THE OXFORD UNIVERSITY EXPEDITION TO SPITSBERGEN
1921

An account, done in 1978-83

by

CHARLES SUTHERLAND ELTON

FOREWORD

This Expedition was the first of three ventures from Oxford to the Spitsbergen archipelago (now known as Svalbard). They later inspired the foundation of the Oxford University Exploration Club in 1927. The Club undertook further expeditions to Spitsbergen, to other countries in the Arctic, and to many in lower latitudes. It is still (1983) very active. But no general account of the 1921 Expedition was ever published. I have written these notes in order to bring together as much as possible into one account, since most of the information, quite extensive in scope, is to be found in widely scattered publications, or has not been published at all. The main theme in these Notes is the wide ecological survey done by V.S.Summerhayes and myself, but I have included remarks about other general aspects of the Expedition's work, with references by which anyone can find out more fully about them. It has not been easy to track down the biological work done by other expeditions since then, as that also has appeared in a very scattered form. I have noted such information as is known to me, and seems relevant to the extension or the interpretation of our own field studies. This account is therefore both a direct source of information, and a guide to many other sources, and certainly to all important work of the Expedition itself.

Since the Notes are too unwieldy for publication, I prepared three typescript copies, arranged in three volumes each, which are being deposited in the following places:

(1) The Norsk Polarinstitutt, Oslo.

(2) The Scott Polar Research Institute, Cambridge, England.

(3) The original in my own possession.

All copies have the same series of photographs etc.

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61 Park Town,
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1983.

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OXFORD UNIVERSITY EXPEDITION TO SPITSBERGEN 1921

Notes prepared by Charles S. Elton

Origin of the Expedition.

I believe the idea of an Arctic expedition to study bird-life originated with Paget Wilkes. (I attach overleaf a copy of the List of Members of the Expedition published in "Spitsbergen Papers", Vol. (1925), and shall refer to them usually just by surname -- as indeed we did with one another in those days anyway). A Committee was formed, including Jourdain (the Leader), Binney (the Secretary and Organiser), Huxley and Carr-Saunders (Zoologists), and Paget Wilkes (an undergraduate and amateur ornithologist). During the Expedition also Dr Longstaff. Although Jourdain was the titular leader and an experienced rough traveller, Longstaff was the only man with any real knowledge of expedition life and problems, being Britain's most famous mountaineer-explorer, also a medical man and a good naturalist. In practice, I believe the scientific and exploring programmes were decided without much controversy, even though the Committee continued its rule in the field, at any rate on the First Party. But I myself really had nothing to do with the deliberations of leadership and planning, and was able to give my whole energy to research, being allowed by the generosity of Huxley (whose assistant I theoretically was) an entirely free hand.

The nature of these Notes.

No comprehensive account of this expedition was ever published, though about 36 papers and reports resulted from it. But it marked the starting point of a long series of expeditions from Oxford, to Spitsbergen and elsewhere. My Notes, though in some ways rather incomplete, may therefore have some value, especially as I must be one of the few surviving members of the Expedition. They were put together during 1978-83, when I was aged 78-83. I did not keep a continuous full diary, as I did on subsequent expeditions in 1923 and 1924 (which I intend to report fully later), though there are some entries. However, I have kept most of the original documentation involved in my own survey, supported by full ecological data on the labels of specimens -- much of this is in the published papers by specialists as well --, or derivable from the code-numbers referring to my field

OXFORD UNIVERSITY EXPEDITION TO SPITSBERGEN (1921)

L. to r.: J.S. Huxley (birds); F.G. Binney (Organizer); A.H. Paget Wilkes (birds – leaning over); J.D. Brown (birds – with spectacles); V.S. Summerhayes (botanist – in front); F.C.R. Jourdain (Leader, birds & eggs – behind); C.S. Elton (animal ecologist – in roll-neck jersey); R. Pocock (cook, etc. – behind); Dr. T.G. Longstaff (birds & much else – looking back); R.W. Segrit (geologist); H.L. Powell (taxidermist).

The 2nd Party not shown here came out in late July to 'Bruce City': A.M. Carr-Saunders (zoologist); R.A. Frazer (physicist) & N.E. Odell (geologist) as sledgers; R. Stobart i/c sledge-dogs (not used); G. Slater (glaciologist); J. Walton (botanist).

Svalbard). — or any Arctic country — had been sur

List of Members of the Oxford University Expedition to Spitsbergen, 1921.

Rev. F. C. R. Jourdain (Magdalen), (Leader of the Expedition; Ornithology).
Dr. T. G. Longstaff (Ch. Ch.), (Ornithology; Exploration).
Prof. A. M. Carr-Saunders (Magdalen), (Zoology).
Prof. J. S. Huxley (Balliol and New College), (Zoology).
Mr. F. G. Binney (Merton), (Secretary and Organizer).
Mr. J. D. Brown (Oriel), (Ornithology).
Mr. C. S. Elton (New College), (Animal Ecology).
Mr. Seton Gordon (Exeter), (Photography; Ornithology).
Mr. A. H. Paget Wilkes (Lincoln), (Ornithology).
Mr. R. W. Segnit (Balliol), (Geology).
Mr. R. A. Frazer (National Physical Laboratory), (Exploration; Surveying).
Mr. N. E. Odell (Imperial College of Science), (Exploration; Geology).
Mr. Roger Pocock (Cook; Artist).
Mr. H. L. Powell (Taxidermist).
Mr. G. Slater (Royal School of Mines), (Glaciology).
Mr. R. Stobart, (Exploration; Surveying).
Mr. V. S. Summerhayes (University College, London), (Botany).
Mr. J. Walton (Cambridge), (Botany).

It is a spirited and scholarly account by a great e

catalogues. On the first part of the expedition the survey was done in very close collaboration with our botanist, V.S.Summerhayes; while on the second part Walton helped me with plants but published his separate ecological paper. It was the first time that Spitsbergen and Bear Island (now Svalbard), -- or any Arctic country -- had been surveyed ecologically in this way, though inevitably it was mainly at the level of reconnaissance. The field work renged from terrestrial and fresh-water, down to some brackish and intertidal zones, a circumstance made possible partly by the relatively small number of species. The large paper by Summerhayes and myself (Journal of Ecology, 1923, Vol.11, pp. 214-86) will be referred to here as "our paper" (The second large one dealing with the results from 1923 and 1924 expeditions will be referred to forward as "our paper, 1928"). Many background ecological data are to be found also in some of the taxonomic papers by specialists.

In order so far as possible to distinguish between actual Diary entries made at the time, and my memories (which are clear though often not to exact days) I have placed the former in " -- ", the rest of my personal narrative being without them. Information from memory or statements from other sources or other comments I have placed within square brackets, with " -- " round any actual quotations. I have also added some special "Remarks" by myself . A few matters have been relegated to Appendices at the end.

Other sources of information.

(1) The daily Diary of the Leader, Rev. F.C.R.Jourdain [referred to here as "F.J."], kept in the archives of the Edward Grey Institute of Field Ornithology, Oxford Department of Zoology. The Institute's Librarian has kindly allowed me to use this freely. It gives a valuable framework of dates, moves of the ship and various people (during the period of the First Party), a daily note on the weather, and a mass of information about birds and eggs. I have used it mainly for the first two items.

(2) Dr Tom G. Longstaff's autobiography "This my voyage" (Murray, London, 1950) has a chapter on the 1921 and 1923 Oxford expeditions that he was on. It is a spirited and scholarly account by a great explorer [Here "T.G.L.].

(3) Seton Gordon's book "Amid snowy wastes: wild life on the Spitsbergen archipelago" (Cassel, London, 1922). Referred to me as "S.G. It is mainly on birds, is written by a "loner" who achieves the feat of mentioning no single other member of the Expedition by name (!), but is pleasantly written and reliable so far as it

goes. I have not found much relevant to my own work. Excellent photos, but not good enough for further reproduction: I have a number of his much better original prints.

(4) George Binney's book on the 1924 Expedition "With Seaplane and Sledge in the Arctic" (Hutchinson, London, 1925), App.A, gives a list of members of the 1921 Expedition, and brief summary of movements with some dates.

Publications.

A volume of collected reprints of papers, Spitsbergen Papers, Vol.1 (1925) was published through the Clarendon Press, Oxford. It contains 32 papers, and an Appendix (not elsewhere printed) on marine animals from Bear Island and three places in Spitsbergen. It was only a small edition and is not generally available, therefore I give a copy of the list of contents overleaf. The following additional papers were published:

Included in Spitsbergen Papers, Vol.2, Appendix,(1929): N.E.Odell (1922). "Geological notes from the Oxford Expedition to Spitsbergen". Geogr.J. Vol. 60, pp.424-6.

Included in Greenland and Spitsbergen Papers (1934): C.S.Elton & D.F.W. Baden-Powell (1931). "On a collection of raised beach fossils from Spitsbergen." Geol.Mag. Vol.68, pp.385-405.

The following smaller notes were not included in these volumes:

F.C.R.Jourdain (1922). "A little known American bird". J.Mus.Comp.Oology (Santa Barbara, California), Vol.2, Nos.3-4, pp.26-8. [Concerns the Spitsbergen puffin, Fratercula arctica naumanni].

A.H.Paget Wilkes (1922). "On the nesting of the barnacle goose in Spitsbergen". Ibid., pp.28-30. [This rare journal is in the Edward Grey Institute].

Photographs.

I have a number of photo prints, mostly still in good condition. A few of these are my own, for which I have the negatives. All these will go eventually to the Scott Polar Research Institute. There are also a good many, some of them excellent, in published papers, in S.G.'s book, and 3 in T.G.L.'s book. I have included some prints in the present notes

Place names.

Decisions had to be made about the use of these, since there have been many changes. In 1921 - 24, Spitsbergen and Bear Island had not been officially taken over by Norway. We used the Dutch and English names (mostly) of the old British Admiralty Chart, originally made in 1865 and periodically up-dated to 1913. My decision to keep these old names here is not based on any "jingoistic"

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* [Items marked * are those based almost entirely on my collecting, (✓) those to which I gave some help].

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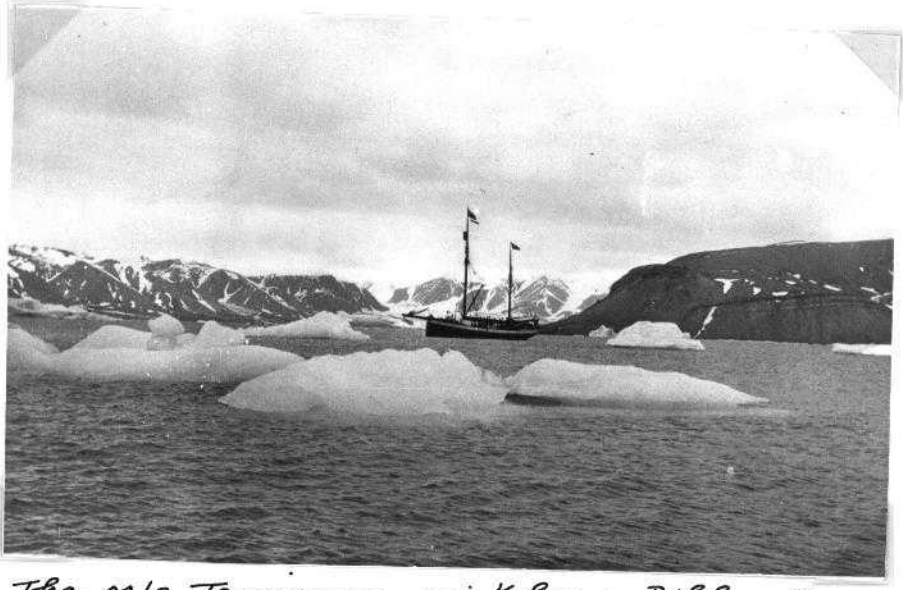


The M/S Terningen in Klaas Billen Bay, opposite 'Bruce City', with Petunia Bay beyond. The ice was from the Nordenskiold Glacier (off r.).
(Photo Seton Gordon).

reasons, but because all the related published work, specimen labels, archive diaries, and the earlier literature, use the old-established names. Also the excellent modern maps e.g. the 1:500,000 scale ones issued in 1968 and 1970 (Norsk Polarinstitutt), although with names changed to Norse equivalents or completely, are usually fairly easy to interpret in older terms. Some straight translations present little difficulty e.g. Prince Charles Foreland to Prins Karls Forland. But in most instances I have added the present-day names in square brackets. These changes are dealt with in "The Place-names of Svalbard", Skrifter om Svalbard og Ishavet, 1942, No.80, 539 pp.; and reviewed in an article by B.Roberts (1948), Polar Record, Vol.5, pp. 172-84.

An additional difficulty about place-names has arisen more recently. Since the region came under Norway in 1925, the name Svalbard has become used to cover the whole archipelago, including Bear Island. Within it the main island has been called West Spitsbergen [Vestspitsbergen]. But in 1969 the name of the latter was changed to Spitsbergen, leaving no general name for the main island group outside Bear Island etc. In the present Notes I am compelled, for reasons already explained, to use "West Spitsbergen" throughout, otherwise there would be much confusion.

The M/S Terningen.

This excellent and very strong wooden sealing sloop of 70 tons [Binney,p.28] was manned by a Norwegian crew under Capt.M.Jensen [Binney, p.357]. I can record little about them, since I spent only short periods on board, and part of that time was very sea-sick. Just in case of misunderstanding, although Pocock is listed on the Expedition as "cook", we had in fact an excellent Norwegian sailor-cook who did most of the work and produced food at unlikely hours. I was to sail in this ship again much more extensively in 1923, and came to have tremendous respect for Norwegian sailors and for the ship. It had semi-diesel engines and sails. These engines could propel the ship at not more than about 8 knots, even under good conditions of wind and ice, which did not always obtain. [T.G.L. refers to it, correctly, as a "roomy two-masted schooner. The hold, stinking with the blubber of many voyages, was fitted as our sleeping quarters. It had the usual auxiliary engine, nominally for work in the ice; but Norwegian sailors, to save hands, are under-sailed and the engines are run for most of the time..."]

[Note: The term "schooner" used by T.G.L. is strictly correct, as this was a two-masted sailing-ship; but "sealing sloop" was a phrase widely used, though by dictionary definition a sloop has one mast. As a rule I shall use the term

"ship". High up on the tall fore-mast was the barrel used as a crow's-nest for ice-spotting (see photo)].

Joining the Expedition.

It was by good fortune that I was able to join the Expedition at rather short notice. In mid-April, when I was just 21, my tutor at New College, Julian Huxley, wrote to say that there might be a vacancy for me, because he had an offer to investigate egret-farming in Venezuela! But by 4 May he again wrote that Carr-Saunders would be unable to come on the First Party, and there would be room for me. Meanwhile Huxley had decided to come himself, and I would be his assistant in the field. At this stage he was especially interested in studying the life of phalaropes (waders whose male incubates instead of the female). As will be seen later, he did instead a major study of the mutual courtship and biology of the Red-throated Diver.

I was an undergraduate in my second year at Oxford (which meant mainly the unwilling study of comparative anatomy), working in the advanced zoology class. But I had privately had a great deal of field experience as a naturalist, with plants, birds, and some insects; and especially of fresh-water ecology. My particular interest was in fresh-water Crustacea. On the Expedition I carried out a wide-ranging ecological survey of the animal communities of terrestrial, fresh-water, and some intertidal and brackish-water habitats; also collected a few vertebrate parasites. I worked very closely (on the First Party) with V.S.Summerhayes, a young botanist from Prof. F.W. Oliver's Department at University College, London. [He was three years older than I, had been in the battle of the Somme, a small and slightly-built man with the greatest determination and a very high capacity both for field ecology and plant taxonomy. At Kew, he eventually became one of the greatest authorities in the world on orchids, among other things. There is a good Obituary of him in the Bull. British Ecological Society, Vol. 6, No. 2, pp. 5-6].

My Father, Professor Oliver Elton, put up some money, my Mother did many tasks in fitting me out in a hurry, and my older brother Leonard (who had served through the War) lent me essential equipment. I took a complete range of collecting equipment, preserving fluids etc., and several books, the most important of which was a copy of V.E.Shelford's classical "Animal

Communities in Temperate America" (1913). I was very inexperienced, very raw indeed, for I had never left the soil of Britain, although I had done some rough camping. I was encouraged by the message that Huxley sent to my Father: "Please assume that there is no danger in the Expedition further than that involved, say, in elementary Swiss climbing, certainly much less than difficult mountaineering and indeed negligible". My diary does not confirm this optimistic forecast!

Expedition Organization.

In general, there was a First Party with a strong contingent of ornithologists, and a later Second Party that included the sledgers for a journey into New Friesland . The First Party consisted of 12 members, the ornithologists being Jourdain, Huxley, Longstaff, Brown, Gordon, Paget Wilkes, plus the taxidermist Powell; and in addition Binney, Segnit as geologist, Summerhayes and myself, and Pocock, whose role was never quite clear to me, though he had a life-history as a pioneer in North America.

The First Party left Tromsø on 11 June and, after some members had stayed on Bear Island from 13 - 23 June, reached Spitsbergen on 25 June. Most of them had gone home by 22 July. The Second Party reached Spitsbergen on 21 July and all had left by 26 August. Longstaff, Segnit and I stayed on with this Party, the newcomers being Carr-Saunders, Frazer, Odell, Slater and Walton; also Stobart, who had been already doing some work with the Scottish Spitsbergen Syndicate [S.S.S.].

Walton and I left our base on 16 or 17 August, and for home the following day. The three sledgers, Odell, Frazer and Longstaff, returned to base on 25 August just in time to return on a sealing ship, and I think Segnit, Slater and Stobart with them.

Detailed Summary of the movements of the Expedition.

[A good deal of the following information is based on or has been checked by F.J.'s Diary].

The "Terningen" left Tromsø at 4 a.m. on 11 June and landed a party of seven on Bear Island on the 13th. The ship returned to Tromsø and picked up some members, and on the morning of the 23rd the Bear Island party. We reached Advent Bay in Icefjord on the 25th, where we found Stobart. Here the nesting barnacle geese were the special objects of the bird people. On the 26th one group -- Jourdain, Binney, Brown, Gordon, Paget Wilkes, Summerhayes and myself, landed at Gips Valley, rowed by the elderly ice-pilot (see photo). Some of them camped overnight, though not Summerhayes and myself). Another party -- Longstaff, Huxley and Segnit -- went in the ship to Dickson Bay

[see T.G.L. p. 243] partly in a search for Triassic vertebrate fossils. On the 28th the whole Expedition sailed for Green Harbour [Grønfjorden] and on the 29th stopped by the Edinburgh Islands [now Forlandsøyane], which lie off the S.W. coast of Prince Charles Foreland. A party, including Summerhayes and myself, landed briefly. The same day the ship reached the north tip of P.C.F. at Vogel Hoek [Fuglehuken], where Jourdain, Gordon, Brown and Paget Wilkes landed on the N.E. corner of the great sea-bird nesting cliffs. [F.J.: "Drizzle, then steady rain. Had long and very arduous walk in marshy snow-melt conditions to Richard Lagoon over Aberdeen Machar and got very wet. Reached rendez-vous by Richard Lagoon 4.20 a.m. Very cold wind! Terningen in sight but anchored and no deck watch. Not picked up until 8 a.m., when Huxley's party crossed Lagoon and landed stores and then took the others back to the ship, which left for Vogel Hoek again later"].

The shore party, consisting of Huxley, Segnit, Summerhayes and myself, were left by the inner shore of the Lagoon, where we made camp and worked from it as a base from 30 June to 11 July.

Meanwhile the "Terningen" proceeded northwards with all the bird people except Huxley. I will not give details of this northern visit (available in F.J.'s Diary). The places visited included King's Bay [Kongsfjorden], various parts of Liefde Bay (Reindeer Peninsula, the Station Islands, the Mouette Islands [Måkeøyane], the Canard Islands [Andøyane], Lerner Islands); then northwards, to Moffen Island, and back with landings at Clowen Cliff [Klovningen] and Magdalena Bay. [T.G.L. has interesting notes on this part of the Expedition].

The shore party meanwhile spent its time on the coast between Richard Lagoon and Vogel Hoek, and little on the hills behind.

