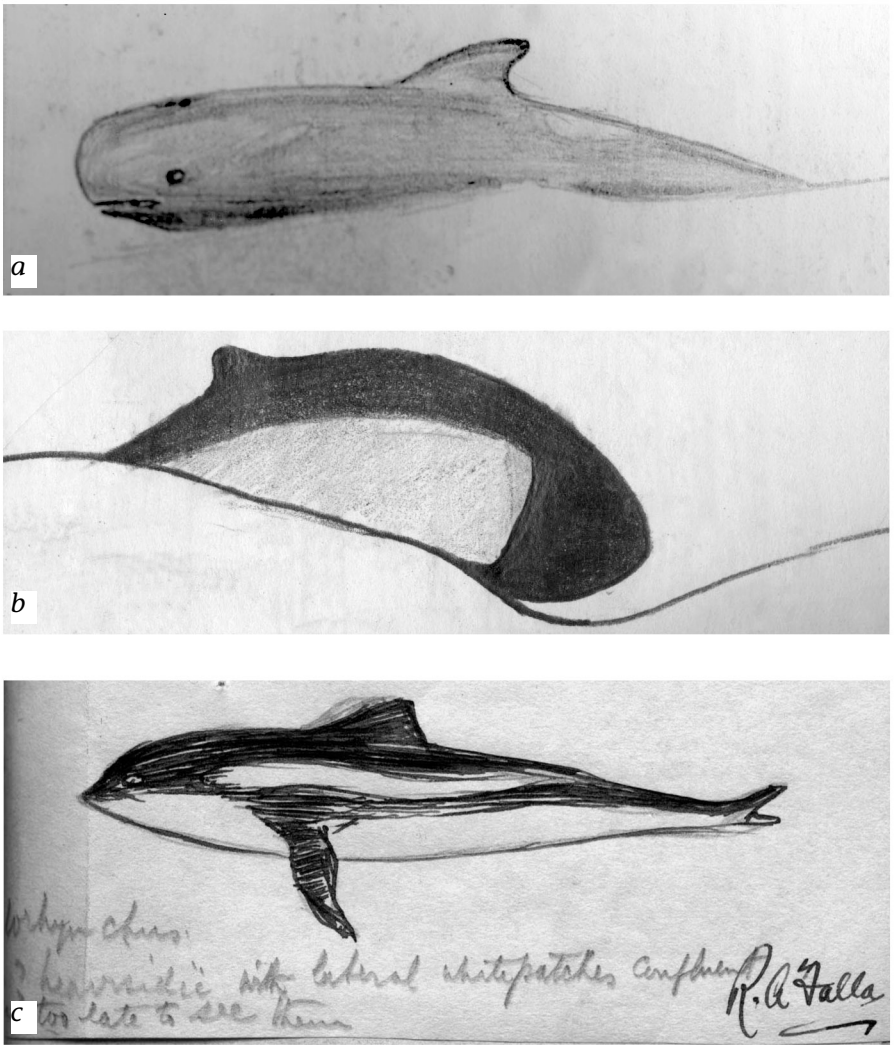

Figure 1. *Sketches of small cetaceans seen from 'Discovery' in 1929–30 and 1930–31. a) Long-finned pilot whale seen on 30 October 1929; noon position 43°36'S, 41°03'E (Sketcher was not identified in the log book; J. W. S. Marr wrote the entry, but the entry for 31 January 1931 implies that R. A. Falla was the sketcher). b) Commerson's dolphin at Bras Karl Luyken, Kerguelen on 20 February 1930 (J. W. S. Marr). c) Southern right whale dolphins at 50°25'S, 107°53'E on 7 March 1931 (R. A. Falla). Note: images a and b have been digitally modified, removing the heavy, ruled lines from the original writing paper.*

also by Mr MacKenzie.

Practically black body colour. Large triangular dorsal fin on a rounded back; snout was not prominent. The description agreed with Beddard's fig. 30, plate 18, except for the colour. [That plate is labelled "Heavyside's Dolphin (*Cephalorhynchus heavisidii*)", Beddard 1900]. Estimated length 12 to 15 feet (3.6 to 4.5 m). Their colour was like that of *Globicephalus*, but they had a different fin and head. They were identified as *Cephalorhynchus heavisidii*.

17 March 1930
10h20 A sperm whale followed astern of the ship for several minutes. It was 50 yards (45 m) away when nearest and had a grey-black colour with large, typical head. It was about 60 feet (18 m) long, with a small but very distinct triangular dorsal fin. It threw the anterior half of its body out of the water and rolled slightly. It blew when just awash, with the spout slightly forward [the log contains a small sketch].

21 March 1930
Morning. Some blackfish (*Globicephalus*) and also several schools of cowfish (*Tursiops truncatus*) [bottlenose dolphin] were sighted. The latter were playing under the ship's bows. A calf about 4 to 5 feet (1.2 to 1.5 m) long was with its parent; many others were also present, about 8 or 9 feet (2.4 to 2.7 m) long. Their colours were as described by Wood Jones (1925, p. 285).

Afternoon. About a dozen *Delphinus delphis* [common dolphin] swam close to the ship and played for a few minutes.

28 March 1930 (Noon position 35° 33'S 130° 12'E)
17h00 A rather low blow was seen several times about ¼ mile (400 m) astern (?humpback); no whale was seen.

Adelaide to Melbourne

4-8 April 1930
Many *Lagenorhynchus obscurus* [dusky dolphins] were seen (RAF and JWSM).

Observations 1930-31

Tasmania to Macquarie Island

22 November 1930 Tasmania
Afternoon Several small dolphins were seen in D'Entrecasteaux Channel. They had a dark grey back and a falcate shaped fin [the log contains a small sketch], and were tentatively identified as *Delphinus delphis*.

29 November 1930

A whale with a high blow was seen going south (blue or fin whale).

Macquarie Island

[1-4 December 1930]
Elephant seals were abundant on beaches at the North End and at Lusitania Bay. Most were pups and large males (not mature); some large females were also present and a number of mature bulls 18 to 21 feet (5.5 to 6.4 m) long. Of the last, some were aged or ill, others had just reached mating age (probably), since some attempted to copulate with young females or even with young males.

The carcass of a leopard seal was seen. The skull was cleaned and added to the collection [specimen not located]. Part of another skull was also seen.

Macquarie Island to 'Sir James Clark Ross'

10 December 1930, 16h35
Two whales were blowing on the starboard bow in company. They were about 2 miles (3.2 km) away and swam close to the ship. They were medium sized sei whales and were moving southwards.

11 December 1930
19h00 A crabeater seal was sighted on a floe.

12 December 1930
14h00 A crabeater seal was sighted on a floe.

13 December 1930
13h45 A crabeater seal was sighted on a floe.

A whale was seen during the late afternoon.

Three whales (blue) seen between 20h00 and midnight were very close to the ship. They comprised a single animal and a pair.

14 December 1930
11h30 The ship passed alongside a dead female whale which was inflated through decomposition [identified by T. Harvey Johnston as a blue whale in section II.H]. Silver grey petrels [Southern fulmars], nellies [giant petrels], Wilson's storm petrels and Cape petrels were on and around the carcass. Its flukes were not damaged. It was lying ventral side up; its fin was not seen. It was a small blue whale, about 70 feet (21 m) long. It had black baleen plates, and a greatly swollen tongue. Falla fired a whale mark into it.

Many blue whales and a humpback whale were brought in by whale chasers while we were there (Plate 15).

Plate 15. *A whale chaser towing a dead whale (BANZARE, Photo: W. R. Colbeck)*

Although sperm whales were in the area, they were not taken since there is no desire to mix the oil with that of the other three species. One sperm whale was seen by Hurley beside a catcher.

Plate 16. *The whale factory ship 'Sir James Clark Ross'*
(BANZARE, Photo: W. J. Griggs)

Plate 17. *'Discovery' approaching the whale factory ship 'Sir James Clark Ross'*
(BANZARE, Photo: T. H. Johnston)

15 December 1930
Sir James Clark Ross (Plates 16 and 17). A fin whale female was being used as a fender–long strips of throat blubber of fin and blue whales were also used as fenders (Plate 18). Many whales moored beside the ship. There were barnacles on humpback whales (male and female), on their throat and near their genital region. Fin whales (male and female) were present and many blue whales (male and female), some probably 85 feet (25.9 m) long. Some blue whales were on the flensing deck and the meat deck when we arrived.

'Sir James Clark Ross' to 'Kosmos'

16 December 1930
Humpback and blue whales were caught and some blue whales escaped.

A foetus about 6 feet (1.8 m) in length was floating near the factory ship. It had escaped from the viscera which are not utilised. Carcasses are sometimes thrown overboard if a rush of whales is brought in. Blubber and tongue are utilised, also bones. The meat is treated separately; viscera are not used at all. After oil is extracted from bones and meat etc., the refuse is dried, carried out by conveyors and thrown overboard when plenty of oil is available (Plates 19 and 20).

The *Sir James Clark Ross* was completed in October 1930 and is on its first trip. There is an account of it in the *Marine Engineer* of about that date or a little earlier.

The Third Officer reported seeing a small whale yesterday—his account would fit a *Minkehval* [minke whale] although he recorded it as a humpback whale.

17 December 1930
Afternoon. Numerous killer whales were sighted in small groups—two or three in each, with perhaps 20 in total. Some were near the ship. There were many birds in the vicinity. The whales had high fins and their body coloration was distinctly visible in some cases. Most were moving leisurely.

18 December 1930
A blue whale surfaced and blew alongside the ship during the evening (Mr Child).

19 December 1930
A whale blow was seen in the distance during the morning (RAF and THJ).

12h15 A whale blow was seen on the port beam.

20 December 1930
12h00 Two whales were seen in the distance this morning.

A pair of blue whales blew four times before sounding.

15h00 Two blue whales passed close to the ship's bows heading east.

15h30 One blue whale was seen on the starboard bow travelling east.

21 December 1930
Early morning. in the early morning Mr Colbeck saw three humpback whales idling near the ship. Two were side by side and one was nearby.

23 December 1930
08h00 Two blue whales were sighted (Mr Child).

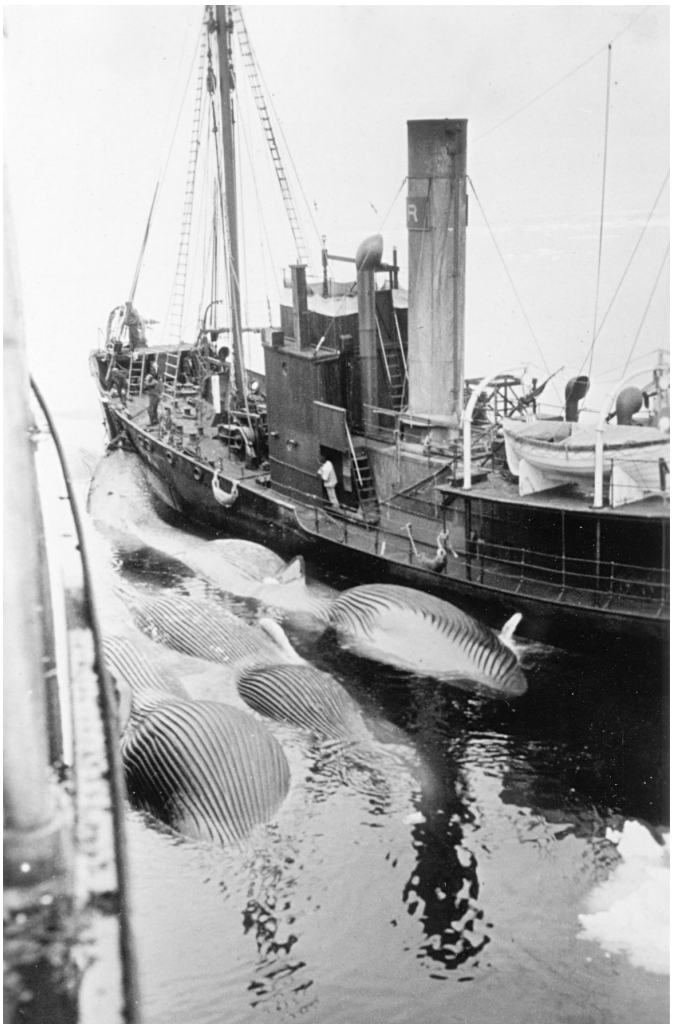

Plate 18. *A whale chaser alongside a factory ship; dead whales used as fenders (BANZARE, Photo: B. F. Welch)*

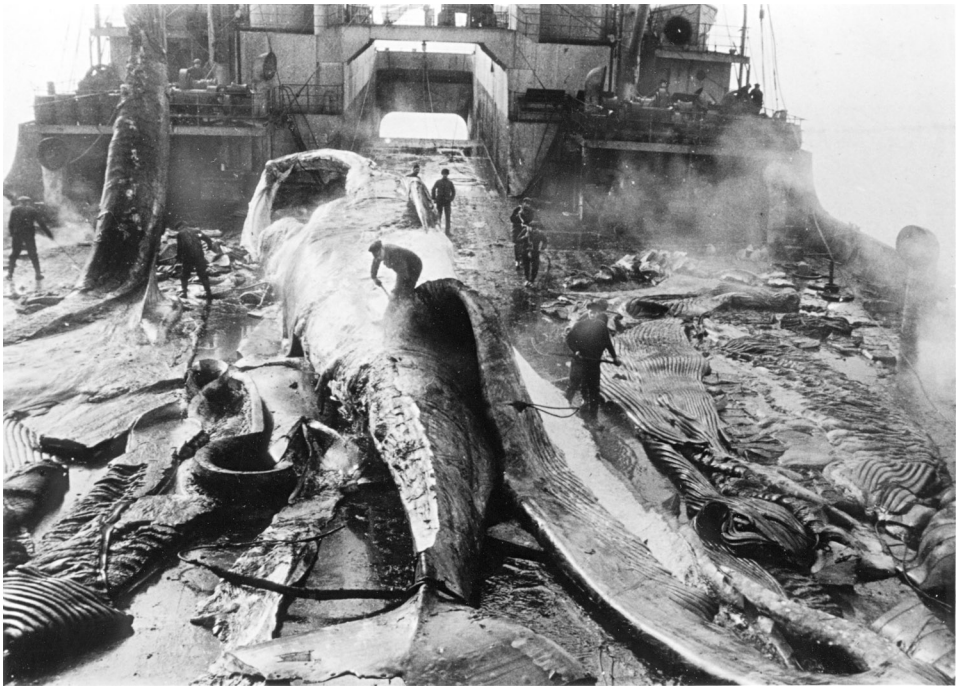

Plate 19. *Flensing operations on the deck of a whale factory ship (BANZARE, Photo: R. A. Falla)*

11h30 A whale was seen on the starboard beam travelling easterly; it blew twice (DM).

18h00 Three fin whales were seen (Mr Child).

26 December 1930
A crabeater seal was seen on a floe beside the ship.

28 December 1930
09h00 Two whales were sighted blowing.

18h00 Five or six whales were sighted blowing strongly.

Three whales with strong blows were seen in company on the starboard beam. Two were large and one was smaller (? parents and calf).

Two whales (with similar blow) were sighted further out on the beam at the same time as the preceding observation. A small sketch [in the log] shows the appearance of the blow in strong wind.

Other blows were seen soon after, probably belonging to some of the whales recorded above (blue or fin whales). A seal was seen swimming near the ship.

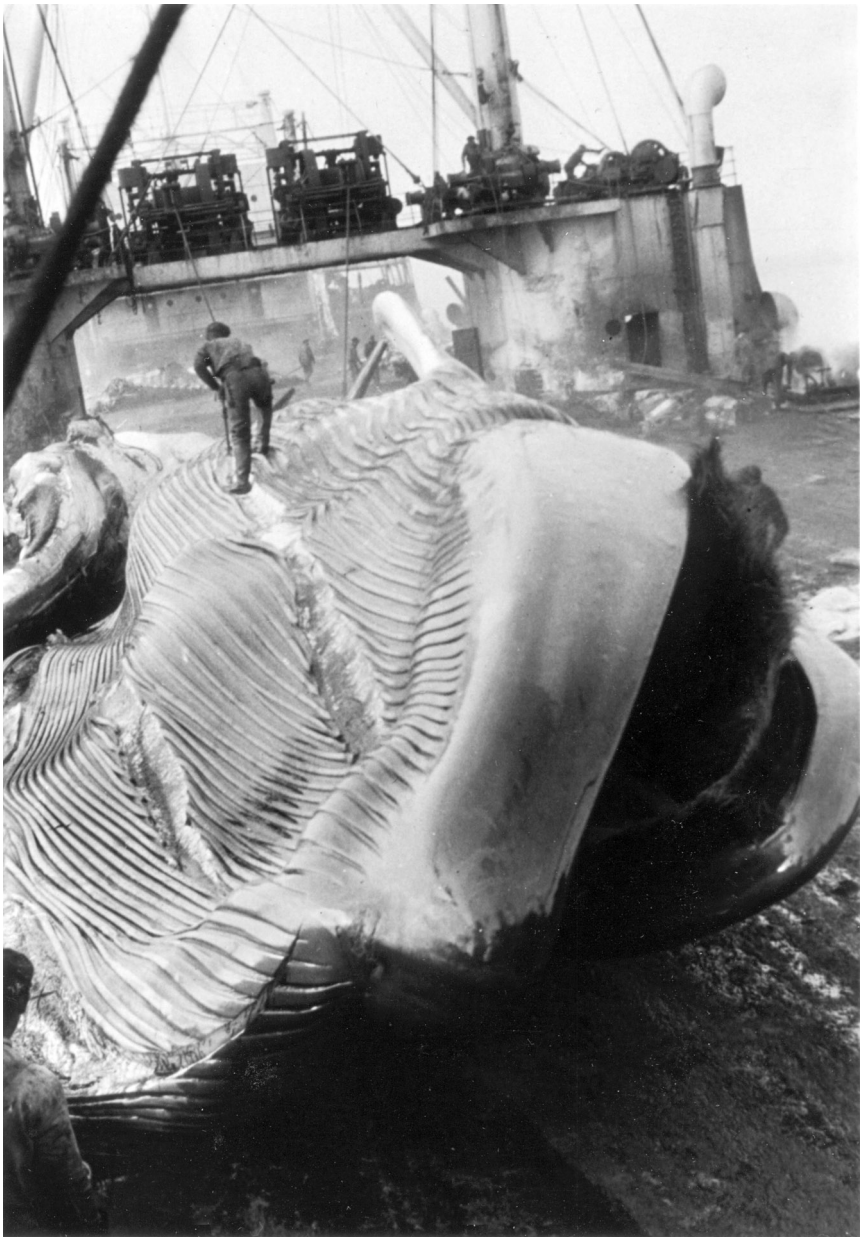

Plate 20. *The flensing deck of a whale factory ship looking aft (BANZARE, Photo: A. J. Williams)*

Mr Child reported seeing four whales during the afternoon (excluding those reported above).

DM was told that whales may sound as deeply as 500 fathoms (300 m) and stay down for 3 hours.

Kosmos chasers reach a speed of 12 knots and have a cruiser shaped stern.

29 December 1930
Alongside *Kosmos* (Plate 21). Twenty-two whales were taken that day until we cast off, of which all but two or three were fin whales. A chaser with three whales (at least two of which were fin whales) came alongside soon after [we departed] and two more chasers (each with at least one whale) arrived still later (Plates 22 and 23). The ship's officers told DM that the catch was chiefly fin whales at this distance from the pack ice and that blue whales were closer in to the pack ice.

Minke whales and others are said to become imprisoned and suffocated in pack ice. Sometimes whales are taken with damaged flippers and fins, suggesting injuries are caused by violent contact while trying to escape from pack ice. (Refer to pictures by Byrd (1930) of minke whales poking their heads out of leads in pack ice).

30 December 1930
Several crabeater seals were seen during the morning (08h00 to 09h30). Some were on floes alone; in one case four were on a floe alongside the ship. There were many scars on a large specimen. Pale coloration of the head was noticeable, especially in two more slightly built animals, along with a stripe along the side of their body. They move over ice without using their fore flippers, which are held against their side.

Mr Child reported several crabeater seals and a Ross seal (THJ).

1 January 1931
Afternoon A minke whale rose close to the ship in a large pool within the pack ice (Mr Colbeck).

19h00 One crabeater seal was on the edge of the pack ice.

2 January 1931
A small whale was seen just astern; it was probably a minke whale (DM).

King George V Land and Terre Adélie

5 January 1931
Falla saw a minke whale near the ship. Weddell seals were also seen.

Plate 21. *A whale being drawn up the stern ramp of the whale factory ship 'Kosmos' (BANZARE, Photo: E. Bond)*

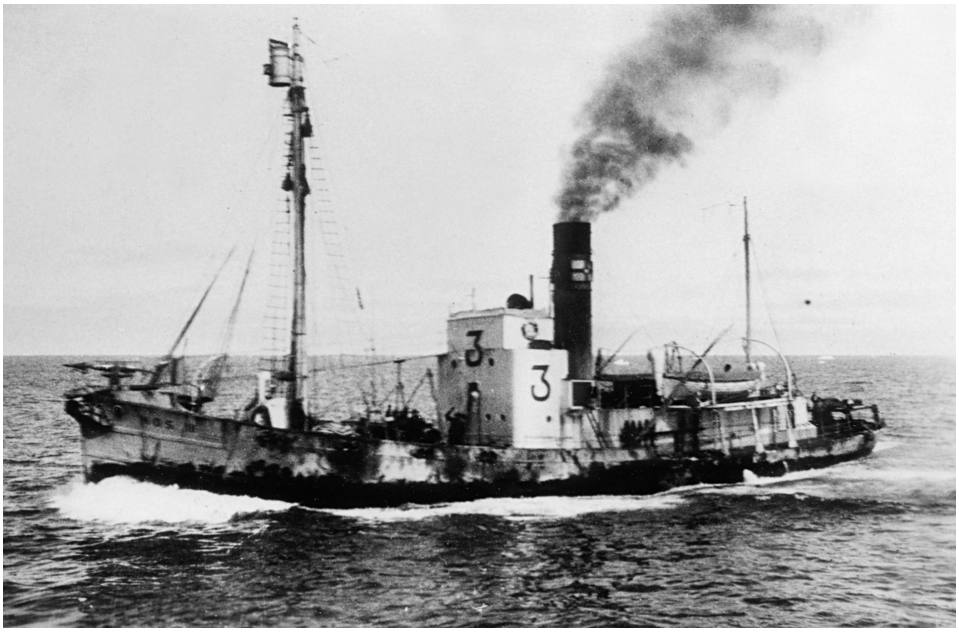

Plate 22. *The whale chaser 'Kos III' (BANZARE, Photo: A. Howard)*

6 January 1931
A small dolphin with triangular shaped dorsal fin [the log contains a small sketch] was seen off the MacKellar Islets. It arched its dark grey body slightly; no other colour was visible. Perhaps it is Wilson's *Lagenorhynchus* [hourglass dolphin *L. cruciger*] or a blackfish.

7 January 1931, Adélie Land coast
Noon A whale (blue?) was seen off the starboard beam near the ship (Simmers).

8 January 1931
Several crabeater seals were seen on the pack ice.

Three killer whales were sighted between 20h00 and midnight (Mr Child).

Westward to Princess Elizabeth Land

10 January 1931
Four whales (blue or fin) were sighted between 11h00 and noon (Mr Child).

13h30 One blue whale was idling alongside the ship (Captain MacKenzie).

12 January 1931
Two blue whales were sighted between 20h00 and midnight (Mr Child).

14 January 1931
Several crabeater seals were seen along the edge of the pack ice.

17h00 A fin whale was close to the ship (DM).

15 January 1931
11h00 A blue whale came up alongside the ship when near the edge of the pack ice.

14h30 Numerous crabeater seals were seen in the pack ice close to the ship. Five were on one floe; others were scattered about. Some were very light in colour, and some were heavily scarred; one had about five double rows of marks on its venter [the log contains a small sketch], apparently from killer whales.

Six blue whales were seen by Mr Child during his watch between 08h00 and noon.

22h00 One blue whale with a very high spout was seen. (The ship was close to or in the pack-ice edge during the day). A female crabeater seal was collected during the late afternoon [specimen not located].

A leopard seal pushed its head through the brash ice near the ship and ate Adélie penguins. It was shot by Falla (RAF) [specimen not located].

Plate 23. *Harpoon gun on the bow of a whale chaser (BANZARE, Photo: T. H. Johnston)*

16 January 1931
Noon One blue whale was near the ship (near the pack-ice edge).

16h40 Four minke whales (2 pairs) were idling near the ship, and two blue whales were about ¼ mile (400 m) off. All were near the pack-ice edge.

Crabeater seals were seen in the pack ice.

Six minke whales were seen by Mr Child between 20h00 and midnight.

17 January 1931
Two blue whales, two minke whales and another whale were seen by Mr Colbeck between midnight and 04h00.

16h00 Two very large blue whales were near the ship (alongside the pack-ice edge).

18 January 1931
Five blue whales were seen along the pack-ice edge by Mr Child between 09h00 and 10h30.

Several blue whales were seen during the afternoon, some of which were near the ship (close to the pack-ice edge).

19 January 1931
Crabeater seals were abundant on floes in pack ice surrounding the ship (190 were counted from the barrel by Mr Child). They all left during the early evening, apparently going to open water to feed.

20 January 1931
Many [crabeater seals] were seen returning [to ice floes] during the early morning and many were seen on floes during the day. The ship was still lying in the pack ice.

21 January 1931

Station 94 [64°28'S, 114°59'E]
A leopard seal and a crabeater were taken (Table 3, Plate 24).

A very large leopard seal (?male) was seen on the pack ice close to the ship.

18h00 Two minke whales were near the ship close to the pack-ice edge (Mr Child).

Several minke whales were seen between 20h00 and 21h00 (Mr Child).

20h45 A leopard seal was swimming around the ship.

21h00 A fin whale was alongside the ship.

22 January 1931
A few crabeater seals were sighted on the pack ice between 08h00 and 10h00.

Mr Colbeck saw a killer whale push hard through brash ice and obviously peer across floes. Several crabeater seals scuttled from water to floes.

24 January 1931
18h00 Two large blue whales were near the ship.

19h00 A blue whale was alongside the ship.

25 January 1931
A small blue whale about 50 feet (15 m) from the ship blew three times before sounding.

Three blue whales not far from the ship between 18h00 and 19h00 produced high blows.

26 January 1931 (alongside brash ice)
09h30 A blue whale alongside the ship blew three or four times before sounding. There were hundreds of crabeater seals on pack ice and amongst loose brash ice.

10h00 Two small blue whales were close to the ship.

27 January 1931
08h00 to noon Four blue whales and six minke whales were sighted by Mr Child.

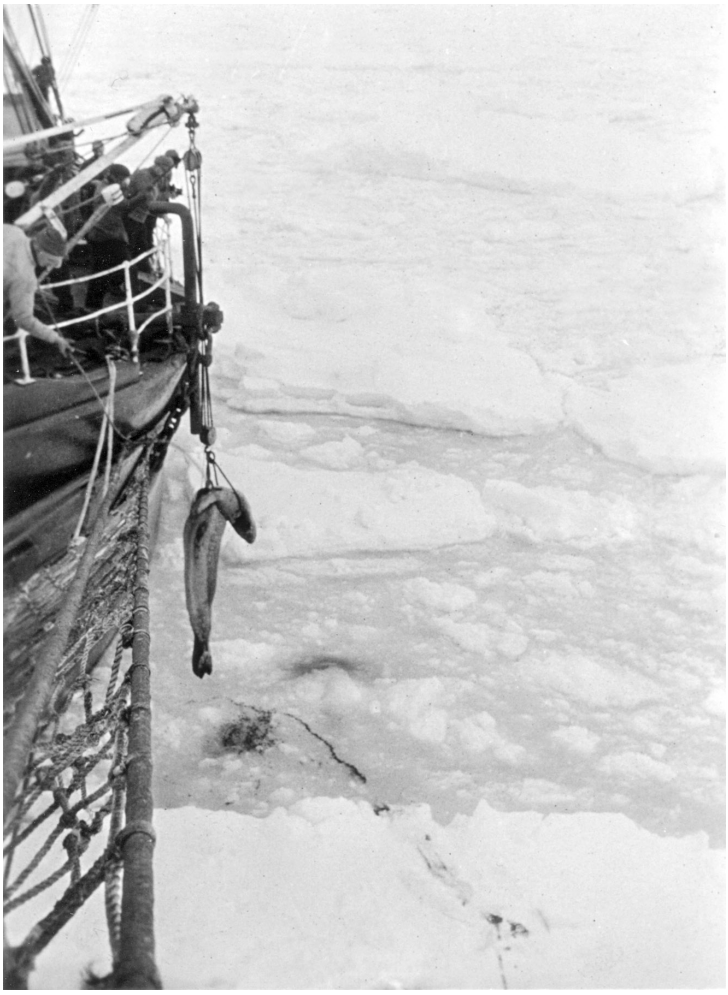

Plate 24. *Bringing a dead crabeater seal aboard 'Discovery' from pack ice (BANZARE, Photo: K. Oom)*

11h30 Fin and minke whales were alongside the ship (DM).

Crabeater seals and a leopard seal were seen on the pack ice while the ship was close to the pack-ice edge.

28 January 1931
A blue whale was sighted during the afternoon.

Two fin whales were sighted by Mr Child between 20h00 and midnight.