On the way back to Icefjord, where the Expedition was to spend all the rest of its time (apart from the sledging), there was a call at Hermansen Island, which lies in Foreland Sound just outside St.John's Bay. Summerhays, but not I, went ashore here (I was catching up on sleep). On 11 July Cape Boheman [Bohemanneset] was reached. This lies on the S. side of Icefjord. Here Huxley, Summerhayes and I stayed at the small Dutch coal-mine settlement until the 16th. Meanwhile there were various local journeys by individuals and parties within Icefjord. The localities included two islets near Cape Bohemen; the mainland near the Cape; Mt.Congress and Cape Wyk [Kapp Wijk] in Dickson Land; Ebba Valley, Mima Valley and

"Bruce City" [the S.S.S. base huts] at the head of Klaas Billen Bay [Billefjorden]; and the Anser Islands [now Gåsøyane] at the mouth of K.B.B. [Ebba Valley is not named either on the old Admiralty Chart or on the modern Norwegian 1:500,000 map. The following notes are given here, because it is the place from which a unique spider was obtained. The 1962 map of Southern New Friesland, assembled by the Cambridge Expeditions of 1949-58 and published by the Royal Geographical Society, shows it as a small valley with a glacier at its head, leading into Petunia Bay (opposite Bruce City). It is well described by Slater [S.P.1, No.32], with the S.S.S. map and some photos*].

On 17 July the ship visited Sassen Valley (Temple Bay). Summerhayes being in the party that landed was able to make a good record of the vegetation around bird-cliffs, which we did not manage to do elsewhere in 1921. The ship and full party then proceeded to Advent Bay, arriving early on the 18th, and learned that the Second Party had sailed from Tromsø on the "Phoca", but were 9 days late because of transport delays. [Frazer, S.P.1, No.1]. The "Terningen" touched at Cape Boheman on the 19th, to collect Gordon who had been there for several days, and reached Bruce City, where Longstaff and Stobart were already. On the 20th the ship called at Gips Valley to arrange for transport by the S.S.S. ship for the Second Party. The "Terningen" ran aground but came off on a rising tide; then returned to Bruce City. The main First Party now left for home on the "Terningen" on the 21st. It met the "Phoca" at Advent Bay, whence they proceeded on the 22nd. After a call at Green Harbour, the ship sailed south that day, and with a following wind reached Norway on 26 July. Summerhayes went with them, but the arrival of Walton meant that we still had a trained plant ecologist.

The Second Party, having gone on to Bruce City, was based there for the rest of its stay. There was a group of well-made wooden huts belonging to the S.S.S., whose own men were also there part of the time, otherwise working on the other side of the fjord. We had two main fields of work: preparations for the sledge parrty that explored New Friesland: Odell, Frazer and Longstaff were away from 7 - 25 August [see Frazer, S.P.1, No.1; and T.G.L.]. The rest of us worked more or less independently around

* For fuller accounts see these Notes pp. 136-7 and Appendix 3.

Bruce City and occasionally on the opposite side of the Bay. Slater studied the glaciology of the Nordenskiöld Glacier; Walton plant ecology, especially of a salt-marsh; Segnit helped me to map a raised beach section; and I did various things described later. Stobart helped greatly with the sledging equipment but was unable to accompany the sledge-party because of the after-effects of an illness. He was also in charge of several sledge-dogs, though these were not used. Carr-Saunders did some marine dredging with my assistance, but had to return to Advent Bay and home in a hurry because of suspected appendicitis, though fortunately he recovered without any operation. Slater, and, I think, Stobart and Segnit, awaited the sledgers' return and travelled home to Norway.

Collections and Taxonomy.

Our paper thanks 6 plant taxonomists and 20 animal taxonomists for naming the collections we made. This gives a good notion of the extent of the surveys we did, though they were never claimed to be more than a general reconnaissance. We accordingly took a wide range of materials for preserving specimens properly. For example, I took some "Viets Solution", a glycerine mixture for water-mites, in which it happened that the first and only species ever recorded up there was preserved. Dry insects were killed in cyanide and put in screws of tissue paper with code-number pencilled inside, referring to my catalogue with ecological data. These were lightly packed in cigar-boxes. Softer animals such as spiders and Collembola and some aquatic forms were put in glass tubes of alcohol or formalin with code-labels. Their corks were sealed with paraffin-wax to prevent evaporation. I made a collection of fresh-water algae from streams etc.; of sea-weeds; and (from some areas, but not Bear Island) dried soil and moss samples for the study of micro-fauna by specialists. In addition I took material of molluscs, etc. from a raised beach section near Bruce City, for which benthic molluscs dredged in the sea near-by provided useful comparisons. The marine work was done by several people, including myself, from a small boat. omitting the paper by myself and Baden-Powell on the raised beach, the published work on taxonomy of these collections consists of 4 papers on plants, and 15 on animals, all in S.P.I. Besides this, I named fresh-water and brackish-water Crustacea myself, with some specialist help, but mainly by using the monographs by Olofsson, whose work will be referred to under the Klaas Billen Bay section of this account.

On land my collecting was done by catching flying insects in a butterfly net; by turning over stones; by shaking out plants onto a white mackintosh sheet; and by examining leaves, flowers and sea-wrack. But I did not have any heat-extraction funnel, such as was used with effect later by Thor in 1928, and also by Bertram and Lack on Bear Island in 1932. This method produces many more of the smaller kinds of mites and some Collembola e.g. those that live among moss especially. Thor's monograph (1930) was also a notable addition to the taxonomy of Acarina in the Arctic. See also some further information in Thor (1934) based on collections made for him in Svalbard.

For aquatic collecting I used a small tow-net in fresh water (but most of the water-bodies I studied were relatively small and shallow), a long-handled plankton-concentrating net, and a small dredging net. I took with me a good Bausch and Lomb microscope (monocular), used in Spitsbergen but not on Bear Island. From the latter I brought back preserved samples, but others were smashed by accident. I made extensive microscopic examinations at Bruce City, and some on Prince Charles Foreland and Cap Boheman. (Those on P.C.F. were of little use, because of the earliness of the season, which was in full snow-melt). I had with me Ward and Whipple's "Fresh-water Biology" handbook (1918 New York ed.), which enabled me to name, at any rate to genus, some microfauna such as Protozoa. I must make it clear that I was not aware of Olofsson's important work until after my return home. Dr A.H. Church, at the Oxford Department of Botany, had taught me a good deal about microscopic algae, and such groups as dinoflagellates etc.

Since the location of the various collections is not given in any of the papers, I list them below:

The plant collections went to the British Museum (Natural History), though possibly some may have been lost in the London Blitz.

The main insect collection is in the Hope Department of Entomology, University Museum, Oxford, as part of an important group of Arctic collections by Oxford Expeditions to Spitsbergen and elsewhere. A good many duplicates of Diptera Nematocera were given to the B.M., but these are noted on red-ink labels in the Hope cabinets. Some of Bertram and Lack's material from Bear Island, mainly in the B.M., has duplicates at Oxford. The main collection of Collembola is also in the Hope Department, though Manchester University Museum has a small sample series (Dr G.H.Carpenter, who named our collections from the three Oxford expeditions, became Director there). The spiders (Aranea) also eventually went to that Museum. I have been unable to trace the specimen ♀ Apatania arctica (Trichoptera) from Bear Island either in Oxford

or London. It was undoubtedly named by F.D.Morice at the B.M. Fortunately the Museum has specimens from the Island, collected by Bertram and Lack. Bird-lice (Mallophaga) went to the B.M. Some bird-fleas (Siphonaptera) are in Tring Museum, now part of the B.M.

The terrestrial mites (Acarina) were lost owing to the gross carelessness of the specialist who named them (together with all those that I got in 1923 and 1924). Thor complained in his paper that this made it impossible to verify the species in the light of later taxonomic ideas. To some extent this is true; but although the names have changed in some instances, I do not think that the 12 species I took in 1921 were critical ones, except in the genus Bdella -- a point discussed in Appendix 1 of these Notes. He was, however, incorrect in stating that we did not give the species authorities in our paper: they are given on the first mention in the text, but not thereafter. Any other procedure would have clogged up the text, which was complicated enough anyway! We also assumed that the species authorities could be obtained from the various papers by experts, including that on Acarina. In the present Notes I have inserted them in the text in a few instances where they are not easily available in print (such as the Appendix on marine animals in Spitsbergen Papers, Vol.). I give some unpublished records of algae, mainly from fresh water, but am unable to attach the species authorities, which are not in the original lists given me by the expert -- a reliable one -- who named them.

The water-mite (Sperchon lineatus) from Bear Island is in the B.M. (slides of ♂, ♀, and nymph); as also are such marine and brackish-water animals as were kept, and the parasitic helminths from mammals and birds. We did not have all the marine collections named and published. The very good ecological and taxonomic monograph by Olofsson (see our paper pp. 215 and 285) made it seem unnecessary at the time to keep specimens of smaller fresh-water and brackish Crustacea, named by myself from his and other standard works, especially since he had worked partly in the same area at Klaas Billen Bay as I did. This decision I now consider ill-advised, though I have no doubts about the identifications.

The Oligochaeta are all in the B.M. -- the unique specimen of Nais josinae from Bear Island , and the various Enchytraeidae.

Although there have been a number of changes in the nomenclature and also to a lesser extent in the substance of the species determinations, I have not attempted to trace these in any complete manner; though I have added some notes on those known to me. It seems that noone had previously, or has since the three early Oxford Expeditions, tried to make any general survey of plant and animal communities combined in Spitsbergen. The fine survey of Bear Island by Bertram and Lack in 1932 is the chief exception. There have been, however, some valuable modern studies of local areas in Spitsbergen by Scandinavian and German workers, that have partly added also to our understanding of the taxonomy of invertebrates there. Birds, have, of course been investigated by a number of expeditions, as the enormous bibliography by H.L.Løvenskiold (1964) "Avifauna Svalbardensis" (Skrifter Norsk Polarinstitutt, No. 129, pp. 1 - 460) demonstrates. He is good enough to remark (p.15) of our two papers that they are "very important and quite indispensible for the study of vegetation and animal life in the area".

A feature worthy of remark is that the ecological survey results in our paper were published within two years of the Expedition's return. Considering that we collected and recorded animals and plants from all accessible habitats and for most taxonomic groups of invertebrates and plants, the speed with which specialists were able not only to provide nearly all their taxonomic conclusions (involving the descriptions of some new or apparently new species) is rather astonishing. This happy result was made possible by three things. First, the Arctic still exercised a considerable romantic influence on British people, who had followed Polar exploration with interest for over a hundred years. Also Bear Island and Spitsbergen had been incompletely studied, and this fact gave some promise of new species turning up, as well as of increasing our knowledge of geographical distribution in the Arctic. The second reason was that we did supply to specialists material that was in excellent condition. The third reason was most important. In Oxford Professor E.B. Poulton was then a highly regarded head of the Hope Department, with its great insect collections (also spiders, etc.). It was his generous help to me amd his enthusiasm that galvanized various taxonomists (both professional and amateur) to work so quickly. He almost stood over them and insisted on results! In his Department there was a brilliant entomologist-technician, Mr A.H.Hamm, who handled most of my dry specimens. Some of these, especially the small

gnats (Diptera, Nematocera), were very delicate indeed. One notable instance was a large haul of the latter found dead and somewhat tangled together on the inside windows of huts at Bruce City. These he relaxed and patiently separated and set, e.g. 40 ♂♂ and 52♀♀ of Cricotopus glacialis (a gnat with aquatic early stages), described as a new species by Edwards (S.P.1, No.15). The material that was ——→ in alcohol etc. was sent direct to various specialists. Much the same story could be told of Professor F.W.Oliver's help to Summerhayes, with the plants.

Professor Poulton, ahead of his time, was especially insistent that all my habitat data should be transferred to the insect labels, and included in taxonomic papers mostly as well. He spent a long time with me, copying and verifying each record of a species-event. At that date this insight into the matter was rather unusual, taxonomists usually giving only the place and date, if that. In addition, he greatly encouraged one who, after all, was still only a student.

Without attempting to trace the very scattered and rather episodic histpry of the collecting of land invertebrates in Svalbard in earlier years, I will mention only the following points. The first insects to be described and records published were by Carl Boheman in 1865 ("Spetsbergens Insekt-Fauna", Öfversigt Kongl. Svensk. Vet.-Akad. Förhandl., Stockholm, Vol.22, pp. 563-77). He included collections from 1 French and 3 Swedish expeditions dating from 1828 onwards. He did not go on any of them himself. Then came the great monograph by A.E. Holmgren, a zoologist on Nordenskiöld's expedition of 1868 ("Bidrag till kännedom om Beeren Eilands och Spetsbergens Insekt-Fauna", Kongl.Svensk. Vet.-Akad. Handl., 1869, Vol.8, No.5, pp. 1-58). This report (to which an incomplete reference is given in our paper) is rather hard to get hold of in Britain. At that time I had not read it, because I assumed that it dealt solely with taxonomy. But recently I obtained a copy from the British Museum (Natural History) library. It does indeed describe many species. But I found also useful remarks about the habitats, even the habits, of insects, as well as lists of all his and previous localities and dates for each species, with names of collectors, -- in Latin. His work is remarkable, because with only a few exceptions there was no such extensive collecting of insects again in Svalbard until our visit in 1921.

DIARY AND OTHER NOTES BY C.S.E.

[I travelled from my home in Liverpool to Newcastle-upon-Tyne, where I met some members of the Expedition, and thence by steamer to Bergen. The coastal steamer journey to Tromsø, 2 - 7 June needs no comment, except that I had an opportunity of getting to know these members, and to go ashore at stopping places with Summerhayes and learn something of the northern flora e.g. Salix herbacea and S. reticulata near Tromsø. Here I saw two red-throated divers on the fjord.]

[F.J. recorded "a good deal of swell" on the 12th (the day after we set sail) and "considerable swell" on the 13th when (as noted earlier) our party of seven landed on the S.E. shore of Bear Island [Bjørnøya]. He mentions that there was a stiffish N.E. breeze and plenty of swell on, and landing at Walrus Bay [Kvalrossbukta] not easy: "though we got ashore safely many of us got a good wetting". He noted that one light boat was left, and subsequently used to get along by the cliffs or to islets.]

[For me the voyage had been extremely unpleasant, since I was violently sea-sick for 2½ days — my first experience but not my last, because I was to discover that I never acclimatise to motion, though I learned to control sickness by lying down. I heard Dr Longstaff say: "I must do something for that poor boy". This took the form of a stiff drink of brandy on a very empty stomach, so that I went ashore sitting on top of a large load of baggage in the whale-boat, and singing loudly!]

[We camped in two parties at the ruined old whaling station, close to the shore, littered with bits of machinery and timber, and surrounded by the extraordinarily barren frost-shattered country for which Bear Island is well-known. Walrus Bay lies about half-way between the main mountain, Mount Misery, and the southern tip of the Island. The Bay got its name from the walrus colonies that were there in old days but later slaughtered in thousands: skulls and other animal bones were still lying in the valley, down which a small stream runs down through a moss-bog to the sea. In F.J.'s Diary I found a cutting from the chart made by the Swedish Polar Expedition of 1898, with a large inset of Walrus Bay and of South Haven just south of it, with soundings. The latitude of the Haven is given as 74°21′30″N. There is now a first-class large map of the Island issued by the Norsk Polarinstitutt, scale 1:25,000, latest edition seen by me 1955. English readers may find convenient for general purposes the small map reproduced by Bertram and Lack (1933) in the Geographical Journal,

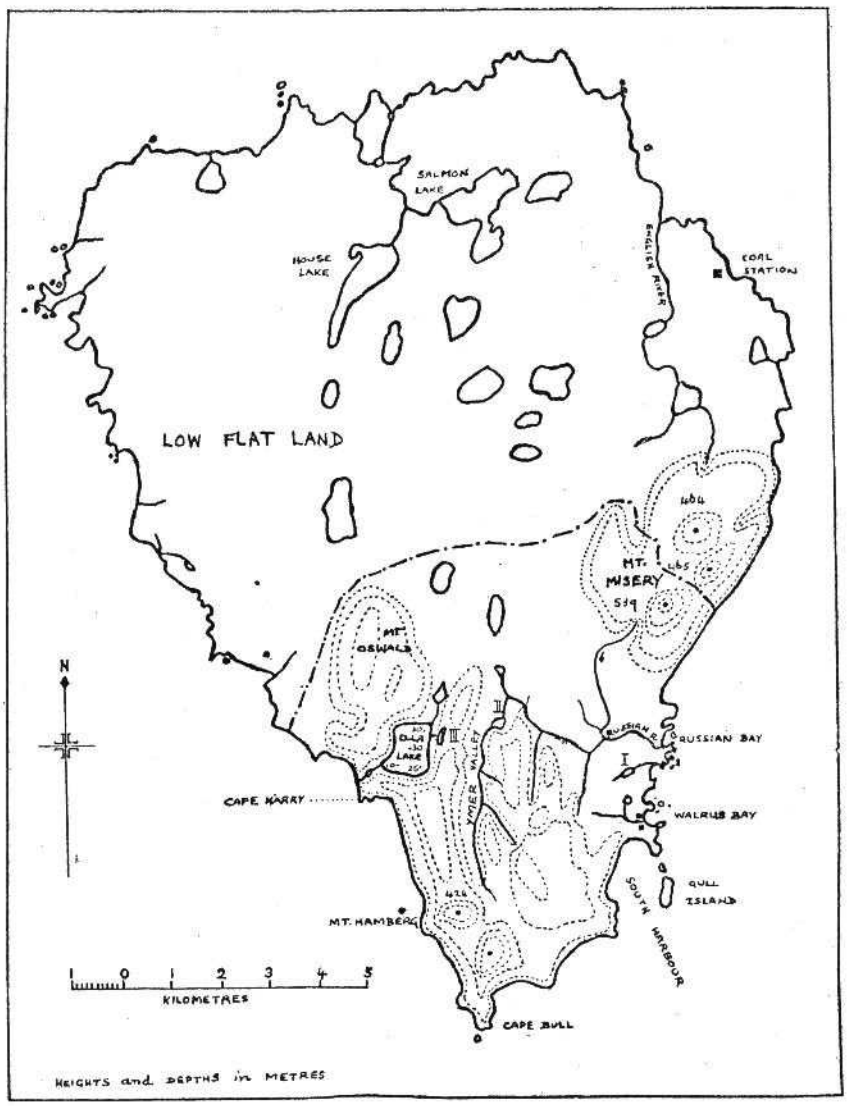
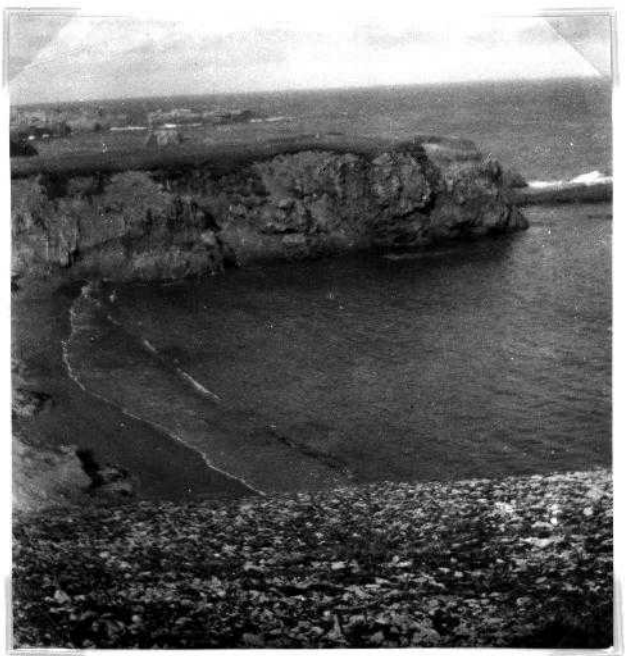


FIG. 1. Map of Bear Island. Dotted lines are form-lines, not contours.
-·-·-·-· Boundary of area investigated.

From V.S.S. & C.S.E. (1923) p. 217. Drawn by C.S.E. from current sources.



Walrus Bay, Bear I.
(C.E. 1921 : Photo No. 904)

81:45-53, and in the Journal of Animal Ecology (1938), 7:27-52 (not to mention a rather similar one widely available to the layman, in Alistair MacLean's thriller "Bear Island" (1971)!). Our paper has a sketch-map marking general mountain contours and showing the northern limit of our ecological reconnaissance, in the south part of the Island.

[On one slope of the little valley was a decrepit wooden hut containing quantities of ancient dried haddock. These were thrown out and the place -- named by us "Haddock Villa" -- occupied by the main bird party. On the other was the old forge, with two rooms, in one of which Longstaff, Summerhayes and myself slept on the floor, and in the other was a large open hearth and a rough work bench. There was plenty of derelict timber for firewood, so we cooked here. There was no sign of recent occupation, only a small brick-hard loaf preserved except for green on the cut end, and a scrap of German chart.]

[I shall make little reference to the large amount of work that was done on birds, which included a lot of egg-collecting, and the preservation of skins by Powell, a trained taxonomist. From him I learned some useful tricks about chopping wood, which were to serve me well on the 1924 expedition, when one relied upon driftwood. (Powell had graduated in wood-chopping while doing penance for some minor offence while in the Army). The results of the bird studies are contained in papers in S.P.1, more fully in F.J.'s Diary, and of course in the various museums that received collections. F.J. was a very indefatigable egg-collector, and on this expedition he once blew eggs until he fainted.]

14 June. [This day seems to have been fine, for Bear Island -- so famous for its storms and mist, some of which we were to experience. I was able this day to take absolutely clear photos of Walrus Bay, also of Mount Misery from Russian River. But the day began in an odd fashion. We three were awakened at 2.30 a.m. to find the tall rangy figure of Jourdain standing there, who told us to arise and get to work at once. His theme was that we had no time to lose. Longstaff remarked: "I must have my 8 hours sleep", and whispered to us "Don't take any notice" . So F.J. and his party set off, while we rose at normal time. They soon learned to get enough sleep, for they were exhausted by evening.]

My Diary notes: "14.6.21. Very barren and desert looking rocky coast as seen from ship. Mount Misery very aptly named, but this feeling passed away

Our habitation on Bear I. in June 1921. H.L. Powell, our taxidermist.

(Photo J. D. Brown).

14 June ...

on landing. The coast round Walrus Bay is hard dolomitic rock. South and inland is a lot of hard shaly limestone much altered (in some places to fine white ?calcite crystals). On the cliffs are thousands of guillemots plus eggs. Many fulmars and glaucous [gulls]. A few Richardson's skuas (black and white). A few purple sandpipers. 2 golden plovers, probably breeding."

"Saxifraga oppositifolia in flower and many lichens and some mosses".

"Kittiwakes on Tarn 1 [see later] in large flocks. Skuas occurred on a little tarn near, but never on Tarn 1, & evidently would not tackle flocks of kitties, though often seen going for isolated birds. Kitties watched pecking some black or dark stuff for their nests. (Nests brought in consisted chiefly of moss). Remains of whales, About 30 walrus skeletons. 1 bear's skull. 1 or 2 Arctic fox skulls. Some tarns are constantly visited by large flocks of kittiwakes. They settle and wash and dip in the water, getting up suddenly en masse every now and then & wheeling round like a flock of starlings & returning again to wash. Sometimes they get up & go and settle on a hill side, where they look like beds of white tulips in a town park. They may add a lot of dung to the water, but do not add an appreciable amount of salt."

"Pink-footed geese seem to visit the Island but not to breed probably. Their droppings contain mosses, etc. Glaucous gulls make their nests of mosses entirely, but do not appear to make long journeys inland for this -- but perhaps they had finished when we got there. Some used Cochlearia".

"All the swift streams on Tetradium limestone have an alga on the rocks and stones (filamentous). In some of these there appeared to be another of a darker green. In a large stream it was very luxuriant". [In fact we obtained 7 species of algae, named by B.M.Griffiths from my collections -- see our paper p.230. On p.230 there it is stated that we found no animals among the algae. Bertram and Lack (1938, p.33) noted that "They run fastest after the snow melt, and some of them dry up later in the summer. Apart from the larvae and pupae of Prosimulium ursinum [Edwardsellina] and various Chironomidae, they contain almost no animal life." on p.35 they note:"The larvae of Prosimulium ursinum were found in several fast-running rivers and streams, but only in those which had come from lakes, presumably since only in these was there sufficient plankton food". We did not encounter Simuliids, and B. & L. the early stages but not the adults].

[The 14th and 15th were spent in local reconnaissance not far from base, making notes and collections both on land and in fresh-water bodies. I did not collect in the extreme south of the island at any time; nor on bird-cliffs except for glaucous gull nests on the cliff-tops, mentioned for the 22nd. The results of these two days are grouped here into two main habitats: terrestrial and fresh-water. Details of dates and habitats are given in the specialist papers except for the spiders and mites, but for the latter I have annotated lists keyed to my catalogue of specimens. I have not kept the original notes for fresh-water Crustacea etc. that are given fully in our paper].

[For the 15th F.J. noted: "We got back loaded with eggs in spite of the unfavourable weather, as there was a good deal of mist about and it was cold and raw. T.G.Longstaff and C.Elton report a single goose seen, which from the description could only have been a "Grey Goose" and therefore a Pink-foot]. My diary: "Pink-foot geese seem to visit the island but not to breed probably. Their droppings contain moss etc." [The latter were in Walrus Valley. We were walking in thick mist in the area towards Mt. Misery when this goose loomed up. I said loudly "There's a goose", and it flew away before T.G.L. could unsling his gun...]

[During these days some insects were flying over the fjaeldmark (sawflies, Diptera), but most were on the ground or under the shelter of stones and plants. The list below contains all species found over or on the fjaeldmark in these two days, this being the habitat (other than totally bare rocky ground) covering most areas. Much of the snow had gone, if indeed winds had allowed it to lie at all].

[Matters connected with taxonomic changes etc. are dealt with in the full list of my Bear Island collections in Appendix 1, where the species authorities are also included. There have been changes in names and some in substance or opinion . Skua hummocks, though not strictly fjaeldmark, have been included].

I have attached some abbreviations:

F = Flying
Skua h. = Skua hummock or closed herb/grass mat
S.opp. = In flowers of Saxifraga oppositifolia
\+ means that such habitat is additional to fjaeldmark ordinary collecting.

14-15 June ...

Collembola (springtails):	Achorutes viaticus	
	Xenylla humicola	+S.opp. & Skua h.
	Onychiurus armatus	
	Isotoma viridis	
	I. multisetis	+Skua h.
Diptera (flies):	Sciara ?praecox	
	Lauterborniella ?coracina	+F over Skua h.
	Camptocladius longicosta	S.opp.
	Orthocladius ?conformis	+ Skua h.
	Diamesa ursus	+ Skua h.
	Trichocera lutea	+F
Hymenoptera (Tenthredinidae, Nematini, sawflies):	Amauronematus villosus	+F
	Pristiphora frigida	
Acarina (mites):	Bdella groenlandica	
	Sphaerozetes notatus	S.opp.
Aranea (spiders):	Coryphaeus homgrenii	
Oligochaeta (Enchytraeidae -- small white worms):	Enchytraeus albidus	

[In our paper the occurrence of X. humicola in flowers was accidentally omitted. In all instances the collecting yielded extremely few specimens, the largest catch being a small swarm of Lauterborniella over a Skua hummock -- 15 ♂♂, 3 ♀♀. And I took everything I could see and catch. In our paper we included three further species of Collembola recorded by Wahlgren (1900), but I am now less certain that his habitat records do refer to fjaeldmark or closed mat.]

Fresh-water tarns and lakes. [A schematic sketch-map of those that I visited between 14 - 19 June is given overleaf (p.20), with an explanation of its make-up. I have not found it difficult except in one unimportant instance, to equate them with those shown on the accurate modern map].

Tarn 1 ("Pond 1" in our paper ; also taken to be the "Habitat 13" for the diatom records by Cleve (1900) and other alga records by Lagerheim's "Pond near Russian Haven" (1900)).

My diary: "Depth does not appear to be, at any rate, more than 10 feet in middle. There is a shallow (6 in. - 1 ft.) shelf of rough shingle round edge out to 10 or 15 feet or so. Water quite clear. Wind when strong blows everything to one side. On 14th was blowing everything towards the outlet. Does not taste salt. Probably shaded by hills at some times of the day. Snow and ice still on one side and corner. Various collections made. A good deal of an alga. Some plankton [copepod]. Kittiwakes in large flocks came and washed in the Tarn. Purple Sandpipers* round edge: several pairs apparently feeding round the edge picking many minute things off the shore

*[1 stomach examined by me had "Collembola (up to largest size) and small black flies (these were the main part). Had been feeding by a tarn edge"].

& in shallow water. Many kittiwake feathers. 2 Black Scoters seen by Longstaff one day. No Skuas on this tarn."

"Alkalinity PTH [Phenolpthalein] pink, PR [Phenol Red] pink = 8.5 pH. 15th June, 10.20 p.m. after misty day, but now partially in sun:

Surface in sun 41°F. [= 5°C.]
" in shade 40.5°F. [= 4.7°C.[
Near unmelted icy snow (half a foot away) 39-40°F. [= 4 - 4.4°C.]

"Evening of the 15th, a Red-throated Diver on tarn". [F.J. notes this and that it settled close to me. Tameness was a feature of these birds in Spitsbergen -- see Prince Charles Foreland]."

[In our paper we list 19 species of algae from here, some of which had been found previously by Cleve and Lagerheim. We state that the shore was stony with almost no vegetation except algae and a little moss. The date of observations given there should be 14th, not 13th June. Cleve is cited as giving the depth as 7 m., and the bottom black mud. The tarn is described by us as 100 - 200 yards long. The modern map shows about 250 yards (metre equivalent)].

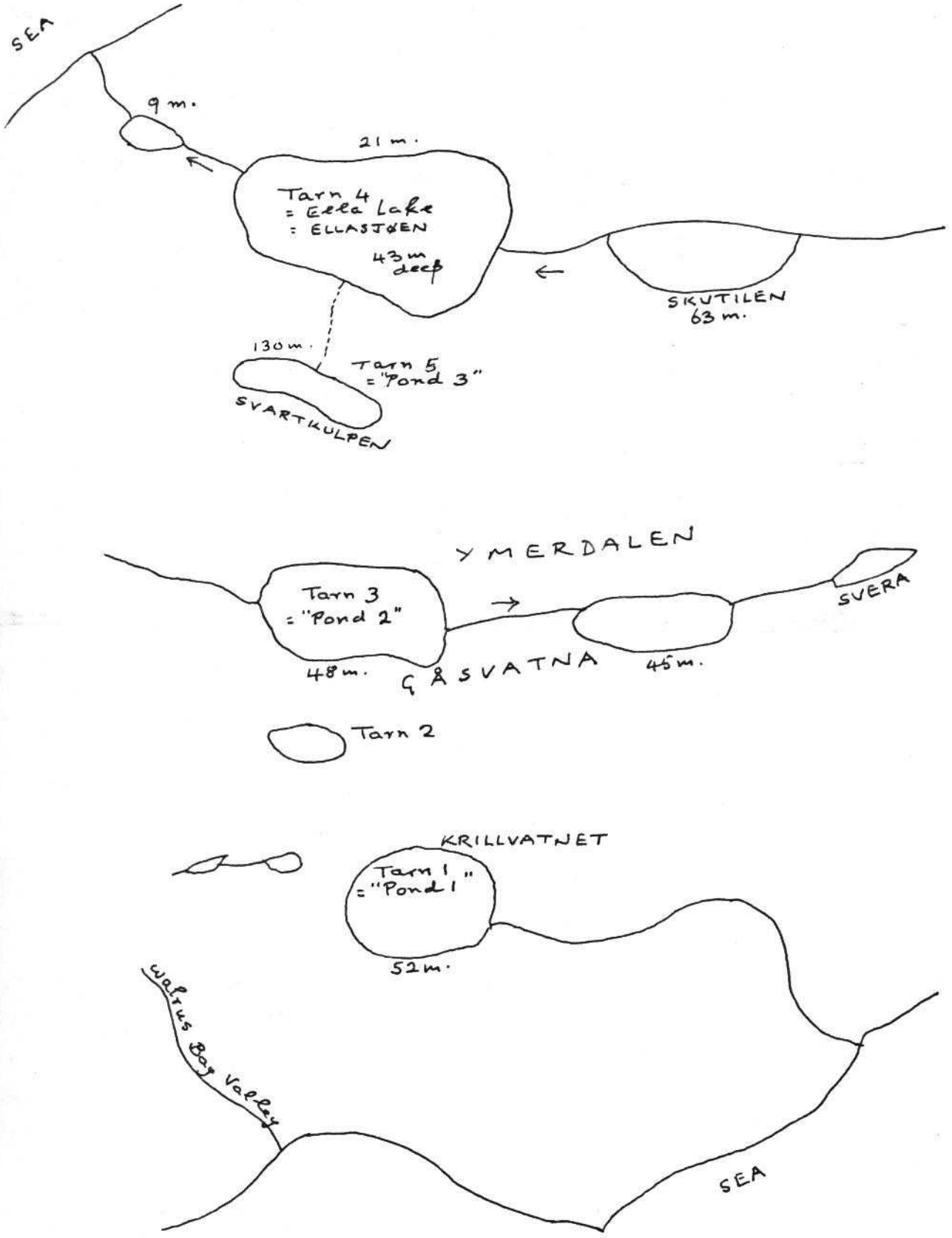
Rotifera:	Polyarthra platyptera
Oligochaeta, Naididae:	Nais josinae
Tardigrada	Macrobiotes macronyx
Diptera:	Chironomid flies: adults on water surface Larvae [undoubtedly Chironomidae]
Crustacea:	Daphnia longispina (plankton) Cyclops strenuus " Lepidurus arcticus (littoral) Chydorus sphaericus " Cyclops gigas "

[We should have noted in our paper that Lilljeborg (1900) also found all the Crustacea species here ("small lake near Russian Haven"), except for Chydorus sphaericus].

[Nais josinae is still the only non-Enchytraeid Oligochaete to be recorded up to the present (so far as I know) from Svalbard, with the exception of a single young indet. earthworm found by Nurminen (1965) in a moss-bank in West Spitsbergen (?introduced). Mine was a single non-sexual specimen, which my specimen catalogue shows to have been under stones in the littoral zone. Stephenson (S.P.1, No. 24) thought that it was the only record of this non-Enchytraeid found north of the Arctic Circle].

[Our paper gave Orthocladius ?conformis for the Chironomid flying: but I can find no specific record of the species by Edwards, and this may be an error, particularly as it is a difficult species taxonomically].

Explanation on p. 21



Schematic sketch-map by C.S.E., Diary, June 1921, of water-bodies visited, between Walrus Bay and Ella Lake.

The outlines are traced from my Diary, and the Tarn* numbers are those used for notes and collecting. The sizes and shapes (especially of Tarn 4 which is too big, and Tarn 1 which is also too big and its outlet stream too long) are notional, but these waters are easily identifiable with those on the modern map. I am, however, not absolutely sure of the identity of Tarn 2, but believe it to be the small pond N.E. of Survey point 22 with outlet stream to Russian River [Russeelva]. No collections were kept. Where they are referred to in our 1923 paper I have put the "Pond" numbers used there, which for Tarns 3 and 4 differ.
All names in BLOCK CAPITALS are added from the modern Norsk Polarinstitutt map, also the heights above sea-level and the depth of Ella Lake.
On the original sketch-map I had pencilled the names of bird species seen at some of these Tarns. These are noted in my text.

* ["Tarn" is the name for ponds and small lakes commonly used in our northern English Lake District and familiar to me from my work on them. It is derived from an almost identical Old Norse word used by the "settlers" there].

Snow Bunting
In typical rocky nesting habitat.
(This photo was taken in Spitsbergen
by A.N.T. Rankin, 1924 Oxford Exp.,
place and date not recorded).

14 - 15 June. Streams. [These are referred to on p.16 supra. I made three collections of algae from "swift streams on Tetradium limestone"].

16 June. [Today I accompanied Longstaff on a walk to the top of Mount Misery, approaching it from the S.W., which takes one over lower parts that are Devonian rock].

My Diary: "To Mount Misery. In the plain below a Skua nest with 2 eggs. Snow Buntings about. One pair observed. The rest only half-a-dozen cocks. One cock shot had in its mouth 2 or 3 of the large yellow and small dull brown ichneumon flies [actually sawflies -- I saw no Parasitic Hymenoptera on the Island, although a few species occur there]. Carrying them to a sitting ♀ ?|Purple Sandpipers about. A pair of Ice-Ducks [= Long-tailed Ducks]".

[The sawflies are those mentioned by Morice (S.P.1, No.18) as from "Tundra W. of Mount Misery, 0 - 150 feet":

1 ♂ Amauronematus villosus [The large one]
2 ♂♂ Pontania birulae [the small ones]

Presumably I kept the good specimens. N.B. In their paper (1933) on the birds of Bear Island, Bertram and Lack state that Snow Buntings are absent from the upper parts of Mount Misery where there are not rock crevices, as also in some other areas of the Island, even where food resources are the same. They note that they eat Chironomid flies, & Apatania (caddis), among other things].

"The slopes of M.M. consist of masses of boulders and screes with very little life except mosses, lichens, saxifrages etc."[More detail in our paper pp. 224-6, where the lists show that the lichen and bryophyte flora is very rich, and phanerogam flora very poor].

[On Devonian I collected:
Diptera: 3 ♂♂ Metriocnemus ursinus
Acarina: Bdella groenlandica
Scutovertex lineatus
Aranea: Coryphaeus holmgrenii]

"The top cliffs contained many Spirifer etc. and small corals. The Carboniferous top is dull, boggy, and wind-swept". [The modern map gives the highest top as 536 m. Although F.J. noted: "Weather much milder today, but still misty", T.G.L. and I obtained a clear view of the flats below to the west, which was invaluable in that it enabled him on the 20th to avoid the direct route to the Coal Mine which would have taken us over a morass of swamps and boulders in a blizzard"].

Mount Misery (main peak) seen from the mouth of Russian River, Bear I., 14 June 1921. (Photo C.E. 1921 : No. 1).

16 June... We did not see any ptarmigan or Arctic foxes. [Longstaff (1924) in his paper on the birds seen on the 1923 Expedition stated:"Dr Hoel further said he had shot specimens on Mt.Misery, Bear Island, which proved to be identical with the Spitsbergen bird. In 1921 we were told by officials of the coal mine that they came to Bear Island only in winter, it being supposed that they migrated from Spitsbergen at that season. It now appears certain that they are residents, confining themselves to Mt.Misery during the summer.". Bertram and Lack ddd not find them on Mount Misery in 1932, though three pairs were seen on the scree-slopes above Ella Lake — "doubtless breeding, but no nests were found". Duffey and Sergeant (1950) did not see any in their full survey in 1948, and were told by the meteorologists there that the last time a flock had been seen was in August 1947. Lovenskiold (1964) has misinterpreted a statement about ptarmigan food in our paper, which is a general one not relating to Bear Island specifically -- we saw none in 1921. It is hardly surprising that this species has such a sporadic presence, considering the poverty of potential food-plants on the island].

[The coal mine people told us that one or two Arctic foxes were said to live on Mount Misery; that some young ones were introduced in 1916-18, but that there was also an old one which had been seen for several years and must have got there over the sea-ice. According to Bertram and Lack unusual abundance of foxes was reported in 1932].

[The damp mossy area on the flat plateau parts of the mountain top were classified under "Moss-mat" in our paper. I brought back two species of moss and two of lichen mentioned there].

17 - 19 June. [I have no information or collections for the 18th. F.J. (17th): "Weather fine and not cold at first, but afterwards turned quite windy and chilly...Brown and Longstaff also snared a good many Guillemots on their eggs...which came in useful ... for food." T.G.L. remarks: "When it became evident that bad weather must delay the return of the Terningen I had to look to rationing. Doubling a line through the two lower joints of a salmon rod I snared guillemots on the cliffs. Both birds and eggs were welcomed; even incubated eggs could be successfully served as ham omelettes to all but the most suspicious of the party, if the beaks were taken out". Since a number of bodies were left, of various species, after skinning them for specimens, we had an even more varied diet, -- discovering that the most unlikely species of sea-birds were very edible after the skin with the subcutaneous fat had

17 - 19 June... been removed. Jourdain refused to eat kittiwake, until we succeeded in deceiving him by telling him it was guillemot...]

17th & 19th. [On the 17th we all walked across the Island to Ella Lake on the S.W. coast. I particularly remember this walk, over the extraordinarily barren rocky ground -- though not at all impassable & with with little snow -- , because Summerhayes and I decided to follow Longstaff, while the bird group went off at top speed in a direct line to the lake. Longstaff went at an angle of perhaps 15° northwards, and he also instructed us to start the day walking rather slowly at first. However, we got there first! This was the result his remarkable trained instinct for the shape of country.]