30 January 1931
The following whales were sighted: three blue (19h00, RAF); one fin and two

whales with high blows in the distance (19h30); three blue and six small fin whales (20h00–midnight, Mr Child).

31 January 1931
07h45 A small school of cetaceans was seen. They had high fins and resembled small killer whales.

A school of about eight cetaceans was seen on the port quarter. They surfaced independently while moving fairly fast. Most of the fore part of the body was projected out of the water. Their dorsal fin was high like that of a killer whale, but was more falcate. Their snout was similar in shape to that of a *Globiocephalus*. No colour patch was apparent in front of the flippers or behind the eye, but there was a well defined patch posterior and dorsal to the flippers that did not reach beyond the level of the dorsal fin. The remainder of the flank was black. Their size was estimated at 12 to 15 feet (3.6 to 4.5 m). They appear to be the new species of *Globiocephalus* with white flanks and can be compared with Falla's sketch of a similar whale seen on our last trip [Fig. 1a, on 30 October 1929] (DM, Oom and the ship's watch).

09h45 A blue whale was near the ship.

10h00 A blue whale was seen in the distance.

12h00 One minke, six blue and one other large whale (?fin) were seen by Mr Colbeck between noon and 16h00.

15h30 A small blue whale was seen on the edge of brash ice, and a large blue whale was in the distance.

15h30 Whale entrails were seen floating in brash ice, evidently from the Norwegian whaler *Alonzo*.

16h00 Mr Child reported seeing two Weddell seals on a floe in the pack ice between 16h00 and 18h00. His account suggests Weddell rather than Ross seals.

17h30 A few crabeater seals and a leopard seal were seen on floes.

Princess Elizabeth Land and Far Eastern Mac. Robertson Land

1 February 1931
Several crabeater seals were seen on pack ice.

21h00 Whale entrails and a whale carcass were seen in brash ice and pack ice today (drifted from the *Alonzo*).

2 February 1931
The ship was moving through loose pack ice all day. A leopard seal (large and very dark) was seen on a floe.

Noon A very large dark sea leopard and many crabeater seals were sighted on

floes. Crabeater seals can raise themselves a little on their foreflippers and use them to shuffle along, but usually they use only their shoulders as do leopard seals.

Other sightings of seals reported were: crabeater seals and a leopard seal (14h00); six crabeater seals and four leopard seals during the afternoon (Mr Colbeck); many crabeater seals during the day.

3 February 1931
Several crabeater seals were sighted during the morning while the ship was making way through pack ice.

4 February 1931
Animals seen today were: a minke whale in a small pool in the pack ice near the ship (10h00), a leopard seal and two crabeater seals (during the afternoon), and two fin whales (by Mr Child between 20h00 and midnight).

5 February 1931
A whale (? blue) was seen near pack ice just ahead of the ship.

6 February 1931
Four dead whales were alongside the whaler *Falk*. One blue whale and apparently one fin whale were partly flensed; the others were completely flensed.

7 February 1931
Some crabeater seals were seen on floes.

8 February 1931
A small whale (*Globicephalus* sp.) was near the ship during the morning with its dorsal fin and back showing in choppy seas (RAF).

Three whale factory ships were sighted today: *Tafelberg* (Irvin and Johnson, South African) was passed between 08h00 and 10h00, *Southern Empress* (Lever Brothers, British) passed during the morning and *Thorshammer* (Norwegian) passed at 19h00. Many chasers belonging to the three factory ships were in sight during the morning and afternoon.

09h40 A crabeater seal was seen on a tongue of pack ice.

9 February 1931
16h00 Two crabeater seals were seen on a floe.

A leopard seal chased and caught a small crabeater seal beside the ship. The leopard seal threw its body out of the water and dived down to the dodging crabeater seal. It then came up with its jaws holding the crabeater's abdomen. The leopard seal then descended and neither was seen afterwards.

10 February 1931
The whaler *New Sevilla* (British) and its chasers (*Bouvet*, etc.) were seen during the morning and the former was visited by DM. We observed one chaser bringing in two fin whales and another bringing in a blue whale. Six whales were taken this morning up to time of our departure. Five were taken yesterday.

15h00 A leopard seal was sighted lying on a floe.

Mac. Robertson Land

13 February 1931
Weddell seals were seen ashore.

14 February 1931
Three Weddell seals were swimming and feeding on the lee side of a small iceberg during the height of a blizzard with heavy seas breaking on the iceberg.

15 February 1931
Five killer whales came close to the ship (Mr Colbeck and Douglas).

16 February 1931

Station 107 (66°45'S, 62°03'E)
11h45 About 12 small killer whales were hunting in pack ice near the ship.

18 February 1931

Station 108 (67°26'S, 60°49'E)
Weddell seals (mothers and well grown, dark-skinned cubs) were ashore and on the ice-foot.

Mac. Robertson Land to Tasmania

20 February 1931
08h30 Four killer whales (small type) were seen.

08h45 Two high blows of a whale were sighted to the eastward.

Six blue whales were sighted moving northward between 08h00 and noon (Mr Child).

There was an abundance of whales both in the morning and afternoon. Apparently they were chiefly blue whales and were travelling northward. Several killer whales (small type) were seen this afternoon.

24 February 1931
Two blue whales were seen this morning and more were seen in the evening (Mr Child).

25 February 1931
08h15 A killer whale (smaller type) was close to ship. It threw its body clear of the water revealing the typical coloration (Simmers).

Two fin whales were seen (including their dorsal fins) between 08h00 and noon (Mr Child).

26 February 1931
Two whales (?fin) were seen between 08h00 and noon (Mr Child).

1 March 1931
A dolphin was sighted; it was about 5 feet (1.5 m) long with a pale patch on its back behind the falcate dorsal fin (Simmers).

4 March 1931
Several dolphins were playing around ship between 08h00 and midnight (Mr Child).

7 March 1931 (50°25'S, 107°53'E)
About five medium sized dolphins 5 to 6 feet (1.5 to 1.8 m) long were leaping from the sea at a distance from the ship. Each one leaped clear, vertically into the air and then fell back [the log contains a small sketch]. Although they were swimming away from the ship, their whole ventral surface was exposed to our view at each leap. This was white from chin to tail. No clear view of dorsal colours and shape of snout or dorsal fin could be obtained. An impression that Simmers, Fletcher and I gained is conveyed by a rough sketch [Fig. 1c]. They were identified as *Cephalorhynchus ?heavisidii*, with lateral white patches confluent. I arrived too late to see them (RAF).

10 March 1931
Noon A fin whale surfaced alongside the ship and then sounded; its dorsal fin was showing (RAF).

12 March 1931
18h00 A whale was seen by Oom.

17 March 1931
Captain MacKenzie saw porpoises near the ship during the past two or three days.

Tasmania

18 March 1931
09h00 Several *Lagenorhynchus obscurus* came alongside the ship off Cape Maatsuyker [presumably Maatsuyker Island, southern Tasmania] and were also seen during the remainder of the day.

19 March 1931

08h30 Delphinus delphis were sighted in D'Entrecasteaux Channel.

Off Port Phillip Heads, Victoria

26 March 1931

18h00 A school of porpoises was sighted. They had a [high, curved] dorsal fin [the log contains a small sketch] and were dark all over, with a slightly lighter venter. They were 8 feet (2.4 m) long with a fairly deep body [the log contains a small sketch]. When they leapt, all of their body came out of the water. They appear to be *Tursiops truncatus* rather than *Delphinus delphis*.

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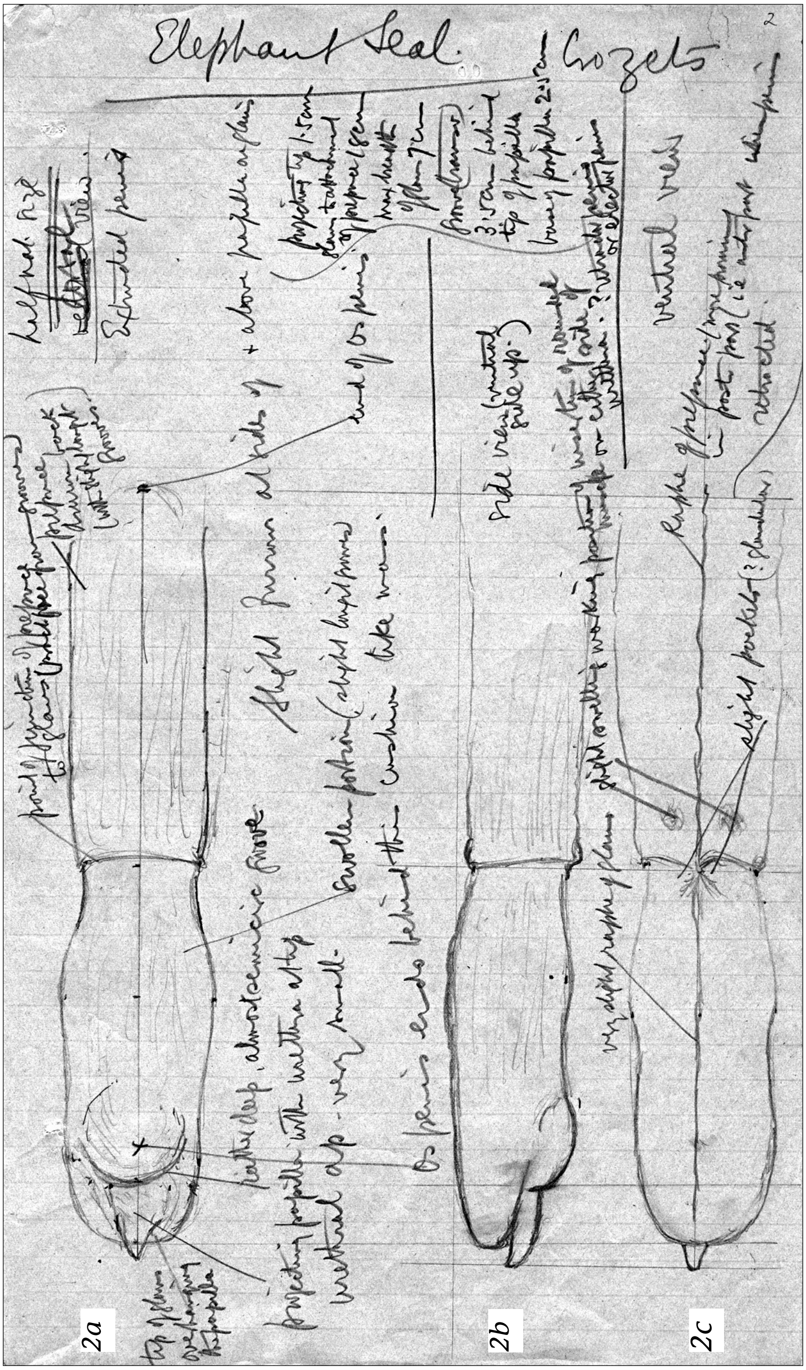

Elephant Seal.
Crozets
2a
2b
2c

II.G Notes on seals
T. Harvey Johnston

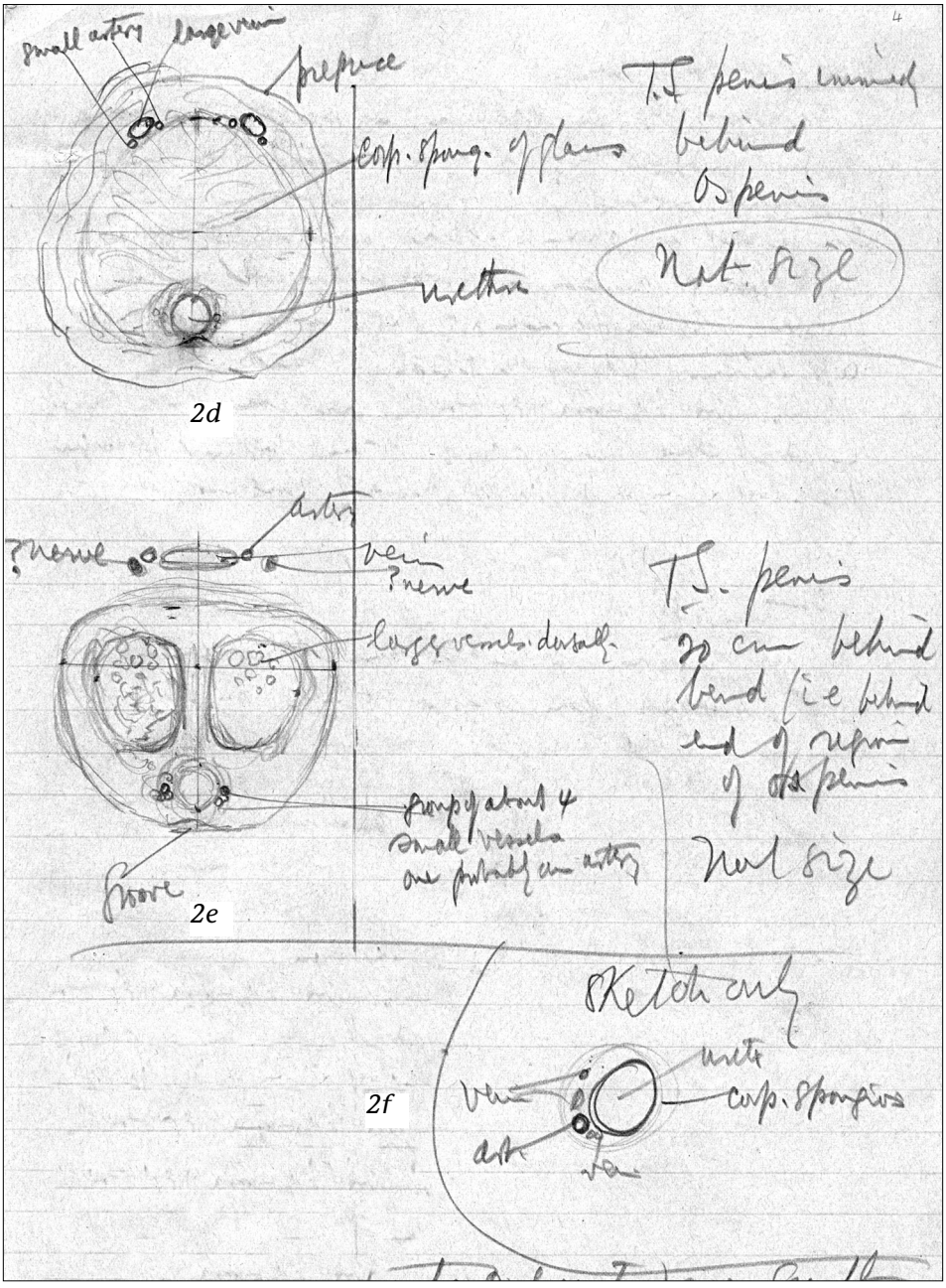
Introduction

The notes by T. Harvey Johnston can be divided readily into seven sections as indicated below (with numbers of pages from the original manuscript). They primarily refer to southern elephant seals *Mirounga leonina*.

- Reproductive anatomy of male and female southern elephant seals (14 pages)
- Mating habits of elephant seals (6 pages)
- Various aspects on the biology and harvesting of elephant seals (5 pages)
- Information on leopard seals collected at Heard Island (4 pages)
- Information on Weddell seals collected in the pack ice (2 pages)
- Description of killer whales chasing a crabeater seal (1 page)
- Harvesting at Kerguelen (1 page).

Several pages include measurements of seals that were collected; they are in Tables 4 to 6. The first section includes ten field sketches. Seven sketches of the male reproductive system have been reproduced (a to g in Figure 2), and three of the female reproductive system (a to c in Figure 3). Labels for the sketches are shown on the Figures in Harvey Johnston's handwriting and are included in the captions.

Figure 2. *Sketches of the male reproductive system of southern elephant seals by T. Harvey Johnston. Question marks included here are on the originals. 2a-c: Sketch of an extended penis, original drawing at half natural size. a) Dorsal view. Labels are listed from left (distal) to right (proximal): tip of glans overhanging the papilla; projecting papilla with urethra at tip, urethral aperture very small; rather deep, almost semicircular groove; Os penis ends behind this cushion-like mass (distal); swollen portion (slight longitudinal groove); point of junction of prepuce to glans (practically free from grooves); Prepuce drawn back (with slight longitudinal grooves); slight furrows at sides of and above papilla on glans; End of os penis. b) Side view, ventral side up. Labels are listed from to: projecting tip 1.5 cm ; glans to attachment of prepuce 18 cm; maximum breadth of glans 7 cm; groove (transverse) 3.5 cm behind tip of papilla; base of papilla 2.5 cm. c) Ventral view. Labels are listed from left (distal) to right (proximal): very slight raphe of glans; slight pockets (?glandular); slight swelling working posterior of insertion of rounded muscle on either side of urethra, ?retracted penis or erect penis?; Raphe of prepuce, more prominent in posterior part (i.e., anterior/part when penis is retracted).*


small artery
large vein
prepuce
corp. spong. of glans
urethra
T.S. penis immed behind Os penis
Nat. Size
2d
artery
? nerve
vein
? nerve
large vessels dorsally
groups of about 4 small vessels one probably an artery
groove
T.S. penis 2 cm behind bend i.e. behind end of septum of Os penis
Nat Size
2e
Ketch only
urethra
corp. spongiosum
vein
artery
2f

The third and fourth sections of "Notes on seals" each include a single sketch of the vibrissae of elephant seals and a leopard seal, respectively. They have not been reproduced here.

(p. 1) Notes on seals etc. [title only]

(p. 2) Male reproductive system, Elephant seal, Iles Crozets

[Sketches of the male reproductive system of southern elephant seals by T. Harvey Johnston are provided in Fig. 2. Three sketches show an extended penis, half natural size (Fig. 2a to 2c).]

(p. 3) [Text begins] The prepuce is very loose.

?Imagma glands (preputial) at the junction of prepuce and glans on either side of the mid-ventral line are indicated by a slight depression. The penis between them is very slight and the raphe is merely indicated from this point forward, some becoming lost on the fleshy ventral mass of the glans into which the urethra becomes deeply buried.

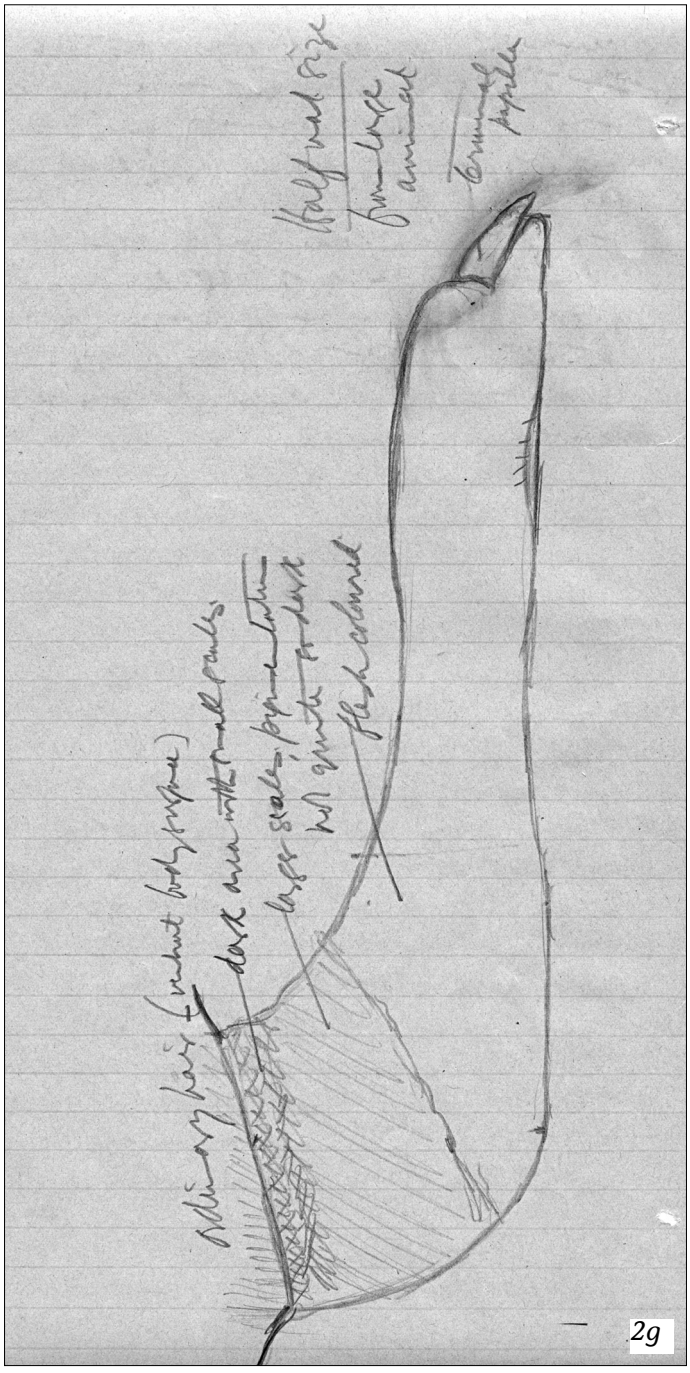
The retractor penis muscle on either side is inserted near the mid-ventral line about 3 cm behind the preputial glands. Each is a kind of bursa or sheath.

The os penis is nearly 30 cm long in the specific drawing (probably of a small male). It lies just under the dorsal region. Just in front of its anterior end is a rounded lobe separated by a transverse groove from a prominent papilla. It is more or less conical but is attached obliquely so that the apex is directed forwards and slightly downwards, and it projects beyond the thick rounded fleshy anterior end of the ventral surface. The urethra opens by a tiny aperture at the top of the papilla.

(p. 4) [Sketches of transverse sections of the penis immediately behind the os penis and 20 cm behind the bend (i.e., behind the end of the region of the os penis) are provided in Fig. 2d and 2e.]

Further back the two corpus cavernosa practically merge, and the septum is not well defined.

Figure 2d-e. *Sketches of the male reproductive system of southern elephant seals by T. Harvey Johnston. Labels are listed in a clockwise direction, beginning at the top; Question marks included here are on the originals. d) Transverse section of penis immediately behind the os penis, original drawing natural size: small artery; large vein; prepuce; corpus spongiosum of glans; urethra. e) Transverse section of penis 20 cm behind the bend (i.e., behind the end of the region of the os penis). Natural size. ?nerve; artery; vein; ?nerve; large vessels dorsally; group of about 4 small vessels, one is probably an artery; groove. f) Transverse section through the urethra, corpus spongiosum, vein and artery*


2g

The large muscles (retractor and erector) are greatly flattened and are practically in contact in the mid-ventral line below the urethra. These bands are narrower and slightly thicker at the point of natural bending of the resting penis, but flatten out on either side of this part, especially posteriorly where (p. 5) they become strap-shaped. They move freely in their sheath of loose connective tissue devoid of fat. Their point of origin was not traced. The penis does not show along the ventral surface of the resting animal, nor even immediately prior to erection. It does not show during copulation (with the exception of its extended portion). This is due no doubt to the great mass of blubber in the subcutaneous tissue of the ventral body wall. The resting penis has a very marked bend about 40 cm from its distal point.

Query the position of the external aperature on the body in relation to the umbilicus, length of the animal, and distance from anus.

The aperture is more or less rounded and somewhat elongate, with a number of deep radiating grooves leading into it. The part surrounding the grooves and part of the area between them appears to be devoid of hair. Hair is not so abundant in the immediate vicinity of the aperture and is not markedly longer or thicker than that on the general ventral surface. The skin of the aperture is provided with scanty, very small hairs for a little way into the aperture, after which the hairs disappear. The skin in these portions is darkly pigmented and provided with abundant, closely set small ridges, which may be like low, linear, elongate scales or papillae. Their arrangement may be more or less alternate (shown in a small diagram).

(p. 6) There may be a linear succession of smaller and more rounded papillae: oooooo which presents a moniliform arrangement. The papillae are closely set near the outer extremity, but become fewer, larger and more widely separated, with light coloured skin showing through. The papillae and pigmentation disappear about 10 cm from the entrance. The scaly appearance gives place to the smooth, reddish or flesh-coloured prepuce lining the tube. This is thrown into ridges when the penis is at rest. Thus a dark scaly ring about 10 cm broad surrounds the base of the protruded organ. The latter can be protruded for about 40 cm beyond this region (i.e., about 50 cm in total) in a dissected or dead animal. The elbowed bend lies 4 or 5 cm beyond the scaly portion.

Figure 2g. *Sketch of penis, original drawing at half natural size, from a large animal. Labels are listed from left (distal) to right (proximal): ordinary hair (ventral body surface); dark area with small scales; large scales, pigmentation not quite so dark ; flesh coloured; terminal papilla.*

Viewed ventrally when the organ is fully extended, the scaly part of the prepuce may extend for 14 or 15 cm along the mid-ventral region of the organ, and has a medial groove at its extreme posterior part. On each side of this region is a structure which probably represents a rudimentary teat, each in a short longitudinal groove. These grooves are about 1.5 to 2 cm on either side of the medial line and all three are about 4 cm long, quite shallow and like lines in appearance. The outer half of the resting penis is wider than the remainder and may be as much as 50% as wide (8 cm as against 5 cm).

(p. 7) A sketch of the penis at half natural size from a large animal is shown in Fig. 2g.

(p. 8) Os penis

Just behind the os [penis], the corp. cavernosa functionally fuse and then diverge and become a thin covering over the lateral parts of the os penis, which occupies the greatly developed septum. The corpus cavernosum becomes relatively inconspicuous, its function being taken over by the os penis. The urethra and corpus spongiosum lie in a groove under the os penis, but eventually enter more deeply into the tissues of the penis and are not felt in the anterior part of the organ, which is thick and fleshy at its ventral surface.

(p. 9) There are relatively inconspicuous teats, one on either side laterally from a little behind the level of the umbilicus. The nipple projects very slightly. It can be felt when the animal is lying on its back or side (eg, when sleeping). They suckle in this position. There is dark pigmentation around the nipple.

(p. 10) Adult female system [Sketches are reproduced in Fig. 3a to 3c]

There is a slit-like aperture between and in front of the hind flippers ventrally. The opening faces posterio-ventrally, or rather more posteriorly. The slit is 10 to 12 cm long. Its sides are more or less approximated with rounded edges from which a number of short grooves pass down into the cavity. The hair on the edges of the cavity is similar to that on the body, but becomes shorter and more scanty as the aperture is entered. The pigmentation is much darker in this region (as it is in the male aperture). The skin here is finely scale-like, and there is a series of prominent ridges and grooves which allow an increase in diameter (during copulation).

A number of the posterior grooves converge into the anal aperture, which lies 5 to 6 cm inwards from the posterior margin from the female depression (which is really a kind of cloaca). The anus is in a depression on the upper wall of the cloaca and has a slight projection on its anterior margin that faces posteriorly. Pigmentation does not enter the anus, which shows as a flesh coloured aperture. Behind and beside the anus the skin becomes slightly wrinkled in such a way as

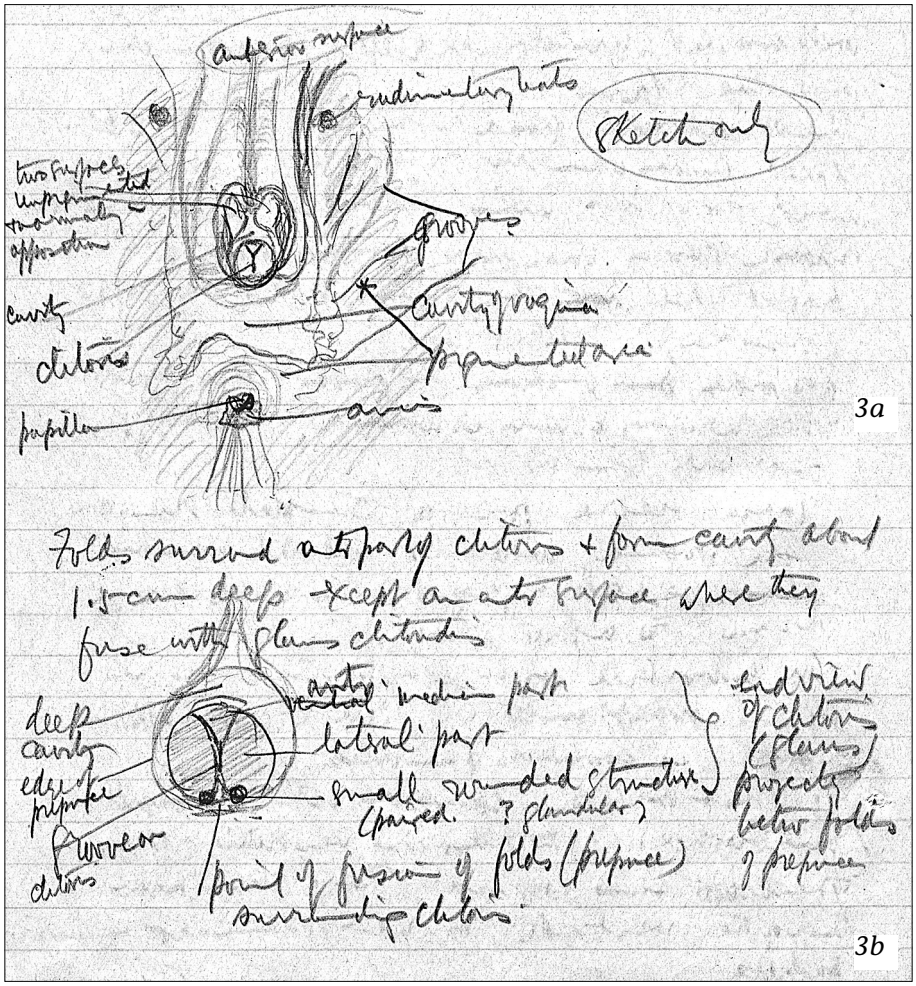
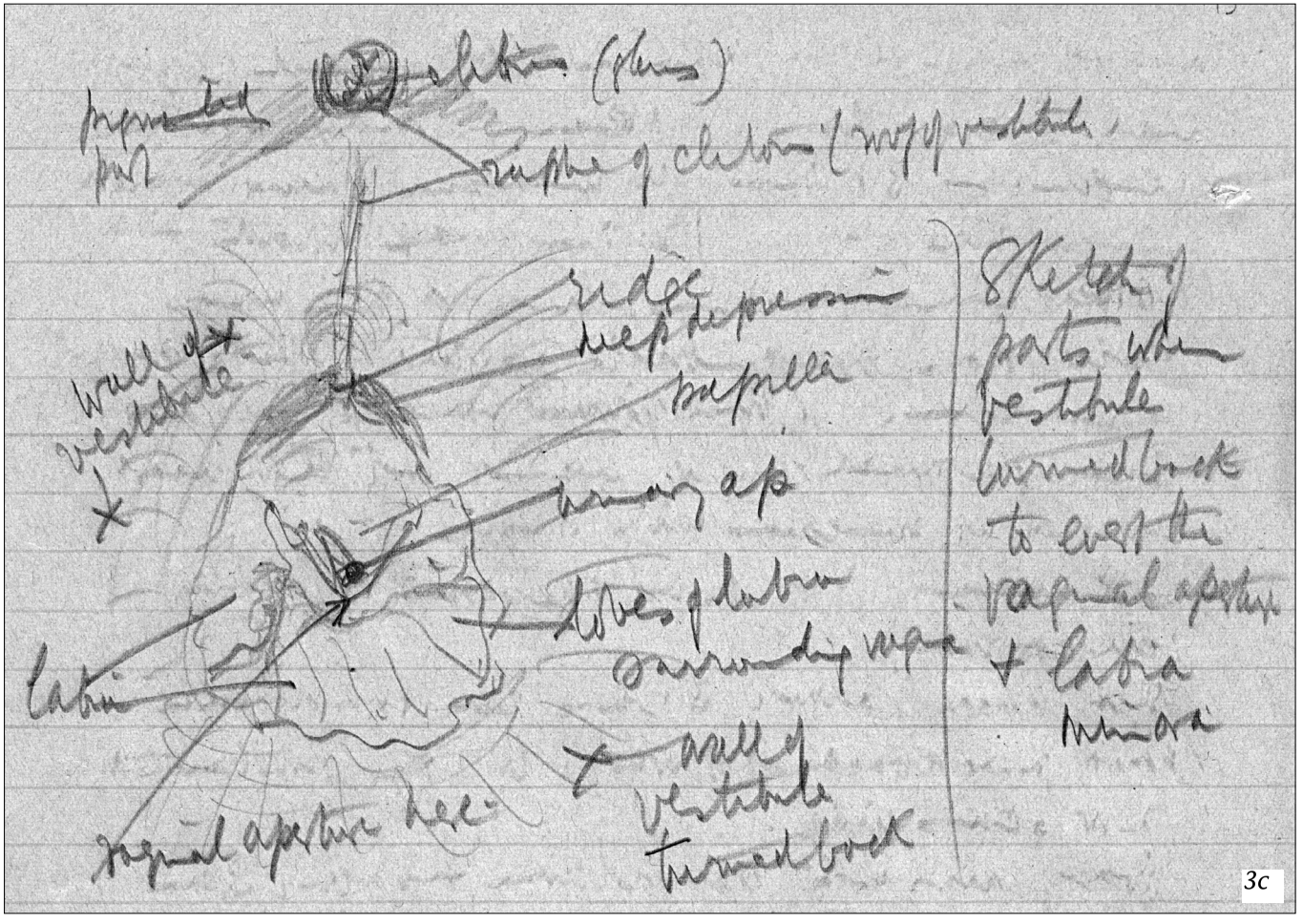


Figure 3. *Sketches of the female reproductive system of southern elephant seals by T. Harvey Johnston. Labels are listed in a clockwise direction, beginning at the top. a) Anterior surface: rudimentary teats; grooves; cavity of vagina; pigmented area; anus; papilla; clitoris; cavity; two surfaces, unpigmented and normally in opposition. b) End view of clitoris (glans) projecting between folds of prepuce: anterior medial part; lateral part; small rounded structure (paired, ?glandular); point of fusion of folds (prepuce) surrounding clitoris; groove on clitoris; edge of prepuce; deep cavity.*

to form a series of small folds that partly surround the anus (on all sides except posteriorly). The pigmented area ceases about 2 cm behind the anus. Thus there is a pigmented ring about 8 to 9 cm deep posteriorly but only 5 to 6 cm anteriorly within the cloaca.


Sketch of parts when vestibule turned back to expose vaginal aperture + labia minora
3c

On the ventral wall of the cloaca, hairy integument is replaced by a brownish area with shorter hairs and more scaly appearance succeeded by a darker, narrower, hairless region which extends to the upper edges of the clitoris, but does not extend on to its upper surface. All these tissues have thick mass of blubber below them. Beyond the pigmented area is the pinkish vagina and vestibule.

(p. 11) Clitoris

The shallow medial ventral (i.e., anterior) groove leads backwards and downwards into the clitoris. The edges of the groove become more prominent to form the labia. As already mentioned, these are pigmented, but the pigmentation stops short on its [inner] edges so that the opposed surfaces actually surrounding the clitoris are smooth, soft and pinkish or flesh coloured. The folds diverge to surround the clitoris. Thus a small but definite prepuce surrounds the organ, leaving a definite cavity in front of it anteriorly but attached to it posteriorly.

Folds surround the anterior part of the clitoris and form a cavity about 1.5 cm deep, except on the anterior surface where they fuse with the glans clitoridis.

(p. 12) The whole clitoris (including the prepuce) projects about 2 cm towards the vaginal aperture and is about 4 cm wide at the base and only 1 cm at the tip when its labia are approximated, but 1.5 cm or more when the clitoris is showing through and the labia are not approximated (as in the sketch opposite). The glans clitoridis is about 1 cm in diameter when viewed end on. The clitoris forms the ventral wall of the anterior part of the vagina and its undersurface is devoid of pigment (it is really part of the vestibule). An area in the anterior part of the vestibule immediately behind the glans seems to be glandular. A medial groove is indicated and leads back to the well marked urinary papilla. The groove does not reach the glans.

The os clitoridis is relatively broad and short (about 1 cm long). When erect, the clitoris probably serves to guide the penis. About 8 or 9 cm behind the clitoris is the very prominent reddish, fleshy, triangular urinary papilla which projects freely (3.5 cm) from the ventral wall of the vagina (vestibule). Its sides pass backwards as fleshy labia minora; the urinary aperture is minute and situated just anteriorly from its tip.

Figure 3c. *The vaginal aperture and labia minora with the vestibule turned back. Labels are listed in a clockwise direction, beginning at the top: pigmented part; clitoris (glans); raphe of clitoris (roof of vestibule); ridge; deep depression; papilla; urinary aperture; lobes of labia surrounding the vagina; X wall of vestibule turned back; vaginal aperture; labia; wall of vestibule X.*

These labia form a complete ring around the vagina, more deeply coloured than the vestibule, and project 3 cm or less and through a few folds. On either side is a slight depression into which glands probably enter. The free edge (except for the triangular papilla) is somewhat fimbriate. There is a marked depression between the papilla (ventro-laterally) and the adjacent vestibular wall, these two being separated by a ridge in the medial line of the vestibule. The ridge terminates in the papilla.

(p. 13) The vaginal aperture and labia minora with the vestibule turned back are shown in Fig. 3c.

The inner walls of the labia pass inwards as the vaginal wall. Very large sphincter muscles surround the anus and vagina. The vagina is capacious, being 26 cm long (i.e., from labia minora) and about 9 cm in transverse width (walls in opposition). The large circular cervix is about 10 cm in diameter and projects downwards into the vagina for about 4 cm. Surrounding the os uteri is a fairly thick fringe with somewhat fimbriate edges which projects into the vagina for a further 3.5 cm. The examined seal was obviously multiparous.

The cavity of the os cervix is about 3 cm in diameter. There is a slight narrowing higher up at the entrance to the uterine cavity. The uterus is 18 cm long with thick walls. The cavity is 5.5 cm across, with the uterine walls in opposition.

(p. 14) One uterine horn looks like an invaginated stomach, it is highly muscular and is thick-walled. Its maximum length is 21 cm, 38 cm if measured along the middle of the curvature, and 12 cm in maximum width. The other horn is 14 cm long and 9 cm wide. The distance from one fimbriate aperture to that on the opposite side is 29 cm (measured from the base of one round ligament to the base of the other). The ligament is thick, flattened and round, but more nearly circular at the junction with the uterus. The broad ligament is very broad and is traversed by tubules (per ovarium). The ostium abdomen is about 3 cm long and surrounded (except near the attachment of an ovary) by the fimbriate membrane which is 2 or 3 cm wide. The ovary dips into the ostium abdomen and is about 3 cm in diameter. The ost. abdomen opens into a large thin walled cavity about 6 or 7 cm deep which communicates with the lateral cornua. Each uterus suddenly narrows anterio-laterally and opens by a minute and strongly bent canal into the wide, free end of the Fallopian tube. The opening is too bent and small to admit passage of the handle of the dissecting needle. The ovary is more or less enveloped by the end of the Fallopian tube.

(p.15) Mating habits of Elephant Seals at Iles Crozets

Elephant seals are sexually dimorphic; the males are longer and heavier than females, have a large proboscis, and have well developed teeth.

They formed harems along the beach, the smallest of which had only three or four breeding females, and a small number of immatures. The largest groups had perhaps 30 or 40 with a bull at either end of the harem and many young animals, chiefly sucking pups with their fine black, rather woolly hair.

The bulls were scarred; some scars were recent and extensive. Unattached bulls were along the beach at intervals or were lying in the water more or less submerged, waiting an opportunity to mate with outlying females of the harems. When they went too close and were observed by the bull of the harem, a charge took place and, in most cases, the intruder promptly made off to a safe distance or even went into the sea. Sometimes an intruder was chased by bulls from adjacent groups.

On rare occasions a fight ensued when the intruder held his ground, but generally he was forced to retire before the fight became serious. One real fight was seen, just as described by Mawson [presumably Ainsworth's description in Mawson 1915a, vol. II, p.219]. It was high up on a beach; one bull was driven off after a fight of 10-15 minutes. Most of a bull's time was spent in dozing and copulating.

Females not infrequently leave the outer part of a harem and make their way down to the beach or the breakers to a waiting male and copulated with him unless headed off, and the intruder is driven off by the harem bull. The latter copulates with her even if the intruder has just done so. Intruders may be seen sneaking up the steep beach which affords them some shelter from the dozing bull lying in the middle or (p. 16) on one side of the harem. They shuffle up for a few yards and then lie quietly, close to the ground as if dozing but usually wide awake. If a female does not come down to the intruder, he will reach the outskirts of the harem and copulate with the first available one. Sometimes advantage seems to be taken of the copulation by the harem bull to utilise some other member of his harem. The intruder may be actually copulating before being seen by the harem bull, who is sometimes too lazy or too tired from his own amatory efforts. Otherwise the harem bull swings himself around on his abdomen as a pivot, raises his proboscis and charges down on his rival, who usually promptly withdraws himself from the female (copulation obviously incomplete) and makes a hasty retreat. The harem bull then supplies the willing female.

In one case the female had wandered off to the water's edge to a waiting bull and had undergone a lengthy copulation in the water. They were still coupled (apparently) when the harem bull noticed the pair and charged down the beach into the shallow water. He drove off the other male and then immediately copulated with the female. They were then in deeper water, with the sea breaking over them both so that their heads were above water only as the waves receded. A bank of sand washed up against the female's body, the female being on landward side.

Although their bodies were being rolled to one side or the other, it made no difference, the union was maintained.

Sometimes the cow approaches the male in such a way as to suggest the desire for union, which is promptly gratified. But usually the male selects a female, which may be the most convenient one or may be one at some distance from him. In either case he (p.17) may pin down the young suckling pup: most females have just given birth to a pup. Copulation is effected soon after pupping and continues for a considerable part of the females' shore life. The pup barks and strives to free itself, but sometimes is crushed under the ponderous male.

When the male approaches the desired female, he moves rapidly or leisurely towards her, and usually places his heavy head and neck across her neck or body and pushes her down. Then he places his flipper across her shoulders or body. Frequently he bites her neck, especially if she is refractory. He eventually lets go and then she is held securely by his fore flipper, which clasps her body and she is drawn closer or he shuffles closer. Usually the female is quite willing and shows a marked desire to receive the male. (He may pat her body a number of times as if courting the refractory female, who usually becomes amenable to his further advances).

The female then moves her body across towards him so as to lie beside him. During this movement she is obviously sexually excited, since her tail is partly raised and her flippers are somewhat apart. The cloacal aperture becomes directed posteriorly and is evidently partly extruded and opened. If viewed low down, one can see that the cloaca is wide open and the pale flesh coloured portion of the vestibule is plainly visible. The urinary papilla is brought fairly near the vagina so that the vaginal orifice is at its nearest position to the exterior.

The female moves her body so as to lie close beside the male and part of his body together with the flipper of that side is over part of her. She moves her hind flippers (p. 18) in such a way that the one nearest him may be pushed under his body. Her aim is to place her posterior end in very close contact with the male. She may adjust her position from time to time if it is unsatisfactory.

The male is now stimulated and the huge penis suddenly slips out of the male aperture as a reddish or orange coloured organ. It is shot forward and downwards towards the female, usually becoming inserted at once into the wide open vagina. Sometimes the organ misses and passes over the female's back or flipper. Sometimes she at once strives to adjust herself. The penis is too low and rubs in the gravel, which it picks up and may transfer into the female. The penis normally passes over her near flipper, between it and the tail. The male moves his body slightly once or twice to make sure that entry is satisfactory. The female has adjusted her body. Then the male swings his hind flippers around in a curve so as to be behind and close to the hind flippers of the female. After a few strokes he makes no

further efforts unless the penis is in danger of becoming displaced. The female lies quietly for a time and then the rear part of her body undergoes a slow rhythmical movement, suggesting that her organs rather than her body are applying the friction. Copulation may be rapid, but is generally prolonged. The male generally places his head on the ground beside the female and appears to doze during the act. The female is quiet, but quickly responds to any disturbance, of which the male is then aware. There is no sign of any orgasm on the part of either sex. There is no rapid copulatory movement, nor anything to indicate when ejaculation occurs or (p. 19) when female satisfaction is reaching a climax.

Sometimes the female bends the posterior end of her body over slightly (apparently to receive full benefit of the male) so that part of the undersurface near her hind flippers can be seen at a low height above the sand. The penis can then be seen in position. A considerable part of it does not enter the female but lies behind her in the same axis as her body. Apparently the part containing the os penis is inserted while the erectile portion behind it is not.

The erect penis resembles a bent arm, the prepuce being withdrawn well above the elbow. Sometimes part of the penis can be seen plainly between the male aperture and the female's body, but usually the aperture is brought sufficiently low down to be near the female's body.

When copulation is complete, the penis slips out and the female micturates. The penis is withdrawn into its sheath, slowly at first but the terminal, long portion slips back more suddenly.

The two seals may then lie side by side for a long time and doze, his flipper being withdrawn from the female's body.

A refractory female is pulled in towards the male by his flipper. But the female may keep moving her body away, to be more or less at right angles to the male, and utters cries. Sometimes he bites her and keeps his heavy head across her to pin her down. When he endeavours to place his body beside her, she may succeed in keeping her posterior region away from him. Sometimes he throws part of his body over her posterior region, partly mounting her in his endeavours, but she may still evade him.

(p.20) One instance was seen in which the male had extended his penis but had failed to enter it since the female kept her tail down. She prevented entry and eventually managed to evade the male. On the other hand, several females were seen to pass direct from one copulation to another bull for copulation.

The penis and the female organs generally become stained with yellow fluid from the female's anus. This comes into contact with the copulating penis owing to the proximity of the anus to the vagina.

When a female lies beside a male, she lies on her venter, but at other times she is more likely to be lying more or less on her back. A male often lies on his side so that his venter is more or less upwards, but the female lies more or less flattened out, venter to the sand, with neck and throat lying on sand, dozing or watching.

Females and young seals play with their hind flippers which they spread out, rub together and more or less entwine while held up in the air. Occasionally they [flex?] their bodies, making their ventral surface tense and curved instead of being flabby as in ordinary locomotion and during rest. Their bodies are more tense when they are lying on their backs.

Elephant seals have large, round eyes and are probably near sighted. Young pups have pug noses.

Young animals (weaned pups) are generally found some distance from the beach. There are large numbers of them in the swampy meadow, in small puddles or lying in the stream behind the beach. They frequently scratch themselves with their foreflipper. Their eyes (other than the iris and pupil) are often red.

Biology and harvesting elephant seals

(p. 21) Midway between Iles Crozets and Kerguelen [early November 1929], Mawson and I saw two large seals protruding their heads above the water.

Kerguelen [12-24 November 1929]
Only two young sea elephants were seen by any member of our party whilst we were at Kerguelen; they were seen by Mawson at Grave Island. A sealing vessel was examining the beaches at the entrance of Royal Sound for seals.

Heard Island [26 November–4 December 1929]
There were plenty of sea elephants on the beaches of Corinthian Bay (a few), Atlas Cove and other beaches in the vicinity. Only two or three old bulls were seen, and they were obviously sick. The rest evidently had migrated to sea, as had the adult females. There were many large (but not fully mature) bulls present, also females near breeding age and especially younger animals, both males and females.

A great many were moulting. Their skin comes off in patches giving them a very ragged appearance, like mange. The fresh skin is soft with hair below. Small pieces of cast skin were commonly washed up on the beach. The animals were restless and scratched to remove their loose hair.

Bulls engaged in mock fights, which occasionally became too rough and real, and drew blood. The fight continues until one gives way. Fights are either in freshwater puddles and pools, on land, in shallow water near the beach or on the beach. Females also play and fight like males. When not fighting, animals wedge

themselves together as tightly (p.22) as possible between the tussocks. They are either alone or, more commonly, in small groups of animals of similar age.

Some animals were remote from the beach and, occasionally, were fairly high above sea level, but most were lying either amongst tussocks playing in fresh water (from melting snow and drainage) or were just beyond high tide mark in shingle at the foot of the cliffs.

Other animals were playing in pools like children; they were "ducking" each other and testing their strength. Some large males bullied smaller and younger animals. Others were lying on their backs in the water, raising one flipper after the other, or were lying with their faces down and their heads partly under water, as if dozing. Some larger males showed a tendency to be solitary along the beach and resented the approach of other large males.

The proboscis of larger males was developing. The faces of those with slight development of the proboscis looked lion-like. Other males were more like fully grown females, except they were rather more heavily built and they flattened out more when resting.

A young bull was embarrassed to enter our hut this morning. The hut was probably on his track to a favourite resting place and curiosity may have caused him to try to put his head into our open door.

Sea elephants apparently detected our odour if we approached them from the windward side even while they were dozing.

At Kerguelen the sealing captain of the *Kilfinora* told us that his colleague of the — [name missing] had recently returned from Heard Island where he had cleaned up the beaches in the vicinity of Corinthian Bay, including Atlas Cove and North West Bay, (p. 23) and that in other inaccessible bays, sea elephants were still plentiful. Those we saw must have migrated from neighbouring beaches. Atlas Cove was a real cemetery, a bone yard for seals. There were probably thousands of skeletons which had soon fragmented on account of frost, ice and the strong prevailing wind carrying grit. There were many carcasses (especially of large bulls) lying close to the beach and were partly awash at high tide.

We measured many carcasses; practically all of the large ones were 18 to 20 feet (5.5 to 6.0 m) long as they lay there. Muscles and exposed viscera of the carcasses had become hard and very dry, protecting the underlying tissues which appeared quite fresh. When the carcasses were opened, blood flowed freely and coagulated later. There was no odour of putrefaction if above tail level, except in the case of the head cavities (mouth, nose and brain).

Parasitic worms were taken from the stomach and intestines of all adults examined, even though they had been dead for over a month.

Skua gulls, *Macronectes* [giant petrels] and to some extent paddies (sheathbills) fed on the carcasses if they were not too hard and dry. They fed on those which I opened; the hard dry outer tissues (muscle etc.) were too strong for the birds until I cut through them during my examination. The lower parts of carcasses tend to sink into the sand which washes round them and putrefaction slowly sets in, assisted (where the sand is not saline) by the agency of a peculiar wingless fly whose eggs, larvae and pupae (as well as adults) together with some beetles occur commonly (p. 24) under such carcasses.

The soil was saturated with freshwater from melting snow and by drainage from snow pools etc. amongst tussocks. A species of small oligochaete was very common also in such situations, along with the maggots in the wetter soil below.

The stomachs of four very young animals were examined, both male and female. They contained no food of any kind and no worms. The stomachs were full of beach gravel. The animals had probably weaned this season and not yet fed at sea.

Body temperatures of sea elephants were measured at Heard Island. They were taken per rectum in male and per vagina in female. About a dozen records were taken on 28 November 1929, from very young to nearly mature males and females that were dozing amongst tussocks. Temperatures were in the range 98 – 99°F, with most nearer 98°F.

Measurements of a young female sea elephant, probably in its first season are in Table 4. Glands were taken from the seal by Ingram.

Newborn sea elephant pups are clothed with relatively long black soft hair, so that they look black.

(p. 25) The arrangement of vibrissae in several full grown sea elephant bulls was examined at Heard Island. They had been killed by sealers. There are six rows on the cheek. The hairs are smaller towards the front, increase in size and become darker and stiffer; the largest is below and behind. There are six on each side in the lowest row (i.e., nearest the upper lip). The last three are very large. There are eight in the next row, the last three of which are very large. The next row has eight, of which the last two or three are very large. The next row also has eight, of which the last two are very large. The next row has six, of which the last one is very large. The top row has two or, sometimes, three rather small bristles. There is one hair about midway between top of the nostril and the front angle of each eye.

There are three rows above each eye near its anterior end. The row nearest the eye has two bristles, the next has three, then two. The last rows have the longest hairs.

The distance between lowest row on the cheek and the edge of the upper lip is nearly half the width of the vibrissal area of the cheek. All cheek vibrissae project backwards and more or less downwards. There are no vibrissae on the lower lip.

[The position of the vibrissae on the left upper lip is sketched, but is not reproduced here; labels for the sketches follow].

Edge of nostril

(Maybe absent)

Anterior, left upper lip, posterior

Front, left eye, behind.

(p. 26) Leopard seal (Hydrurga leptonyx)

Two male sea leopards were measured at Heard Island on 26 November 1929 (Table 5).

The stomach of the larger specimen contained masses of penguin feathers and a few fish bones; the smaller specimen contained penguin feathers.

Coloration of the leopard seals was creamy white, and blotched, spotted or marbled with dark brown. Brown was more prominent towards the posterior end. The marbling was particularly apparent between the flippers and the body. The foreflippers were dark brown along their lower (i.e., anterior) margin and were streaked upwards on their outer surface. Their inner surface was mainly dark brown except near the axilla, where there was more white. The hind flippers were mainly dark brown except dorsally where they were marbled. The throat was mainly light with some dark spots.

(p. 27) The arrangement of vibrissae on the left cheek of the smaller male sea leopard found dead on a beach at Heard Island is shown in a sketch [The sketch is not reproduced here, but labels follow].

Left nostril

behind and above posterior end of nostril

laterally from nostril

Arrangement of vibrissae on left side of cheek

Upper lip.

There is a space of about 1½ inches (3.8 cm) free between the vibrissae of opposite sides of the upper lip. There is a small bristle above the eye, and two small vibrissae on either side of the lower lip close to the mouth.

The stomach contained a mass of penguin feathers and some nematodes. There were fragments of tapeworms in the intestine.

A female sea leopard was shot and measured at Heard Island on 1 December 1929. Markings on the ventral surface of the flippers were essentially similar to those described for males above (i.e., brown to grey brown). The mid-ventral surface was nearly devoid of brown over an area extending for 23 inches behind the umbilicus to 27 inches (58 to 69 cm) in front of it along a band five to six inches (13 to 15 cm) wide. [Measurements of this seal are in Table 5].

(p. 28) The seal's dental formula was 2.1.5/2.1.5

The arrangement of vibrissae of the cheek was as follows. There was a row of six on each side just above the upper lip, with a row of three above these and a further row of three above them. Thus there were 12 vibrissae on each side. The longest hairs were 2¼ inches (5.7 cm); the lowest row was 3 inches (7.6 cm) long, the next was 1 inch (2.5 cm) and the top row was ¾ inch (1.9 cm). The distance between the second and the bottom row of bristles was 7/16 inches (1.1 cm), and that between top and second row of bristles was ¾ inch (1.9 cm). The distances between bristles of opposite sides in various rows were as follows: in the lowest row 2 inches (5.1 cm), in the second row 1½ inches (3.8 cm), in the third row 1½ inches (3.8 cm). Between the hairs of each row the distance varied from 9/16 to 5/8 inches (1.4 to 1.6 cm). The mouth was flesh pink; the lips had a dark brown band inwardly, which became wider towards the angle of the mouth.

The eye aperture was 1½ inches (3.8 cm) long; the iris was light brown and the pupil watery green. There were vibrissae above the eye, and one just behind and lateral from the upper (posterior) end of the nostril. The nostril was 1.8 inches (4.6 cm) long and the distance between nostrils anteriorly was ½ inch (1.3 cm), posteriorly the distance was 1¼ inches (3.2 cm).

(p. 29) The distance from the nasal vibrissae to the upper angle of the nostril was ¾ inch (1.9 cm). From there to the anterior angle of the eye was 7 inches (17.8 cm). From the eye vibrissa to the nose vibrissa was 4 ¾ inches (12.1 cm). The tongue had abundant, closely set papillae and was flesh coloured.

The urinogenital slit has rather longer hairs that radiate outwards and backwards. It is a deep brown colour. The distinct perineum is well sunken below the body level. The ducts are hairless and the dark colour is then replaced by a light purplish to flesh colour. The area surrounding the clitoris is flesh coloured. The vaginal length to the perineum is 7 inches (17.8 cm). The clitoris projects ¼ inch (0.6 cm) as a small conical papilla. In front of it are small labia (preputial) which approximate but fuse behind the clitoris as a prepuce (frenum). Apparently there are glands on each side along these folds. A definite os clitoridis (at least a rod-like mass of firm tissue) can be felt along the anterior wall of the vagina (vestibule). If the parts be pushed through the urogenital cloaca, a definite median ridge becomes obvious, leading backwards along the anterior wall of the vestibule.

(p. 30) Weddell Seal (Leptonychotes weddelli)

On 25 January 1930 two females were shot and measured on ice floes a few miles off Proclamation Island, Enderby Land (Table 6). Seal no. 2 [presumably SAM-M14893, incomplete skin] was skinned for museum purposes and the skull was kept [not located]. Seal no. 1 [presumably SAM-M8683, skin and skull] was used for a commercial skin, but the head was skinned and the skin and skull were kept.

Complete female genitalia of seal no. 1 and all of the organs except the urogenital aperture of seal no. 2 were removed and preserved. The stomachs of both seals contained fresh debris. A few small amphipods were in the stomach of one seal, and one stomach contained an enormous number of nematodes. The pylorus was crowded with large cestodes which practically blocked it. A delicate species and a very small species were both present in the duodenum and the anterior part of the small intenstine of both seals. A larger, very delicate cestode was in the posterior region of the intestine of both seals. *Corynosoma* were well distributed in the middle and lower intestine, but none was in the rectum. Trematodes were not present.

(p. 31) Seal no. 1 was mottled longitudinally, more especially laterally and ventrally. It was creamy and pale grey to deeper grey. It was moulting. Seal no. 2 showed light brownish mottling on a creamy background ventrally. It was mainly light brown dorsally and laterally on its head, neck, back and foreflippers. Its fur was longer than in no. 1, and it was very soft and much paler. The pelage was pale just behind the foreflippers and ventrally. Its large intestine contained many fish eye lenses.

(p. 32) Killer Whales (Orcinus orca)

Three killer whales were seen hunting a crabeater seal off Enderby Land. The killer whales had typical coloration: porcelain white on the sides of the head, and a large creamy patch on each side of the body. Each whale had a high dorsal fin, estimated by Marr and me to be about 5 feet (1.5 m) high. The whales passed practically under the bows of *Discovery* and made for a crabeater seal which was just beyond some very light brash ice and well outside the pack ice.

The seal tried to escape by diving and rapidly turning but the three killer whales manoeuvred to cut off its escape. The killer whales then swam deliberately towards the seal which raised its head and neck out of the water and then turned in another direction. It was then cut off by another killer whale. The killer whales turned markedly while pursuing. The hind quarters of the seal projected nearly perpendicularly from the water and convulsed as one of the killer whales submerged itself in its direction, apparently biting the seal in half. The other killer whales closed in and there was no further sign of the seal. The three killer whales

swam leisurely in the vicinity for many minutes with dorsal fins out of the water most of the time and backs showing for a considerable part of the time while blowing lightly.

The three killer whales were still cruising leisurely in the vicinity when the ship was a quarter of a mile (400 m) off. The encounter took place less than 100 yards (91 m) from the starboard beam. The killer whales were estimated to be 30 feet (9 m) in length (perhaps more).