Ella Lake (= Tarn 4 =now Ellasjøen). My Diary: "A big loch about ?½ - 1 mile long [the modern map shows it to be c. 0.87 miles]. Fed by several streams. Steep hills all round. [Said by coal compamny manager to be very deep, below sea-level -- information on 20th -- but his figures were incorrect in detail: from the modern map it is 21 m. above sea-level, and the greatest depth 43 m. i.e. the bottom reaches 22 m. below sea-level]. There was a small boat, and net and rods, which indicated fish. Also a hut. [The manager said there was a sort of trout in the deep water & these could only be got by fishing from a boat]. Longstaff tried fishing with a small phantom minnow & a small spoon from the south bank, but with no result. The day was unfavourable, being windy and cold. Algae on littoral boulders. Mites & caddis grubs. Also insect larvae in mud cases on stones from ¼ to 1 inch (winding about), in littoral region". [Birds noted by me here on the lake were: 3 Red-throated Divers, Ice-duck, Black Scoters, Eider Duck, Kittiwakes and Glaucous Gull." F.J. noted on the 19th: "We found that Elton and Summerhayes had crossed the island again to the big lake near Cape Harry and had identified the Diver on the lake as Red-throated. They also saw two Scoters on the lake and flushed a Purple Sandpiper from a nest at their feet with 3 eggs"].

[I lost my plankton collection through breakage later, and the Crustacea given below are from Lilljeborg (1900), collected June 1898 & July 1899]

Diptera:	Chironomid larvae
Trichoptera:	Apatania arctica (larvae & 1 ad.♀)
Crustacea:	Chydorus sphaericus
	Cyclops strenuus
	C.vicinus
Acarina, Hydracharinæ:	Sperchon lineatus (♂, ♀, nymphs)
Fish:	Arctic char (Salvelinus alpinus) (the Salmo umbla salvelinus-insularis of our paper)

17 & 19 June... [On bare rock near Ella Lake I collected some small Chironomid flies on the 17th, described as a new species by Edwards [S.P.1, pp.203-4] -- 3 ♂♂ & 1 ♀ Camptocladius eltoni. More were found later at Walrus Bay. Bertram and Lack also collected some on the N.E. coast and at Tunheim (Edwards, 1935). This time the latter used the names Spaniotoma (Limnophyes) eltoni. There he also gives Ella Lake as the locality for the three following Chironomid flies, among other rich information for the 1932 collecting:

Cricotopus basalis
Spaniotoma (Orthocladius) decoratus [= festivus for 1921]
S. mixtus

Cricotopus is certainly aquatic in its early stages: it was studied by me at Raas Billen Bay].

[On the 17th I collected 11 ♂♂ and 5 ♀♀ Lauterborniella ?coracina flying over bare rock between Ella Lake and Tarn 5 above it].

[The caddis-fly Apatania arctica, a widely distributed Arctic species, had numerous larvae in sand-mud cases. The only previous record for Bear Island was 1 ♀ in June 1907 (Koenig, 1911). Bertram and Lack (see Lack, 1933), who found both sexes and so enabled the status of the species to be clinched, observed numbers of it in many lakes. They had arrived on 20 June, but found the first adult caddis on 7 July and "large numbers over most of the island on and after July 14". In referring to my specimen there is a misprint -- July should be June, which makes sense of the remark that I took it much earlier than theirs. But the 1932 season, as they have recorded, was remarkably late, and a number of birds failed to breed successfully or at all. The only locality for A.arctica in the main islands of Svalbard is Wijde Bay in West Spitsbergen, where there are the deep "Salmon Lakes". Goes and Smitt collected one specimen in 1861 of a caddis which Boheman (1865) described as a new species "Goniotaulus arcticus", now equated with Apatania arctica. I almost certainly saw this at the same place in 1923!!]

[The water-mite, Sperchon lineatus, was a new record for Bear Island, and is still the only water-mite known from Svalbard. It was already known from cold lakes in the Scandinavian mountains. On Bear Island, Bertram and Lack found it on stones in the bottom of some lakes; and Thor (1930) stated that it was abundant in the thick moss at the sides of rivers]. My diary: "Crawls typically over stones & among algae. On a white saucer bottom it gets along by crawling, which lifts it just off the bottom sometimes. The palpae are very long & stout (½ as long as the front legs). The legs are rather thin. The size and colour seem to vary enormously, through all combinations of reddish-brown to green. One red eye on each side, wide apart.

17 & 19 June... "2 mites (different ones on different occasions) often come together and "grapple". Dont eat each other; but separate after a bit. Copulating? They climb about over the caddis cases, as also do small caddis on big ones. The caddis do not appear to eat the mites." [Soar in 1922 [S.P.1, No.22] gave an account of my specimens with good line-drawings, and quoted my description of them in much the same terms as that above. I added: "The mites were in large numbers. There would appear to be very few animals upon which they could be parasitic in the larval stage, since they occur only in this one piece of water [i.e. of those I inspected] and there were no insects except dipterous larvae and the caddis." [I did not then know that some Chironomids are hosts of certain water-mites]. Soar noted: "As far as we know, all species of Sperchon deposit their ova on stones, or in the green slimy growth on stones, thus it would be quite easy for birds to convey ova on their feet from one district to another...The colouring these mites usually exhibit in life had been lost in the preservative solution [some in Viets solution, others in 5% formalin]."

[Bertram and Lack (1933), in their account of the birds in 1932, mention that there was evidence of both Great Northern and Red-throated Divers catching Arctic char, but that the latter more often flew out to sea to fish]. [They also mention that the Purple Sandpipers were never far from water; and that early in the season -- a very late one -- small flocks were seen far out on the lakes picking food (presumed to be Chironomid fly larvae) through cracks in the ice, and that "later they fed mainly on Chironomid larvae in the moss at lake margins"].

[Under stones by a small stream flowing into Ella Lake, I collected the following Collembola & mites:

6 Achorutes viaticus
4 Xenylla humicola
2 Isotoma viridis
2 I. multisetis
6 Sminthurides malmgreni*]

Acarina: Cyta brevirostris

Tarn 5 = Pond 3 = Svartkulpen. (For location see p.20, where the map shows it relatively too large). My Diary:" 100 - 200 yards long, 50 yards wide. In a rock basin of Tetradium limestone. Bottom of small shaly stones. Shallow, up to 3 feet deep round margin. Possibly deep in middle. Partly perpendicular edge of rock, partly shale shingle with mosses and saxifrages. Completely unfrozen."

"Insect larvae fairly numerous in plankton. Moss (sometime mixed with & Saxifraga alga) ?rivularis over stones. Clear water. No mites or caddis (probably

*[New record for Bear Island (Carpenter & Phillips, SP1, No.19)].

17 & 19 June... "Stream out, sinks underground, & original water course to Ella Lake is dry".[I collected 4 species of algae mentioned in our paper. We noted: "The Crustacea showed that it resembled Pond 1." I have no details now].

Tarn 3 = Pond 2 = Gåsvatna (a name that seems to cover the tarn below it as well). My Diary: "Tarn with stream running through, leading to two or three other tarns. Stream comes from the valley with so many birds nesting -- therefore possibly rich water."

"Alkalinity: PH only just pink 8.3 pH "
PR faint brownish pink

"Cyclops, mosses etc., insect larvae taken". [It was Cyclops gigas]

"Glaucous gulls, kittiwakes, Ice Duck, Eider".

[Moss and algal collections seem to have been lost. Cleve (1900) gives a large list of diatoms -- his "Locality 10"].

Between Ella Lake and Walrus Bay. Flying over Tetradium limestone:

Diptera: Diamesa septima 1♀ [described as new species]

Hymenoptera: Amauronematus villosus 1 ♀

20 June. [Today I accompanied Dr Longstaff at his request, on a difficult and very cold walk to the Coal Station at Tunheim. The following account is from his book and F.J.'s Diary:

F.J.: "Cold blustering day with strong N.E. wind and storms of rain and some hail. As the day wore on the wind grew stronger till at last a regular gale was blowing... We had now been a week on the island and Huxley had agreed with Longstaff to send a wireless message to the Coal Bay settlement..., giving us information as to when to expect the Terningen. Longstaff and Elton then set off... Late in the afternoon T.G.L. & Elton returned bringing a message that Huxley expected to reach the island on Tuesday. They had a trying time, but were none the worse for it. On the way they found two nests of Richardson's Skua each with 1 egg."

T.G.L.: "As the storms continued we decided to send a message to the ship at Tromsø to say that we should be all right for food for another week. I asked Charles Elton to walk with me across to the north-eastern corner of the island where there was a Norwegian coal-mine with a wireless station. A wet blizzard raged the whole day and the going was atrocious. Although the distance was only seven miles we took four hours each way, always over

20 June... "unstable spiky rocks with swamps of mud in every hollow. It was our introduction to the bad footing of the Arctic which causes two miles an hour to be reckoned good going. Working by compass we passed below Mount Misery -- aptly named -- which dominates the island, but that day its black top was never clear in the driving sleet".

[When we reached the Coal Station, Longstaff knocked on the door of a house. The Norwegians were surprised to see a rather short man with a red moustache, wearing a native Eskimo anorak made of the intestines of some marine animal and framing his face. The anorak was topped with a tuft of human hair! He fished in his pocket and produced a calling card that said:

Dr T.G.Longstaff
Picket Hill
Ringwood
Hampshire

They welcomed us in and gave us coffee and cakes, as we dripped on their nice floor.]

[Besides the information about fishing, ptarmigan and foxes already mentioned, the Coal Station manager told us that Polar Bears came in winter -- 3 were shot in the winter of 1920-21, and 15 in that of 1919-20. He also said that the large seal -- storkobbe -- [Erignathus barbatus] came sometimes on drift-ice; and that fulmar petrels and eider ducks stayed during the winter, but the latter only if the water was open.]

[The conditions this day were much too bad for me to do any collecting. I well remember when we stopped for a very short stand-up lunch by a torrent stream, with the wet snow blowing, that my hands were so cold I could not open a pocket-knife. In later expeditions I always wore a sheath-knife].

21 June. [F.J.noted: "Gale still blowing hard from the N.E. all day so none of us went out much...There was a heavy sea in the Bay, and it would have been quite impossible to have got off even if the Terningen had appeared. Some of our stores are running very short, especially fats and bread. Our margarine was exhausted which made cooking difficult...Altogether a miserable day, cold, wet and gloomy & we could get no exercise".]

My Diary: "Storm. Collected stuff thrown up on beach which normally has nothing on. Much of a huge Laminaria." [This phenomenon occurs also on the west coasts of the Spitsbergen group e.g. Bruce (1911) recorded that "after a storm on Prince Charles Foreland I have seen piles of laminaria and other seaweed fully 5 or 6 feet in height, heaped up above the ordinary high-water level". In Richard Lagoon there were "huge piles of Laminaria and Fucus ... cast up by the tide." See later, p. 55 .]

21 June... [The species of marine animals collected from amongst this sea-wrack are listed below, with some comments by specialists. The Hydroida and Tunicata and Polyzoa [Bryozoa], were included in a specially printed Appendix to S.P.1 and not published elsewhere. These were named by specialists at the British Museum (Natural History), where the specimens were deposited. The date is given as 22 June, but should be 21st -- an unimportant error. The crab and Holothurian were not included and have not been published by the Expedition: they were named by J.Armitage Robertson in 1931. He was then working at the Fisheries Laboratory of the Ministry of Agriculture at Lowestoft. I do not know what he did with the specimens. He was at that time engaged in marine survey in the Bear Island region, in connection with the then recent northward extension of the cod fishery resulting from the temporary amelioration of climate that was then gaining momentum, but cannot have had much impact in 1921. The modern map shows a 20 m. bathymetric contour all round the Island, within which is a shelf of varying depths. Opposite Walrus Bay it extends outwards to about 750 m. Within the headlands of the Bay the depths on this map are given as down to 7 m.; the 1898 chart of the Swedish Polar Expedition gives depths from 1 - 5.5 fathoms = c. 2 - 10 m. There must be a pretty rich littoral fauna around most of the Island.]

HYDROIDA (det. by A.K.Totton)

Selaginopsis obsoleta (Lepchin)."Mr Totton states that this is an interesting and little-known form, and that although the specimens are imperfect, and identification therefore difficult, he is of opinion that it is the same species as described by K.Bonnevie (Norske Nordhavs Exp. 1876-8, Zoologi, Vol.26, Pl.6, Fig.3, 1899) which was found in 74° 57′ N., 19° 52′ E. at a depth of 21 fathoms".

Campanularia integra (McGill). "Growing on Alcyonidium sp."

POLYZOA (det. by R.Kirkpatrick)

Gemellaria loricata (Linn.)

Menipea ternata (Ellis; Solander).

Membranipora arctica (d'Orbigny)

Cribrilina annulata (Fab.)

Schizoporella hyalina (Linn.)

Alcyonidium hirsutum (Fleming)

Flustrella corniculata (Smitt)

Scrupocellaria scabra (Van Beneden)

21 June... HOLOTHURIA (det.J.A.Robertson)

Cucumaria frondosa (Gunnerus). "Also found at Bear Island by J.A.R."

TUNICATA (det. by R.Kirkpatrick)

Styela loveni (Sars)

Dendrodoa aggregata (Rathke)

Synoicum turgens (Phipps)

CRUSTACEA, MALACOSTRACA (det. J.A.R.)

Hyas araneus (Linn.) "Much larger than any of my specimens. J.A.R."

[Bertram and Lack in 1932 and Duffey and Sargent in 1948 found this crab extremely numerous, as shown by the numbers eaten by glaucous gulls in parts of the Island that had few sea-birds for them to prey on.]

[Today I wrote to my Mother, Mrs L.M.Elton, later posted at Advent Bay, which partly reads: "We got here on the 13th & have radiated...on long expeditions over the island. All your arrangements & provisions & ideas have come in useful. Have nearly worn out one pair of boots in a week here, owing to walking over knife-edge stones. The general life is rather fun. We feed on stores off the ship, on guillemot eggs for breakfast, stew of fulmar, eider duck, long-tailed duck, purple sandpiper, snow bunting, vegetables & rice! We have plenty of food, huge fires of wood, comfortable sleeping quarters except when it rains in. *** Interruption. Chopping wood, cutting up guillemot -- I'm cook today. The ship may turn up tomorrow early or in the night, so now go to bed. Will write another if not sea-sick, before Advent Bay". My Army boots had no nails: when we got to Spitsbergen I was fortunate to be lent a properly nailed pair that lasted for the rest of the summer.]

[As indicated, we were not short of protein, but running out of bread and fats. I decided to try cooking Laminaria. This consists of very long flat brown straps several inches wide, anchored by a stout stalk and holdfast. When boiled the straps first of all turned green. Further boiling turned them white. At this stage they were soft and edible -- but tasted of absolutely nothing! We decided to give them a miss.]

[A letter to my Father, Professor Oliver Elton, on this date, included the information that "the rule is that we go out in pairs, in case of accident". Although this rule was not strictly adhered to later in the Expedition, it almost certainly saved my life on Prince Charles Foreland (see 8 July). I also mention that Longstaff and I brought back some fossils from [the Carboniferous limestone of] Mt.Misery. I have not been able to locate these at Oxford.]

22 June. [F.J.: "Today the weather was rather better: the wind had dropped somewhat but was still fairly high and a good deal of sea running, while the hills are swathed in mist".]

[I chose a site about quarter of a mile from the sea, up the Walrus Valley, and set up a transect starting on a south-facing slope, with six collecting points. It was barren-looking fjaeldmark. The following notes are from my Diary, but although I shall describe the Stations separately, the animal species are grouped into one list because the numbers taken at any one Station were mostly very few. The total numbers of taxa for each Station are given below. I include notes made at the time about some of the animals e.g. field descriptions of them made at the time, because so few taxonomists tell you what such animals look like when alive].

Station A. Gentle slope, shaly stones, none larger than a foot, chiefly small and flat, probably all limestone.

Salix herbacea	the most ab.
Draba alpina, Oxyria digyna, Ranunculus pygmaeus, Saxifraga caespitosa, S.oppositifolia	fairly ab.
Grass	in a few spots
Mosses	fairly ab.
Lichens	fairly ab., including white semi-thallose & white crumbly fruticose

Station B. Higher up on steeper slope. Flat shale -- more than a foot deep. No large stones.

Same plants as A, but very sparse.

Station C. Flat top. Shale (small pieces) and a few big stones.

Papaver radicatum, Saxifraga oppositifolia, Sedum rhodiola — sparse

Station D. Dry gully (stream bed). Mosses and small stones.

Station E. Steep slope, rather fine shale.

Salix herbacea
Saxifraga oppositifolia
Lichens: Cetraria
White crustaceo-fruticose sp.
(Mosses)

— Chief plants

Station F. By stream in gully with fairly large stones.

Numbers of taxa

A	B	C	D	E	F
12	7	9	3	7	5

Nearly all these records had specimens, a few are derived from field descriptions used on the same transect.

22 June... Species of animals on Transect A - F

Collembola:

Onychiurus armatus ("yellow springtail")
Isotoma viridis ("black springtail")
I. multisetis ("brown springtail")
"Minute black sp. indet." [Certainly a Sminthurid -- 3 species of this family are known from the Island]

Diptera:

♀♀ Camptocladius longicosta (at 5 stations)
1♂,2♀♀ Exechia frigida ("Quick sudden flight when stones overturned")
1♂ Orthocladius ?conformis
few Metriocnemus ursinus (Nos. & sexes not separable in records)
1♀ Diamesa hyperborea
1♀ D. ursus

Hymenoptera,(Tenthredinidae, Nematini):

3 ♂♂ Pontania birulae ("Walking over Salix etc." [Morice, S.P.1,No.18: "No doubt a gall-maker" (probably on Salix)]

Aranea:

2 imm♀♀ Coryphaeus holmgrenii

Acarina:

Bdella groenlandica ("Large sluggish red mite with black back and long nose, red and white legs")
Cyta brevirostris ("Small active red mite with white legs, very fast") (Found at 4 Stations)
Rhagidia gelida [Known to me later as "rather slow, pale orange mite"]
Scutovertex lineatus ("Grey-brown stagnant mite." Station A, ab. on undersides of stones . Ab. also at E., present at B,C & F)
Sphaerozetes notatus ("Shining black mite")

Oligochaeta, Enchytraeidae:

Enchytraeus albidus

Note. [The colours of Isotoma viridis vary greatly -- see Carpenter & Phillips S.P.1,No.19. Therefore colour is not a good distinction between the two species listed; but these records had specimens described]

[If this list of 18 species is compared with that from general collecting on 14-15 June in similar habitats mainly, it will be noted that in the latter there are 17 species, of which 10 are the same. The general spectrum of groups is close].

[Today, other collecting in Walrus Bay Valley bottom gave: under walrus skulls, on moss, 5 ♂♂, 1 ♀ Exechia frigida & 1 ♂ Metriocnemus ursinus. On stones and walking on the edge of moss bog: M.ursinus (few), 6 ♂♂ & 3 ♀♀ Camptocladius eltoni, & 6 ♀♀ C. oxonianus (new species). The last three at c. 20 ft. above sea-level. Also on moss-bog the springtail Achorutes viaticus; but not Agrenia bidenticulata as stated in our paper, p.228. Neither I nor Bertram and Lack recorded the latter in our surveys; but Thor (1930) collected it at Tunheim in 1929.

22 June... [The Glaucous Gull (Larus hyperboreus) often nests on the top of bird-cliffs, the nests varying much in size. They are often composed of mosses and dry sea-weed, etc. I believe they are continually added to. From one such nest I collected 2 ♂♂ & 3 ♀♀ of a Heleomyzid fly, described as a new species by Collin [S.P.1, No.16]: Leria septentrionalis. This was from South Haven [Sørhamna], just S. of Walrus Bay. At the same time he included in his description 6 specimens collected in 1905 by Waterston on St.Kilda, but not then studied. Edwards (1935) recorded the same species from 6 localities at Bear Island, from collecting by Bertram and Lack, who found a number in the sea-cliff manured zone, also another species L.modesta (Mg.). He suggested that the latter was the same as L. geniculata Zett. given for Bear Island by Lundbeck in "Avifauna Spitzbergensis". Bertram and Lack observed that both species were associated solely with bird-cliffs, and that they sometimes visited flowers of Sedum rhodiola and Saxifraga caespitosa, etc., there. Although they found the fauna of most bird nests usually to be much the same as that of surrounding habitat, they state that one huge nest of a Glaucous Gull "contained many Dipterous larvae (chiefly Leria)". This nest was also exceptional in having the high temperature of 24.5°C. in the centre, but "large nests of this type were rare", and they concluded that heating from decaying vegetation etc. was not an important factor in these cliff habitats. In 1923 I was to catch this fly in Wijde Bay, West Spitsbergen, though not in a nest. Hackman (1968) reported collections made by various people in Spitsbergen, mainly in 1965. By this time L. septentrionalis had apparently become "Neoleria prominens Becker" -- I do not know the taxonomic rights of this. It occurred at Wijde Bay and various places in Icejjord, and it is called "necrophagous", and he states that it is attracted to cheese baits].

23 June. [F.J.: "At 4.15 a.m. the Sloop Terningen arrived in the Bay and at 4.45 a boat from her landed, bringing J.S.Huxley and others. Luckily the wind had dropped and though there was a little swell embarkation was easy ... The last boat got away about 7.15 a.m."].

[At the last moment Seton Gordon begged me to go back with him for a short glimpse of conditions ashore. We visited a cliff-top with nesting Fulmars, etc. On our return he remarked to me: "Now I have material for another chapter in my book". We had been ashore for about 15 minutes. This was my first personal introduction to the ways of popular writing!]

[Some Remarks on Bear Island (written in 1980)]

1. A systematic list of invertebrate animals collected by me here, with their species authorities, and a comparison with the survey by Bertram and Lack, is given in Appendix 1.

2. In our paper (pp.231-3) there are some notes on "Food and enemies ('Nitrogen Cycle')", with a diagram of what would better have been termed the food-cycle, under which it is given in my text-book "Animal Ecology" (1st. ed. 1927, still current as paperback, 1980). This was, so far as I know, the first attempt to portray the organic part of the Arctic ecosystem (as it would now be called), from sea to land and fresh water. It was based upon our Bear Island experience, amplified by my later knowledge gained in Spitsbergen, and from extensive reading about the Arctic. The feature of special importance (already quite well-known as a general phenomenon) was the effects of the sea-bird community, itself based upon an intricate set of marine food-chains, locally on the land and fresh-water systems, by manuring. It is noticeable at Skua hummocks, and above all at bird cliffs and other sea-bird colonies. The difference in richness between manured and unmanured sites is, however, most conspicuous in the climatically less favourable parts of Svalbard.

3. I realised, later, that we should have referred to the "Nitrogen and Phosphorus Cycle", with the proviso that Nitrogen might be fixed from the air, a subject of which little was then known for the Arctic.

4. No doubt this diagram includes some mistakes in detail e.g. some Copepoda in fresh water are now known to be predatory or scavengers, especially on other Entomostraca. Hence our statement that "here the Entomostraca have no enemies in the water itself (except in Ella Lake) [which was excluded from the diagram]" is not correct. And later survey showed that fish (Salvelinus alpinus) occur in a number of Bear Island lakes.

5. Some remarks (pp 233) on the significance of size in animal food-chains anticipated a fuller development of this point in my "Animal Ecology". We noted that "the species in food-chains of parasites get smaller and smaller, while in food-chains of carnivores they get, on the whole, larger and larger". This conclusion remains "on the whole" broadly true.

6. I insert here, as a generalization mentioned by us under Prince Charles Foreland (our paper p.249) another point I developed later viz. the unimportance in the Arctic, especially in the High Arctic, of day v. night

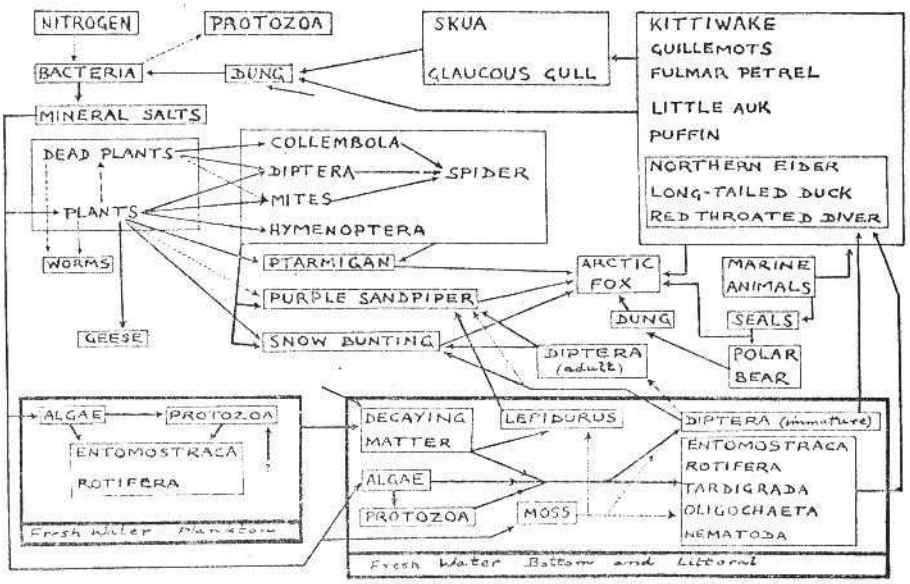


Fig. 2. Diagram of "Nitrogen Cycle" on Bear Island.
..... Probable, but no evidence from here.
– – – – – Transformation.

(From V.S.S. & C.S.E. 1923, p. 232)

[Some Remarks on Bear Island, cont.]

faunas, because of the continuous daylight in summer. An exception among moths in N.E.Greenland was noted; but we concluded that "the 'relay system' of day and night forms which enables more animals to occupy any area in lower latitudes, is absent from the Arctic. This is one cause of the poorness in species of the fauna. Other causes in Spitsbergen are geographical isolation and severe conditions". These remarks apply just as much to Bear Island. There certainly are some variations in diurnal/"nocturnal" amount of activity, which have been studied in birds. And the emergence times of some insects during development are not all at random hours e.g. Kureck (1966) states that the partly aquatic fly Diamesa arctica in Spitsbergen emerges in the afternoon, just after the brightest and warmest parts of the day.

7. Weather. We seem to have been lucky in having more tolerable than bad days, and only two that made field work almost impossible. By contrast, Bertram and Lack spent 52 days doing their 1932 ecological survey, and experienced in that time only five sunny days, and 22 when the visibility was limited to 50 yards! And one of our two really stormy days washed up a useful small harvest of marine animals.

8. Vegetation Survey. After re-reading this account of work on Bear Island's ecology, I consider that I should have given more details about the vegetation survey done by Summerhayes. However, all the known information is contained in our paper, and I have no unpublished data. As far as I know, this remains the only systematic reconnaissance of the Island's plant communities, and certainly the only one done in conjunction with their animal communities as well.

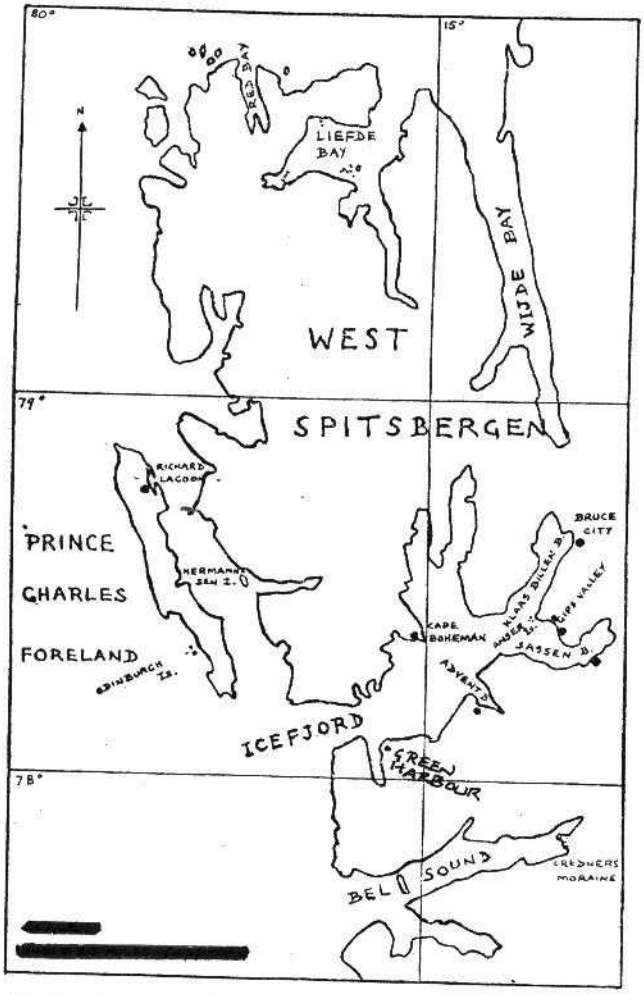


FIG. 3. Map of N.W. Spitsbergen. Places dealt with, or referred to in this paper are marked.

From V.S.S. & C.S.E. (1923) p. 234.
(Sketch-map by C.S.E.)
[Scale given on published map is wrong, because of reduction in printing. Treat as rough locations derived from old inaccurate chart]

24 June. [The previous day F.J. had noted that "at first there was not much sea, but later on the boat rolled a good deal". Today he wrote: "About 7 a.m. we encountered drift-ice ahead and in order to avoid it had to steer due south for some distance...When we got clear of the ice we found the sea choppy and the wind dead ahead of us, so that we were only able to make about 2 knots.".]
25 June. [F.J. "The weather is now splendid...Early in the day we saw a big Finner Whale and a school of porpoises was also reported...About 10 p.m. we reached Longyear City in Advent Bay & here we met Stobart...We decided to set off in a few hours for Gyps Valley." But they went up Advent Bay valley [Adventdal] for an hour or two to see barnacle geese, and secured two egg clutches (Jourdain, S.P.1, No.13). They also brought me some parasites, and meanwhile I had made a collection of algae from fresh-water (see p.34 A).]
26 June. [Since the general movements of the Expedition members have already been outlined, I shall henceforward confine myself chiefly to events connected with my own field work. But the reader should bear in mind that the habitat surveys and classification of vegetation that Summerhayes did provided me with an essential background for the animal surveys. Judging by what has been stated by later ecologists in Spitsbergen, his account of plant communities and their relationship to terrain etc. has well stood the test of time.]

[According to F.J. today was dull at first but fine later i.e. as we moved up Icefjord. A party (see photo p.34B) was landed at Gips Valley [Gipsdalen] -- at 3 a.m. according to S.G. --; and while Summerhayes and I did a limited reconnaissance of the area near the S.E. end of the Valley, the bird party went up it, partly in search of barnacle geese. (The glacier in this 25 km. long valley even at that time had retreated almost entirely. But I have a photo by G.Wardle of the S.S.S. -- who were prospecting there -- of the actual head, showing a large moraine at the end of the residual ice). A photo by S.G. gives a good notion of the structure and beauty of this valley, with its cathedral-like Carboniferous buttress rocks. One of the fjaeldmark is given in our paper, p.264. Various photos show that the snow had almost gone, on the lower ground and slopes. Our visit was very limited in scope, and invertebrate life pretty sparse, yet of interest. This place has apparently not been much visited by ecologists, with one main exception -- the work of Holm and his colleagues upon spiders in 1954, referred to on p.36. One can infer from his account that the habitat pattern here is similar to that which we saw.]

ADDENDA to 25 June, Advent Bay (for p. 34)

Two species of ectoparasites were collected by the barnacle goose party:

Mallophaga (bird-lice): Trinotum anserinum (coll. by Brown). Waterston (S.P.1, No.20) noted that "T.anserinum occurs commonly on various Palaearctic Geese..."

Siphonaptera: (almost certainly on this date). A.C. in nests. Ceratophyllus vagabunda Bohem. Karl Jordan wrote to me in November, 1921:"The species is widely distributed in the North. The specimens being from the type locality they are most welcome, as we are enabled to compare them with specimens from other places". The species was originally described by Boheman (1865) from material, collected by A.J.Malmgren, in the area of Cape Thordsen , a few miles north of Advent Bay.

Both these records are alluded to in our paper, p.282, without details.

The following species of fresh-water algae were collected by me, but the records not published (B.M.Griffiths det.):

Pool in bog:	Oscillatoria amoena
Pool on grass by sea:	Ulothrix subtilissima
	Tribonema bombycinum
	T.affine
	Trochiscia hirta
	Microspora amoena
Pool in Cassiope heath:	Cosmarium spetsbergense
	C.hexalobum
	Staurastrum capitulum spetsbergense } Desmids
Stream in valley:	Tribonema sp.

Some marine dredging was done either today or in July, but the only published record of specimens is of Terebellides? stroemi Sars, a polychaete worm listed by Fauvel in S.P.1, No. 25. Any other specimens of marine animals from there would have been sent to the British Museum.

Boat party going to Gifo Valley, Icefjord, 26 June 1921. L. to r.: Paget Wilkes, Summerhayes, Ice Pilot, Binney Gordon, Jourdain, Elton, Brown.

(Photographer unknown)

26 June... Gips Valley... My Diary: "Shingle beach with nothing on. A few seaweeds washed up. Sea muddy as snow still melting & carrying down mud in streams. [Northern] Eiders, Ice- [=Long-tailed] Duck, Fulmars, Black Guillemots swimming about in the bay. Arctic Terns flying and settling on shingle. Further inland is raised beach, shingle and mussel shells. A Pecten (large) was found in shingle several miles up the valley. Many of the stones have come recently from the hills, but some are water-worn; many contain shell fossils. There are often alternating zones of more or less consolidated shingle and of bog, real or temporary. Purple Sandpiper. There is one flat pan of mud, in which [is] thick Enteromorpha (on mud nearly out of the water) & brown scummy masses of diatoms. (Zygnema in pools near). In one place right below the Temple Rock there is a warm slope & Dryas & very fine Saxifraga oppositifolia & insects. [Northern] Eider nesting. Snow Buntings."

[I also noted the detailed behaviour of some Eiders courting, but this information adds nothing new].

[Our paper, pp.274-6, describes the lower raised beaches and something of their flora, with marked difference between the ridges and hollows. On consolidated shingle, among plants and under stones I noted:

	Collembola:		Onychiurus armatus var. arcticus v.ab. ("yellow springtails")
	Acarina:		Sphaerozetes notatus ("black shining mite")
	Aranea:	1♂	Typhochrestus spetsbergensis ("black spider")
+	Birds:		Purple Sandpiper Nesting
			[Ringed Plover Nesting]
			Arctic Tern Possibly nesting

Here and in the next two lists S.notatus was named in the field, from its very recognizable black shining appearance, size and slow motion, but not verified from specimens. The occurrence of Ringed Plover is an unfortunate error of mine: in fact, those seen on this Expedition were at Advent Bay (see p.79). We noted that B.W.Tucker saw an Arctic Fox here in 1922.]

[In a warm sheltered valley in the moraine and scree of Temple Range, facing south there was a series of richer communities, the highest of which we stated "could almost be termed a 'herb slope'", with Salix polaris and Sax. oppositifolia the chief phanerogams, and among the latter Festuca rubra, Pedicularis lanata and Polygonum viviparum, with rather damper Dryas tussocks lower down. There were also many boulders. I recorded:

26 June...Gips Valley...

Collembola:		Isotoma viridis
		Onychiurus armatus var. arcticus
Diptera:	2♂♂ 2♀♀	Camptocladius extremus
	1♀	Syrphus tarsatus(var.)
	1♀	Acroptena frontata
Hymenoptera: (sawfly)	2♂♂	Pristiphora frigida
Aranea:		?sp. imm.
Acarina:		Bdella decipiens ("large sluggish red mite")
		Sphaerozetes notatus
Birds:		Snow Bunting Nesting
		Northern Eider Nesting

Search of the ordinary fjaeldmark near here had given very scanty results:

Aranea:	?Leptyphantes sobrius imm.
Acarina:	Bdella decipiens
	Sphaerozetes notatus

[The Syrphus implies some aphid species for its larvae to feed on (for a note on this species see Advent Bay). It and Acroptena seem to be confined to a few places in inner fjords with good climatic conditions; also mainly, the sawfly. So this first exiguous collection was interesting to me, in view of our later classification (1928) of the archipelago into life-zones. Camptocladius extremus is a taxonomically puzzling species, and may have been another species (see Edwards, 1924, p.167, where he identifies it with C. aquatilis). But in 1967 Hirvenoja remarks: "In my opinion this well-known species should perhaps be described as a new species, because all the names used seem to have had different meanings originally" (!). In our 1923 paper there should have been a query before L.sobrius. Bdella decipiens, though we did not mention this, was also found under stones by the edge of a small tarn at the mouth of Gips Valley].

[The occurrence of reindeer horns was noted here].

[I must draw attention to the massive survey of spiders in the region lying between Gips Valley and Sassendal and including these valleys, done by Holm and his colleagues (Holm, 1958). The extent of the collecting (partly using extraction apparatus), the taxonomic expertise and the meticulous recording of habitats, call for admiration. In this general area the Swedish party worked from 9 July to 2 August 1954 at 68 collecting stations, each of which is briefly described. Since he gives all earlier known localities for all species, it can be said that noone had collected spiders at Gips

26 June...Gips Valley... Valley before 1921. Holm and his helpers got 10 species of spiders in the whole area, and most of them also in the Gips Valley/Temple Mountain [Templet] part! With the inclusion of a certain amount of material from Advent Bay and elsewhere, they collected c. 2700 individuals, about half being immature, though a number of the latter could be named. .]

[I obtained an alga, Enteromorpha micrococca, from the river; and three species of algae from streams running into the river through the moss-bogs. The latter are given in our paper, which notes also that the moss species were similar to those found at Cap Boheman.]

27 June. [We then called at the Anser Islands [Gasøyene]. Here we observed a nesting pair of Grey Phalaropes; also saw the beautiful blue-flowered Mertensia maritima on the shore shingle (mentioned as well by S.G.). The latter is the only member of the borage family in Svalbard. The Islands lie in the entrance of Klaas Billen Bay, and were chosen as the site of a raft that was sunk 7 fathoms in the sea, in an experiment to measure the rate of growth of marine forms in Arctic seas [Orton, S.P.1, No.4]. There was surprise at finding the growth of sea-urchins to be rather similar to that in temperate waters. This experiment was supervised by Huxley, and I did not take part in it.]

28 June. Advent Bay. My Diary: "It seems to me that Spitsbergen can't be considered as an entity, but is cut up by barrier mountains and fjords into isolated areas. The glacial valleys, being comparatively recent, have marked dispersal differences [i.e. of plants and animals]. Advent Valley is a glacial-retreat valley like Gipsdal There is a low-lying boggy region near the coast -- the delta of the glacial river, with moss etc. Then there is the river valley area with Saxifraga oppositifolia (like Gipsdal & animals probably like there too). Then there is the side of the valley with flowering Dryas, Andromeda [= Cassiope] tundra, etc. and small flies and many spiders". [In our paper we listed 6 species of Diptera collected on flowers, but the records of Collembola, Aphid, Mites and Spiders have not been published . For lists of these see 18 July].

[F.J. noted that the weather was still fine, with the barometer steady at 29.80; but judging from his records while in Spitsbergen, the barometer had little to do with the fineness of the days! After his party had spent the day on Barnacle Geese, we left and reached Green Harbour about 10 p.m.]

28 June. Green Harbour [Grønfjorden]. [Having but an hour here, I was not able to do much. Segnit's photo of the land across the fjord to the west shows it almost completely snow-covered, even on the lower parts. I have a photo taken by Gordon, of Fulmars feeding around a dead whale -- no doubt the one whose carrion flies I studied in 1924. My Diary: "Very soon after snow melting. Flat shingle shore. Above this, tundra mostly snow-covered, and temporary bog. Some dry gravel humps with Luzula, Potentilla, Dryas, Draba, Ranunculus, etc. Absence of Saxifraga oppositifolia [i.e. visibly]. Snow Bunting, Grey Phalarope, Purple Sandpiper, Fulmars, Terns. Fast-running mite, & small fly under large stones [apparently not caught]. Gnats flying. Algae in pools by houses".]

[The gnats were Nematocera, named as Diamesa poultoni, new sp., and and Camptocladius extremus, both noted by Edwards [S.P.I, No.15] from my labels, as "0 - 100 ft., flying". However, by 1924, Edwards having by then looked at the original collections described by Boheman and Holmgren, made a number of changes in name and status. He decided that D.poultoni was not new, but identical with the arctica of Boheman, and with most of those so named by Holmgren. For Camptocladius extremus, see my remarks on p. 36 of these notes..]

[The following records of fresh-water algae (det. by B.M.Griffiths) have not been published:

Pool by houses:	Ulothrix tenerrima Tribonema bombycinum Prasiola crispa
Pool:	Leptothrix sp.
Pool:	Oscillatoria tenuis
Stream:	O.limosa laete-aeruginosa
Stream:	Lyngbaea perelegans]

[F.J.: "Left at 11.15 for Prince Charles Foreland. Weather here misty".]

29 June. Edinburgh Islands [now re-named Forlands Øyene]. [F.J. : "Anchored off the Edinburgh Islands in comparatively calm but misty or dull weather. Back to ship by mid-day, but did not leave till after 1 p.m. when went on to Vogel Hoek".]

[Summerhayes and I looked at the second largest island (see our paper, p. 280). The group lies just off the S.W. coast of Prince Charles Foreland, in an exposed position. The islands are Eider holms, but had been much exploited. They were poor in vegetation. Our island consisted mainly of flat moss bog, where Hypnum

29 June...Edinburgh Islands... polygamum, a mainly maritime species, and Splachnum vasculosum, associated with manured situations, were abundant.]