(p. 33) Kerguelen 9 February 1930

Humpback, fin whales and blue whales were taken there according to du Baty (1914).

Three female elephant seals seen at the head of Swains Bay among the low vegetation had been killed during the present season, judging from the condition of their cartilages. Similarly, the skeletons of a male and several females were the product of recent killings. Several (at least eleven) elephant seals were seen a little further on in Swains Bay by an officer and members of the crew. The seals included adult males, females and young animals.

Many carcasses were seen at Murray Island and on the mainland nearby. One carcass was seen at the head of Bras Bolinder, and many were at the head of the Bras and at the end of Greenland Harbour.

References

du Baty, R. R. 1914. *15,000 miles in a ketch*. Nelson, London, 374 pp.

Mawson, D. 1915a. *The home of the blizzard*. Heinemann, London, 2 vols.

II.H Journal (13 October 1929 to 27 March 1931) T. Harvey Johnston

Sections of the journal that concern marine mammals are included here.

3 November 1929, Possession Island, Crozet Archipelago

The day was spent collecting in the bogs in the lowest part of the valley, in observing the sea elephants and in collecting parasites from carcasses left by the sealers. The sealers anchored during the night at another part of the island (Ship Cove); they came back early this morning and a party was on the island before us. We saw them shooting the animals at very close range (bulls and cows) and knocking all the seal pups on the head with sledge hammers. Not a solitary animal was left in the harems they visited. I was informed that the men would be there for another two days to clean up the place. I assumed that they meant to dispose of the carcasses of the slaughtered animals, but they meant to take every seal there — a dreadful massacre that was disgraceful since it meant practically wiping out the entire herds that congregated there to breed. The ship had come from other islands where they had acted similarly. The sealing business is a sickening, senseless butchery. The seal cows suckling their young and a small proportion of bulls should be left, but it is a case of killing the goose that laid the golden egg. Only the blubber was sliced off, the rest of each animal was left for the skuas and giant petrels to pull to pieces. These scavengers (skuas) tore out the eyes and the intestines, they danced and squabbled with yards of small intestine dragged out in various directions from the beast, while the beach was soaked in blood. Of the many hundreds of seals living on that beach on the morning of our arrival, probably not one would have survived. The sealers then move on to some other beach or island and continue the massacre.

The pieces of blubber were dragged down to the beach and tied on to a steel rope connected to the ship. This long string of material (floating and attracting hundreds of sea birds, especially Cape petrels) was hauled back to the ship and eventually taken to the mother ship to be tried down into oil.

The habits of the sea elephants were studied. We saw them mating and suckling; bulls were fighting, and many young animals were wallowing in the puddles in the bog or lying in the little stream. Others were in small clusters on the beach, their parents presumably killed the previous day and they themselves probably doomed to slaughter after those on the [beach] have been destroyed. The flensing is done by a gang of coloured "Cape boys" (a mixture between whites and Malay slaves in the old Dutch days of the Cape Colony).

1 December 1930

Macquarie Island

Sea elephants were very abundant; thousands were counted by Sir Douglas Mawson in the area traversed. There were young pups, growing females and males, a number of old bulls, as well as a number of huge dead bulls along the beach. There was no evidence of there having been a slaughter for several years. Bulls (young) were sleeping, playing, fighting or wallowing in mud. Some were unable to escape from the wallows. S[illegible] a number packed closely in an oozy wallow with perhaps only head or snout protruding. Males of about the same age tended to segregate into small groups.

One young male endeavoured unsuccessfully to copulate with several very young pups. Females were much bitten and blood stained, and one was bleeding from its cloaca. A young male attempted union with another young male, which was resented. Mawson and I measured some large males (by stepping): they were 18, 19, 20 and 21 feet (5.5 to 6.4 m) long.

Sea elephants (or at least most of them) visited inshore waters during the evening (perhaps feeding and playing) and returned during early morning (5–6 a.m.). The larger animals move farthest from beach and some move up to flats at perhaps 100 feet (30 m) above sea level, especially if the terrain is swampy. They like to cover themselves with mud; they play in small lakes in the swamps.

Young pups were very fat and sleek; many still had glossy dark grey hair. Large animals were moulting. The carcass of a sea leopard was near our camp; apparently it was female. Its skull was removed and cleaned [not located]. There were a few old try pots at Buckles Bay at the boiling down works.

14 December 1930

Noon position 64°22'S 177°05'E. We passed alongside a dead blue whale. Its baleen, tongue, venter and one fluke were showing. Its throat, tongue and abdomen were greatly swollen due to decomposition. Its flukes were not damaged. It was about 70 to 75 feet (21 to 25 m) long.

15 December 1930

Noon position 65°35'S, 178°36'E. We came up near the *Sir James Clark Ross* during the early morning, but had to make a long detour on account of dense pack ice. We tied up alongside about 9.30 a.m. A female fin whale was used as a fender and long strips of blubber with corrugations (from the throat of blue and fin whales) were suspended over the side of the factory ship. Many whales were moored beside the ship near its stern. For miles around there were many floating carcasses stripped of blubber and masses of viscera. They had all been thrown overboard and were being utilised by birds. Hurley saw a whale foetus 6 feet (1.8 m) long near the ship.

Moored beside the ship were humpback, fin and blue whales (males and females of each species); eight of them were blue whales. On deck were two male blue whales. About six more blue whales were brought in by chasers during the afternoon.

Hurley went on board a chaser and returned early next morning; he and Douglas then went off again. Their chaser caught a blue whale and a humpback whale, missed several blue whales and went alongside a sperm whale. The last species is not taken since it is inadvisable to mix this oil in tanks along with that from the other three species. No sei whales were seen. Minkehvals were not used.

Cestodes and acanthocephala were collected from three male blue whales. We also collected diatom film and (?) diatom slime from the baleen of a female blue whale that was at least 85 feet (25.8 m) long. An abscess from the pleural surface of a lung was preserved, also sores from the intestines caused by acanthocephala. Greenish cheesy pus was present in these sores (with or without the echinorhynchs). The latter seemed quite greenish but usually flabby, flat and pale. Trematodes were looked for but not seen. *Penella* [parasitic copepods attached to the skin] were not seen. There were no open scars, although there were plenty of the pits with radiating dark areas, like those in whales taken in South Africa. They are not due to barnacles. Barnacles of the genera *Coronula* and *Conchoderma* were abundant in both humpbacks on the throat and near the anal aperture; some of them were collected.

The penis was fully extended in many blue whales and in a fin whale, and partly extended in a humpback whale. The soft terminal part of the penis thickens into a long cone at least one foot (0.3 m) in diameter at the base. A finger can be easily inserted in the urethra. The organ projects forwards and can be withdrawn into a cavity. The clitoris projects slightly and the vagina had a rather indefinite opening in a very large female blue whale. The vaginal mucosa was congested which indicates that the whale was probably pregnant. The floating foetus we saw the next morning probably came from it.

16 December 1930
Station 85, at depth 2400 fathoms was very successful, with very heavy catches, especially in the oblique nets. We drifted, as did the *Sir James Clark Ross* and the pack ice, about 5 miles (8 km) in 24 hours. Hurley and Douglas returned in a chaser (*Star X*).

Noon position 65°41'S, 178°29.5'E. Hurley described whales feeding in patches of krill. The whales turned on their side close to surface after reaching a high speed; they had one fin out of the water and their mouth opened vertically to the sea surface. Whales were shot at about 20 yards (18 m). Some were killed at first shot. Generally another shot without a barbed harpoon and with higher explosive was used to kill the whale once it was fast to the line.

31 December 1930
Blizzard. There was very little life in the pack ice: we saw an emperor penguin, a few Adélie penguins, snow petrels and crabeaters seals. One of the crabeaters had at least two large gaping, bleeding wounds on its flanks, probably caused by a killer whale.

15 January 1931
A female crabeater seal was collected [specimen not located]. Another was shot but it slipped through the tackle while it was being hoisted aboard .

19 January 1931
Many seals were seen, chiefly crabeaters (190 were counted from crows nest at noon), also a few sea leopards.

20 January 1931
Crabeaters were seen returning to pack ice during early morning, presumably having fed during night in sea adjacent to pack ice.

2 February 1931
Noon position 64°57.5S, 90°21E. All day we have been passing through pack ice that was not very heavy, but it prevented us using the fishing nets. We spent the day coaling ship and the operation is to be repeated tomorrow. Many sea leopards and crabeater seals were seen. Three emperor penguins were collected. Two of our men were lowered from the bow to the floe on which the penguins were shot. A large sea leopard and two crabeater seals tried to get on the floe; the leopard was probably after either the crabeaters or the penguins. He was shot while in the water [specimen not located]. They are very active when in the sea. We had noticed him some minutes previously crossing the wake of the ship.

6 February 1931
We went alongside an old type of pelagic whaler, the *Falk*, and a collier, the *Sestris* (both Norwegian). Four dead whales (part carcasses) were alongside and used as fenders; they smelt vile.

8 February 1931
We sighted the *Thorshammer*, a Norwegian ship owned by Christiansen. It carried Larsen, the Norwegian airman.

10 February 1931
We sighted the *New Sevilla*, a British ship belonging to a new company. Its chasers are named *Bouvet*. The ship has a tunnel astern and looks as if it were a converted Liverpool White Star ship. This is its first season as a whaler.

16 February 1931
Noon position 66°46'S, 62°00'E. A dozen killers were seen hunting in their characteristic manner. They have a very leisurely movement in a definite direction.

III COMMENTARIES

Plate 25. *A large elephant seal bull at Macquarie Island (AAE, Photo: H. Hamilton)*

III.A COMMENTS ON PINNIPED OBSERVATIONS
P. D. Shaughnessy

Aspects of the original reports that deal with pinnipeds are discussed in this section in the light of recent knowledge. Particular use is made of the reviews of antarctic seals by King (1983) and Laws (1984). Reference is made to AAE and BANZARE reports on other specialities that briefly deal with marine mammals and to other pertinent information from the expeditions. The comments are arranged by species.

III.A.1 Southern Elephant Seal *Mirounga leonina*

(a) Distribution

Southern elephant seals (Plate 25) breed at many islands in the Southern Ocean on both sides of the Antarctic Convergence, with concentrations at South Georgia, Kerguelen, Heard and Macquarie Islands (Laws 1960). They also haulout at various sites on the Antarctic continent (King 1983). A large one was sighted in the pack ice in December 1913 and two were collected at Commonwealth Bay, a large male and a juvenile (specimen numbers SAM-M305 and Aust-S1356). Males from Macquarie Island move south to feed near the Antarctic coast (Hindell *et al.* 1991).

As H. Hamilton noted, southern elephant seals also occur at Marion and Crozet Islands; but not at Guadalupe, where the northern elephant seal *M. angustirostris* breeds.

(b) Seasonal

Detailed studies of the life history and ecology of elephant seals at Macquarie Island in the 1950s made by R. Carrick and colleagues expand on the early observations of H. Hamilton and E. R. Waite. In particular, the annual cycle is described by Carrick *et al.* (1962a). The breeding season begins in August when bulls arrive on the beaches, followed by cows at the end of August. Pups are born from early September to early November. They wean at 3 weeks of age, at which stage cows are mated. Adults are ashore again for 3 to 4 weeks from January to April to moult; immatures moult earlier (November to January).

(c) Harvesting

Accounts of methods used to harvest elephant seals at Macquarie Island in the early 1900s provided by Hamilton and Waite supplement those by Ainsworth (1914, 1915) and Cumpston (1968, pp. 262 and 300). Ainsworth (1914, p. 272) estimated that "fully 700 animals are slaughtered there each full season" (whereas Hamilton estimated 400) and that only bulls were killed.

That the elephant seal was unlikely to be exterminated by the sealers at Macquarie was stated by both Hamilton and Waite. This belief was echoed by Ainsworth (1915, p. 220) and by Davis (1919, p. 67). All four authors noted that sealers took animals only in the vicinity of digesters, and Ainsworth (1914, p. 272) stated that "the increase in numbers annually is much greater than [the harvest], as on fully $^{9}/_{10^{ths}}$ of the coast the animals remain absolutely undisturbed." Nevertheless, Mawson (1923) agitated to limit the slaughter and promoted Macquarie Island as a sanctuary.

At Crozet and Kerguelen, elephant seals were still being harvested in late 1929 when *Discovery* visited, and sealers had recently been harvesting at Heard Island. Harvey Johnston provided a vivid account of the sealers methods at Crozet Islands in November 1929 and commented on the brutality and the uncontrolled nature of the harvest (section II.H and Grenfell Price 1962, p. 29). In the same month he also recorded elephant seals being harvested at Kerguelen and Heard Island (Section II.G). An account of the methods used to harvest elephant seals at Heard Island from 1854 to 1882, and its extent, is provided by Downes (1996).

(d) Population estimates

It is not obvious from Hamilton's report whether his estimate of 25 000 animals for the 1913 breeding season was for part or the whole population on Macquarie Island. As the AAE station was located on The Isthmus, it is possible that the estimate refers to that area alone. On the other hand, Hamilton also estimated numbers at Eagle Bay on the west coast and indicated there were hundreds of other rookeries. These factors suggest that it is likely that Hamilton's estimate of 25 000 animals refers to the whole island. Hindell and Burton (1988) arrived at the same conclusion in their analysis of elephant sealing at Macquarie Island and its effect on population size. Presumably the AAE estimate was made when maximum numbers were ashore during the breeding season, i.e., in October 1913. As no mention was made of an extrapolation to include non-breeding animals at sea, the estimate is likely to be of animals ashore rather than of the entire population. Hindell and Burton (1988) used that figure to estimate the size of the entire population at 88 000 animals in 1913.

Ainsworth (1915, p. 220) estimated that "thousands" of elephant seals were ashore during the breeding season, and elsewhere (Ainsworth 1914, p. 271) stated that they "resort to the island in great numbers for … breeding."

An estimate of elephant seal numbers is available for the BANZARE visit to Macquarie Island from 2 to 4 December 1930. R. A. Falla counted "over 1 000 well-grown pups … on the isthmus between Buckles Bay and Hasselborough Bay and a further 2 000 on other beaches between Nuggets and Eagle Point" (in Crowther 1933, p. 15).

Mawson counted 5 000 animals "from Garden Cove to Nuggets on E. coast and Aerial Cove to beginning of Featherbed on south side of Hasselborough Bay" (Grenfell Price 1962, p. 103). Falla's count is smaller than Mawson's even though Falla's area extended further south along the west coast. Mawson deduced the total number of elephant seals ashore on the northern part of the island to be 20 000 to 30 000. After visiting other parts of the island, including Lusitania Bay, Mawson estimated the number of animals ashore on the whole island to be 50 000, most of which were three months old.

Counts of elephant seal bulls, cows and pups on The Isthmus between 1950 and 1960 ranged from about 8 000 to 11 000, when the population of the whole island was estimated at 110 000 (Carrick and Ingham 1962). The population size remained stable during that period and presumably had recovered from a lower level early in the century before harvesting ceased in 1919. In 1985, the estimate of the population size for Macquarie Island was 86 500 animals, a decrease from an estimated 156 000 in 1959 at an average rate of 2.1% per annum (Hindell and Burton 1987).

The size of the pre-sealing population at Macquarie Island was estimated by Hindell and Burton (1988) as 93 000 to 110 000 animals. The sealing industry reduced the population size and continued to suppress it for almost 100 years.

(e) Size

Contemporary measurements of seals' body lengths (Scheffer 1967) are taken from snout to tail in a straight line (standard length) or, less commonly, over the curve of the back (zoological length), and exclude the hind flippers. Standard length of elephant seals at Macquarie Island was reported by Carrick et al. (1962b) and by Bryden (1972). Physically mature males averaged 4.2 m. The largest male measured was 14 feet 6 inches (4.27 m), and it was estimated that the largest males were 16 to 17 feet (4.9 to 5.2 m). As these measurements are consistently smaller than those provided by Hamilton (maximum 5.5 m), it is likely that the latter measured from nose to tip of extended hind flippers and/or over the curve of the back. Waite stated clearly that his measurements (maximum 5.2 m) included hind flippers.

The length of physically mature cows at Macquarie Island averaged 2.6 m. The largest measured by Carrick et al. (1962b) was 9 feet (2.74 m). Newborn pups averaged 1.27 m. These lengths are also smaller than those reported by Hamilton (2.7 m average and 3.7 m maximum for cows; 1.5 m for pups), presumably for the same reasons.

(f) Food

In his account of the AAE at Macquarie Island, Mawson (1942, p. 283) noted that the stomach of a male elephant seal contained beaks of 50 cephalopods and many nematodes. Ainsworth (1915, pp. 200 and 220) listed gravel, stones, cuttlefish beaks, worms, crabs and fish as stomach contents of elephant seals. Hamilton and Waite referred only to cuttlefish, fish and shingle.

Hamilton noted that the stomachs he examined were from "the first [animals] of the season", which extended from mid-August to mid-March (Ainsworth 1914, p. 271). The beginning of the sealing season would have coincided with arrival of breeding males (Carrick *et al.* 1962a), and it is presumably this age/sex class that Hamilton examined. Furthermore, bulls were the most prevalent class in the harvest (section III.1.b).

Berry (1917) reported that about 90 cephalopod mandibles (i.e., chitinous beaks) were taken from the stomach of a large elephant seal at Macquarie Island by members of the AAE. None of these was identified, but three were illustrated (Figs. 28-30). Dell (1959) reported on cephalopods from the BANZARE, including approximately 70 unidentified mandibles from an elephant seal collected at Possession Island, Crozet Archipelago on 3 November 1929. As the identification of cephalopods from their mandibles has improved in recent years (e.g. Clarke and MacLeod 1982a, 1982b), it may now be possible to identify some of this material.

Although Hamilton reported fish from elephant seal stomachs at Macquarie Island, none of these was included in monographs of fish collected by the AAE or BANZARE (Waite 1916, Norman 1937). The former author suspected that a partly digested *Notosudis hamiltoni* collected from a beach had been ejected by a seal.

A recent study of stomach contents of elephant seals at Macquarie Island revealed cephalopods, benthic fish and small amounts of crustaceans (Green and Burton 1993). Stomachs of elephant seals at Heard Island (*ibid*) and at Signy Island and South Georgia (Laws 1956a, Clarke and MacLeod 1982a, Rodhouse *et al.* 1992) also contained remains of cephalopods and fish.

Many theories have been suggested for the presence of stones in seals' stomachs, but none has provided a satisfactory explanation (King 1983). Of the 139 stomachs examined by Laws (1956a), 84 per cent contained small stones or sand.

The "hair seals (*Arctocephalus forsteri* Lesson)" in South Australian waters mentioned by Waite with stones in their stomachs could have been Australian sea lions *Neophoca cinerea* or New Zealand fur seals *A. forsteri*, both of which breed there.

(g) Behaviour

Hamilton, Waite and Harvey Johnston each wrote in a discursive manner about aggressive encounters among large, male elephant seals and about challenges to beachmaster bulls in control of "harems" or groups. Aggressive and sexual activity of these seals has been studied qualitatively at Macquarie Island by Carrick *et al.* (1962b) and quantitatively at South Georgia by McCann (1981). The former noted the stabilising role of beachmasters. McCann observed that most (more than 90%) of encounters during the breeding season between bulls highly ranked in the dominance hierarchy were walkovers and only 4% involved physical contact. Harvey Johnston also described mating behaviour (section II.G) which has been described in detail by Laws (1956a).

(h) Skin and moult

Moult in southern elephant seals at Macquarie Island has been studied by Ling (1965). The hair and outermost layer of skin are fused and so are shed together, as noted by Waite and by Harvey Johnston.

Both Hamilton (section II.A) and Harvey Johnston (section II.G) noted adult female and young elephant seals scratching and rubbing their hind flippers. This was possibly to alleviate irritation caused by the louse *Lepidophthirus macrohini*, which burrows into the hind flippers. Murray and Nicholls (1965) reported that the majority of elephant seals at Macquarie Island are infested with this louse, particularly young seals, and that density is greatest on the hind flippers.

(i) Probocis

Hamilton commented on the "wonderful nose" of male elephant seals and attributed its function and development to the sense of smell. Although the sense of smell is believed to play an important part in the life of pinnipeds (reviewed by King 1983), the inflated proboscis of adult male elephant seals is thought to act as a resonating chamber to amplify sound (Laws 1956a). Vocalisations have an important function in the males' aggressive behaviour, especially their "roar" which is made with the proboscis erected (Carrick *et al.* 1962b, McCann 1981).

III.A.2 Southern Fur Seals *Arctocephalus* spp.

Eight species of southern fur seal are recognised (Repenning *et al.* 1971), six of them on islands and continents of the Southern Hemisphere, one on the equator at the Galapagos Islands and another off the south-west coast of North America. The species whose breeding range lies closest to Macquarie Island is the

New Zealand fur seal *A. forsteri*; it breeds on the South Island of New Zealand and on several New Zealand subantarctic islands.

Hamilton's statement that no fur seals were seen at Macquarie Island by the AAE party is consistent with that of Ainsworth (1915, p. 168). According to Mawson (1943, p. 38), the headsman of the gang taking elephant seals for oil informed the AAE party that "in his experience of the Island, which extended over eleven years, odd fur seals had appeared on the beaches on a number of occasions. Of course, needless to say, they were killed forthwith' (for their valuable skin).

The identity of the fur seal harvested at Macquarie Island has not been determined, as it was exterminated soon after 1820 and no specimens or records remain. It was known to sealers as the "upland seal". In 1948 when ANARE established a station on The Isthmus, *A. forsteri* was observed (Gwynn 1953b). Numbers of New Zealand fur seals have been increasing (Shaughnessy and Goldsworthy 1993), and the subantarctic and antarctic fur seals, *A. tropicalis* and *A. gazella* have also been reported at the island (Shaughnessy and Fletcher 1987). These authors deduced that of the three species, *A. tropicalis* is most likely to have been the upland seal. Taylor (1992) has argued that upland seals were juvenile New Zealand fur seals.

III.A.3 Leopard Seal *Hydrurga leptonyx*

(a) Distribution

The leopard seal (Plate 26) has a circumpolar distribution in the Antarctic pack ice with stragglers extending north to subantarctic islands and to southern continents. They haul out frequently in Tasmanian waters and should be considered as part of the Australian fauna (Rounsevell and Pemberton 1994). During summer small numbers of them are seen in inshore waters of Antarctica where they are well known predators at penguin colonies.

At Macquarie Island, Mawson (1942) reported that leopard seals "came ashore … more abundantly in winter than in summer" (p. 285) and that they "become numerous … during the month of July and remain plentiful for about 3 months" (p. 295). This is not inconsistent with Hamilton's statement that they are most abundant from May to July.

Mawson also noted that at Macquarie Island "altogether the Expedition Party killed 36 during their two years of occupation" (Mawson 1942, p. 284). Dates for 21 of these have been extracted from his and Hamilton's accounts, and from the list of museum specimens (Table 7). Many more must have been seen, judging by the statements cited above, but the number cannot be ascertained. Rounsevell and Eberhard (1980) and Rounsevell (1988) reported that sightings between 1949

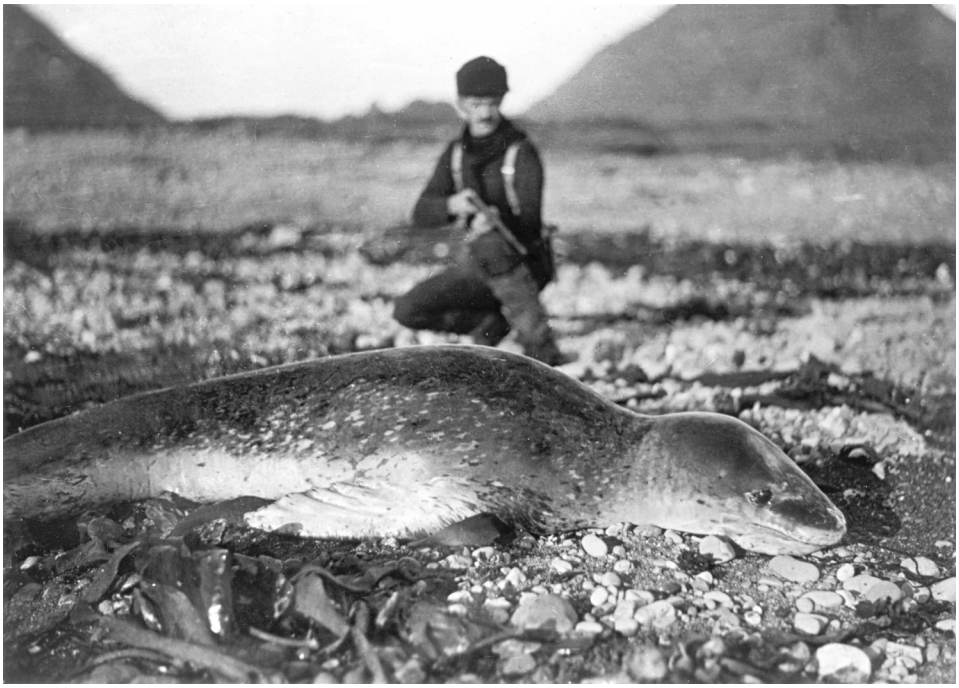


Plate 26. *A leopard seal at Macquarie Island; A. Sawyer with gun (AAE, Photo: H. Hamilton)*

and 1986 at Macquarie Island oscillated in four or five year cycles between a few and 100 to 300 animals. Most of the sightings they reported were made between June and December, which is later than the period reported by Hamilton and by Mawson (1942).

Three leopard seals were collected at Heard Island, two in late November and one in early December 1929 (see Table 5). The pelage of the first two seals was described by Harvey Johnston as brown and in pre-moult condition (section II.G), which contrasts with the blue-grey dorsum and silvery white venter of the newly moulted pelage. Leopard seals are frequent visitors to Heard Island (Gwynn 1953a, Brown 1957, Ingham 1960).

At Commonwealth Bay, only three leopard seals were seen in two years: one in 1912 and two in September 1913 (Mawson 1915a, vol. II, p. 161).

(b) Reproduction

At Macquarie Island, four pregnant female leopard seals were reported by the AAE party, one each on 11 May and 26 July 1912 (Mawson 1942), and on

9 July and 21 November 1913 (H. Hamilton, Section II.A.3). This contrasts with the situation between 1949 and 1979 when leopard seals sighted at Macquarie Island were classed as 1-, 2- and 3-year-old seals, and sexually immature (Rounsevell and Eberhard 1980).

The length of the fetus taken on 11 May 1912 ("a foot", Mawson 1942, p. 284) is similar to that of fetuses measured by Brown (1957) at Heard Island on similar dates.

Waite suggested that the leopard seal breeds at sea and H. Hamilton suggested that its pups "are born in the sea", because pupping had not been observed on land. Limited observations near the Antarctic Peninsula indicate that pups are born on pack ice from late October to mid-November and that mating takes place in the sea in December and early January (Siniff and Stone 1985). The fetus collected at Commonwealth Bay on 19 September 1913 (SAM-M312) would have been a little more than a month from parturition. The large pup (estimated at about 2.1 m long) with its mother sighted from *Discovery* on 18 December 1929 near 65°S, 76°E would have been at least a month old if the pupping season reported for the Antarctic Peninsula by Siniff and Stone (1985) also pertained to this area.

The fetus reported by Hamilton on 9 July 1913 moving "down the beach" at Macquarie Island after being removed from the uterus was much more developed than would be expected three and a half months before the beginning of the pupping period. But that is consistent with the wide variation in length of foetuses taken at particular times of the year (J. E. Hamilton 1939a, King 1983). No measurements are available of the fetus observed on 9 July 1913, nor is its fate reported. The date of the event is repeated in a hand-written note by H. Hamilton located elsewhere in AAE archives (114 Box 13). Mawson (1942, p. 295) also records a pregnant female with a well developed pup being killed on that day.

H. Hamilton noted that the fur of the fetus he examined on 9 July 1913 at Macquarie Island was tawny yellow. Coat coloration has been described for two foetuses and four newborn pups (J. E. Hamilton 1939a, Gwynn 1953a, Brown 1957); all included yellow in their description, but this may be discolouration resulting from oxidation of fat.

(c) Predation and food

Leopard seals are well known predators of penguins and also feed on euphausiids, cephalopods and other invertebrates, fish and other vertebrates including crabeater seals, and several petrels (reviewed by Øritsland 1977, Laws 1984, Siniff and Stone 1985). Interaction between leopard and crabeater seals is referred to below (III.4.C).

The stomach of a leopard seal killed at Macquarie Island on 26 July 1912 contained kelp and nematodes. J. E. Hamilton (1939a) also reported algae in stomach or gut contents. On the Antarctic mainland, members of the AAE at Commonwealth Bay observed a leopard seal feeding on a Weddell seal carcass on 3 April 1912 (Mawson 1915a, vol. I, p. 164; Jacka and Jacka 1988, p. 70). Other records of seal remains in stomachs of leopard seals are documented by Øritsland (1977).

At Macquarie Island, Mawson (1942, p. 284) reported that the stomach of a leopard seal killed on 27 May 1912 contained "Penguin and Shag feathers", H. Hamilton (section II.A.3) found "remains of penguins, shags and fish" in stomachs, and Ainsworth (1915, p. 182) noted that "stomachs of all specimens … taken by us during the penguin season contained penguin feathers." At Heard Island, the stomachs of two leopard seals collected in November 1929 contained penguin feathers and one of them also contained fish bones (section II.G).

King penguins *Aptenodytes patagonicaus* have been recorded as prey of leopard seals at Macquarie Island (Csordas 1963, Rounsevell and Copson 1982). The "shag" at Macquarie Island is the imperial shag *Leucocarbo atriceps purpurascens*. Leopard seals have also been reported to feed on imperial shags *P. a. albiventer* at the Falkland Islands (J. E. Hamilton 1946).

(d) Behaviour

Leopard seals followed small boats at Heard Island (Csordas 1963) and at Macquarie Island (H. Hamilton, section II.A.3). This behaviour was inoffensive or non-aggressive, in contrast to the overt interest some leopard seals directed towards SCUBA divers at the Antarctic Peninsula (DeLaca *et al.* 1975, Lipps 1980) and their attacks on boats reported by J. E. Hamilton (1939a). In the last case, provocation by humans was suggested as the cause.

Interaction between a leopard seal and several kelp gulls *Larus dominicanus* in Lusitania Bay on 31 August 1912 was described by Mawson (1942, p. 286). The gulls sat on the sea surface until approached closely by the seal, flew up and then swooped on it.

Although Waite noted that leopard seals at Macquarie Island did "not appear to utter sounds" (section II.B.2), Rogers *et al.* (1995) have recorded 11 in-air vocalizations of this species.

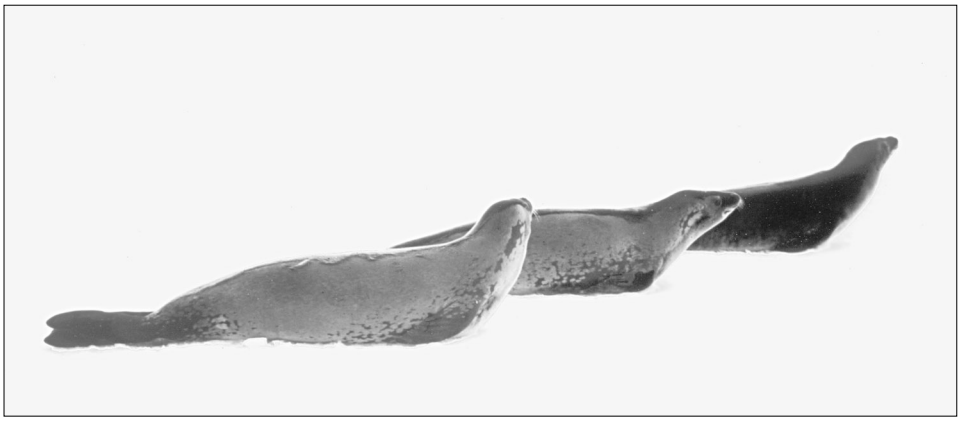


Plate 27. *Three crabeater seals (AAE, Photo: J. F. Hurley)*

III.A.4 Crabeater Seal *Lobodon carcinophagus*

(a) Distribution

The crabeater seal (Plate 27) has a circumpolar distribution in the antarctic pack ice with an abundance estimated at 11 to 12 million animals (Erickson and Hanson 1990). In summer they occur principally in the outer unconsolidated parts of the pack ice. A few vagrants have been reported from subantarctic islands and southern continents.

Crabeater seals are usually found in low density, but aggregations have been reported in summer, for example 600 within a radius of 5 km (Gilbert and Erickson 1977). Such concentrations were observed twice during the BANZARE cruises in January 1931: 190 were counted from the barrel on the 19th and "hundreds" on the 26th. (sections II.F and II.H) Noon positions on these days were 64°20'S, 115°37'E and 65°10'S, 109°25'E (Table 1). During the first of the AAE voyages, Mawson (1915a, vol. I, p.54) reported "at one time as many as a hundred would be counted from the bridge." This was in late December 1911 to early January 1912 as *Aurora* approached Commonwealth Bay.

At Macquarie Island, Hamilton recorded two crabeater seals and Mawson (1942, p. 296) noted that they were "reported at other times on the Island." Mawson (op. cit.) also noted that the second of the crabeater seals reported by H. Hamilton (on 10 September 1913) was at Nuggets Beach rather than at The Isthmus (3 km away) and that members of the Macquarie AAE party had described these seals as "hybrids" between elephant and leopard seals. After they visited Antarctica some months later (in early 1914), they realised that their "hybrids" were crabeater seals.

Visits of crabeater seals to Macquarie Island appear to be uncommon. None was reported by: Law and Burstall (1956) in a review of observations and research carried out by ANARE personnel at the island; Ingham (1960) in a report on the status of seals at Australian antarctic stations; Erickson and Hofman (1974) in a survey of the seals' distribution. The last authors noted several sightings in south-eastern Australia and Warneke (1995) noted 13 records in Victoria.

The only other report of a crabeater seal at Macquarie Island is for a single animal in 1982 (Fletcher and Shaughnessy 1984). Thus the report of two stragglers within one year by the AAE party is unusual. As they sighted several icebergs near the island, it is possible that the Antarctic Convergence was further north then than at present and that the distribution of crabeater seals also extended further north. Such movements of the Antarctic Convergence have been recorded; for example, Houtman (1967) placed it north of Macquarie Island in November 1958.

(b) Food

Little information on food of crabeater seals is available from the reports included here. Hunter reported that the large intestine of an animal killed on 8 January 1914 (presumably MV-7396) contained reddish faeces; these may have been so coloured by euphausiids (section II.C). He noted that most of the stomachs examined were empty. Harvey Johnston observed crabeater seals feeding beside ice floes close to *Discovery* on 5 January 1930, but gave no indication of the prey (section II.F).

Some information is available on the food of crabeater seals from the BANZARE. Dell (1959) reported that cephalopod remains (six mandibles, two pens and two eye lenses; all unidentified) were taken from the stomach of a crabeater seal collected in pack ice at 64°28'S, 114°59'E on 21 January 1931 (specimen SAM-M14895, M14986 and/or M12132; Table 3). As noted in section III.A.1.f, it may now be possible to identify these cephalopods from their mandibles. Several authors have reported on the food of antarctic seals, for example Øritsland (1977) and Bengtson (1982); crabeater seals feed primarily on krill *Euphausia superba* as well as on small amounts of fish and cephalopods.

Members of a large group of crabeater seals were observed from *Discovery* on 19 January 1931 leaving the pack-ice surface "during the early evening" and returning to the surface "during the early morning" of the following day. This diel behaviour has been recorded in individual animals using time-depth recorders during autumn in the Antarctic Peninsula area (Bengtson and Stewart 1992).

(c) Predation

Hunter (section II.C) noted scarring on two crabeater seals taken on 16 January 1914 and suggested they had been attacked by killer whales. Later (29 January 1914), he observed a leopard seal chasing three crabeater seals and wondered if scars on crabeater seals were caused by leopard seals. These observations and suggested causes were repeated by Mawson (1942, p. 97). Harvey Johnston also observed "double rows of marks" on a crabeater seal on 15 January 1931 (section II.F).

A graphic description of a leopard seal chasing and catching a crabeater seal is related in the deck log of *Discovery* for 9 February 1931. Less informative is the brief description of a leopard seal hauling-out on to a floe in pursuit of two crabeater seals and three emperor penguins *Aptenodytes forsteri* on 2 February 1931 (section II.H).

Killer whales were recorded in the deck log of *Discovery* chasing crabeater seals twice during the BANZARE voyages. On 22 January 1930 in pack ice, three killer whales chased and killed an unidentified seal (section II.F). Harvey Johnston described the same event (section II.G) and identified the seal as a crabeater. On the second occasion (22 January 1931), a killer whale pushed through brash ice and "several crabeater seals scuttled from water to floes" (section II.F).

Several authors have discussed interaction between killer whales, leopard seals and crabeater seals. A review by Siniff and Bengtson (1977) concluded that leopard seals are the cause of scars on crabeater seals; J. G. Hunter tentatively reached the same conclusion. Smith *et al.* (1981) described the hunt of a crabeater seal by a group of killer whales and reviewed the literature on activities of killer whales. Crabeater seals have been reported to move from the sea to the pack-ice surface when disturbed by killer whales (Dzhamanov 1992).

III.A.5 Weddell Seal *Leptonychotes weddelli*

(a) Distribution

Adult Weddell seals (Plates 28–30) inhabit the fast-ice zone adjacent to the Antarctic continent and nearby islands; younger age classes are believed to occur in pack-ice areas (DeMaster 1979). There are occasional records of them from subantarctic islands and southern continents (King 1983).

Both Hamilton and Waite refer to a Weddell seal at Macquarie Island. Hamilton (section II.A) is uninformative (no date, no location), but Waite (section II.B) was ashore on 20 August 1913 and indicates that the seal was seen between Nuggets Beach and The Isthmus. Mawson (1942, p. 296) was less convinced of its identity; he noted within an entry that covered 20 to 27 August 1913 that "possibly stray

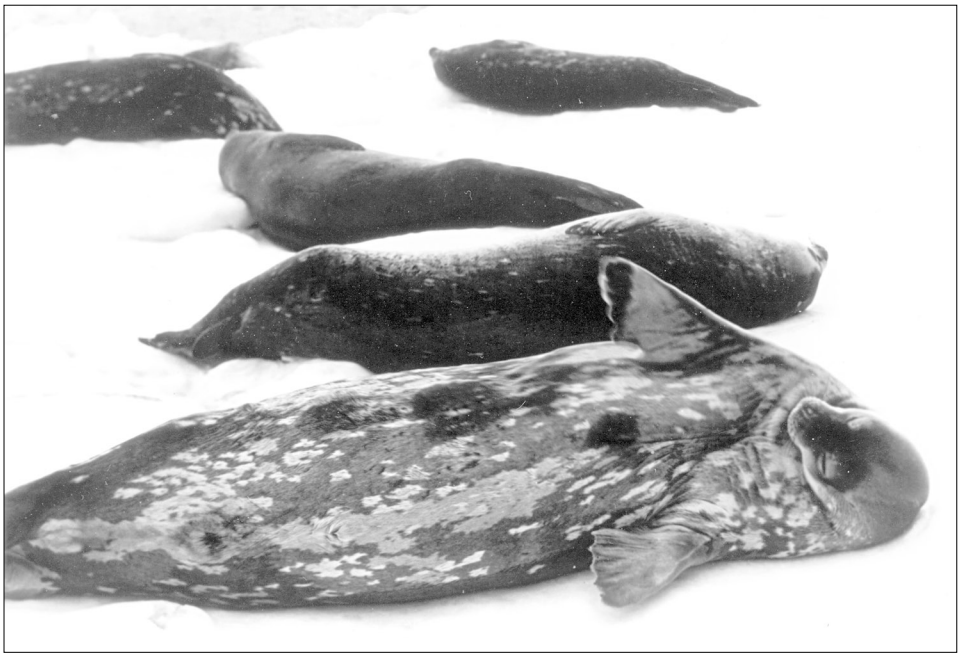


Plate 28. *A group of Weddell seals asleep, with one stretching (AAE, Photo: J. F. Hurley)*

Plate 29. *A Weddell seal (AAE, Photo: J. F. Hurley)*

Plate 30. *A Weddell seal (AAE, Photo: J. F. Hurley)*

Weddell Seals also reach Macquarie Island." On the other hand it is clear that Waite checked its identification, and this is supported by his description of its placid behaviour. It is specimen SAM-M310, which was collected at Macquarie Island during the AAE (section III.D.4).

Between 1949 and 1957 three Weddell seals were reported from Macquarie Island (Law and Burstall 1956, Ingham 1960). Each was seen on several occasions. No further observations have been reported (eg, see Erickson and Hofman 1974, Fletcher and Shaughnessy 1984). In August and September 1976 a young male was seen on The Isthmus on several occasions and was recorded in the seal log book kept at the ANARE station.

(b) Food

Information on the food of Weddell seals is available from the AAE collections. Berry (1917) found fragments of half-digested cephalopods of the genus Moschites (Family Octapodidae) and four loose cephalopod mandibles in the stomach of a Weddell seal shot on 3 November 1912 at 67°S in Adélie Land (presumably at Cape Denison, Commonwealth Bay, see section III.D). Waite (1916) reported the remains of a *Trematomus newnesi* from the stomach of a Weddell seal collected

in Adélie Land on the same date, and two specimens of another *Trematomus*, possibly *T. centronotus* from the stomach of a Weddell seal collected on 3 September 1912. Harvey Johnston (section II.G) noted that the stomach of a Weddell seal killed on 25 January 1930 off Enderby Land contained amphipods, and a large intestine contained fish eye lenses [presumably SAM-M8683, skin and skull, and M14893, incomplete skin].

Øritsland (1977), Laws (1984) and Green and Burton (1987) reviewed studies of stomach contents of Weddell seals. Fish is the primary food; other food items include small amounts of krill *Euphausia* spp., cephalopods and other invertebrates. Clarke and MacLeod (1982b) have identified eight types of cephalopods from Weddell seals taken at Deception Island. Food of subadults is not known (DeMaster 1979).

III.A.6 Ross Seal *Ommatophoca rossii*

The Ross seal (Plate 9) has a circumpolar distribution in the antarctic pack ice. It is generally associated with larger ice floes and greater ice cover than are crabeater and leopard seals. The densest concentrations have been observed in the southeast Atlantic Ocean (Erickson and Hanson 1990).

Aspects of the biology of Ross seals described by King (1969) and by Ray (1981) expand on the description in section II.D of six animals collected by the AAE in January 1914. The shape of the stomach of the Ross seal, including the constriction, has been described by King (1983).

From the description of the collection of these Ross seals in sections II.C and II.D, it is apparent that six encountered at Haswell Island were collected. The report by Mawson (1940) that seven were seen there and taken seems to be in error. Note that the report in section II.C is taken from Mawson (1942).

The six animals must have been close together because J. G. Hunter and his colleagues walked to them and between them. Ross seals are usually solitary, although groups of five, four and three have been observed (Bonner and Laws 1964, C. J. R. Robertson in Erickson and Hofman 1974, Zenkovich 1962). The six Ross seals seen by Hunter were on fast ice which is consistent with the general documentation that higher densities of them are usually associated with large floes (Laws 1984). During the BANZARE voyages they were observed in low numbers (1 or 2) on four occasions.

From Hunter's description of the six Ross seals (section II.D), it is apparent that the teeth were small. This accords with the description by Laws (1984, p. 653), who noted that they are suited to tearing and holding cephalopod prey. As there is no indication of how the snout to tail lengths (Table 2) were measured, it cannot

be determined if they represent zoological length (measured over the curve of the back) or standard length (measured in a straight line).

No pups were reported by Hunter. This is not unexpected, because pupping is now known to occur in November (Tikhmirov 1975, Thomas *et al.* 1980). The only information on reproduction for the six specimens collected in late January is that one of the two females did not contain a fetus. Nor did Skinner and Westlin-van Aarde (1989) find fetuses in any of 26 adult female Ross seals collected between mid-January and early February. They concluded that implantation is delayed in Ross seals.

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III.B COMMENTS ON T. HARVEY JOHNSTON'S OBSERVATIONS OF PINNIPED REPRODUCTIVE ANATOMY
R. A. Tedman

1. Male Reproductive Tract Anatomy

The macroscopic appearance of the male reproductive tract in two phocids, the common seal *Phoca vitulina* and grey seal *Halichoerus grypus* has been described by Harrison *et al.* (1952). This work is often cited as the basic description of the phocid seals' reproductive tract (see Laws 1956b, Harrison 1969, King 1983), and no other drawings or photos of male phocid genitals, other than those for the Ross seal *Ommatophoca rossii* (Tedman 1991a), have been published. The descriptions of the penis and preputial opening in these articles are brief. The diagrams and descriptions provided by T. Harvey Johnston give a much more detailed account of these structures.

Several features of Harvey Johnston's descriptions deserve comment. The overhanging papilla at the tip of the glans, plus the deep, almost semicircular groove on the dorsal surface of the glans were not mentioned by Laws (1956b) in his description of the reproductive tract in the southern elephant seal *Mirounga leonina*, nor have they been described in other phocid seals (Owen 1868, Hepburn 1896, 1912, Harrison 1969, Tedman 1991a). However, Laws (1956b) described the urethra as opening at the tip of a pointed process, about two to three centimeters long, in the adult. Harvey Johnston's description of the raphe of the prepuce and glans, the slight pockets (preputial glands) at the point of junction of the prepuce and glans, and the slight swellings on the ventral surface of the penis, proximal to the glans, have not been referred to in other studies of phocid seals. Harrison *et al.* (1952) described a urethral meatus opening terminally on the underside of a claviform glans penis, whereas Harvey Johnston's observations indicate a urethral aperture at the tip of a papilla which projects beyond the glans. It would seem that not all phocids possess the same glans structure.

Harvey Johnston's sketches of an extruded penis (Figure 2) show a transition from the flesh-coloured penis to a slightly pigmented area with large scales which lies adjacent to a narrow, dark area with small scales. This is continuous with the ventral body surface covered with hair. Again, this has not been described elsewhere.

The glans penis of a phocid seal differs markedly from that of an otariid seal. In a description of the penis of the southern sea lion *Otaria byronia* and

Californian sea lion *Zalophus californianus*, Harrison *et al.* (1952) indicate that the distal end of the glans displays a 'lobed collar' of erectile tissue with the urethral meatus opening below and a little proximal to the tip of the os penis, which projects subepithelially to the tip of the glans. The glans penis of the walrus *Odobenus rosmarus* is about one and a half inches (3.8 cm) long and is laterally compressed. It is fleshy and rugose, with a wrinkled appearance (Murie 1871). This is similar to the description given by Murie (1874) for *O. byronia*.

The os penis (almost 30 cm long) in *M. leonina*, as described by Harvey Johnston, projects into the glans penis and ends behind a cushion-like mass on the dorsal surface of the penis. In subadult *P. vitulina* the os penis ended 2.3 cm proximal to the tip of the glans (Harrison *et al.* 1952). Laws (1956b) recorded os penis lengths of 31.0 and 33.2 cm for two seven-year-old *M. leonina*. Animals from four to five years old had an os penis about 30 cm in length. Sexual maturity in this species is attained at about four years of age, although a male does not usually acquire and maintain a harem until seven years of age (Laws 1956b).

Harvey Johnston gives a detailed account of the external aperture (preputial opening). Laws' (1956b) only comment on this area was to remark that the tube containing the retracted penis opened in the mid-ventral line about two-thirds of the distance from anus to umbilicus. Harrison *et al.* (1952) merely commented that the opening was about half way between anus and umbilicus in *P. vitulina*, whereas Harrison (1969) made the generalisation (for pinnipeds) that the opening was two thirds of the distance from the anus to umbilicus. The penile opening of the northern fur seal *Callorhinus ursinus*, is similar to that described by Harvey Johnston in that the skin of the opening is hairless and fleshy pink, surrounded by black (Scheffer 1962). Harvey Johnston's description is far more detailed than that given for any other pinniped. His description of pigmentation, hairs, scales and papilla is meticulous.

It is unfortunate that Harvey Johnston's careful descriptions did not include any comments on the testes or scrotum. As outlined by Harrison (1969) and King (1983), the testes in all phocids and in the walrus are inguinal, lying ventral and lateral to the pelvis. While the testes lie outside the abdominal muscles, they do not produce a visible swelling. In the Otariidae the bulges of the testes are visible externally in a scrotum, anterior to the tail and anus.

Sketches (Figure 2) plus Harvey Johnston's notes provide a detailed account of the internal anatomy of the elephant seal penis. His descriptions of the retractor penis muscle, the corpora cavernosa and the corpus spongiosum are consistent with those given for other phocids *P. vitulina* (Harrison *et al.* 1952), *H. grypus* (Hepburn 1896), *L. weddelli* (Hepburn 1912), *M. leonina* (Laws 1956b) and *O. rossii* (Tedman 1991a), the walrus *O. rosmarus* (Murie 1871), and an otariid *O. byronia*

(Murie 1874). Harvey Johnston was unsure of the function of the muscles he found within the penis. He called them retractor or erector muscles. Erector muscles are not mentioned in the descriptions of other phocids and the otariids referred to above. These muscles are normally referred to as m. retractor penis or retractores penis. The tissue lying dorsal and lateral to the urethra in the glans plus the tissue surrounding the urethra in the body of the penis was referred to as the corpus spongiosum by Harvey Johnston. This is consistent with descriptions by Murie (1871) for *O. rosmarus* and by Tedman (1991a) for *O. rossii* for the body of the penis. Harrison *et al.* (1952) described a "fully developed" corpus cavernosum urethrae for *P. vitulina*, but Murie (1874) could not find a corpus spongiosum in the otariid *O. byronia*.

2. Female Reproductive Tract Anatomy

(a) External genitals

The external female genitals have been poorly described in the literature. Laws (1956b) shows a clitoris, vestibule and anus in a sketch of a two-day-old female *M. leonina* but does not comment further on the surface features of this area. Some details of pigmentation and hair, plus the appearance of the clitoris are presented for *L. weddelli* by Harrison *et al.* (1952), *O. byronia* by Hamilton (1939b), and the Australian sea lion *Neophoca cinerea* by Tedman (1991b). Brief observations have been made on the clitoris of *H. grypus* and *P. vitulina* (Owen 1868), *O. byronia* (Cleland 1900) and *O. rosmarus* (Burne 1909).

Harvey Johnston's careful descriptions of the surface appearance of the external genitalia of female *M. leonina* are far more detailed than anything else that has been published. His reference to the "female depression", as a kind of cloaca with the anus in a depression on the upper wall, is reminiscent of Owen's (1868) mention of a common cloacal sphincter muscle that surrounds anal and urogenital openings in *P. vitulina*. A cloaca has been described in *N. cinerea* (Tedman 1991b), *L. weddelli*, *P. vitulina* and *H. grypus* (Harrison *et al.* 1952).

Phocids and otariids appear to differ in the relative size and appearance of the clitoris, preputial sac, labial folds and hymeneal fold (Harrison *et al.* 1952). At least in *M. leonina*, the clitoris varies in size according to age and sexual condition (Laws 1956b). Considerable variation in size of the clitoris was noted in adult *N. cinerea* (Tedman 1991b). Burne (1909) described a clitoris in *O. rosmarus* as a 'large, twisted prominence upon the ventral surface of the urogenital sinus and terminating in a swollen trifid glans'. The two centimetre long clitoris that was described by Harvey Johnston in *M. leonina* is much larger than that found in an adult otariid, for example in *N. cinerea* (Tedman 1991b) or *O. byronia* (Hamilton 1939b, Harrison *et al.* 1952), and larger than that reported for adult

phocids such as *P. vitulina*, H grypus, and *L. weddelli* (Harrison *et al.* 1952). Harvey Johnston's reference to the erect clitoris as probably serving as a guide for the penis during copulation has not been suggested by other authors.

An os clitoridis (clitoris bone) has been recorded sporadically from *M. leonina* (Laws 1956b), *L. carcinophagus* (Mansfield 1958), *P. vitulina* and *C. ursinus* (Owen 1868; Scheffer 1949), *Z. californianus* (Sierts 1950), *N. cinerea* (Tedman 1991b) and *O. rosmarus* (Fay 1982). In *L. weddelli*i (Mansfield 1958), an os clitoridis is normally present in adults and is found occasionally in young pups. The one centimetre long os clitoridis described for a subadult *M. leonina* by Harvey Johnston was smaller than that reported by Laws (1956b) for a seven year-old animal.

A urinary papilla is characteristic of pinnipeds. It has been described in a variety of phocids and otariids (Owen 1868, Hamilton 1939a, Harrison *et al.* 1952 and Laws 1956b). The urethra opens in a sulcus in the vestibule in *N. cinerea* (Tedman 1991b). In *O. byronia* the urethra may open upon a mammiliform papilla in a sulcus (Hamilton 1939b, Harrison *et al.* 1952). Harvey Johnston also describes a papilla in *M. leonina*.

Labia minora are usually not prominent in pinnipeds. They are frequently described as folds separated by the clitoris and merging with the folds of the urinogenital canal; their homology with the labia minora being presumed (see Hamilton 1939a, 1939b, Harrison *et al.* 1952). Harvey Johnston's descriptions of the labia minora in *M. leonina* give the impression of well developed, fleshy folds, although his sketches are not particularly clear.

Most descriptions of the female reproductive tract in pinnipeds divide the tract into (a) a urinogenital canal into which opens the urethra and which contains the clitoris, (b) a vagina which begins at the hymen and ends at the external os of the uterus, and (c) the uterus which consists of a body or corpus, two uterine horns or cornua and uterine tubes (fallopian tubes). The urinogenital canal or vestibule is relatively long compared to that in most mammals. It can be up to 16.5 cm long, as in *L. weddelli* (Harrison *et al.* 1952).

Although Harvey Johnston does not give measurements for the vestibule in *M. leonina*, some of his descriptions would indicate a rather large structure; for example, he stated that a urinary papilla projects (3.5 cm) into the vestibule and was 8 or 9 cm behind the clitoris. One sentence in Harvey Johnston's description is a little misleading. He described the vagina as "capacious being 26 cm long (i.e. from labia minora)". Usually the vagina is measured from the hymen and not the labia minora. Laws (1956b) recorded 6-7 inches (15 to 18 cm) and 5-7 inches (13 to 18 cm) for vestibule and vagina lengths respectively, for *M. leonina*

up to eight years of age. It seems likely that Harvey Johnston mistakenly referred to the vagina plus vestibule as the vagina. Vagina lengths vary from 13 cm to 21 cm in adult phocids such as *H. leptonyx*, *L. carcinophagus* and *L. weddelli* (Hamilton 1939a, Harrison *et al.* 1952).

Externally, the uterus of pinnipeds usually is seen as two uterine horns (cornua) attached to a single body (corpus) which blends with the vagina. Internally, the canals of the uterine horns remain separate within the body, only forming a common canal in the cervix near the vagina. In some otariids the cervical canal might also be septate with two openings into the vagina (Harrison *et al.* 1952). The urinogenital canal in *L. carcinophagus* and *L. weddelli* is closed off from the vagina by a large dome-shaped hymeneal fold that projects into the cranial end of the canal. This fold may prevent water entering the vagina during deep dives (Harrison *et al.* 1952). The hymeneal fold is less prominent in otariids (Harrison 1969). Although Harvey Johnston does not remark upon the hymeneal fold in *M. leonina*, this part of the reproductive tract should be as well developed in *M. leonina* as in the phocids examined by Harrison *et al.* (1952), considering the deep diving habits of this species (Boyd and Arnbom 1991).

The uterus of the multiparous *M. leonina* that Harvey Johnston examined contained a cervix about 3 cm in diameter, and the corpus uteri (referred to as the "uterus") was 18 cm long and contained a cavity 5.5 cm across. His description of this region is probably incomplete because he does not indicate any separation of the uterine canals within the corpus uteri. It is likely that the 'uterine cavity' was merely the cervical canal and the fused distal parts of the uterine canals. His description of the uterine horns is consistent with that for other pinnipeds. The asymmetry of the uterine horns is typical of multiparous individuals in which one horn has recently contained a fetus. Ovulation in pinnipeds occurs from alternate ovaries in successive pregnancies. Hence the uterine horns are used alternately (Harrison 1969).

The uterine horn that has recently contained a fetus has a thicker wall, is longer and contains evidence of a placental scar in its lumen. These features progressively change to return the uterine horn to a resting phase while the contralateral horn prepares to receive the next blastocyst (Tedman 1991b).

Harvey Johnston's description of the ovarian bursa that contains the ovary and has openings to the peritoneal cavity and the uterine tube are consistent with those presented elsewhere (see Owen 1868, Hamilton 1939b, Harrison *et al.* 1952, Laws 1956b, Tedman 1991b).

The ostium abdomen of 3 cm described by Harvey Johnston is much larger than the opening of 1 cm diameter reported by Laws (1956b) for this species. This is the

largest size for this opening recorded for any species of pinniped.

Harvey Johnston measured the diameter of an ovary in *M. leonina* as 3 cm. He does not refer to any asymmetry in ovarian size so the implication is that both ovaries were of this diameter. Laws (1956b) recorded the sizes of the ovaries from 34 female *M. leonina*, none of which had symmetrical ovaries, although several had ovaries of similar sizes. Three centimetre is near the upper limit of the ovary diameters given by Laws (1956b).

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III.C COMMENTS ON CETACEAN OBSERVATIONS
G. J. B. Ross

Though limited in descriptive detail, the cetacean observations made on *Aurora*, and particularly on *Discovery*, provide valuable insight into the status of blue whales in antarctic waters between 43°E and 170°E, before or at the onset of commercial whaling in this region. The deck log of marine mammal sightings from *Discovery* also provides several new distribution records for small cetaceans and information on two species that would have pre-dated more modern descriptions by several decades had they been published promptly; they are described here. Positions given for sightings on *Discovery* have been interpolated from the time of sighting or estimated from the ship's positions at noon each day (Table 1).

Mawson's interest in establishing whether southern right whales were present in any numbers along the Antarctic coast during the AAE is understandable. Though reduced markedly by over-exploitation in the 19th and early 20th centuries (Best 1970), right whales were still much in demand commercially at shore stations then, and the report of a population in Antarctica would have been valuable both commercially and for conservation purposes. It is not surprising that Captain James Davis did not observe any right whales on the second AAE voyage, partly because these whales usually migrate south to the region of 40°S to 50°S, and rarely cross the Antarctic Convergence, and primarily because populations of these whales had been reduced to very low numbers then (Best 1970, Omura *et al.* 1969). The sighting of three right whales only in whaling Areas I and II from 1978–79 to 1983–84 on six cruises of the International Decade of Cetacean Research (IDCR) of the International Whaling Commission (IWC) indicates the rarity of this species in the Antarctic even after several decades of recovery (Kasamatsu *et al.* 1988). Mawson (1942) reported sighting a right whale at about 64°S, 132°E in pack ice on 4 January 1914, but Hunter was sceptical of its identification.