My Diary: "Low rocky island covered with a flat moss bog about a foot deep, with several low humps containing grass, Saxifraga caespitosa, & mosses. Much Enteromorpha growing on the bog. One patch of lichen among the bog-moss. Very small Cochlearia growing on the shingle. [Grasses collected on the larger island were Catabrosa -- now Phippsia -- algida and Poa arctica]. Several shallow ponds of fresh water on the island, of varying extent. Shingle round the edge. Here Arctic Terns nesting, with eggs. Up to a dozen Grey Phalaropes & some smaller parties swimming in pools & in sea & walking on shingle. One nest with 2 eggs on which bird was observed to take its place. This was just between the shingle and the bog. [Northern] Eiders v.ab. nesting everywhere on the drier spots. A pair of Skuas. Red-throated Divers -- several pairs nesting on the margins of the ponds. 5 Dunlins [a rare species in Spitsbergen] flying around. Also Purple Sandpipers. Snow Bunting making a nest on the shingle. Several kinds of flies sitting on stones on shingle, one with very small wings. A [species of] black Collembola v.ab. on surface of ponds round the edge. Grey stagnant mite ab. under stones, also many grey spiny eggs...Brent Geese feeding [they were nesting on the larger island]. Weather calm, not sunny. "

[The two kinds of flies, whose larvae are known to be aquatic, were taken on stones on the rocky beach just above high tide: 8 ♂♂, 10 ♀♀ Metriocnemus ursinus, and 3 ♂♂, 6 ♀♀ Cricotopus glacialis. The latter was described by Edwards (S.P.I, No.15, pp.209-10) as a new species -- I later found it also at Bruce City. And it was collected at Adventdal (Tuomikoski, 1967) in 1965. The grey mite was not named from specimens brought back, but I decided that it must be Scutovertex lineatus, from my experience on Bear Island. The Collembola were probably Achorutes viaticus].

30 June.[As noted on p.7 of these Notes, Summerhayes and I did not land at Vogel Hoek, but a party of four ornithologists did so in order to see the vast sea-bird cliffs. They walked south to Richard Lagoon, while the ship took the rest of us down there, and anchored in Freshwater Bay. Four of us, Huxley, Segnit, Summerhayes and myself, went ashore with our gear in a ship's boat, together with Dr Longstaff & Binney, who came to help us in choosing a site and setting up camp for an 11-day stay. The map on the next page was copied

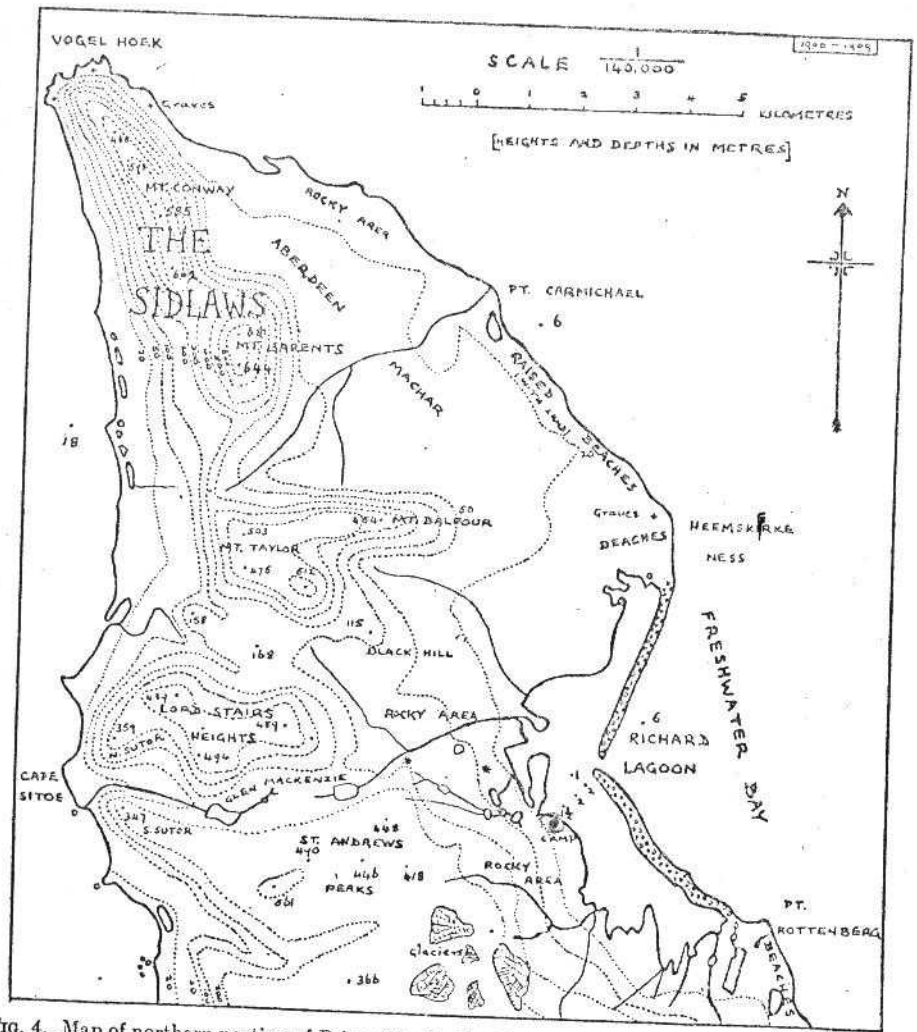


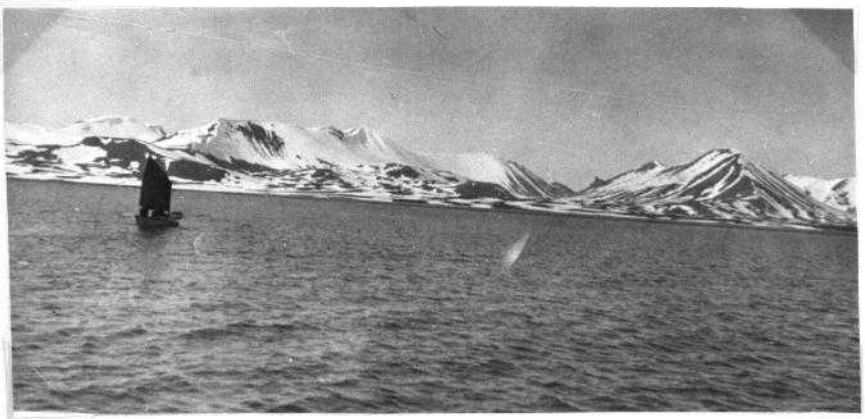
FIG. 4. Map of northern portion of Prince Charles Foreland. After survey by Dr W. S. Bruce and Mr J. Mathieson, published by the Prince of Monaco. (By kind permission.)

From V. S. Summerhayes & C.S.E. (1923). J. Ecology, Vol. 11, p. 236. The North Polar Institute map of 1968, shows that the lagoon entrance in the centre has closed up, and there is one at the N. and another at the S. end.
(This map was copied by C.S.E.)

30 June...Prince Charles Foreland... by me from the excellent survey by W.S.Bruce and his colleagues in the years 1906-09 and published in 1913. (Some of the large number of Scottish names they put on the map have been changed since then). He said that earlier maps and charts had entirely omitted to put in Richard Lagoon, an exception being that of Edge long ago.* The revised Admiralty Chart of 1913, which was our general stand-by then, had by then included it. Bruce named the Lagoon after Dr Jules Richard, the Director of the Oceanographical Institute of Monaco, a distinguished scientific explorer in Spitsbergen). Bruce's accounts of their work (1907, 1908, notes also in his book "Polar Exploration", 1911) contain much of general interest to the naturalist. Of Richard Lagoon he remarks (1907) that "it appeared to me an interesting place for the naturalist". Indeed, he found sanderling breeding there, the first definite record for Spitsbergen . The Lagoon lies some 15 km. S. of Vogel Hoek (or Hook) [now Fuglehuken] on the N.E. side of the Foreland. It is about 7 km. in length, the inner part having an irregular curved shape, the outer part consisting of a long bar of heavy shingle. In 1921 (and in 1906) this had a tidal entrance about half-way along; but the Norwegian map of 1968 shows that this has closed, and there are instead two entrances, one at each far end. Our camp was on the rocky shore S.E. of the entrance. Although tides are only several feet in Spitsbergen, the rush of water through the lagoon entrance can be strong, -- in 1920 Wordie's party were unable to row through and had to track the boats through from the banks. We did not encounter much trouble ourselves, with the small but fairly heavy dinghy that was left at our camp.]

[F.J.noted: "Strong S.E. wind. Bright but bitterly cold". A photo taken this day shows the land mainly snow-covered (see photo p. 46A). But the rush of Arctic spring was already in full spate, so that during our stay the snow disappeared from a great deal of the land. Two photos by me (the negatives of which have been lost) in the paper by Huxley and Odell on soil polygons [S.P.1, No.2] give a good idea of the general terrain during this snow-melting period, also of stone polygons. I include here (p.46A) one of these photos, copied from their paper. Also a photo of mine from our camp across the calm water of the Lagoon, to the wonderful "spiky mountains" of the mainland, whose form gave Spitsbergen its name. Foreland Sound is out of sight beyond the shingle bar. This photo is published in T.G.L.'s book. It shows especially well the old elevated peneplain at several thousand feet, now dissected into these pointed mountains.]

* [And see Note on p. 62]



Sailing to land at Richard Lagoon, Prince Charles Foreland, 30 June 1921. Glen MacKenzie can be seen. (Photo J. D. Brown).

30 June...Prince Charles Foreland...

[We pitched three small tents, one of which I shared with Huxley. And Longstaff helped us to make an excavation in the loose rocky ground, to be covered with a roof-cloth, in which we could huddle for meals when the weather was bad. Before returning to the ship, he instructed me not to walk across the Lagoon ice at the northern parts that he specially pointed out. (He usually followed a curious rule: he did not repeat advice -- if you did not heed it, it was your fault. See later!). The cold wind on this exposed spot encouraged us to build some dry-stone walls in order to give some shelter to the tents. By evening we were cold and hungry.]

June 30 - 1 July. My first impressions are combined under these two dates in my Diary: "There is a large lagoon, several miles long, at present more than half-covered with ice on which may be seen seals, eider duck, a few Mandt's guillemots. Red-throated divers swim about on the Lagoon. Arctic Terns flying round, nesting on the shingle which cuts off the Lagoon from the sea. There is a narrow entrance. Jourdain took 5 clutches of (3) eggs of terns on this shingle. The shingle is composed of rather large stones and is absolutely bare of plants. A little Fucus etc. [seaweed] thrown up."

"There are up to 30 seals to be seen lying on the ice. One I watched looked very white. It lay on its back & waved flippers occasionally. Sometimes one puts up its head through a hole and bobs under again. Glaucous gulls, kittiwakes, fulmars & occasionally a large goose (pink-foot) fly over the camp. The land between the base of the mountains and the shore of the Lagoon is chiefly covered with snow, but is uncovered in places, chiefly on hummocks. Where there is no snow, & especially on the higher bits, the plants are already beginning to flower, and in places the Saxifraga oppositifolia is over [corrected by me to "no: last year's flowers"]. Silene, Saxifraga caespitosa, Dryas, are out. Polygonum and Oxyria in bud. Black spiders come among the stones of our camp. Mites --?eggs under stones further inland. Purple sandpiper, Snow bunting, fairly ab. Skuas rather scarce."

"Took some flies about (on snow even). The snow is melting as rapidly as it can [sic!]. Plankton towing on the Lagoon gave a small ctenophore and some dying calanids [copepods]. This was taken where the ice was

30 June - 1 July...Prince Charles Foreland... "melting, & the water tasted quite fresh."

[My notes state that the gnats caught over rocks and snow, in rain and mist, on 1 July were 3 ♀♀ Diamesa "poultoni" = arctica (see p. 38). This species was encountered throughout our stay].

2 July.[Today I made no collections and few active notes, and it was undoubtedly the time that I suffered a sharp attack of food-poisoning, as a consequence of eating some corned beef that had been left in its opened tin instead of being turned out. It was a fine day, and I spent part of it lying out in sun on "Silene Hill" near the camp, recovering. I made some observations on birds. I omit those on the behaviour of Red-throated Divers on the Lagoon, because this matter was treated in the monograph by Huxley on the breeding behaviour of this species [S.P.1, No.7]. My Diary has the following observations upon Purple Sandpipers: "The Purple Sandpipers do not seem to be paired up yet. Cries noticed so far:

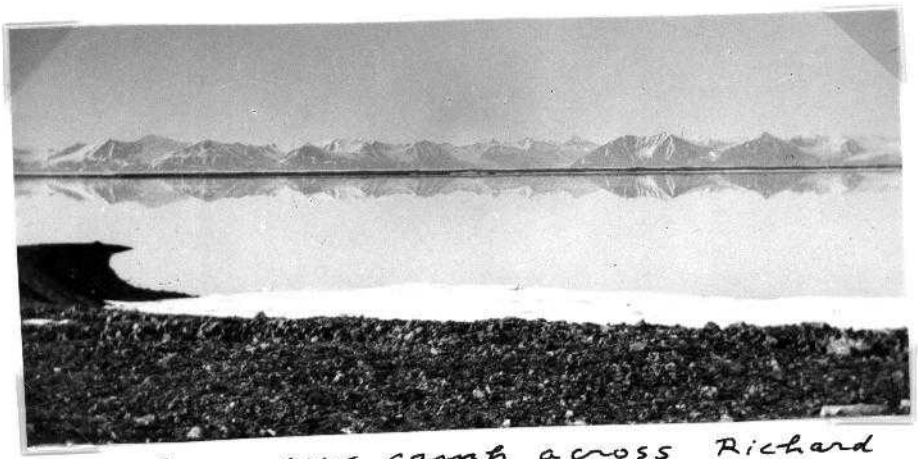
(1) 'Phoui phoui phoui phoui -- curi curi curi curi'. Always while flying? The last stanza while descending.

(2) Night-jar-like noise heard, made by a solitary one here, quite loud [i.e. the trilling note]

(3) A low grasshopper noise [was] described by Longstaff [from elsewhere], made by one to other on nest.

P.S. cant start living as a pair in one locality until there is enough land uncovered in one place to provide food for 2. Purple Sandpiper heard piping at midnight. Divers flying round".

3 July. My Diary: "Walked along coast to Carmichael Pt. Rowed across to the outer shingle wall of the Lagoon. The Lagoon is shallow near the edge but shows no sign of animal life, though there are large amounts of Fucus etc. growing. Saw 2 dead sea-urchins among this growth. The new shingle between the Lagoon and the sea is very rough and looks as if it was much disturbed by sea and snow etc. There is absolutely no plant life on it. Huxley found springhoppers [=Collembola or springtails]. The next stage is consolidated shingle with saxifrages etc. on. After this comes land or bog. Further north along the coast is raised beach covered in places with a foot or two of sand on which grow clumps of Saxifraga oppositifolia, Oxyria, etc. On the shingle are pools on which are many black springhoppers [Collembola]. Everywhere the snow and ice are melting & it is difficult to tell whether pools



View from our camp across Richard Lagoon to the mainland - Foreland sound out of sight beyond the shingle bar. July 1921. (Photo C.E. 1921: No. 901).
[Published by T.G.L., Pt. 19, p:229]
(Mountains c. 2000 ft. +)

The raised beach, looking N. towards Vogel Hoek: plants colonizing shingle.
July 1921. (Photo C.E. 1921 No. 913) -

3 July...Prince Charles Foreland... "are permanent or temporary. Took a sample of bottom muck from pool at Carmichael Point. A gnat-like fly abundant everywhere along the coast, though it was raining hard. Tracks of Arctic Fox on snow occasionally, also a hole, which must be that of a fox. Eiders & Arctic Terns nesting on the Lagoon shingle. Purple Sandpipers about, feeding but obviously not paired (on shingle). 2 Phalaropes (♂ & ♀) swimming in the sea. Large numbers of King Eider cocks in flocks with the common one. Red-throated Divers are abundant, swimming in the sea or fresh-water & flying round. A Pinkfooted Goose flying. Large and small fly on Saxifraga oppositifolia [flowers]".

[I shall group together the observations made on habitat classification and collecting details, for 3rd and 4th; but give below my general Diary for 4 July. Most of the collecting was done on the 4th.]

4 July. "Rowed out nearly to Carmichael Pt. & back [i.e. across the Lagoon and along the sea-coast]. Investigated shingle and sand. Flock of many hundred Common Eider flew over north-east. Puffin. 6 Geese (?Pink-footed). Skull of a seal. Lower jaw of a fox."

"There is a high raised beach along the shore to the north of the Lagoon. In the middle of this shingle beach (40 feet high in places) is a thick band of sand. In places the shingle is eroded down to the sand, & a deep sandy earth broken into polygons is formed. In other places there is a wind-blown sand from this formation, which forms beds up to a foot deep. In some parts near the edge, this again has been eroded. There is a very definite succession from bare shingle formation to one gradually, and finally quite, covered with sand. After this there is a succession from sand-accumulating areas (Saxifraga oppositifolia) to sand-blast-free areas (Cetraria and Luzula). The gnat-like flies so abundant yesterday were very scarce today."

[The "gnat-like flies", flying in the rain on the 3rd, were Diamesa "poultoni" = arctica, of which I coll. 2 ♂♂ & 2 ♀♀, and 7 ♂♂ Orthocladius consobrinus.*]

[The zonation of the flat raised beach system has been alluded to above, and its plant-life is described in our paper. The barest shingle had little vegetation i.e. even on the consolidated raised beach, but where a little sand had blown onto it there was a meagre flora of 9 species of phanerogams, 2 mosses and a lichen (Cetraria islandica). Under stones on the shingle and by shaking the lichen I collected:

---

*The early stages of Diamesa species are aquatic, as are those of O. consobrinus -- see Styczynski & Rakusa-Suszczewski (1963), who studied Tendipedidae at Hornsund in 1960. Kurek (1966) confirmed this for D.arctica by using emergence traps set in a cold torrent stream at King's Bay [Ny Ålesund] in 1964.

3 - 4 July...Prince Charles Foreland...

Aranea: 2 ♂♂ Typhochrestus spetsbergensis ("black spider")
8 imm. ?sp.

Acarina: Bdella decipiens ("red mite")

Our paper notes that in damp hollows there were 4 species of mosses and 3 lichens. In the moss Rhacomitrium lanuginosum:

Collembola: 1 Isotoma viridis

Aranea: 4 imm. ?sp.

In the same moss species, of which a dried sample was taken home, Bryce [S.P.I, No.26] found 5 species of Rotifera. Habrotrocha insignis was a new record for Spitsbergen, but 3 of the others had been collected on P.C.F. in 1906 by Bruce, who brought back moss samples. The fifth species was not named to species. Bryce found also a sparse number of Rhizopoda, Nematoda, and Tardigrada. In one relatively large species of rotifer, Mniobia russeola, the single specimen found in this sample contained a parasitic worm of unknown status (though not a nematode), previously seen by Bryce in Britain, but described here. (It also turned up in one specimen in moss from Bruce City, and one from Cap Boheman.]

[Walking on the stones of the shingle here were two species of flies:

Diptera: 1 Spiara tridentata
S. sp. or spp. indet.]

[It will be noted that the flora and fauna were extremely scanty. On areas where rather more sand had accumulated, a Luzula-Cetraria community developed with some differences in plant species. But no animals were to be found, except in another moss sample examined for rotifers. Bryce notes this as composed of Hypnum uncinatum and Polytrichum alpinum. But evidently a mistake occurred in transcription, since the only Polytrichum mentioned for this habitat in our paper was P. juniperinum -- abundant. The rotifers were the two species mentioned above: Habrotricha insignis and Mniobia russeola.]

[For the deeper sandy areas, our paper does not mention much detail about animals. Here I collected:

fls.
Diptera: 2 ♂♂, 9♀♀ Camptocladius extremus on Sax. oppositifolia
1 ♂,1 ♀ Diamesa "poultoni"
1 ♀ D."poultoni"var.flavipilis on S.opp. fls.
1 ♀ Fucomyia frigida*

Aranea: 1 ♀ Typhochrestus spetsbergensis ("black spider")

Though Collembola seemed scarce in dry habitats, they were ab. on the surface of melted snow-water in hollows.]

*Known to be a shore species, breeding in seaweed in the drift-line (cf. Hackman (1968)).

3 - 4 July...Prince Charles Foreland...

[In places there were "blow-outs" of this sand, which comes from a deep layer inside the beach, and these areas were poor in plants, except surviving clumps of Silene, though Saxifraga oppositifolia was recolonizing in places.]