The detail in Davis's letter, written some 12 years after the voyage, suggests that it was compiled from other documents. Clearly blue whales and killer whales were very numerous close to coastal ice in 1912–1913 between about 150°E and 95°E, forming aggregations of up to 20 or 30 whales at times. The identification of whales seen on the return journey north to about 55°S is not made clear; although some may have been blue whales, they may equally have been fin whales once *Aurora* moved northwards away from the ice shelf.

The observations of large whales along the ice edge during the *Discovery* voyages probably comprise the only available record of their status in this region before

the advent of whaling or at its onset. Pelagic whaling using factory ships had been conducted on an exploratory basis by C. A. Larsen on the *Sir James Clark Ross* in the 1923–24 season. This was the first vessel bearing that name, of 8 223 tons (Tønnessen and Johnsen 1982). By the end of the 1929–30 season, 5 841 blue whales and 270 fin whales had been killed in the Ross Sea and around the Balleny Islands (Tønnessen and Johnsen 1982). However, no catches had been made along the coast to the west of the Ross Sea before the 1930–31 season.

No whaling vessels were encountered by the *Discovery* near Antarctica in the 1929–30 whaling season. In the following season, the *Discovery* met up with the *Sir James Clark Ross* at about 65°S, 177°E, and took coal from her. The latter was processing numerous blue whales, several fin whales, some humpback whales and a single sperm whale. This vessel, of 14 500 tons, was the second with this name, and it was her first voyage (Tønnessen and Johnsen 1982).

The purpose built factory ship *Kosmos* (17 800 tons), which the *Discovery* met on 29 December 1930 at about 66°S, 142°E, was the most modern of its type when completed in 1929. The *Discovery* took on 50 tons of coal from her (Grenfell Price 1962). Tønnessen and Johnsen (1982) noted that the factory ship *Alonzo* encountered on 31 January 1931 was a Norwegian vessel, but they made no reference to the whaler *Falk*, which was apparently a factory ship from its activities as reported by the *Discovery* scientists. The purpose built *Tafelberg* (13 640 tons, completed 1930), the *Southern Empress* (12 398 tons, converted 1928) and the *Thorshammer* (12 215 tons, converted 1928) were sighted on 8 February 1931, at about 66°S, 79°E; the *New Sevilla* (13 800 tons, converted 1930) was seen two days later some 4° to the west. The presence of these vessels indicates the rapidity with which this new phase of pelagic whaling was initiated and its high intensity. In the ensuing eight seasons some 62 000 blue whales were captured south of 60°S and between 0° and 130°E. This region comprises the southern part of whaling areas III and IV, two of five whaling grounds defined by Hjort et al (1932) based on catch distributions, mainly those of blue whales; a sixth area was suggested later by Mackintosh (1942). The western boundary of areas I through VI are, respectively, 120°W, 60°W, 0°, 70°E, 130°E and 170°W (Tønnessen and Johnsen 1982). After the BANZARE voyages, Mawson promoted the possibilities of commercial whaling in the Southern Ocean (e.g., Mawson 1935; Grenfell Price 1962, pp. 95, 164), but with concomitant strict regulations (Jacka and Jacka 1988, p. il).

Blue whales were the most abundant cetacean species recorded on the two *Discovery* voyages: an estimated 185 to 193 were seen in 91 sightings along the Antarctic coast. Six of these individuals, in four sightings, were identified tentatively as blue whales. A further 18 whales (in seven sightings) were

categorised as blue whales, based on their high blows and presence within the pack ice, both of which are characteristic of blue whales. The distribution and numbers recorded are summarised in Table 8 for each 10° of longitude, and in Fig. 4 they are compared with the distribution of blue whale catches between 0°E and 180°E (whaling areas III, IV and part of V) provided by Omura (1973) for the years 1931–1939. Despite the disparity in sample sizes of about 190 sightings versus some 62 000 captured blue whales in the region over this eight season period, the relative paucity of sightings around 70°E and 130° (the western and eastern boundaries of whaling Area IV; Mackintosh 1966) conforms with the lower catches of blue whales there.

Blue whales were observed near Kerguelen on 8 November 1929, in association with prions. These were probably pygmy blue whales, *Balaenoptera musculus brevicauda*, which occur north of about 54°S and from 0°E to about 80°E in the southern summer (Ichihara 1966). In late 1929 the whaler *Radioleine* was reported (section II.F) to be catching these whales off Kerguelen. The *Kilfinora*, which reported on humpback whaling off Kerguelen earlier in 1929, was a sealing vessel out of Cape Town (Grenfell Price 1962); it had recently arrived from the Crozet Islands.

Fin whales were encountered infrequently in the Antarctic, partly because they prefer areas further away from the edge of the pack ice. In addition, three of the passages to and from the Antarctic coast passed through areas in which densities of blue and fin whales were relatively low, based on catch rates, and which coincide with the divisions between whaling areas III and IV, and between areas V and VI (Mackintosh 1966). The passage to the Antarctic coast in 1929 passed through the centre of area IV during early December, some two months before numbers of southward migrating blue and fin whales peak. Single animals were seen on 21 October 1929 (close to 37°S, 19°E) and on 5 December 1929 (56°S, 78°E); a group of six was observed on 26 October 1929 at 40°S, 28°E. These animals were presumably migrating south at the time.

Sei whales were recorded twice only during the *Discovery* voyages. A pair of adults was seen on 29 December 1929 (noon position 65°S, 68°E) near the ice edge, and two whales were observed north of the pack ice on 10 December 1930 (noon position 62°S, 164°E). Usually this species does not extend much further south than subantarctic waters, accounting for the rarity of sightings near the pack ice.

Minke whales were observed on 23 occasions. Fourteen of these were single animals seen along or within the ice edge between 64°S and 67°S, and from 59°E to 142°E. Four pairs, a group of four and two groups of six were also observed. A widespread aggregation of five animals was observed in Royal Sound, Kerguelen in November 1929, and a pair was recorded near Murray Island, Kerguelen in February 1930.

Minke whales were sighted occasionally within the pack ice. Concern was expressed that they could become imprisoned and suffocated in pack ice (section II.F, entry for 29 December 1930). This seems unlikely, for they have been reported many times within pack ice and are capable of rising vertically to breath through narrow cracks (e.g., Taylor 1957, Ensor 1989).

Sperm whales were seen infrequently. One adult male was recorded near the ship on 17 March 1930 (near 38°S, 111°E). Only two animals were noted south of 60°S; the sperm whale seen alongside the *Sir James Clark Ross*, and a single animal seen at 66°18'S, 73°30'E.

Captain James Davis noted that killer whales were 'plentiful' along the Antarctic coast in January 1913, but provided no details. These whales were seen off Antarctica on both BANZARE voyages, between 46°E and 170°E (table 9). In total, 16 groups were recorded, which ranged in size from single animals (seven occasions) to about 40 animals; the median group size was five. They were observed chasing crabeater seals (section III.A.4c), and also attacking a blue whale (on 16 January 1930) and a large whale (18 January 1930).

The distribution of killer whales along the Antarctic coast was irregular and, to some extent, matched the distribution of crabeater seals seen by the *Discovery* expeditioners. Numbers of both species are compared in Table 9. The similarity in their distributions suggests that crabeater seals had a significant role as prey for killer whales, at least at that time.

In November 1929, pairs of killer whales were seen twice at Possession Island, Crozet group and a single animal was observed in Royal Sound, Kerguelen. At this time of year killer whales appear at these islands, coinciding with the period that elephant seals and other prey species are ashore to breed (Guinet 1992).

The identification as *Cephalorhynchus heavisidii* of the schools of 'porpoises' seen on 15 March 1930 at about 40°S, 107°E is clearly in error, since this species is known with considerable certainty to be confined to the continental shelf of the west coast of southern Africa (Findlay *et al.* 1992). However, the true identity of these sightings is far from certain. The observers seemed clear that they were not pilot whales, based on head and fin shape. The presence of a large triangular fin and the feeding behaviour are all more suggestive of killer whales. This interpretation seems to be borne out by subsequent sightings of similar whales in the 1930–31 expedition, such as 'the new species of *Globiocephalus* with white flanks' (31 January 1931), or small killer whales (groups February 1931). All had in common a high dorsal fin and the presence of white flank patches, suggesting all were killer whales, though small in size.

Pilot whales, *Globicephala melas*, were observed infrequently during the *Discovery*

voyages. Groups of animals were seen on 26 October 1929 at about 40°S, 28°E and on 21 March 1930 at about 35°S 118°E, beyond the continental shelf. A single animal was observed on 8 February 1931 at about 66°S, 79°E. Of particular interest was a group of whales seen on 30 October 1929 to the north of the Prince Edward Islands at about 43°S, 41°E. The observation is one of the earliest to describe the white postocular streak characteristic of the *leucosagmaphora* form subsequently described by Rayner (1939), and now known to be typical of most southern hemisphere pilot whales (Brownell 1974). A grey postocular streak also occurs in some north Atlantic animals (Sergeant 1962).

The identity of eight whales seen on 31 January 1931 is less certain. In his description of the animals, Harvey Johnston is presumably referring to the sighting noted above when he comments on the new species of '*Globiocephalus* with white flanks', though the only white on the flank of these animals is the postocular streak. The reference to the dorsal fin resembling that of 'small killers' is also difficult to ascribe to a pilot whale. These animals remain unidentified for the present.

At least six species of dolphin were observed on the two *Discovery* cruises near South Africa or Australia. Two of these were continental forms seen close to the beginning or end of these voyages. The common dolphin *Delphinus delphis* was seen off the shelf due south of Albany, Western Australia, on 21 March 1930, and on two occasions in the D'Entrecasteaux Channel, Tasmania. A group of dolphins seen in Table Bay, South Africa was also tentatively ascribed to this species.

Bottlenose dolphins were seen twice. The several groups of animals, including at least one calf, sighted on 21 March 1930 were almost due south of Albany and beyond the continental shelf. The estimated length of 2.4–2.7 m is consistent with the lengths (2.8–3.2 m) of large *Tursiops* that mass-stranded in South Australia (Ross and Cockcroft 1990). The suggested association of these animals with pilot whales may indicate feeding on similar prey, perhaps squid. Such associations between these two species occur commonly elsewhere (Leatherwood and Reeves 1983). The description and the sketched appearance of the dolphins seen off the entrance to Port Phillip Bay, Victoria fits *Tursiops truncatus* well. The mean length of five male and five female bottlenose dolphins from Port Phillip Bay was 2.64 m (range 2.41–2.80 m); the mean length of dolphins along the Victorian coast was similar, although males reached lengths of 3.0 m (Warneke, *in litt*., 13 April 1966).

Two sightings made on two successive days in February 1914 (section II.E, Mawson 1942, p. 102) were probably of hourglass dolphins *Lagenorhynchus cruciger*. Although Hunter's reference to a piebald colour pattern and a white band in front and behind its foreflipper could also describe Peale's dolphin, *L. australis*, this

species typically occurs in shallow water. Hunter's sightings were made over the south-east Indian Ridge in deep water, near 51°S, 104°E and 50°S, 107°E.

Two further sightings, made in 1931 on 6 January, off the MacKellar Islets, near 67°S, 142°E, and on 1 March, near 56°S, 85°E were probably *L. cruciger* as well. The presence of a triangular and falcate fin in both supports this identification. But the backs of the first animals were described as grey not black, and it is surprising that the pale patch posterior to the dorsal fin of the single animal in the second sighting was mentioned but not the anterior patch. Moreover, no appropriate alternative species are known from such high latitudes.

The totally white ventral surface and leaping behaviour of the dolphins seen on 7 March 1931 at 50° 25'S, 107° 53'E is typical of southern right whale dolphins *Lissodelphis peronii* (Fig. 1c). Although the sketch by Falla shows the basal part of a dorsal fin, he noted specifically that the dolphins were some distance from the ship and swimming away from it, and that no clear view of the fin or snout form could be obtained. Had the dorsal surface of these animals been visible to the observers, identification would have been very simple, since the dorsal fin is absent in this genus. Although *Australophocaena dioptrica* is a possibility, because it too has a totally white ventral surface, the behaviour of these dolphins and their deep water location is atypical of *A. dioptrica*. These animals were not *C. heavisidii* as identified by Falla (section II.F), or any other species of that genus; in each the posterior caudal peduncle and ventral surface of the flukes are dark or black (Leatherwood and Reeves 1983).

Falla and Marr reported observing many dusky dolphins *L. obscurus* between Adelaide and Melbourne on 4–8 April 1930. Although the location of these animals is uncertain, the ship's course went through Backstairs Passage (between Kangaroo Island and the mainland) and thence to Melbourne along the coast inshore of the 200 m isobath. Dusky dolphins were also reported off southern Tasmania on 18 March 1931, close to the noon position of 43°44'S, 146°25'E. The occurrence of dusky dolphins in Australian waters has been confirmed recently from clear video film of a group off the east coast of Tasmania (41.8°S, 148.5°E), and by the stranding of a female which gave birth, and was subsequently released, at Pirates Bay, Tasmania (43.0°S, 147.9°E) on 16 November 1995 (Gill *et al.* in press). Several unconfirmed records include those of Lillie (1915) off southern Australia, those made from a research vessel off south-western Australia on 5 March 1993 (35.4°S, 117.6°E), and that made by W. Dawbin in Backstairs Passage, inshore of Kangaroo Island, on 8 November 1986 (van Waerebeek *et al.* 1995, Gill *et al.* in press.). A specimen stranded in Tasmania and reported to be this species was re-identified as *Lissodelphis peronii* (van Waerebeek 1993).

The small delphinids observed by Marr in the Gulf of Morbihan at Kerguelen in February 1930 were Commerson's dolphin *Cephalorhynchus commersonii* (Fig. 1b), where there is a small population of this species isolated from that along the southern tip of South America and the Falkland Islands. The grey flanks of the Kerguelen animals noted by Marr are characteristic of this population, whereas those of the South American animals are white. Although the presence of this species was suspected from the observations of Studer (1889), it was confirmed much later by Paulian in 1951 (Pascal 1981). The difference in colour pattern was first noted by Robineau (1986).

The sightings logs maintained on the *Discovery* voyages are probably the most comprehensive available for any cetacean population in the Antarctic before whaling began. These observations are too imprecise to use for absolute abundance estimates because of uncertainty about the distance between the ship's track and sighted animals, the period and intensity of observation, the length of the survey track, and variation in sighting conditions. However, they are appropriate for comparisons based on relative abundance, particularly for blue and minke whales, the species seen most frequently along the Antarctic coast. Sightings data for this region have been refined as far as possible, as indicated below.

Three factors are important in ensuring that sightings data for different species are comparable: the level of sighting effort; the distance of each sighting from the ship; and whether there are appropriate environmental conditions for sighting. Although the data on all three factors are imprecise and were not collected purposefully, they permit some refinement of the sightings data in various ways, with concomitant reduction in sample size.

The number of sightings of marine mammals made at different times of the day provides a simple measure of sighting effort (Table 10). No observer was recorded for about one third of the sightings, but it seems highly likely such sightings were made by expeditioners who omitted to note the observer when sightings were entered into the log. The distributions of sightings by each of the three groups of observers (expeditioners, ship's officers on watch, unrecorded observers) are similar for large whales and seals, suggesting that observer effort was reasonably consistent for both small and large animals in a range of habitats. The distribution of large whales sightings by expeditioners and unrecorded observers were similar, concentrated between 0800 and 2000 hours. However, those sightings made by ship's officers were distributed quite evenly over 24 hours, with about 50% of sightings between 0800 and 2000 hours. In view of this apparent dichotomy in effort, the data have been treated *in toto*, or limited to the peak 12-hour period (Table 11).

The estimated distance in nautical miles (nm) of a sighting from the ship was recorded on a few occasions. Most often, however, sighting distances were noted qualitatively, in terms of far, distant, near, close and so forth. Assuming that terms such as "distant" or "far", "near" , and "close", "alongside" or "next to", relative to the ship, were applied in a fairly consistent way by observers for all whale species, the sighting distances can be expressed qualitatively in four categories: "next/close to the ship"; "near the ship"; "far from the ship" and "not recorded". Few data indicate quantitative limits for these categories. Comment on a sighting of two blue whales indicated that one whale 400 m (ca 0.25 nm) was further away than the second, which was "close to the ship". Based on this, the innermost group ("close to", including "next to" and "alongside") includes the few sightings estimated to be 0.25 nm or less from the ship. Sightings described as "near" formed the next group with which sightings estimated to be less that 1 nm were grouped. Perusal of some comments suggest that the division between "far" and "near" was at about 1 nm from the ship. In Table 11, data have been divided into three groups: all data, "close" + "near", and "close" only.

There is no information on sighting conditions in the marine mammal log of the *Discovery*. However, weather conditions and periods when observers were busy with other activities were recorded by Mawson in his daily log for the *Discovery* voyages (Grenfell Price 1962). These entries are sufficiently detailed to enable each day to be rated as *poor*, *moderate* or *good* for purposes of observation. These ratings were based primarily on the level of visibility (reduced by ice cover, wind, falling snow and cloud cover) coupled with the length of time available for observation. On these criteria, of the 118 days spent next to the Antarctic coast (10 December 1929 to 27 January 1930; 12 December 1930 to 18 February 1931), 50 days were classified as poor, 21 days were moderate and 39 days were good for observation purposes. On a further 8 days, observers were fully occupied with ship's activities (for example, moving cargo or coal, assisting with the launch of the aircraft, landing on shore or festivities).

Various combinations of sighting data are presented in Table 11, modified in accordance with these sighting factors. Comparison of the ratios of minke and blue whales in combinations of "all conditions" or "moderate + good conditions", and when "close" or "near + close" to the ship suggest strongly that sighting rates of blue and especially minke whales are strongly affected by sighting conditions, and also by distance. The larger size and more visible blow of blue whales are undoubtedly the most important factors in the greater visibility of this species. On these grounds, the higher ratios of blue to minke whales seen in all conditions and at all distances are highly likely to be biased upwards in favour of blue whales. Uncertainty as to the value of the ratios based on all sightings is increased

further by the large number of unidentified whales in these two categories.

Sighting rates (whales/hour) for whales seen on both *Discovery* expeditions south of 60°S have been calculated for various conditions (Table 12). This table also includes comparable figures for whales seen during the cruises of the International Decade of Cetacean Research (IDCR) from 1978–79 to 1983–84 (Kasamatsu *et al.* 1988).

Comparison of these indices of abundance of blue and minke whales observed in moderately good conditions on the *Discovery* and IDCR cruises suggest that the ratio of blue:minke whales has changed from about 2.1:1 (5.1:1 if distance is not accounted for) to 1:266, a change of at least some 550-fold, and indicative of large-scale changes in the relative population sizes of these species in the intervening 50 years. The impact of whaling on blue whales in this region is well-documented. Numbers were reduced very rapidly from 1930 onwards in this region; in Area IV, 35,750 blue whales were caught south of 60°S between 1931–32 (when documentation of catches began) and 1938–39. In this same period, the number of blue whales caught per catcher day's work was reduced from 1.62 to 0.51 (Omura 1973).

No humpback whales were seen during the *Discovery* cruises, probably reflecting the effects of intense whaling in lower latitudes throughout the 1920s. Those seen on IDCR cruises are suggestive of the recovery of this species presently in progress. The proportions of sperm whales in these pre- and post-whaling observations suggest also that numbers of this species may well have increased in Antarctic waters.

The sighting rates of killer whales in the two periods are roughly similar, suggesting that their abundance may not have changed much. This may indicate that the overall food resources available to them has not changed, although the prey composition of their diet may have.

One group of whales that was conspicuously absent during the *Discovery* voyages is the beaked whales. With the exception of a beaked whale about 4.9 m long stranded at Hasselborough Bay on Macquarie Island on 17 February 1912 (Ainsworth 1915), none of the whales unidentified here could be ascribed to this group. Rostral fragments from two beaked whale specimens were collected in 1965 and 1966 at Hasselborough Bay; these were identified as *Mesoplodon layardii* (Baker and Van Helden, 1999) and *M. bowdoini* (by the author) (Museum of Victoria registration numbers C235696 and C23595, respectively). In contrast, beaked whales of several species were the second most frequently sighted cetaceans seen during the IDCR cruises. Some of this difference may be ascribed to the difficulty of observing several of the smaller beaked whales. But the larger

species, such as the southern bottlenose whale *Hyperoodon planifrons* can be quite conspicuous and are readily seen at sea. Most of the large beaked whales seen by Kasamatsu *et al.* (1988) were probably bottlenose whales. The significance of such a marked increase in beaked whales is not certain. It may imply an increase in squid resources at depth if the increased presence of these deep diving whales is attributable to changes in availability of their food. This might reflect the increased availability of krill to squid species at moderate depths following reduction of baleen whale populations by whaling (Laws 1985).

According to entries in the deck log of marine mammal sightings made on *Discovery* (section II.F), whale marks were fired from the ship on at least three occasions: 21 and 29 December 1929, and 14 December 1930. None was reported to have hit a whale. Both Grenfell Price (1962, p. 55) and Jacka and Jacka (1988, p. 296) noted that Ingram 'missed … with the marker gun' on 29 December 1929. Falla also used the marking gun (Plate 14). Fletcher (1984), in his account of the expedition, refers to unsuccessful attempts to fire 'information discs' into blue whales on about 22 December 1929 when the ship was in Prydz Bay.

Marr referred to the marks as 'covered darts' (section II.F, entry for 21 December 1929). In reviews of the history of whale marking, Hardy (1940), Rayner (1940) and Brown (1977) referred to early marks as 'drawing pin' type. They were used for several years until 1932 when an improved mark comprising a hollow stainless shaft and pointed lead tip was introduced: it is still in use. There are five drawing pin type marks in the Mawson Antarctic Collection, University of Adelaide. Each bears the inscription REWARD PAID FOR RETURN TO DISCOVERY COMMITTEE around its periphery, and COLONIAL OFFICE LONDON and a four digit number around an inner circle. It is likely that these drawing pin type marks were used from *Discovery* during the BANZARE.

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III.D MUSEUM SPECIMENS
P. D. Shaughnessy, J. M. Dixon, L. Gibson and L. Queale

Numerous marine mammal specimens were collected by both expeditions. The main sources of information on them are the databases maintained by the museums where they have been deposited: the Australian Museum (Sydney), Museum of Victoria (Melbourne) and South Australian Museum (Adelaide) and, to a lesser extent, the Powerhouse Museum (Museum of Applied Arts and Sciences, Sydney) and Canterbury Museum (Christchurch). Extra information was obtained from hand written lists of specimens compiled by J. G. Hunter, biologist to the AAE, for each of the Australian Museum, Museum of Victoria and the South Australian Museum. In a few instances, Section II of this report clarified or added to existing data. The information is summarised in Table 13. It is arranged alphabetically by species, by Museum and then by specimen number.

A survey of skeletal material in the British Museum, London, from antarctic expeditions indicated that none had been deposited there from the AAE or BANZARE (Cruwys 1991). This is not surprising because Mawson stated in his objectives of the AAE that specimens collected on his expeditions would be deposited in Australian museums. There are no marine mammal specimens from Mawson's expeditions in the Queen Victoria Museum and Art Gallery, Launceston (T. Kingston, *in litt*. 1 September 1993), the Tasmanian Museum and Art Gallery, Hobart (A. P. Andrews, *in litt*. 16 August 1993), the Western Australian Museum (J. L. Bannister, *in litt*. 2 September 1993), the Museum of New Zealand, Wellington or the Otago Museum, Dunedin (A. N. Baker, *in litt*. 24 May 1993).

A total of 71 specimens has been identified: 43 from the AAE and 28 from the BANZARE. Sixty five of these are pinnipeds and six are cetaceans (Table 14). All of the BANZARE material is housed at the South Australian Museum; the AAE material is spread among several museums, primarily the Australian Museum, Museum of Victoria and South Australian Museum, with two specimens at the Canterbury Museum and one at the Powerhouse Museum, Sydney.

Several specimens of the South Australian Museum collection are listed in their catalogue (and in Table 13) as housed at "University of Adelaide"; they have not been located.

The location "Adélie Land" given on many museum specimens collected by the AAE is misleading. During and after the AAE, that expression was used by Mawson and his colleagues for the area that included their "winter quarters" at Cape Denison, Commonwealth Bay. Mawson (1915a, vol. 1, p. 61) noted that "Commonwealth Bay … was placed under the territorial name of Adélie Land."

T. Harvey Johnston (journal entry for 7 January 1931) defined "French Adélie Land" as extending "from Cape Découverte (west of Cape Hunter) to Cape Pepin or Cape Robert". In current usage, Commonwealth Bay is within the eastern part of the Australian Antarctic Territory (AAT), which extends from 142°E to 160°E. Terre Adélie refers to the part of Antarctica claimed by France between longitude 136°E and 142°E (Summerson 1993), which is west of Commonwealth Bay. The position for Cape Denison, Commonwealth Bay in the Gazetteer of the Australian Antarctic Territory (*ANARE Research Notes 15*, 1983) is 67°00'S, 142°40'E. In Mawson's Antarctic Diaries, Jacka and Jacka (1988, p. 58) also noted that the AAE Main Base at Cape Denison was east of the eastern boundary of Terre Adélie.

In reports from the expeditions (section II), there are many instances of animals being shot or found dead, and indications that specimens were collected. These have been cross-referenced to museum specimen numbers where possible; alternatively it has been noted that the specimen could not be located.

Comments on some of the specimens follow, together with attempts to supplement information available from museum records.

III.D. 1 Southern Elephant Seal

Although elephant seals were being harvested at Macquarie Island when the AAE party was based there, few specimens were collected. At Commonwealth Bay, a notable specimen taken by the AAE party was a large adult male (SAM-M305) shot near the Hut, according to Mawson (1915a, vol. 1, p. 94) and a note in the South Australian Museum letter book dated April 1914, numbered 15723 and entitled "List of specimens for Museum Adelaide". The author (J. G. Hunter) noted that the specimen was the second record for an elephant seal for the Antarctic, 'the previous specimen being obtained on the late Captain Scott's "*Discovery*" expedition' (cf. Mawson 1915a, vol.1, p. 95). A second elephant seal was collected at Commonwealth Bay by the AAE. It was recorded as "one spare skull" by J. G. Hunter in his "List of specimens presented to the Australian Museum" and allocated specimen number Aust-S1356. The skull was identified as that of a juvenile elephant seal by J. E. King (*in litt*., June 1982).

The Canterbury Museum holds the skull of an elephant seal (FMa221) and an articulated skeleton of a young female elephant seal collected at Macquarie Island (G. A. Tunnicliffe, *in litt*. 28 May 1993). The former may be from the specimen collected by E. R. Waite in 1912, but that is not indicated in the Canterbury Museum records.

III.D.2 Leopard Seal

Specimen SAM-M312 is a fetus taken from an adult female (SAM-M313) which was collected at Commonwealth Bay on 19 September 1913. This would have been a month or so before parturition, provided that the pupping period there is similar to that reported for the Antarctic Peninsula, that is, from late October to mid-November (Siniff and Stone 1985). Mawson (1942, p. 134) indicated that the adult was shot and collected on the pack ice near shore and that it "measured 12 feet 3 inches long" (3.73 m). Surprisingly, it is referred to as a male by Mawson (1915a, vol. II, p. 161).

III.D.3 Crabeater Seal

Although two specimens were collected at Macquarie Island by the AAE (Section II.A.4), neither has been located in a Museum.

Dell (1959) reported on cephalopods from crabeater seals collected by the BANZARE from 64°28'S, 114°59'E on 21 January 1931. They are presumably from the same animals as specimens SAM-M12132, M14895 and M14896 which are housed in the South Australian Museum.

III.D.4 Weddell Seal

One Weddell seal (SAM-M310) was collected at Macquarie Island on 20 August 1913 or soon after, according to reports by both H. Hamilton and E. R. Waite. In his "List of specimens for Museum Adelaide", J. G. Hunter noted that "this constitutes a new record, Weddell seals not being previously recorded from here."

The pup MV-C7399 was born around 20 October 1912; it "had a miserable time" and "became so weak that it thawed a hole in the soft, sludgy ice and could not extricate itself (Mawson 1915a, vol. 1, pp. 211-212).

III.D.5 Ross Seal

Hunter and Ainsworth recorded that six Ross seals were taken near Haswell Island in January 1914. Specimens from at least five of them are in Australian museums. Information on the snout to tail length and the sex of five of the six specimens enables them to be matched with material described in Section II.D and summarised in Table 2.

The sex of specimen MV-C7298 is in doubt. This specimen appears to be Hunter's no. 3 (see Table 2). The "List of specimens for the National Museum, Melbourne" (a hand-written document of three pages signed "J. G. Hunter, Biologist to the Expedition") includes a single Ross seal marked "No III" and notes that its sex is male. The specimen's length measurements and sex in the "List" match those for

specimen no. 3 in Table 2 (which is taken from Hunter's manuscript). They differ from those of the tanned skin at the Museum of Victoria, being 6 feet 5 inches (compared to 7 feet 7 inches) from nose to the end of the hind flippers, and 5 feet 5 inches (compared to 6 feet 9 inches) from nose to the end of tail. But we attach little importance to these comparisons, since measurements on tanned museum skins may be shorter than those on the original animal.