[Two small ponds on the beach were examined for algae. Our paper does not give the full record of species, which is listed below: (B.M. Griffiths det.)

1st Pond:
- Merismopedia glauca
- Lyngbya perelegans
  } Cyanophyceae
- Cosmarium crenatum bicrenatum
- C. costatum
- Staurastrum Bieneanum
- S. polymorphum
- S. brevispinum
- S. pachyrhynchum
- Euastrum elegans Novae-semliae
- Hyalotheca dissiliens
  } Desmids

2nd Pond:
- Cosmarium crenatum bicrenatum
- C. punctulatum
- C. cucumis
- Staurastrum clypsedra sibiricum
  } Desmids

Red-throated Divers nest at the pond edges. Streams were not studied as they were torrents from melting snow.]

[Huxley went up onto Lord Stair's Heights, a hill behind our camp, and on a rich flower slope at c. 1350 ft. collected:

Collembola: 2 Isotoma viridis
Aranea: 1 imm. probably Leptyphantes sobrius]

[In our paper, V.S.S. comments on the enormous effect of insolation on stabilised slope vegetation, and included in his list of plants on the hill were 13 species of phanerogams, two of which were not noted on the low ground, while the list on damper aspects of this formation included the clubmoss Lycopodium selago.]

5 July. My Diary: "Microscope work in the morning [partly] stuff from the Edinburgh Islands ponds. [Notes on these omitted as of no particular value].

"Huxley says Skua has taken Diver's egg. This must be the chief check on their increase, except for shortage of food. Do Skuas go to bed?"

[Note: Huxley [see S.P.1, No.8] had been studying Diver breeding etc. as his main occupation here. He wrote in his paper: "On a small tarn about a mile from camp a single Diver was observed on June 30. The tarn had then only partially thawed, and nest-building was out of the question... A single

5 July...Prince Charles Foreland... "bird was observed here on July 4 nest building had almost certainly begun...On July 5 both birds of the pair were seen on the tarn, and one visited the spot where the nest afterwards proved to be...Next day (July 6) I spent about 9 hours at the tarn [in a hide]". He made an intensive study of the birds' behaviour both at the nest sites and on the Lagoon, fully described in this classical paper. "Another nest was discovered on a neighbouring tarn on July 7. This already contained two eggs, although this tarn had been still later in thawing than the other, and had ice extending for some distance in from all its margins on July 2. This tarn was within a short distance of camp". He observed that moss played an important part not only as a main nest material, but in the ceremonial making of a primitive "false nest" at which mating took place. From the 9th until our departure he continued to watch the second nest. I mention these events partly to confirm the lateness of the thaw on P.C.F., compared with, for example Gips Valley, and indeed Bear Island. It was the chief reason why I was unable to do any fruitful work on fresh-water Crustacea etc. But, as is well-known, breeding of Arctic birds starts immediately after the thaw has begun.]

My Diary: "Went up to a hill at the bottom of Glen MacKenzie [behind our camp on a scree at 300 - 400 feet]. 45° slope. Scree of Hekla Hook chiefly angular and flat.[Stones of various hard quartzite or gneiss, according to our paper]. Plants in sparse clumps [because of the unstable ground -- mainly Saxifraga oppositifolia; also Luzula confusa, the grey moss Rhacomitrium canescens var. ericoides, and crustaceous lichens. A sample of the moss was rather poor in microfauna: Bryce found 1 or 2 rotifer specimens, Macrotrachela plicata var. hirundinella. Under stones or shaken from plants:

Collembola:		1 Achorutes viaticus
		1 Xenylla humicola
Aranea:	2 imm. ♀♀	?Leptyphantes sobrius
	1 imm.	sp.
Acarina:		Bdella decipiens ("red sluggish mite")
		Sphaerozetes notatus ("black shining mite")
		Scutovertex lineatus
Birds:		Snow Bunting Nesting]

"Flattish bit at bottom. Rutmarks 6 - 10 feet. [N.B. This is the Swedish term, actually "Rutmarken", for polygonal soils. In my Diary I had spelled it "Rud mark", being still unfamiliar with the matter. I have

Large stone-polygons with little plant cover, and some secondary markings within the larger areas. P.C.F., early July. (Photo C.E. 1921, neg. lost) (Publ. by Huxley & Odell, S.P.I. No. 2).

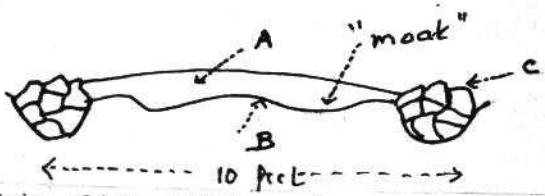
Plant-covered stone-polygon margins, ditto. (Photo C.E-1921: No. 909).

5 July...Prince Charles Foreland... changed this throughout.] "Edges covered with Salix, Polytrichum, etc., lichens [including] Cetraria. There were no animals obtained by shaking these. Centre of rutmarks + small flat stones sporadic & covered with lichens and moss:

Collembola: not coll.

Acarina: Cyta brevirostris ("red mite")
Ceratoppia bipilis

"There is a beautiful series of rutmarks here. Most of them were on the side of the hill. Here the snow was melted. They are small here and a section across them is like this:



A. Very thick, slimy, sticky mud -- very hard to dig. Few plants on it except orange lichen [presumably Solorina crocea -- see our paper p. 243, where it is noted as characteristic in such habitats and often the only species].

B. Ground ice.

C. Big or biggish stones.

There was no gradation from small to large stones. Some were quite bare of plants along the drainage channels. There were all stages between this and a complete ridge of plants: mostly Salix, Cetraria and other lichens, and mosses:

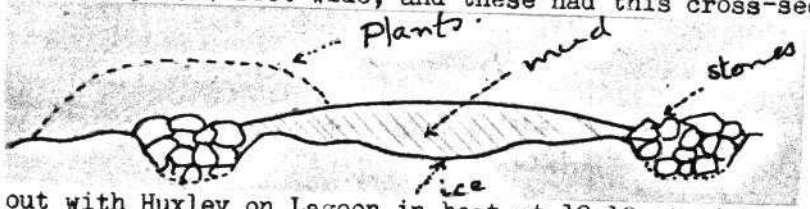
On the northern side of the hill there was still snow lying on the shale slope. Below this there were some very large rutmarks, up to 20 feet across. It was noticeable that near the base of the hill the drainage channels had fewer stones in, but as one went out from the still-weathering bluff the channels became wider and filled higher with stones. The ones on the outside were older. This shows that that the big stones of the rutmarks are gradually weathered off a flat surface. The big rutmarks examined here

NOTE. Diagrams are Xerox copies of inked-in pencil ones in my Diary.

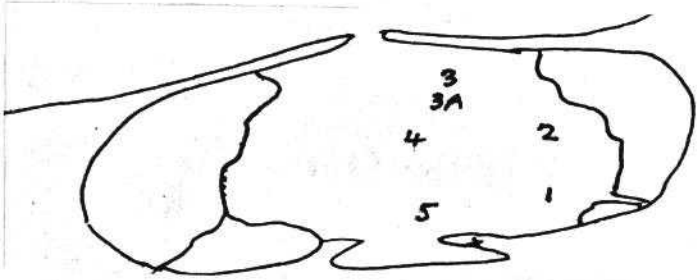
5 July...Prince Charles Foreland... "were interesting in cross-section; the one looked at had 8 or 9 secondary humps in it each with its moat & one hump in the centre.

"The rutmarks are all typically circular or polygonal, but if there is a strong run of water off a steep slope, as here, they tend to become oval in the direction of drainage.

"On the flat part between "Silene Hill" & Diver Tarn, I cut sections of small rutmarks 3 or 4 feet wide, and these had this cross-section:



"Went out with Huxley on Lagoon in boat at 10-12 at night. There were 7 Divers doing various stunts, but they moved off when we came near. Black Guillemots look like clear-wing moths when they fly. We dredged at various places:



Schematic sketch, areas at each end still ice-covered

1. Gammarid with ridged segments [= Gammaracanthus loricatus]. "Chiton-like" worm. Green seaweed. Brown fine-stalked seaweed with various things on. Bivalve -- alive. Water tasted fairly fresh.
2. Brown Fucus chiefly. Many Polyzoa etc.
3. Barren. A white worm among shingle.

5 July...Prince Charles Foreland...

" 3A. White patches of worm casts and mud and dead bivalves.

4. Barren too.

5. We could see Laminaria, Fucus, brown fine seaweed and many grey piles of worm castings on the bottom."

[The list of plants and animals found in the Lagoon today is given in our paper, p.238. It comprised 9 species of seaweeds, 1 Hydroid, 3 Polychaeta, 2 Polyzoa, 1 Amphipod Crustacean, and one Mollusc:

Algae:	Chaetomorpha melagonium Kjellm.
	Cladophora arcta Kuetz.
	Desmarestia aculeata Lamour.
	Dictyosiphon foeniculaceus Grev.
	Fucus serratus f. arctica J.G. Agardh
	Laminaria sp.
	Phloeospora tortilis Strömf.
	Pylaiella litoralis Kjellm.

[Omited from this list is Rhodomela lycopodioides, for which I can find no catalogue record, although I collected it in intertidal pools at Cap Boheman later].

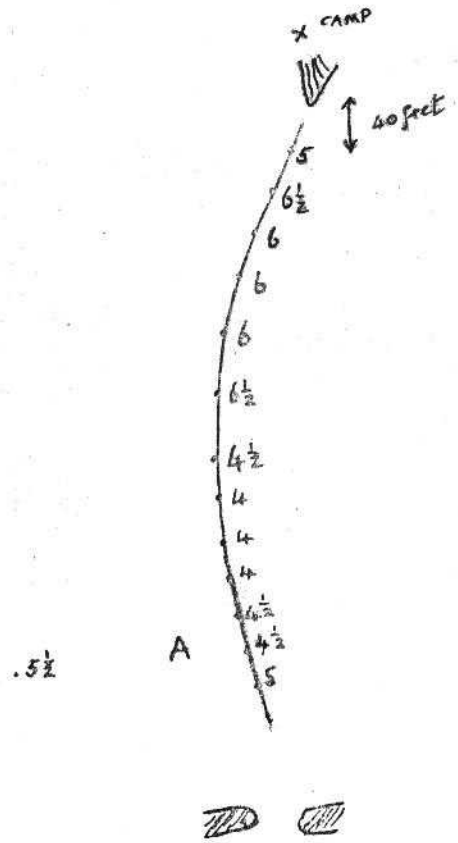
Hydroida:	Operculariella lacerta (Johnston)
Polychaeta:	Capitella capitata (Fab.)
	Harmothoë imbricata (L.)
	Ophelia limacina Rathke
Polyzoa:	Alcyonidium gelatinosum (L.)
	Gemellaria loricata (L.)
Crustacea:	Gammaracanthus loricatus Sab.
Mollusca:	Liocyma fluctuosa Gould

The Hydroid, det. by A.K.Totton, is listed in the Appendix to S.P.1, also the Polyzoa, det. by R.Kirkpatrick. The Polychete worms are included in Fauvel's paper in S.P.1, No.25. G.C.Robson, of the British Museum, of the mollusc, wrote to me that the specimens were dwarfed in size, and all but two were abnormal in certain respects. But other expert opinion confirmed his naming. He thought the abnormalities were caused by the brackish habitat. It is a circumpolar species. The ecological character of the Lagoon is discussed fully in our paper, where we concluded that "The brackish character of the fauna is shown more by the absence of certain marine forms, than by the presence of any freshwater ones". A water sample taken near the entrance when the tide was flowing in had a "chloride* content" of 15.77 g. per litre, -- a bit lower than the open fjord by Bruce City, Klaas Billen Bay, where there is or was considerable input of fresh water from the glacier. On 10 July the chloride* content of a sample by the camp at low tide was only 6.34 g. per litre.]

* this, in our paper, should have read "chlorine" — see these Notes, p. 97.

5 July...Prince Charles Foreland...

[About this date we made a depth transect of the Lagoon from the Camp to the entrance, which is copied below. My Diary notes that the tide was rushing in, and that the alkalinity of the water was about pH 8.5.]



N.B. Entrance not directly opposite camp.
Depths in feet.

Final Diary note today: " It is curious how snow seems to melt earlier round clumps of plants. In the case of grasses the snow may be loosened by wind acting on the leaves". [I have annotated this "No! Heat".]

6 July. My Diary: "Rowed out [with Segnit] to Point Carmichael. Dredged & towed beyond here. The plankton is very poor --an ordinary Gammarus, a nereid worm, a few Calanids. The dredging was also barren -- I got nothing but Laminaria, Fucus & Polyzoa, brown fine-leaved seaweed, a few other algae, & Gammarus (which has bright red eyes). A lot of the bottom was barren stones and shingle, especially near in."

[The land beyond Pt.Carmichael was weathered rock with rutmarks.] "On the weathered Hecla Hook is a tundra composed entirely of mosses and lichens .

6 July...Prince Charles Foreland... "When I was there it had a lot of melting snow passing through, but I imagine will be more or less dry in a few weeks."

[Of our scanty marine collecting, I only have species records of one seaweed and 4 Polyzoa, the latter named by R.Kirkpatrick and listed in the Appendix to S.P.1:

Algae:	Desmarestia aculeata	Lamour
Polyzoa:	Membranipora unicornis	(Fleming)
	Cribrilina annulata	(Fab.).
	Schizoporella hyalina	(L.)
	Alcyonidium mamillatum	(Alder)

In the Appendix the Polyzoa are listed under the date 4 July. This may or may not have been an (unimportant) error.]

[We made a transect diagram of the strata as seen from the sea along the 30-40 foot high shore between the Lagoon and beyond Pt. Carmichael; but though it was done with the help of our geologist, I omit it here as being too sketchy. But it does show how the raised beach system overlies rock that gradually becomes nearer the surface as one goes north, finally appearing as described. That area is mentioned in our paper (p.245) as follows: "Moss-mat. Near Vogel Hoek there is a large flat mossy plain which may be included in this community [viz. Rocky Lowland], though it shows transition to Moss Heath. The plants were probably little affected by the sea-birds. There are practically no higher plants". We listed 6 species of Bryophytes and 7 lichens.]

[Our return journey was difficult. We had set out in good weather and a fairly quiet sea to row over 6 miles along this coast (not counting the Lagoon crossing). Occupied with our work beyond the N. point of Pt. Carmichael, we did not realize that one of those strong breezes that can occur rather suddenly in Spitsbergen had arisen. When we started back, we found on rounding the Point that a rough sea was sweeping waves right up the Sound. I now realize that this occurrence may have been exacerbated by the existence of a very shallow bar across the Sound a little S. of the Lagoon. It is marked on the modern map as "Vorlandsrevet" -- between Murraypynten on the Foreland and the projecting Sørstangen on the mainland. The old Admiralty chart marks a depth of only 2 fathoms in one place. It was the still-frozen ice on this bar that caused Barents to turn back after trying to sail S. down the Sound in 1596 (see Conway, 1906, pp.14-15). After a while we found that we were making little progress -- almost staying in the same place -- and rapidly tiring, and could not possibly get back by sea. We were a few hundred yards out to sea, but it was difficult to turn into shore because of the danger of being swamped. Eventually we edged in at an angle, shipping some water,

6 July...Prince Charles Foreland... [But here we found a shelving beach with a low vertical edge above. We were unable to haul the dinghy up. Segnit then had the idea of turning the boat sideways, and thus we lifted each end alternately a few inches at a time, until it was at the drift-line. Here we left it, propped up by a small piece of drift-wood. Thereafter we had a tedious walk to camp, crossing on the final stretch a wide shallow torrent stream that issued from a small ravine full of snow. I just waded across. Segnit, more particular, walked over the snow-filled ravine. We met Huxley coming from camp, rather anxious about us, as it was nearly 10 p.m.] [Next day Segnit and I walked back to retrieve the boat and row back, the sea conditions having improved. We found it delicately balanced on its keel. But the piece of wood had been washed away! On the way we had come to the little ravine over which Segnit had crossed. His foot-marks led to the edge, -- and continued on the other side. All the snow had fallen in during the "night"...]

Final Diary entry: "Arctic Tern chasing a Richardson's Skua between 23 and 24 o'clock."

[I will include here, since the exact date of collection is neither certain nor significant, some sub-fossil shells I collected from the surface of the raised beach between Heemskerke Ness and Pt. Carmichael. They are mentioned in the paper by myself and Baden-Powell (1931) [see p. 3 of these Notes]. They consisted of Mya truncata with a morphological tendency towards the "cold climate" variety udevallensis; and Astarte borealis with a "warm climate" tendency. These remarks refer to discussion of the well-known warmer period or periods some thousands of years earlier, known as the "Mytilus Period", discussed under our notes on Klaas Billen Bay.]

7 July. [The journey for the boat took some hours and I did no collecting today, but made a few observations in the vicinity of the camp.]

My Diary: "A Purple Sandpiper came and fed for some time on the shingle spit by camp this evening. My traps [pitfalls set previously] have caught enormous numbers of Collembola [see 9 July] which apparently feed on ?decaying sea-weed. cf. (1) Springtails found in stomach of P.S. at Bear Island [these Notes p.18] (2) P.S. picking things off snow. I have found Collembola right out on the snow here [see 10 July]."

7 July...Prince Charles Foreland... "Found spiders' coccoons on underside of irregular Hekla Hoek stones on Silene Hill. There are about a dozen yellow eggs in a rough criss-cross coccoon of white threads. The whole thing about ¼ inch across. Near most of the ones examined was also an object (presumably fly or springtail) done up in a complete mummy coccoon. Is this food of young? In one case there was a spider done up in a parcel, in another case a tight parcel with contents indistinguishable."

"Watched a small red mite, with thick legs and a brown Y on back, apparently trying to get into a coccoon of spider threads & being baffled. Enormous numbers of red mites hatch out of coccoons [sic = ?eggs] -- sphaerical brown spiny, on under sides of rocks. Some were covered with a green alga."

8 July. My Diary: "Fell up to neck in Lagoon, through ice." [It happened thus. I had (sadly) forgotten Longstaff's warning, and was, with Segnit, walking across the northern fast-ice, when I chanced on a weak spot, fortunately limited in size, where the torrent from Glen Mackenzie had thinned the ice below. I was saved from drowning by two things. First, I had on a ruck-sack and also supported myself on my arms a bit. I climbed out gingerly, the ice edge was firm. But I was wearing sun-goggles, and blinded by water, also temporarily bewildered, and so did not realise that I had faced about. I was just going to step into the hole again -- in which case I would probably have gone under -- when a shout from Segnit checked me in time. The shout seemed to come from a little way off. When he saw me go in, he sensibly ran away and not towards me. He explained later that in the previous winter he had been skating on a shallow lake in Paris, when someone fell through the ice. Whereupon a crowd rushed to the rescue and of course broke through themselves. I went back to camp to dry out. Later I had a good deal of shock. Among other things, the water was very cold. During this camp we did not keep any regular weather records, but I have two notes on air temperatures that give a notion of spring conditions here. A maximum and minimum thermometer set on the morning of the 7th and read on the 8th c. 10 a.m., showed max. 8°C., min. 2.5°C. On 3 July after a similar period, it read on noon that day, max. 5.2°C., min. 1.2°C.]

My Diary continues: "General considerations on rutmarks: the size of the stones very largely depends on the run of the rock strata & the nature of the rocks weathering. The ones with small stones get started with plants

8 July...Prince Charles Foreland... "quicker than those with large stones. Also the actual difference in size affects the plant associations growing there." [Among factors to be taken into account I give] "kind of rock, dip and strike, slope of ground, coldness of area, time during which rutmarks have been forming, size of stones, direction and amount of drainage. The plants growing on the rutmarks will depend on the amount of drainage -- an optimum amount of water --, composition of soil, amount of evaporation & exposure (a) aspect (b) wind, amount of light, amount of heat, whether and how long under melted-snow water, depth of snow over it. "

"Terns near camp hover over the water & dash down & catch things, going almost under at times. One I watched could hover up to 20 strokes. They were evidently feeding on some fine Gammarids which I caught swimming about in shallow water. The tide was just beginning to come in -- [but still] practically fresh water. The snow has melted off the spit in the last 2 days." [During our camp, rafts of winter ice broke away at intervals, and we kept hauling the dinghy further in. In our paper (p.239) we cite information from Mr Mathieson --co-cartographer, with Bruce, of the Foreland -- as saying that large areas of the ice on Richard Lagoon remain unmelted in summer in ordinary years; but that in 1922, which was unusually warm, it disappeared. This was a reason why salt-marshes could not develop in the Lagoon. We also note (p.238) that in shallow water three species of amphipod shrimp live (of which I collected material): Gammaracanthus loricatus, Gammarus locusta var. zaddachi and Pseudalibrotus litoralis. The first reached a length of over 5 cm. These three species were also observed at Bruce City (q.v.) .]