At the Museum of Victoria, the label of specimen C7298 and data in the register indicate that the Ross seal specimen is from a female. Because of the problems described above, a sex is not assigned to this Ross seal in Table 13.

The five specimens are now housed in museums at Adelaide (1 specimen), Melbourne (1) and Sydney (3). King (1969, Appendix C) listed four of those specimens (numbered 2, 3, 4 and 5 in Table 2). The locality of the sixth specimen is unknown. King (1969, p. 26) indicated she had examined two skulls in the National Museum of Victoria (Museum of Victoria from 1983). One of these was collected by the AAE; the other was collected in 1962.

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TABLES

Table 1. *Noon position of 'Discovery' during BANZARE voyages, 1929–30 and 1930–31 (from Harvey Johnston 1937). Distances are in nautical miles (nm).*

Date	Lat. (°S)	Long. (°E)	Dist. (nm)	Date	Lat. (°S)	Long. (°E)	Dist. (nm)
19-Oct-29	33 ° 55 ‘	18 ° 17 ‘		29-Dec-29	65 ° 06 ‘	67 ° 53 ‘	77.7
20-Oct-29	35 ° 13 ‘	18 ° 07 ‘	78.4	30-Dec-29	65 ° 32 ‘	65 ° 44 ‘	59.8
21-Oct-29	36 ° 49 ‘	19 ° 06 ‘	107.2	31-Dec-29	66 ° 10 ‘	65 ° 10 ‘	40.5
22-Oct-29	37 ° 23 ‘	21 ° 35 ‘	123.6	01-Jan-30	66 ° 03 ‘	64 ° 33 ‘	16.5
23-Oct-29	36 ° 51 ‘	23 ° 05 ‘	78.6	02-Jan-30	65 ° 21 ‘	64 ° 45 ‘	42.3
24-Oct-29	38 ° 09 ‘	23 ° 48 ‘	85.1	03-Jan-30	66 ° 01 ‘	62 ° 50 ‘	62.0
25-Oct-29	39 ° 37 ‘	25 ° 29 ‘	118.0	04-Jan-30	66 ° 35 ‘	61 ° 19 ‘	49.9
26-Oct-29	40 ° 27 ‘	27 ° 58 ‘	124.6	05-Jan-30	66 ° 30 ‘	61 ° 08 ‘	6.6
27-Oct-29	41 ° 20 ‘	30 ° 52 ‘	141.8	06-Jan-30	66 ° 22 ‘	59 ° 30 ‘	40.0
28-Oct-29	42 ° 11 ‘	34 ° 10 ‘	156.2	07-Jan-30	66 ° 24 ‘	59 ° 07 ‘	9.4
29-Oct-29	42 ° 38 ‘	37 ° 50 ‘	164.7	08-Jan-30	66 ° 13 ‘	58 ° 13 ‘	24.3
30-Oct-29	43 ° 36 ‘	41 ° 03 ‘	152.3	09-Jan-30	66 ° 06 ‘	58 ° 14 ‘	7.0
31-Oct-29	44 ° 24 ‘	44 ° 37 ‘	161.2	10-Jan-30	66 ° 14 ‘	58 ° 34 ‘	11.4
01-Nov-29	44 ° 59 ‘	48 ° 11 ‘	156.1	11-Jan-30	66 ° 34 ‘	60 ° 13 ‘	44.4
02-Nov-29	46 ° 16 ‘	51 ° 24 ‘	155.4	12-Jan-30	66 ° 03 ‘	57 ° 43 ‘	67.8
03-Nov-29	46 ° 20 ‘	51 ° 40 ‘	11.8	13-Jan-30	65 ° 50 ‘	53 ° 37 ‘	101.1
04-Nov-29	46 ° 24 ‘	51 ° 55 ‘	11.1	14-Jan-30	66 ° 12 ‘	49 ° 21 ‘	106.3
05-Nov-29	46 ° 45 ‘	55 ° 09 ‘	135.0	15-Jan-30	66 ° 35 ‘	45 ° 22 ‘	98.4
06-Nov-29	47 ° 34 ‘	58 ° 51 ‘	158.7	16-Jan-30	66 ° 12 ‘	48 ° 12 ‘	71.8
07-Nov-29	47 ° 47 ‘	63 ° 14 ‘	177.5	17-Jan-30	66 ° 11 ‘	49 ° 33 ‘	23.8
08-Nov-29	47 ° 59 ‘	67 ° 31 ‘	172.8	18-Jan-30	66 ° 14 ‘	49 ° 24 ‘	6.0
09-Nov-29	48 ° 43 ‘	70 ° 10 ‘	114.5	19-Jan-30	66 ° 29 ‘	43 ° 17 ‘	147.9
10-Nov-29	48 ° 44 ‘	70 ° 51 ‘	27.1	20-Jan-30	66 ° 25 ‘	43 ° 05 ‘	6.2
11-Nov-29	47 ° 36 ‘	70 ° 17 ‘	71.7	21-Jan-30	66 ° 40 ‘	43 ° 50 ‘	23.4
12-Nov-29	49 ° 28 ‘	70 ° 23 ‘	111.6	22-Jan-30	66 ° 39 ‘	46 ° 26 ‘	61.8
13-Nov-29	49 ° 30 ‘	70 ° 10 ‘	8.8	23-Jan-30	66 ° 06 ‘	50 ° 50 ‘	110.8
14-Nov-29	49 ° 30 ‘	70 ° 10 ‘	0.0	24-Jan-30	65 ° 48 ‘	53 ° 16 ‘	62.1
to the ...				25-Jan-30	65 ° 57 ‘	53 ° 07 ‘	9.7
23-Nov-29	49 ° 30 ‘	70 ° 10 ‘	0.0	26-Jan-30	65 ° 47 ‘	54 ° 27 ‘	34.2
24-Nov-29	49 ° 29 ‘	70 ° 18 ‘	5.3	27-Jan-30	65 ° 02 ‘	54 ° 56 ‘	46.6
25-Nov-29	51 ° 24 ‘	71 ° 30 ‘	123.8	28-Jan-30	63 ° 51 ‘	54 ° 17 ‘	73.0
26-Nov-29	53 ° 05 ‘	73 ° 25 ‘	122.7	29-Jan-30	62 ° 51 ‘	54 ° 16 ‘	60.0
27-Nov-29	53 ° 05 ‘	72 ° 24 ‘	36.6	30-Jan-30	62 ° 35 ‘	54 ° 10 ‘	16.2
28-Nov-29	53 ° 05 ‘	72 ° 24 ‘	0.0	31-Jan-30	61 ° 19 ‘	53 ° 17 ‘	80.0
to the ...				01-Feb-30	59 ° 30 ‘	53 ° 11 ‘	109.0
03-Dec-29	53 ° 05 ‘	72 ° 24 ‘	0.0	02-Feb-30	57 ° 17 ‘	55 ° 22 ‘	149.7
04-Dec-29	54 ° 28 ‘	75 ° 29 ‘	137.2	03-Feb-30	55 ° 11 ‘	55 ° 55 ‘	127.3
05-Dec-29	55 ° 31 ‘	77 ° 55 ‘	104.8	04-Feb-30	53 ° 14 ‘	56 ° 36 ‘	119.4
06-Dec-29	57 ° 04 ‘	78 ° 05 ‘	93.2	05-Feb-30	51 ° 31 ‘	59 ° 54 ‘	158.8
07-Dec-29	58 ° 40 ‘	77 ° 43 ‘	96.7	06-Feb-30	50 ° 37 ‘	64 ° 03 ‘	165.5
08-Dec-29	60 ° 17 ‘	77 ° 50 ‘	97.1	07-Feb-30	50 ° 11 ‘	68 ° 14 ‘	162.1
09-Dec-29	61 ° 36 ‘	77 ° 53 ‘	79.0	08-Feb-30	49 ° 32 ‘	69 ° 46 ‘	71.0
10-Dec-29	62 ° 43 ‘	78 ° 22 ‘	68.4	09-Feb-30	49 ° 30 ‘	69 ° 48 ‘	2.4
11-Dec-29	64 ° 34 ‘	78 ° 58 ‘	112.1	10-Feb-30	49 ° 30 ‘	69 ° 48 ‘	0.0
12-Dec-29	65 ° 18 ‘	80 ° 12 ‘	54.0	to the ...			
13-Dec-29	65 ° 05 ‘	81 ° 01 ‘	24.3	01-Mar-30	49 ° 30 ‘	69 ° 48 ‘	0.0
14-Dec-29	65 ° 13 ‘	80 ° 53 ‘	8.7	02-Mar-30	49 ° 27 ‘	70 ° 35 ‘	30.7
15-Dec-29	65 ° 19 ‘	80 ° 40 ‘	8.1	03-Mar-30	48 ° 31 ‘	73 ° 57 ‘	143.9
16-Dec-29	65 ° 34 ‘	79 ° 26 ‘	34.2	04-Mar-30	47 ° 43 ‘	76 ° 48 ‘	123.8
17-Dec-29	64 ° 31 ‘	77 ° 41 ‘	77.0	05-Mar-30	47 ° 10 ‘	78 ° 51 ‘	89.5
18-Dec-29	64 ° 04 ‘	75 ° 36 ‘	60.6	06-Mar-30	46 ° 37 ‘	80 ° 52 ‘	89.0
19-Dec-29	65 ° 39 ‘	74 ° 08 ‘	102.1	07-Mar-30	45 ° 53 ‘	84 ° 15 ‘	146.8
20-Dec-29	66 ° 12 ‘	73 ° 42 ‘	34.7	08-Mar-30	45 ° 10 ‘	87 ° 13 ‘	132.2
21-Dec-29	66 ° 20 ‘	73 ° 27 ‘	10.0	09-Mar-30	44 ° 34 ‘	90 ° 05 ‘	126.8
22-Dec-29	66 ° 23 ‘	73 ° 16 ‘	5.3	10-Mar-30	43 ° 26 ‘	93 ° 35 ‘	166.0
23-Dec-29	66 ° 22 ‘	73 ° 21 ‘	2.2	11-Mar-30	42 ° 41 ‘	96 ° 26 ‘	132.4
24-Dec-29	66 ° 22 ‘	72 ° 46 ‘	14.0	12-Mar-30	42 ° 04 ‘	98 ° 46 ‘	109.8
25-Dec-29	66 ° 27 ‘	72 ° 38 ‘	5.9	13-Mar-30	41 ° 18 ‘	100 ° 57 ‘	108.4
26-Dec-29	66 ° 57 ‘	71 ° 57 ‘	34.1	14-Mar-30	40 ° 22 ‘	104 ° 20 ‘	163.5
27-Dec-29	66 ° 48 ‘	71 ° 24 ‘	15.8	15-Mar-30	39 ° 40 ‘	106 ° 19 ‘	100.0
28-Dec-29	65 ° 52 ‘	70 ° 24 ‘	61.0	16-Mar-30	38 ° 42 ‘	108 ° 55 ‘	134.5

Table 1. Continued

Date	Lat. (°S)	Long. (°E)	Dist. (nm)	Date	Lat. (°S)	Long. (°E)	Dist. (nm)
17-Mar-30	37 ° 59 ‘	110 ° 59 ‘	106.3	30-Dec-30	66 ° 04 ‘	141 ° 57 ‘	62.0
18-Mar-30	37 ° 17 ‘	112 ° 47 ‘	95.3	31-Dec-30	66 ° 05 ‘	141 ° 00 ‘	23.1
19-Mar-30	36 ° 41 ‘	114 ° 55 ‘	108.4	01-Jan-31	66 ° 00 ‘	139 ° 25 ‘	38.9
20-Mar-30	35 ° 58 ‘	115 ° 54 ‘	64.1	02-Jan-31	65 ° 55 ‘	138 ° 55 ‘	13.2
21-Mar-30	35 ° 25 ‘	118 ° 03 ‘	110.0	03-Jan-31	66 ° 25 ‘	141 ° 23 ‘	66.7
22-Mar-30	35 ° 02 ‘	119 ° 37 ‘	80.0	04-Jan-31	66 ° 58 ‘	142 ° 39 ‘	44.8
23-Mar-30	35 ° 05 ‘	121 ° 28 ‘	90.9	05-Jan-31	66 ° 59 ‘	142 ° 37 ‘	1.3
24-Mar-30	35 ° 16 ‘	123 ° 06 ‘	80.9	06-Jan-31	66 ° 59 ‘	142 ° 38 ‘	0.4
25-Mar-30	35 ° 30 ‘	124 ° 36 ‘	74.7	07-Jan-31	66 ° 23 ‘	138 ° 45 ‘	99.0
26-Mar-30	35 ° 36 ‘	125 ° 58 ‘	67.0	08-Jan-31	66 ° 17 ‘	140 ° 15 ‘	36.6
27-Mar-30	35 ° 36 ‘	128 ° 09 ‘	106.5	09-Jan-31	66 ° 15 ‘	139 ° 21 ‘	21.8
28-Mar-30	35 ° 33 ‘	130 ° 12 ‘	100.1	10-Jan-31	64 ° 32 ‘	135 ° 04 ‘	167.7
29-Mar-30	35 ° 20 ‘	133 ° 21 ‘	154.5	11-Jan-31	65 ° 51 ‘	129 ° 39 ‘	136.7
30-Mar-30	35 ° 28 ‘	136 ° 02 ‘	131.5	12-Jan-31	64 ° 51 ‘	129 ° 21 ‘	60.5
31-Mar-30	35 ° 24 ‘	137 ° 52 ‘	89.7	13-Jan-31	64 ° 48 ‘	129 ° 21 ‘	3.0
01-Apr-30	34 ° 55 ‘	138 ° 36 ‘	46.2	14-Jan-31	64 ° 57 ‘	129 ° 47 ‘	13.8
02-Apr-30	34 ° 55 ‘	138 ° 36 ‘	0.0	15-Jan-31	64 ° 49 ‘	124 ° 58 ‘	122.7
03-Apr-30	34 ° 55 ‘	138 ° 36 ‘	0.0	16-Jan-31	65 ° 03 ‘	121 ° 27 ‘	90.5
04-Apr-30	36 ° 03 ‘	138 ° 26 ‘	68.5	17-Jan-31	64 ° 28 ‘	117 ° 35 ‘	104.9
05-Apr-30	37 ° 16 ‘	139 ° 29 ‘	88.8	18-Jan-31	64 ° 21 ‘	116 ° 02 ‘	41.0
06-Apr-30	no position given			19-Jan-31	64 ° 20 ‘	115 ° 37 ‘	10.7
07-Apr-30	38 ° 47 ‘	142 ° 44 ‘	177.9	20-Jan-31	64 ° 23 ‘	115 ° 07 ‘	13.4
08-Apr-30	38 ° 12 ‘	144 ° 45 ‘	101.2	21-Jan-31	64 ° 26 ‘	114 ° 53 ‘	6.7
				22-Jan-31	64 ° 24 ‘	114 ° 43 ‘	4.8
23-Nov-30	43 ° 58 ‘	147 ° 35 ‘		23-Jan-31	64 ° 26 ‘	113 ° 50 ‘	22.9
24-Nov-30	45 ° 07 ‘	146 ° 58 ‘	73.4	24-Jan-31	64 ° 43 ‘	113 ° 08 ‘	24.8
25-Nov-30	46 ° 39 ‘	146 ° 50 ‘	92.7	25-Jan-31	64 ° 55 ‘	111 ° 57 ‘	32.7
26-Nov-30	48 ° 15 ‘	146 ° 30 ‘	96.9	26-Jan-31	65 ° 10 ‘	109 ° 25 ‘	65.8
27-Nov-30	50 ° 28 ‘	147 ° 09 ‘	135.4	27-Jan-31	65 ° 07 ‘	107 ° 22 ‘	51.8
28-Nov-30	51 ° 24 ‘	149 ° 27 ‘	102.9	28-Jan-31	64 ° 47 ‘	103 ° 46 ‘	93.7
29-Nov-30	52 ° 12 ‘	152 ° 26 ‘	121.1	29-Jan-31	64 ° 02 ‘	99 ° 20 ‘	123.2
30-Nov-30	53 ° 04 ‘	154 ° 51 ‘	102.2	30-Jan-31	63 ° 41 ‘	95 ° 56 ‘	92.4
01-Dec-30	54 ° 24 ‘	158 ° 22 ‘	148.0	31-Jan-31	64 ° 18 ‘	96 ° 08 ‘	37.4
02-Dec-30	54 ° 28 ‘	158 ° 53 ‘	18.8	01-Feb-31	64 ° 52 ‘	92 ° 10 ‘	107.8
03-Dec-30	54 ° 28 ‘	158 ° 53 ‘	0.0	02-Feb-31	64 ° 58 ‘	90 ° 21 ‘	46.5
04-Dec-30	54 ° 28 ‘	158 ° 53 ‘	0.0	03-Feb-31	65 ° 36 ‘	89 ° 13 ‘	47.9
05-Dec-30	55 ° 03 ‘	158 ° 46 ‘	35.2	04-Feb-31	65 ° 26 ‘	88 ° 36 ‘	18.6
06-Dec-30	56 ° 49 ‘	158 ° 38 ‘	105.6	05-Feb-31	64 ° 44 ‘	86 ° 40 ‘	64.3
07-Dec-30	57 ° 48 ‘	160 ° 02 ‘	75.0	06-Feb-31	64 ° 47 ‘	84 ° 13 ‘	62.5
08-Dec-30	59 ° 17 ‘	160 ° 57 ‘	93.5	07-Feb-31	64 ° 37 ‘	81 ° 35 ‘	68.3
09-Dec-30	60 ° 53 ‘	162 ° 14 ‘	102.8	08-Feb-31	66 ° 04 ‘	78 ° 34 ‘	115.6
10-Dec-30	62 ° 25 ‘	163 ° 36 ‘	100.0	09-Feb-31	66 ° 29 ‘	76 ° 15 ‘	61.2
11-Dec-30	63 ° 06 ‘	166 ° 55 ‘	100.1	10-Feb-31	67 ° 10 ‘	74 ° 28 ‘	58.8
12-Dec-30	63 ° 53 ‘	170 ° 25 ‘	104.6	11-Feb-31	67 ° 53 ‘	70 ° 43 ‘	96.1
13-Dec-30	64 ° 05 ‘	173 ° 11 ‘	73.9	12-Feb-31	67 ° 08 ‘	68 ° 40 ‘	65.1
14-Dec-30	64 ° 22 ‘	177 ° 05 ‘	103.1	13-Feb-31	67 ° 45 ‘	66 ° 58 ‘	54.0
15-Dec-30	65 ° 35 ‘	178 ° 36 ‘	82.5	14-Feb-31	67 ° 23 ‘	62 ° 20 ‘	108.5
16-Dec-30	65 ° 41 ‘	178 ° 30 ‘	6.6	15-Feb-31	66 ° 42 ‘	61 ° 46 ‘	42.6
17-Dec-30	64 ° 42 ‘	176 ° 45 ‘	74.0	16-Feb-31	66 ° 46 ‘	62 ° 00 ‘	6.8
18-Dec-30	64 ° 03 ‘	173 ° 34 ‘	90.9	17-Feb-31	66 ° 46 ‘	62 ° 07 ‘	2.8
19-Dec-30	64 ° 14 ‘	170 ° 24 ‘	83.5	18-Feb-31	67 ° 08 ‘	61 ° 15 ‘	30.0
20-Dec-30	63 ° 40 ‘	168 ° 02 ‘	70.8	19-Feb-31	66 ° 30 ‘	61 ° 41 ‘	39.8
21-Dec-30	63 ° 27 ‘	164 ° 29 ‘	95.7	20-Feb-31	64 ° 47 ‘	62 ° 34 ‘	104.8
22-Dec-30	63 ° 46 ‘	159 ° 15 ‘	140.8	21-Feb-31	61 ° 31 ‘	63 ° 47 ‘	198.8
23-Dec-30	64 ° 15 ‘	154 ° 45 ‘	121.8	22-Feb-31	62 ° 52 ‘	66 ° 02 ‘	102.6
24-Dec-30	64 ° 22 ‘	153 ° 14 ‘	40.0	23-Feb-31	61 ° 59 ‘	69 ° 27 ‘	108.7
25-Dec-30	64 ° 22 ‘	150 ° 23 ‘	74.2	24-Feb-31	61 ° 46 ‘	69 ° 27 ‘	13.5
26-Dec-30	65 ° 17 ‘	147 ° 32 ‘	90.7	25-Feb-31	60 ° 54 ‘	74 ° 38 ‘	149.2
27-Dec-30	65 ° 13 ‘	147 ° 10 ‘	10.0	26-Feb-31	59 ° 31 ‘	76 ° 30 ‘	55.6
28-Dec-30	64 ° 58 ‘	145 ° 50 ‘	36.9	27-Feb-31	57 ° 54 ‘	80 ° 00 ‘	109.1
29-Dec-30	65 ° 03 ‘	142 ° 24 ‘	87.2	28-Feb-31	57 ° 19 ‘	82 ° 26 ‘	78.2

Table 1. Continued

Date	Lat. (°S)	Long. (°E)	Dist. (nm)
01-Mar-31	55 ° 49 ‘	85 ° 20 ‘	95.9
02-Mar-31	54 ° 37 ‘	89 ° 07 ‘	129.5
03-Mar-31	53 ° 33 ‘	93 ° 20 ‘	148.4
04-Mar-31	51 ° 58 ‘	97 ° 36 ‘	130.7
05-Mar-31	51 ° 27 ‘	100 ° 58 ‘	331.3
06-Mar-31	51 ° 06 ‘	104 ° 24 ‘	128.9
07-Mar-31	50 ° 21 ‘	107 ° 53 ‘	132.3
08-Mar-31	49 ° 38 ‘	112 ° 08 ‘	163.9
09-Mar-31	49 ° 01 ‘	114 ° 08 ‘	78.2
10-Mar-31	48 ° 30 ‘	116 ° 51 ‘	107.4
11-Mar-31	47 ° 55 ‘	120 ° 30 ‘	145.9
12-Mar-31	47 ° 10 ‘	124 ° 27 ‘	160.0
13-Mar-31	46 ° 39 ‘	128 ° 08 ‘	151.0
14-Mar-31	46 ° 04 ‘	131 ° 58 ‘	158.7
15-Mar-31	45 ° 30 ‘	136 ° 13 ‘	177.8
16-Mar-31	45 ° 02 ‘	140 ° 23 ‘	175.9
17-Mar-31	44 ° 11 ‘	143 ° 36 ‘	137.4
18-Mar-31	43 ° 44 ‘	146 ° 25 ‘	121.7
19-Mar-31	43 ° 08 ‘	147 ° 18 ‘	38.5
20-Mar-31	42 ° 59 ‘	147 ° 20 ‘	1.5
21-Mar-31	42 ° 59 ‘	147 ° 20 ‘	0.0
22-Mar-31	42 ° 59 ‘	147 ° 20 ‘	0.0
23-Mar-31	42 ° 46 ‘	148 ° 26 ‘	48.4
24-Mar-31	41 ° 13 ‘	148 ° 48 ‘	16.3
25-Mar-31	40 ° 23 ‘	147 ° 44 ‘	48.4
26-Mar-31	38 ° 47 ‘	145 ° 06 ‘	76.3
27-Mar-31	37 ° 55 ‘	144 ° 55 ‘	54.9

Table 2. *Information on Ross seals collected by the Australasian Antarctic Expedition, 1911–14 at 66°S, 92°E, in January 1914.*

Animal no.[a]	1	2	3	4	5	6
Sex	F	M	?[b]	M	M	F
Body length (m)[c] Snout to end of:						
hindflipper	2.21	2.13	2.31	2.34	2.24	2.51
tail	1.96	1.88	2.06	2.04	1.99	2.21
Dental formula						
	2/2	2/2	2/2	2/2	-	2/2
	1/1	1/1	1/1	1/1	-	1/1
	4/4	4/5 or 4/4	3/4	4/4	-	4/4
	1/1	1/1	1/1 or 2/1	1/1	-	1/1
Nails						
Fore-limbs	rudimentary	rudimentary	rudimentary	well developed	-	good
Hind-limbs	very vestigial	rudimentary	rudimentary	well developed	-	good
Mus. no.[d]	Aust-M2505	Aust-M2506	MV-C7298	SAM-M306	Aust-S1360	-
Material	Skin, skull	Skin, skull	Skin, skull, incomplete skeleton	Mounted skin, skull, incomplete skeleton	Whole skeleton	- -

[a] These numbers accord with those allocated to Ross seals by J. G. Hunter in his lists of specimens sent to museums; they are also cross referenced to the text on which section II.D is based.
[b] Hunter recorded this as male, but Museum of Victoria records denote female (see text, section III.D.5).
[c] Converted from feet and inches using 1 inch = 2.54 cm.
[d] Museum number. Abbreviations refer to Australian Museum, Sydney; Museum of Victoria, Melbourne; South Australian Museum, Adelaide.

Table 3. *Measurements of two female seals collected by the British, Australian and New Zealand Antarctic Research Expedition, 1929–31 in pack ice at Station 94 (64°28'S, 114°59'E) on 21 January 1931.*

Measurements	**Leopard seal**		**Crabeater seal**	
	inches	cm[b]	inches	cm[b]
Length overall (snout to end of hind flipper)	118	300	109	277
Length, nose to tail tip	106	269	98	249
Shoulder girth	60	152	51	130
Length foreflipper	26	66	22	56
Breadth foreflipper	9	23	11¼	29
Length hindflipper	21	53	20	51
Spread hindflipper	27	69	26	66
Girth under foreflippers	52½	133	48	122
Girth at base of tail	23	58	24	61
Umbilicus to front of urogenital groove	26	66	25½	65
Umbilicus to level of nipples	5	13	4	10
Nipples apart	3¼	8	4	10
Corner of gape to tip lower jaw	7½	19	4	10
Specimen no. [a]	SAM-M14894 (skin) SAM-M12131 (urogenital tract)		SAM-M14895 or SAM-M14896 (skins) &/or SAM-M12132 (urogenital tract)	

[a] Abbreviations refer to South Australian Museum, Adelaide.
[b] Calculated using 1 inch = 2.54 cm.

Table 4. *External measurements of a young female elephant[a] seal from Heard Island, November 1929.*

Measurements	**inches**	**cm[b]**
Length, nose to end of hindflipper	63	160
Maximum depth of animal (dorsoventral diameter)	17	43.2
Maximum breadth of animal (measured while lying on its side)	15½	39.4
Maximum breadth at hip	7	17.8
Anterior end of urogenital groove to umbilicus	11½	29.2
Umbilicus to either nipple	3	7.6
Length of foreflipper	10	25.4
Maximum width of foreflipper	4½	11.4
Length of hind flipper	14½	36.8
Maximum breadth of hindflipper	(?)	-
Anal (urogenital) slit	4	10.2
Posterior end of urogenital slit to tip of tail	3	7.6
Level of nipples behind umbilicus	1	2.5

[a] The South Australian Museum has three specimens from juvenile elephant seals recorded from Heard Island in late November - early December 1929: M8679 (skin, skull), M8680 (skin, skull) and M12118 (hair).
[b] Calculated using 1 inch = 2.54 cm.

Table 5. *External measurements of three leopard seals from Heard Island, November-December 1929.*

	Young male 26 Nov. 1929		**Small male 26 Nov. 1929**		**Female 1 Dec. 1929**	
Measurements	inches	cm[b]	inches	cm[b]	inches	cm[b]
Total length:						
- tip of snout to end of flipper	103	262	90	229	120	305
- tip of snout to end of tail	-	-	-	-	108	274
Length, tip of snout to umbilicus	-	-	-	-	71	180
Shoulder to shoulder	17	43.2	15	38.1	-	-
Max. width across shoulders	-	-	-	-	25½	64.8
Foreflipper, axilla to tip	17	43.2	15	38.1	20	50.8
Foreflipper, shoulder to tip	23½	59.7	22	55.9	-	-
Max. breadth of head	10	25.4	8½	21.6	-	-
Width across head at level of eyes	-	-	-	-	9	22.9
Max. thickness of body	14	35.6	10	25.4	-	-
Max. width at abdomen	-	-	-	-	26	66.0
Width at umbilicus	-	-	-	-	24	61.0
Anus to end of flipper	17	43.2	16½	41.9	-	-
Anus to end of tail	7	17.8	6½	16.5	-	-
Anus to male aperture	18	45.7	16½	41.9	-	-
Male aperture to umbilicus	7	17.8	7	17.8	-	-
Max. width across hip	10½	26.7	10	25.4	18	45.7
Max. width of foreflipper	6	15.2	7	17.8	7½	19.1
Umbilicus to anterior end of urogenital groove	-	-	-	-	23½	59.7
Length of urogenital groove	-	-	-	-	3	7.6
Posterior end of urogenital groove to tip of tail	-	-	-	-	10	25.4
Umbilicus to each nipple	-	-	-	-	5½	14.0
Umbilicus to level of nipples	-	-	-	-	5	12.7
Distance between nipples	-	-	-	-	4¼	10.8
Length of hindflipper (inside)	-	-	-	-	18	45.7
Width of hindflipper (spread)	-	-	-	-	19	48.3
Specimen no.[a]	Possibly SAM-M8682[c] (skin, skull)		Possibly SAM-M8682[c] (skin, skull)		Presumably SAM-M8681 (incomplete skin, skull)	

[a] Abbreviations refer to South Australian Museum, Adelaide.

[b] Calculated using 1 inch = 2.54 cm.