[Today Huxley set out alone to walk to Vogel Hoek. It is a long rough walk along the beaches etc. He did not return until early on the 9th. The notes on the bird-cliff there given in our paper will have been derived from him and from Jourdain's party that landed on 29 June. This great bird colony had Brünnich's Guillemot, Kittiwake, Fulmar, Glaucous Gull, Spitsbergen Puffin, and Little Auk. Pink-footed Geese nested nearby. Bruce (1907) notes that during his survey of this northern area of the Foreland in 1906, he "saw fully a hundred foxes" in two weeks, both blue and white (i.e. summer brownish condition). Wordie (1921) records that in 1919 or 1920 there were only a few fox tracks, owing to the activities of Norwegian trappers a few years before.]

[The scree below had a continuous plant mat: 8 phanerogams, & 3 mosses are listed in our paper, Saxifraga rivularis and Ranunculus pygmaeus being very luxuriant. Sax. oppositifolia was absent from the closed mat, being unable

8 July...Prince Charles Foreland... to compete in closed vegetation]
[Huxley brought an alga sample from the wet rock face, where it was abundant, Enteromorpha sp., that contained a rich microfauna including Protozoa, nematodes, rotifers and tardigrades; also mites, Scutovertex lineatus (my catalogue lists both adults and nymphs). Besides these animals and the alga noted in our paper, I have an unpublished note of the alga Prasiola crispa collected there: this is a common nitrogen-loving species in Britain -- and in the Antarctic penguin rookeries; and I also found it in 1923 very abundant on nesting sites of Arctic Terns on islands in a lake in Wijde Bay.]

[Huxley brought two soil samples from Vogel Hoek (in taking these we placed them in previously sterilized tins). They were examined for Protozoa by Sandon [S.P.1, No.6]. On pp.456-7 of his paper he gives a table of the various samples from here and elsewhere, with details of site, pH, soil composition etc., and the names of species. A few of the latter were named to genus only, or listed as unnamed taxa. Most were named to species.

"Sample 4": Moss plain below Vogel Hoek, damp mossy peat much manured by sea-bird droppings. pH 6.25. 2 species of Flagellata, 2 Ciliata, 5 Rhizopoda: Total 9 spp.

"Sample 5": Vogel Hoek, fine brown peat much manured by sea-bird droppings. pH 6.0. 7 species of Flagellata, 5 Ciliata, 11 Rhizopoda: Total 21 spp.

He also includes in his paper some soil samples taken by B.W.Tucker, during a visit he made with Jourdain in 1922 to the large bird-cliff at Green Mountain (between Coles Bay and Advent Bay). "Sample 1, 1922" was from grassy slopes on bird cliffs -- very luxuriant (I have a photo by Tucker of these ledges with deep grass). pH as low as 3.9. 4 species of Flagellata, 7 Ciliates, 14 Rhizopoda: Total 25 spp.

Sandon comments on the acidity of these soils and on the abundance of the Protozoa, and notes the occurrence of all the species also in temperate lands.]

9 August. [I have no Diary entry for this day. A sample of the "enormous numbers" of Collembola from decaying sea-wrack by the edge of the Lagoon is recorded by Carpenter and Phillips and in my catalogue, under this date. They were collections from pitfall traps set several days earlier (see p.52 of these Notes):

Achorutes viaticus
Archisotoma beselsi
+ 2 Agrenia bidenticulata

The inclusion in our paper of Isotoma viridis was an error.]

At night I did a spell of watching a diver from Huxley's hide. My Diary, noting actually 1 a.m. on the 10th: "Red-throated Diver watched on nest

9/10 July...Prince Charles Foreland... "from 5 yards away in a tent. ♀ is very tame. She flew off after some provocation but did not mind me standing up unless I made a loud noise. She comes back to the nest by alternately hopping like a frog and doing a few steps walking upright., with her knobby sinuous neck bent in an extraordinary way. She then bends over & arranges her eggs awkwardly with open beak and bent neck, and then settles. She often gets up a second time to arrange them to her satisfaction. You don't notice the red throat until you are near, but when you do catch sight of it suddenly it is startling."

10 July. [Last full day here. No narrative Diary, but a lot of separate notes on collecting from several fjaeldmark sites, catalogue data etc.; also the papers by experts, some of which are annotated with the collecting code numbers. I have re-arranged the order somewhat, and inserted the identifications of animals. The work concerned low rocky hills not far from the camp. I have included a few that are dated between 4 - 6 July, so noted. This brings together my collecting from fjaeldmark, other than from the raised beaches, and from Glen MacKenzie. "Silene Hill" was a low hill, c.150 ft., near camp, whose upper parts were early free from snow and had abundance of flowering moss-campion, Silene acaulis. The vegetation is described in our paper, with a list of animals found. There were 18 species of Phanerogams, 12 Bryophytes and 12 Lichens. "The community is really a 'fjaeldmark' similar to that on Bear Island, but rather richer in species. ...Cetraria nivalis [a yellow lichen] is characteristic of places where the rock is near the surface. Generally speaking, the lower plants occupy a subordinate position" (p.244). The areas with polygonal soil, there and elsewhere in the vicinity, are also described, but they seemed very poor in visible animal life, even in the "often...luxuriant and varied flora" of the edges. I think this might be because they dry out in summer. They had 14 species of Phanerogams, 13 Bryophytes and 13 Lichens, with slight differences between these and non-polygonal areas.]

[Several different sample collections were made on this hill and a few others in the vicinity. The following records are from my Diary, re-arranged as explained above].

[Sample I]. "Silene Hill". "Morning sunny but with coldish wind. Stony Hekla Hoek slope without rutmarks. Cerastium alpinum , Draba (yellow &

10 July...Prince Charles Foreland... ["white), Alsine rubella ("Sagina" in my Diary), Saxifraga caespitosa, S.oppositifolia, Silene, (no Pedicularis or Dryas). Under stones:

Diptera: Diamesa "poultoni" = arctica

Arahea: 1♂ Typhochrestus spetsbergensis. Many spider coccoons & eggs: (1) under stone 7 orange eggs. No prey. (2) under stone, 8 eggs. No prey. Small red mite with no Y on back, on outskirts. (3) Two coccoons under stone. Half-a-dozen small red mites about [undoubtedly Bdella sp.]. Put in tube to see if eggs eaten. Not. (4) 4 coccoons + red mite near one. All ?sucked dry.

Acarina: Cyta brevirostris
Sphaerozetes notatus

Also, on flowers of Silene, a fly, Limnophora megastoma".

[Sample II]. "Slope with Dryas, Papaver, Pedicularis [hirsuta], Sax. oppositifolia and white crustaceous lichens:

(1) Shaking rutmark rampart plants:

Diptera: 1 fly, not collected

Aranea: 1♂ Typhochrestus spetsbergensis
1 imm. ?sp.

Acarina: Bdella groenlandica (small red mites)
Sphaerozetes notatus (shining black mite)
Oribatula exilis

No Collembola were seen.

(2) Summit area. Few plants. Under stones:

Collembola: 1 Isotoma viridis

Diptera: 1 fly, not collected.

Aranea: No spiders seen; but a few coccoons.

Acarina: Cyta brevirostris
Sphaerozetes notatus
Large numbers of brown spiny mite coccoons [= ?eggs] not much hatched out yet.

(3) Dryas zone. Shaking Dryas etc.:

Collembola: 1 Isotoma viridis

Diptera: 1♀ Camptocladius extremus

Aranea: Spiders rare -- one or two coccoons. 1 imm. ?sp.

Acarine: Bdella groenlandica
Ceratoppia bipilis
Cyta brevirostris
A few mite coccoons [= ?eggs]

Oligochaeta: Henlea brucei (new species)"
Enchytraeidae

10 July...Prince Charles Foreland...

[Sample III]. "North side of Silene Hill [between 4 & 6 July]. Weathered outcrop of Hekla Hoek. Stones lying about and shaly stuff in situ half split. Luzula [confusa], Salix, Sax. oppositifolia, etc., mosses, lichens. Where worked in detail, chiefly Sax. opp. and lichens. Under stones:

Collembola: Present, not coll.

Diptera: Diamesa "poultoni" = arctica

Aranea: 1 ♂ Typhochrestus spetsbergensis
1 imm. ? sp.

Acarina: Bdella decipiens
B.sp. + coccoons on under sides of stones. Green ?alga on eggs of mites."

[Sample IV]. A nearby hill,"Hekla Hoek slope of 45°, facing N.E.Large and small irregular stones. Cerastium, yellow Draba [alpina], Luzula, Papaver, Saxifraga caespitosa, S. oppositifolia, moss Polytrichum, few lichens. Flowers very sparse:

Diptera: 1 ♀ Diamesa "poultoni" = arctica (under stone)

Aranea: 1 imm. ? sp. A few spider coccoons.

Acarina: Small red slow mite [undoubtedly a Bdella sp.]

The spider was among S. oppositifolia.

[Sample V]. Small hill about 20 ft. high [between 4 & 6 July] A small hump of plants on top (1). Then sparse plants (2). Round the base a fairly rich tundra (3).

(1) Luzula, Salix, mosses, white crustaceous lichen, yellow fruticose lichen:

Collembola: 4 Achorutes viaticus

Acarina: Red mites [presumably Bdella sp.]
* Hermannia reticulata ("weevil mite")
Sphaerozetes notatus (black mite)

(2) Shaly. Yellow Draba, Papaver, Sax. oppositifolia, Silene.

Aranea: 1 imm. ?Leptyphantes sobrius

Acarina: Hermannia reticulata
No red mites.

(3) Dryas, Pedicularis, Saxifraga nivalis, club-moss [Lycopodium selago] This grades into snow-covered tundra all round;

[Sample VI]. Hill above Diver Tarn. Walking on snow:
Collembola: 4 Agrenia bidenticulata

[* This is the only time I encountered this species during three expeditions. It is Holarctic (also in Britain), and has been recorded by others from localities in fjords on the West coast from Magdalena Bay in the N. to Bell Sound in the S. I do not know of any other record from P.C.F. It is also on Bear Island.]

10 July...Prince Charles Foreland...

[A soil sample from Silene Hill fjaeldmark was analyzed by Sandon for Protozoa [S.P.I, No.6, p.456]. The pH was acid = 6.3. The fauna was much less rich than in soils at Vogel Hoek. He detected 1 species of Flagellata, 1 of Ciliata and 5 Rhizopoda. Of the last, only two came alive in culture, though there were many empty 'tests' of other species. He also gives some notes on Protozoa from dried moss from similar habitats. But, as he points out , these had some soil also adhering. They added several more species].

[The Terningen, returning from its visit to the north, anchored in Fresh-water Bay on the morning of the 10th. F.J.:" Longstaff went ashore to the camp and reported on his return that all were well...It was arranged that the camping party should come off tonight at 10 p.m. but only Summerhayes came on board so that we had to wait at our anchorage till the next morning. Meantime a stiff breeze had sprung up from the North so that Huxley's visit to Guada [Quada] Hook had to be omitted." The fact is that Huxley was so keen to finish his observation of Divers that he decided to ignore this arrangement about joining the ship today. He mentions notes made from his bird-hide from 12.30 - 2 a.m. on the 11th [S.P.I, No.8, p.262]. On the 11th F.J. wrote: "About 8 a.m. Huxley, Sggnit and Elton came off with the last of their stores and equipment and at 9.30 we started our course down Foreland Sound. At first there was quite a stiff breeze from the North, but it died down later. " We had a hard row of over 2 miles to the ship, where Huxley was greeted with some indignation by his colleagues, while I went to get a large breakfast of porridge at the cook's galley. It had indeed been foolish to extend the time. Foreland Sound has another name (which is printed first on the old Admiralty Chart) -- "Foul Sound". This refers, not to storms as such, but is the maritime term for shallow waters (e.g. at The Bar) which may give added waves from sudden winds. It is not a good place in which to anchor for long.]

[F.J. includes here in his Diary a long list of bird notes made by Huxley on P.C.F. Although some of the information overlaps with my own, I give the notes here. Snow Buntings common. One pair at 1800 ft. Pink-foot Goose flocks 5 - 15 seen, seem to go often to foothills to feed. Northern Eider ab. : a few isolated nests on lagoon bar. King Eider seen several times,

11 July...Prince Charles Foreland... [usually with the last. Fulmars seen several times flying. Red-throated Diver, 8 - 10 seen, and some nests. Grey Phalarope -- 1 pair along the shore. Arctic Terns ab., breeding on shingle spit. ??Sabine's Gull on shore at the N. end of the Lagoon. Glaucous Gulls flying singly; at V.Hoek at high sites overlooking other birds. Kittiwakes, a few near camp, a very large flock under cliff at V. Hoek. ?Pomatorhine Skua -- a pair over the sea. Richardson's Skua common. Brünnich's Guillemots only at V.Hoek. Mandt's Guillemots, a few often sat on shore ice of Lagoon. More at V.Hoek. Northern Puffin ditto. Little Auks only at V.Hoek.] [There are only a few absentees from the list of birds commonly breeding on P.C.F., given by Lovenskiøld (1964, pp.54-5), such as the Long-tailed Duck and the Ptarmigan. We had seen Brent Geese on the Edinburgh Is. Jourdain and 3 other observers saw and identified in good visibility a Black-throated Diver (Colymbus arcticus) which came down on the Lagoon on 30 June, but stayed only 20 minutes. This record (noted by him in S.P.J., No.10) was accepted by Lovenskiøld as the first absolutely certain record of this species in Spitsbergen, with none later; though the species has been authenticated for Bear Island.]

[Some Remarks on P.C.F. (written in 1980)]

1. I have said little about the work of Summerhayes, because it is fully described in our paper, and also because I have no unpublished material of his to add. It was essential for my own framework of ecological recording, we worked often together, and he taught me much about the flora. It is instructive to compare his plant list with those he obtained on Bear Island. On P.C.F.: 28 Phanerogams etc., 32 Bryophytes and 35 Lichens: Total 95 spp. On Bear I.: 22 ditto. 43 ditto. and 45 ditto.: Total 110 spp. In neither locality did he collect the whole flora, but the predominence of bryophytes and lichens in both is perhaps the striking feature. On P.C.F. Bruce made an excellent collection of plants-- 58 being the total known from this and scanty previous records. These were described by Rudmose Brown (1908), while Hagen reported (1908) on the mosses.

2. Climate and Weather. It seems likely that we were relatively lucky in the weather during our visit. In spite of a few days of mist and rain, we could work every day. Bruce encountered much bad weather, and in 1908 wrote: "It is seldom that the mountains are clear of the dense canopy of clouds, which are often down to 100 ft., and not infrequently to sea-level."

[Some Remarks on P.C.F., cont.]

2...Rudmose Brown (1923) mentions the prevalence of wind, mist and rain, and that there was only about one fine day in ten. According to Bruce (1907) the vegetation is more luxuriant on the W. than the E. coast, which is often quite barren for miles. Wordie (1921) spent the summers of 1919 and 1920 on the Foreland and remarks that the season there is much later than in Icefjord, as indeed we also noticed. After the winter of 1919-20 the snow disappeared 15 days earlier on the W. than on the E. coast. "As late as July 19, when all the snow had disappeared, the surface of a good portion of Richard Lagoon was still covered with fast-ice." Yet 1920 was "a very open year for ice". These facts, and the absence of a number of plant species found inside the fjords e.g. Cassiope tetragona, influenced us in placing P.C.F. in the "Dryas Zone", in our 1928 paper -- i.e. the outer coastal zone in which the effect of such factors as adiabatic warm winds coming down inland glaciers were not significant. I must note, however, that the climate of Spitsbergen has varied greatly during the last half-century, and that we first went there before a period of marked amelioration was to ensue.

3. Invertebrate Fauna. The Foreland, as far as I know, has been little visited by those studying fresh-water invertebrates. I was myself unable to contribute much, because we were there so early in the season. There had been earlier study of the microfauna of mosses brought back by Bruce [see S.P.I, No. 26]. The numbers of species of land invertebrates collected by me were: 4 Collembola, 6 Diptera*, 2 Aranea, 6 Acarina, 1 Enchytraeid worm + soil and moss Protozoa, and moss Rotifera. The total, excluding microfauna, and collecting on the Edinburgh Is., was only 19 species. Two at least of the Diptera breed in fresh water. The worm (described by Stephenson [S.P.I, No.24] as a new species) was found by me in Icefjord later. But, according to Nurminen (1965) its taxonomy requires further study.

4. Soil Polygons. Huxley, in between other work, studied what he called "surface markings", and wrote a discussion of them with Odell [S.P.I, No.2]. Odell did not visit P.C.F., but the paper states: "The stone polygons which we investigated were chiefly those inland from Richard Lagoon...Here they were extremely well-developed; Nansen, with his wide experience of the Arctic, notes that he has never seen better examples than those in this

* 3 of these were the species collected by the Swedes in the early 1860s (Boheman, 1865) at Seal Point (= Salpynten), the S. point of P.C.F.: Aricia [= Limnophora] megastoma, Coelopa [= Fucomyia] frigida, and Chironomus [= Diamesa] arcticus. Hackman accepts C. frigida, whose taxonomy was varied by Holmgren (1869).

[Some Remarks on P.C.F., cont.]

4... "locality". [This may be so, but there are plenty as good, and more varied, in the northern parts of the archipelago, where I worked in 1923 and 1924. This paper has two photos by me of P.C.F. stone polygons, of which one is included in these Notes; also a good deal of information about the matter is cited there, from my field-work in 1923. I made a much more thorough study in 1924 [publ 1926.]. Odell was at Bruce City, and led the sledging expedions to the interior of New Friesland in 1921 and 1923.]

5. Richard Lagoon. There is sound historical evidence that this Lagoon and "The Bar" across the Sound just south of it have existed from early times i.e. that the relative levels of land and sea in Foreland Sound have not changed for several hundred years.

Bruce (1907) stated that the Lagoon was shown on the early chart by Edge at the beginning of the 17th Century; but that it had been omitted from all subsequent charts, even the 1865 Admiralty Chart. I have examined Edge's map, as published in "Purchas His Pilgrimes", Vol.3, (1625), pp.472-3. A large lagoon which must be this one is placed nearly opposite "Comfortless Cove" (now English Bay = Engelsbukta] on the mainland. "The Bar" is dotted in as two triangles projecting from opposite sides to the south of this. Although their exact placing on P.(F.C.) is incorrect in detail, in so far as they should be further north, it can be seen that the shape of the Foreland itself is very foreshortened. But there can be no doubt as to the identity of these features, which were recorded by Edge during voyages in 1612 - 19, after which he retired from active sea-faring. The Lagoon is shown with a central entrance, but this might have been a chance convention.

Bruce is not quite correct about the omission of the Lagoon from all later charts. It also appears on Van Keulen's map of Spitsbergen, of which a large copy is included in Conway's book (1906) on the history of Spitsbergen. He states that the map was in MS c. 1680-90, but published without date by Giles and Cutger Reps in the very early years of the 18th Century. Conway was not interested in the Lagoon, though he recounts the observations of Barents on The Bar (see p.51 of these Notes). Indeed, he omitted it from his own large map of Spitsbergen from various mainly 19th Century sources. But it appears on the 1913 edition of the old Admiralty Chart.

We can safely conclude that The Bar has been there since 1596 i.e. for at least 370 years, and Richard Lagoon for at least 350 years.

[Some Remarks on P.C.F., cont.]

5... The object of this historical review is to show that the Lagoon, clearly a possible candidate for becoming a future relict fresh-water lake if the entrance closed after relative land rise, has remained for a long time in this transitional brackish tidal stage. Thus, Gammaradanthus loricatus , a common inhabitant attaining large size, and capable of living in almost fresh water at low tide, could remain in such a relict lake. A morphologically slightly different form of it is found in some relict Baltic lakes e.g. L.Ladoga, and elsewhere. Olofsson, in his remarkable survey of of fresh-water animals in Spitsbergen done before the first World War, but published in 1918, found this species in a fresh-water lake on Credner's Moraine in Bell Sound. With it was the well-known Schizopod shrimp Mysis relicta. (And see my notes on Bruce City, later). If one assumes that such a relict Richard Lagoon would have about the same depth as at present, these Crustacea could probably survive the winter, since the water would not freeze to the bottom. Our transect gave a maximum depth of $6\frac{1}{2}$ ft. (c. 2 m.) Rudmose Brown (1923) stated that the average low-water depth of the Lagoon was 8 - 9 ft. (2 - 3 m.).