[c] This skin measures only 181 cm (LQ and PDS, 13 April 1994), considerably shorter than the 'young male' (262 cm) and the 'small male' (229 cm).

Table 6. *External measurements of two female Weddell seals shot near Proclamation Island, Enderby Land on 25 January 1930.*

	Seal No. 1[a]		Seal No. 2[a]	
	inches	cm[b]	inches	cm[b]
Total length, snout to end of flipper	116	295	118	300
Tip of snout to end of tail	106	269	106½	271
End hind flipper to front of groin	18	45.7	20	50.8
Max. width hindflipper	21	53.3	15	38.1
Length of foreflipper, axilla to tip	15	38.1	16½	41.9
Foreflipper width at free-end	11	27.9	10	25.4
Umbilicus to anterior end of urogenital slit	30½	77.5	31	78.7
Umbilicus to nipple	8	20.3	10	25.4
Level of umbilicus to level of nipple	8	20.3	9½	24.1
Breadth of body at hips	16½	41.9	14½	36.8
Breadth ventrally, between foreflippers	28	71.1	29	73.7
Breadth just in front of flippers (i.e., from shoulder to shoulder)	25½	64.8	24	61.0
Length of tail	5½	14.0	4½	11.4
Distance between nipples	6	15.2	4½	11.4
Specimen no.[c]	Presumably SAM-M8683 (skin, skull)		Presumably SAM-M14893 (incomplete skin)	

[a] T. Harvey Johnston (sections II.F and II.G) indicates no. 1 was used for a commercial skin and no. 2 was skinned for museum purposes.
[b] Calculated using 1 inch = 2.54 cm.
[c] Abbreviations refer to South Australian Museum, Adelaide; the date recorded for both specimens is 26 January 1930.

Table 7. *Sightings of leopard seals by the Australasian Antarctic Expedition, 1911–14 at Macquarie Island* [a].

	Leopard Seals	
Date	**Seen**	**Collected**
1911		
11 December	1[b]	-
1912		
11 May	-	1
27 May	-	1
29 May	-	3
3 June	-	3
30 June	-	1
26 July	-	5
31 August	1	-
30 September	-	1
1913		
9 July	-	2
10 July	-	1
21 November	-	1[c]

[a] Mostly from Mawson (1942).
[b] From Mawson (1915a, vol. I, p. 32).
[c] From H. Hamilton, section II.A.3.

Table 8. *Total catch of blue whales and catching effort between the 1931–32 and 1938–39 seasons for 10° square blocks between 0° and 180° and 60° to 70°S (after Omura 1973), and sightings data from the 1929–30 and 1930–31 'Discovery' voyages. Data are displayed in Fig.4*

Longitude (°E)	0-10	10-20	20-30	30-40	40-50	50-60	60-70	70-80	80-90	90-100	100-110	110-120	120-130	130-140	140-150	150-160	160-170	170-180
Commercial catch																		
Total catch																		
	743	956	5271	9828	6439	1656	1425	5159	10736	11622	5239	2181	816	400	374	461	91	0
Catch per catcher day																		
	0.34	0.30	0.44	0.91	0.89	0.70	0.81	1.17	1.14	1.16	0.80	0.49	0.41	0.46	0.49	0.92	0.55	0.00
Discovery sightings																		
(i) All conditions																		
No. whales					53	18	3	20	19	20	8	16-20	15	2	1	1	6-10	4
No. sightings					21	8	2	14	9	8	4	8	6	2	1	1	3	4
No. days					9	12	12	19	8	5	3	9	6	4	9	4	2	8
Whales per day					5.9	1.5	0.3	1.1	2.4	4.0	2.7	2.0	2.5	0.5	0.1	0.3	4.0	0.5
(ii) Moderate good conditions																		
No. whales					47	16	2	20	18	10	5	7	13	0	0	1	6-10	3
No. sightings					19	7	1	14	8	4	2	6	5	0	0	1	3	3
No. days					4	7	9	15	4	2	2	4	3	1	2	1	1	4
Whales per day					11.8	2.3	0.2	1.3	4.5	5.0	2.5	1.8	4.3	0.0	0.0	1.0	8.0	0.8

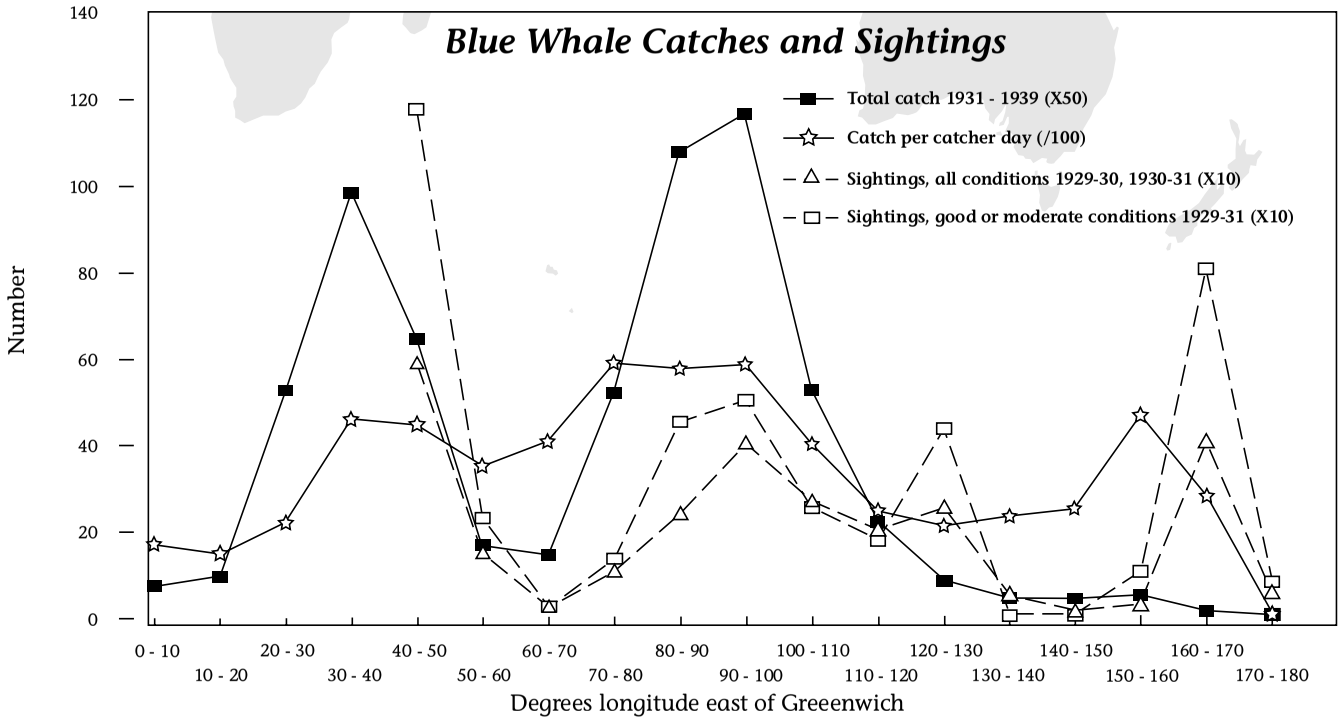

Figure 4. *Numbers and catches of blue whales in the 1930s south of 60°S for each of 10° of latitude*

Table 9. *Distribution and estimated numbers of killer whales and crabeater seals seen during the 1929–30 and 1930–31 'Discovery' voyages. Group sizes recorded as 'some' or as 'several' were estimated as 3-7 animals and 10-20 animals, respectively.*

Longitude (°E)													
-	40-50	50-60	60-70	70-80	80-90	90-100	100-110	110-120	120-130	130-140	140-150	150-160	160-170	170-180
Groups of killer whales	3	1	4	5	0	0	0	1	0	0	1	0	0	1
Number of killer whales	5	15	60-65	7-10	0	0	0	1	0	0	3	0	0	20
Groups of crabeater seals	0	2	3	11	4	0	0	0	4	0	2	0	3	0
Number of crabeater seals	0	4-8	20-40	54-104	32-62	0	0	0	31-61	0	11-21	0	0	0

Table 10. *Number of observations of large whales and seals made by expeditioners (A), ship's officers (B) or undetermined (C) on watch during each 4-hour interval on the 1929–30 and 1930–31 'Discovery' voyages.*

Time	**Large whales**			**Seals**		
(hrs)	A	B	C	A	B	C
00.00-04.00	-	6	-	1	-	-
04.00-08.00	4	4	-	-	1	-
08.00-12.00	19	8	15	9	1	11
12.00-16.00	10	7	18	4	4	12
16.00-20.00	23	3	14	4	1	6
20.00-24.00	13	10	6	2	-	1

Table 11. *Number of whales (with number of sightings in parentheses) observed south of 60°S and between 40°E and 170°E for a range of sighting conditions, times and effort on the 1929-30 and 1930-31 'Discovery' voyages. Ratios of blue : minke whales are calculated from maximum figures in a range; ranges in parentheses are calculated with unidentified whales added to the number of blue whales in the proportion that blue and fin whales were recorded.*

Species	All watches All conditions All distances	All watches All conditions Near or close	All watches All conditions Close	All watches Moderate or Good All distances	All watches Moderate or Good Near or close	All watches Moderate or Good Close
Blue whale	185 - 193 (91)	88 - 96 (50)	37 - 41 (24)	150 -154 (74)	65 - 69 (38)	30 -34 (18)
Fin whale	34 (18)	8 (7)	5 (5)	23 (13)	6 (5)	3 (3)
Minke whale	47-51 (28)	25 (19)	16 (14)	41 (22)	21 (15)	14 (12)
Killer whale	110 (16)	79 (9)	38 (9)	53 (9)	46 (5)	6 (4)
Unidentified	55 (19)	1 (1)	1 (1)	44 (15)	-	-
Ratio Blue:Minke	3.13 -4.10 (5.10)	3.52 - 3.84	2.3 - 2.56	3.66 - 3.75 (4.65)	3.10 - 3.29	2.14 - 2.43
	0800 - 2000 hrs All conditions All distances	**0800 - 2000 hrs All conditions Near or close**	**0800 - 2000 hrs All conditions Close**	**0800 - 2000 hrs Moderate or Good All distances**	**0800 - 2000 hrs Moderate or Good Near or close**	**0800 - 2000 hrs Moderate or Good Close**
Blue whale	148 - 156 (70)	59 (38)	28 (17)	125 - 129 (58)	48 - 52 (28)	21 -25 (11)
Fin whale	18 (11)	6 (5)	3 (3)	17 (10)	6 (5)	3 (3)
Minke whale	27 (16)	20 (16)	12 (10)	25 (14)	17 (11)	11 (9)
Killer whale	45 (8)	20 (4)	20 (4)	9 (5)	5 (3)	5 (3)
Unidentified	53 (17)	1 (1)	1 (1)	42 (13)	-	-
Ratio Blue:Minke	5.48 - 5.78 (7.53)	2.95	2.33	5.0 -5.16	2.82 - 3.06	1.91 - 2.27

Table 12. *Sighting rates (whales/hour) of cetaceans south of 60°S and between 40°E and 170°E. The 'Discovery' observations in 1929-30 and 1930-31 for all (1680 hours), good/moderate (720 hours) and good conditions (456 hours) are compared with data for 2467 hours of observation on cruises of the International Decade of Cetacean Research (IDCR) from 1978–79 to 1983–84 (Kasamatsu et al. 1988).*

	'Discovery' Cruises						IDCR Cruises	
	Sighting conditions			Sighting conditions				
	All	Good or Moderate	Good	All	Good or Moderate	Good		
Species	Number of whales			Sighting rate			Number of whales	Sighting rate
Blue whale	114	100	82	0.068	0.139	0.180	10	0.004
Minke whale	28	17	16	0.017	0.024	0.035	2655	1.076
Humpback whale	0	0	0	-	-	-	51	0.021
Sperm whale	0	0	0	-	-	-	182	0.074
Killer whale	40-44	7-11	0	0.030	0.013	0.000	133	0.054
Beaked whales	0	0	0	-	-	-	210	0.085

***Table 13**. Marine mammal specimens collected by the Australasian Antarctic Expedition 1911-1914 and the British, Australian and New Zealand Antarctic Research Expedition 1929-1931 that are housed in museums.*

Species	Specimen no.[a]	Age class	Sex	Location	Date[b]	Material	Comments
PINNIPEDIA							
Hydrurga leptonyx	Aust-M2499	Adult	F	Macquarie Is[c]	AAE[d]	Skin	Mother of Aust-M2500
Hydrurga leptonyx	Aust-M2500	Foetus	-	Macquarie Is	AAE	Skin	Full-term foetus of Aust-M2499; destroyed 1959
Hydrurga leptonyx	Aust-S1357	-	-	Macquarie Is	AAE	Skull	-
Hydrurga leptonyx	Aust-S1358	-	-	Macquarie Is	AAE	Skull	-
Hydrurga leptonyx	Aust-S1359	-	-	Macquarie Is	AAE	Skull	-
Hydrurga leptonyx	MV-C7401	-	M	Macquarie Is	AAE	Skull, incomplete skeleton	-
Hydrurga leptonyx	MV-C7402	-	M	Macquarie Is	AAE	Skin, skull, incomplete skeleton	-
	-	-					-
Hydrurga leptonyx	MV-C7403	-	F	Macquarie Is	AAE	Skull	-
Hydrurga leptonyx	SAM-M312	Foetus	-	Commonwealth Bay[e]	19 Sep. 1913	Skin	Length nose-tail 4'7" (1.40m); near-term foetus of SAM-M313
Hydrurga leptonyx	SAM-M313	Adult	F	Commonwealth Bay	19 Sep. 1913	Skin, skull, incomplete postcranial skeleton	Mother of SAM-M312
Hydrurga leptonyx	SAM-M314	Adult	M	Macquarie Is	AAE	Mounted skin	-
Hydrurga leptonyx	SAM-M398	Adult	-	-	AAE	Skull	-
Hydrurga leptonyx	SAM-M8681	Adult	F	Heard Is[f]	1 Dec. 1929	Part skin, skull	Skull at Uni. of Adelaide (Table 5)
Hydrurga leptonyx	SAM-M8682	Juvenile	M	Heard Is	1 Dec. 1929	Skin, skull	Skull at Uni. of Adelaide (Table 5)
Hydrurga leptonyx	SAM-M12131	-	F	64°28'S, 114°59'E BANZARE Station 94	21 Jan. 1931	Urogenital tract only	Presumably from same seal as SAM-M14894 (Table 3)
Hydrurga leptonyx	SAM-M12861	-	-	-	BANZARE	Teeth	
Hydrurga leptonyx	SAM-M14894	Adult	-	64°28'S, 114°59'E BANZARE Station 94	21 Jan. 1931	Skin	Presumably from same seal as SAM-M12131 (Table 3)
Leptonychotes weddelli	Aust-M2503	Adult	F	Commonwealth Bay	Dec. 1913	Skin	-
Leptonychotes weddelli	Aust-M2504	Juvenile	M	Commonwealth Bay	Dec. 1913	Mounted skin	-
Leptonychotes weddelli	Aust-M5016	Adult	F	Commonwealth Bay	Nov. 1913	Brain, in spirit	At Haswell Museum, Uni. of Sydney
Leptonychotes weddelli	MV-C7397	Adult	F	Commonwealth Bay	29 Oct. 1912	Incomplete skull, incomplete skeleton	Mother of MV-C7399
Leptonychotes weddelli	MV-C7398	-	M	Commonwealth Bay	19 Mar. 1912	Skull, incomplete skeleton	Total length 9' 1" (2.77 m)
Leptonychotes weddelli	MV-C7399	Pup	M	Commonwealth Bay	29 Oct. 1912	Skin, skull, incomplete skeleton	9 days old, mother is MV-C7397
Leptonychotes weddelli	P-E4518	-	-	-	AAE	Skin	-
Leptonychotes weddelli	SAM-M307	-	M	Commonwealth Bay	7 May 1912	Mounted skin	Length nose-tail 6'9" (2.06 m); formerly listed as *L. carcinophagus*
Leptonychotes weddelli	SAM-M309	Adult	M	Commonwealth Bay	AAE	Skin, skull	No measurements taken
Leptonychotes weddelli	SAM-M310	Juvenile	M	Macquarie Is	20 Aug. 1913	Skin	Reported by E. R. Waite between Nuggets Beach and The Isthmus (Section II.B.3)
Leptonychotes weddelli	SAM-M311	Adult	F	Commonwealth Bay	AAE	Skin, skull	Length 9'5" (2.87 m)
Leptonychotes weddelli	SAM-M8683	Adult	F	65°50'S, 54°23'E	26 Jan. 1930	Skin, skull	Skull at Univ. of Adelaide (Table 6)
Leptonychotes weddelli	SAM-M14893	Adult	F	65°50'S, 54°23'E	26 Jan. 1930	Incomplete skin	See Table 6
Leptonychotes weddelli	SAM-M15034	-	-	61°00'S, 149°00'E	BANZARE	Articulated flipper	Found with BANZARE material in 1987; may be same animal as SAM-M15035 & M15037

Table 13 (continued)

Species	Specimen no.[a]	Age class	Sex	Location	Date[b]	Material	Comments
Leptonychotes weddelli	SAM-M15035	-	-	61°00′S, 149°00′E	BANZARE	Articulated flipper	Found with BANZARE material in 1987; may be same animal as SAM-M15034 & M15037
Leptonychotes weddelli	SAM-M15036	-	-	61°00′S, 149°00′E	BANZARE	Articulated flipper	Found with BANZARE material in 1987; may be same animal as SAM-M15038
Leptonychotes weddelli	SAM-M15037	-	-	61°00′S, 149°00′E	BANZARE	Two humeri	Found with BANZARE material in 1987; may be same animal as SAM-M15034 & M15035
Leptonychotes weddelli	SAM-M15038	-	-	61°00′S, 149°00′E	BANZARE	Two humeri	Found with BANZARE material in 1987; may be same animal as SAM-M15036
Lobodon carcinophagus	Aust-M2491	Adult	F	Commonwealth Bay	14 Feb. 1912	Skin	Length nose-tail 7′4½″ (2.25 m), axillary girth 4′0″ (1.22 m)
Lobodon carcinophagus	Aust-M2501	Adult	M	62°59′S, 95°47′E	16 Jan. 1914	Skin, skull	Length nose-tail 7′6″ (2.29 m, section II.C)
Lobodon carcinophagus	Aust-M2502	Adult	F	62°59′S, 95°47′E	16 Jan. 1914	Skin, skull	Length, 8′0½″ (2.45 m, section II.C)
Lobodon carcinophagus	MV-C7396	-	M	65°02′S,123°12′E	8 Jan. 1914	Skin, skull, incomplete skeleton	Length nose-tail 7′5″ (2.26 m, section II.C)
Lobodon carcinophagus	SAM-M308	-	M	Commonwealth Bay	19 Feb. 1912	Skin, skull, incomplete post-cranial skeleton	Length nose-tail 7′2″ (2.18 m); collected at “winter quarters”
Lobodon carcinophagus	SAM-M12132	-	F	64°28′S, 114°59′E BANZARE Station 94	21 Jan. 1931	Urogenital tract only	Presumably from same seal as SAM-M14895 or SAM-M14896 (Table 3)
Lobodon carcinophagus	SAM-M14895	Adult	-	64°28′S, 114°59′E BANZARE Station 94	21 Jan. 1931	Full skin	Possibly from same seal as SAM-M12132
Lobodon carcinophagus	SAM-M14896	Adult	-	64°28′S, 114°59′E BANZARE Station 94	21 Jan. 1931	Full skin	Possibly from same seal as SAM-M12132
Mirounga leonina	Aust-M2507	Adult	M	Macquarie Is	AAE	Skin	Total length 17 feet (5.18 m); lent to Californian Academy of Sciences 1927
Mirounga leonina	Aust-S1354	Adult	M	Macquarie Is	AAE	Skeleton	Total length 17′7″ (5.36 m)
Mirounga leonina	Aust-S1355	-	-	Macquarie Is	AAE	Skull	Lent to Californian Academy of Sciences 1927
Mirounga leonina	Aust-S1356	Juv	F?	Commonwealth Bay	AAE	Skull	Listed as *L. weddelli* by J. G. Hunter; identified as *M. leonina* by J. E. King
Mirounga leonina	FMa221	Adult	M	Macquarie Is	AAE ?	Skull	Perhaps collected by E. R. Waite in 1912 (Sect. II.B)
Mirounga leonina	FMa222	Juvenile	F	Macquarie Is	AAE ?	Articulated skeleton	Perhaps collected by E. R. Waite in 1912 (Sect. II.B)
Mirounga leonina	MV-C7413	-	F	Macquarie Is	AAE	Skull, incomplete skeleton	Skin destroyed 25 Nov. 1955
Mirounga leonina	MV-C28200	Adult	M	Macquarie Is	AAE	Skull, skeleton	Total length 5.28 m
Mirounga leonina	SAM-M305	Adult	M	Commonwealth Bay	11 Feb. 1912	Mounted skin	Length nose-tail 17′0″ (5.18 m), shot close to Hut
Mirounga leonina	SAM-M315	Adult	M	Macquarie Is	circa 1913	Post cranial skeleton	Length 17′0″ (5.18 m)
Mirounga leonina	SAM-M1598	-	M	49°00′S, 69°00′E Kerguelen		BANZARE	Part skin, nails
Mirounga leonina	SAM-M8679	Juvenile	F	Heard Is	1 Dec. 1929	Part skin, skull	Skull at University of Adelaide
Mirounga leonina	SAM-M8680	Juvenile	F	Heard Is	1 Dec. 1929	Skin, skull	Skull at University of Adelaide
Mirounga leonina	SAM-M12116	-	F	49°35′S, 69°45′E Swains Bay, Kerguelen	11 Feb. 1930	Teeth	-
Mirounga leonina	SAM-M12117	Juvenile	-	Buckles Bay, Macquarie Is	3 Dec. 1930	Hair sample in spirit	

Table 13 *(continued)*

Species	Specimen no.[a]	Age class	Sex	Location	Date[b]	Material	Comments
Mirounga leonina	SAM-M12118	Juvenile	-	Heard Is	28 Nov. 1929	Hair sample in spirit	-
Mirounga leonina	SAM-M12860	-	-	-	BANZARE	Teeth	-
Ommatophoca rossii	Aust-M2505	-	F	Near Haswell Is[g]	22 Jan. 1914	Skin, skull	Hunter's #1 (Section II.D)
Ommatophoca rossii	Aust-M2506	-	M	Near Haswell Is	22 Jan. 1914	Skin, skull	Hunter's #2 (Section II.D)
Ommatophoca rossii	Aust-S1360	-	M	Near Haswell Is	22 Jan. 1914	Skeleton	Hunter's #5 (Section II.D)
Ommatophoca rossii	MV-C7298	-	?	Near Haswell Is	22 Jan. 1914	Skin, skull, incomplete skeleton	Hunter's #3 (Section II.D)
Ommatophoca rossii	SAM-M306	-	M	Near Haswell Is	22 Jan. 1914	Mounted skin, skull, and incomplete skeleton	Hunter's #4 (Section II.D)
CETACEA							
Cetacean	SAM-M12863	-	-	-	BANZARE	Tympanic bulla	-
Balaenoptera musculus (?)	SAM-M5794	-	-	Ross Sea	BANZARE	Tympanic bulla	
Balaenoptera musculus	SAM-M12130	-	M	64°40'S, 178°30'E north of Scott Is, BANZARE Station 85	15 Dec. 1930	Baleen bristles, diatom film, penis	Presumably from whale factory ship
Balaenoptera physalus	SAM-M12859	-	-	-	BANZARE	Baleen plates	-
Megaptera novaeangliae	SAM-M15155	-	-	65°41'S, 178°29'E	14 Dec. 1930	Baleen plate in spirit	Presumably from whale factory ship
Megaptera novaeangliae	SAM-M16827	-	-	-	BANZARE	Part of a bulla	-

[a] Abbreviations refer to: Aust Australian Museum, Sydney; F Canterbury Museum, Christchurch, New Zealand; MV Museum of Victoria, Melbourne; P Powerhouse Museum, Sydney; SAM South Australian Museum, Adelaide.

[b] Dates from the museum registers may post-date the collection date.

[c] The geographical position used for Macquarie Island varies slightly between museum databases: Aust 54°35'S, 158°55'E; MV 55°49'S, 159°00'E; SAM 54°29'S, 158°58'E.

[d] AAE specimens collected 1911-1914; BANZARE specimens collected 1929-1930.

[e] Most specimens collected by the AAE at Cape Denison, Commonwealth Bay are designated as from 'Adélie Land'. The geographical position given by J. G. Hunter in the lists of specimens he provided to museums was 67°00'S, 142°36'E. The position for Cape Denison, Commonwealth Bay in the Gazetteer of the Australian Antarctic Territory (*ANARE Research Notes 15*, 1983) is 67°00'S, 142°40'E.

[f] The geographical position for Heard Island on the five specimens (all held by SAM) is 53°05'S, 73°24'E.

[g] The five Ross seals were taken on pack ice near Haswell Island, off Queen Mary Land at 66°28'S, 92°42'E.

[h] See text, section III.D.5.

Table 14. *Summary of mammal specimens collected by AAE and BANZARE (from data in Table 13).*

	AAE	BANZARE	TOTAL
Hydrurga	12	5	17
Leptonychotes	11	7	18
Lobodon	5	3	8
Mirounga	10	7	17
Ommatophoca	5	0	5
Cetacea	0	6	6
Total	43	28	71

Appendix 1.

Location of material in the archives of the Mawson Antarctic Collection, University of Adelaide (control numbers as listed in Innes and Duff 1990, except for that for II.H which was provided by M. Pharaoh, Mawson Antarctic Collection, University of Adelaide).

Section	Author	Control number
II.A	H. Hamilton	114 AAE (typescript) 110 AAE (manuscript)
II.B	E. R. Waite	122 AAE
II.C	J. G. Hunter	123 AAE
II.D	J. G. Hunter or G.F. Ainsworth (?)	114 AAE
II.E	J. Davis	17 DM, Packet 1
II.F	T. Harvey Johnston	81 BZE, Box 43
II.G	T. Harvey Johnston	15 BZE, Box 28
II.H	T. Harvey Johnston	100 BZE, Box 28

Appendix 2.

Vernacular names of marine mammmals reported during the Australasian Antarctic Expedition 1911–14 and the British, Australia, New Zealand Antarctic Research Expedition 1929–31. Names follow those in Klinowska (1991) for cetaceans and King (1983) for pinnipeds.

Aves

Aptenodytes patagonicus	king penguin
Aptenodytes forsteri	emperor penguin
Pygoscelis adeliae	Adélie penguin
Macronectes giganteus	southern giant-petrel
Macronectes halli	northern giant-petrel
Fulmarus glacialoides	southern fulmar
Daption capense	Cape petrel
Oceanites oceanicus	Wilson's storm-petrel
Leucocarbo atriceps	imperial shag
Larus dominicanus	kelp gull

Cetacea

Australophocaena dioptrica	spectacled porpoise
Lagenorhynchus obscurus	dusky dolphin
Lagenorhynchus cruciger	hourglass dolphin
Lagenorhynchus australis	Peale's dolphin
Tursiops truncatus	bottlenose dolphin
Delphinus delphis	common dolphin
Lissodelphis peronii	southern right whale dolphin
Cephalorhynchus commersonii	Commerson's dolphin
Cephalorhynchus heavisidii	Heaviside's dolphin
Pseudorca crassidens	false killer whale
Orcinus orca	killer whale
Globicephala melas	long-finned pilot whale
Physeter macrocephalus	sperm whale
Eubalaena australis	southern right whale
Balaenoptera acutorostrata	minke whale
Balaenoptera borealis	sei whale
Balaenoptera musculus	blue whale
Balaenoptera musculus brevicauda	pygmy blue whale
Balaenoptera physalus	fin whale
Megaptera novaeangliae	humpback

Appendix 2. (continued)

Pinnipedia

Zalophus californianus	Californian sea lion
Otaria byronia	southern sea lion
Neophoca cinerea	Australian sea lion
Phocarctos hookeri	New Zealand sea lion
Arctocephalus tropicalis	Subantarctic fur seal
Arctocephalus gazella	Antarctic fur seal
Arctocephalus forsteri	New Zealand fur seal
Callorhinus ursinus	northern fur seal
Odobenus rosmarus	walrus
Halichoerus grypus	grey seal
Phoca vitulina	common seal
Leptonychotes weddelli	Weddell seal
Ommatophoca rossii	Ross seal
Lobodon carcinophagus	crabeater seal
Hydrurga leptonyx	leopard seal
Mirounga leonina	southern elephant seal
Mirounga angustirostris	northern elephant seal

Appendix 3. *Abbreviations and acronyms used in this report.*

AAE	Australasian Antarctic Expedition
ANARE	Australian National Antarctic Research Expeditions
Aust	Australian Museum, Sydney
BANZARE	British, Australian and New Zealand Antarctic Research Expedition
DM	D. Mawson
FH	F. Hurley
IDCR	International Decade of Cetacean Research
IUCN	International Union for the Conservation of Nature (more recently, The World Conservation Union)
IWC	International Whaling Commission
JWSM	J. W. S. Marr
M.Q.I.	Macquarie Island
MV	Museum of Victoria, Melbourne;
RAF	R. A. Falla
S. Y.	Steam Yacht
SAM	South Australian Museum, Adelaide
THJ	T. Harvey Johnston