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No. 12, *September* 1962

ABSTRACTS OF PAPERS TO BE READ DURING THE SYMPOSIUM ON ANTARCTIC BIOLOGY TO BE HELD IN PARIS, 2 TO 8 SEPTEMBER 1962*

Session 1. The life sciences in the Antarctic

Chairman: Dr R. A. Falla (New Zealand)

None available

Session 2. Medical research

Chairman: Dr C. H. Wyndham (South Africa)

TITLE: Maintenance of thermal balance in Arctic Eskimos and Antarctic sojourners

AUTHOR: Frederick A. Milan, Arctic Aeromedical Laboratory, Fort Wainwright, Alaska. (Currently at Department of Anthropology, University of Wisconsin.)

Experiments investigating thermal balance in two clothed Antarctic sojourners in the cold were carried out at "Little America V" in the winter months of June and August 1957. Environmental temperatures ranged between −32° and −47° C., and wind velocities ranged between 2 and 17 mph during these experiments. Despite the protective clothing worn and the heat productions of between 3 and 4·8 mets (measured by indirect calorimetry), total heat debt (obtained by calculations of rectal and skin temperature decrements) ranged between 105 and 126 kilocalories for exposures of 40 to 165 min in duration. Finger temperatures ranged between 7° and 18° C. at the end of the experiments. The thermal demands of the environment on these seemingly adequately clothed men was high, and it is suggested that they were moderately cold stressed despite high rectal temperatures.

By way of contrast, a similar investigation of the maintenance of thermal balance in five clothed Eskimos living in the village of Wainwright on the Arctic coast of Alaska was undertaken in March and April 1960. Skin and rectal temperatures were measured as the Eskimos carried on with their daily food quest activities in the cold. There were no statistically significant differences ($P > 0{\cdot}05$) between control values and measurements made in experiments lasting up to 8 hr. in any body temperature parameter. Ambient temperatures ranged between −26° and −14° C. and wind speeds between 0 and 18 mph. At these temperatures thermal balance was maintained by the insulation of the clothing rather than high levels of activity. Eskimos, when compared to Antarctic sojourners, had somewhat elevated resting metabolisms and (as shown in other experiments) a greater peripheral blood

* Those abstracts which were not available at the time of going to press will be published in *SCAR Bulletin* No. 13.

flow and a lower tissue insulation. Despite the small physiological differences between the two groups, the Eskimos maintained thermal balance mainly because of superior clothing and the somewhat lower thermal demands of the Arctic environment.

TITLE: Caloric requirements of man in the Antarctic

AUTHORS: F. A. Milan and K. Rodahl, Director of Research, The Lankenau Hospital, Philadelphia, Pennsylvania.

Dietary surveys and estimates of energy expenditure were made in a small but representative sample of scientists and Navy personnel at "Little America V" in the Antarctic during the International Geophysical Year, 1957–58. For the IGY personnel the average daily expenditure was about 3,775 Cal. and the consumption 3,400 Cal. per man in March, 3,370 and 4,396, respectively, in June and 4175 and 4285, respectively, in September. The Navy personnel expended 3,660 Cal. and consumed 4,925 Cal. per day in September. On this regimen all of the subjects gained weight during the Antarctic stay. It may therefore be assumed that the caloric intakes reported here are, on the whole, in excess of actual caloric requirements under these conditions. The values for the percentages of total calories consumed furnished by protein, fat and carbohydrate are not different from those reported for United States troops eating a garrison ration in Arctic or temperate climates.

TITLE: Human factors in Antarctic operations

AUTHOR: Albert R. Behnke, Captain, U.S. Navy (Ret.), 3350 Divisidero Street, San Francisco 23, California.

An analysis will be presented of injury, illness, physical and psychic deterioration, and attrition incident to special missions in the Antarctic environment involving such stress factors as cold, darkness, isolation, confinement, monotony, and bursts of unusual activity attended by hazard. A comparison will be made between early group-leader expeditions in which physical endurance was the limiting fact and present-day mechanized task force operations involving psychic impediments incident to the association of military and civilian units, the possible conflict of scientific and logistic objectives, and the problems of discipline, slovenly living, poor planning, and inadequate training.

Systematic studies of the physiologist and psychologist will be examined to ascertain personnel characteristics and conduct that make for success of special missions of long duration in a stressful environment. Specific attention will be given to the relative importance of selection, indoctrination, training, and discipline. For comparison a summary will be made of human factors in submarine operations and other military missions involving hazardous duty, isolation, prolonged hardship and deprivation.

TITLE: Physiopathology of polar operations

AUTHOR: Dr Perrier, Expéditions Polaires Françaises, Paris.

The prolonged association of a circumscribed group of individuals of the same sex always gives rise to the possibility of homosexuality. Such a situation arises during the winter in Antarctica.

We have not studied the question of sexual attraction in the physical sphere as we lacked the necessary material for laboratory study.

We were concerned, therefore, with theory and reviewed the problem as follows:

Essentially a problem of selection: elimination of apparent homosexual subjects is a matter of full clinical examination; but detection of latent homosexuals, unaware of their own condition, demands a deeper inquiry.

To this end, we studied the masculine:feminine factor the MMPI (multiphasic Minnesota personality inventory) among subjects who had wintered at Terre Adélie during the IGY. We searched for a correlation between the value of the factor and, on the one hand, the conduct of the subject, and, on the other, the intelligence quotient.

Likewise, in a less objective manner, we considered the influence of conflicting family and social situations on the tendencies shown by the subjects.

Finally, we attempted to specify, and not from the point of view of the individual but as a matter of collective interest, the negative or positive effect of platonic masculine attachments on the efficiency and evolution of the small group.

TITLE: Variation in the urinary elimination of 17-hydroxysteroids and 17-cetosteroids caused by the polar climate

AUTHOR: M. Staquet, Laboratoire de Médecine Expérimentale, Université de Bruxelles, Belgium.

Excretion of 17-hydroxysteroids and 17-cetosteroids was studied in different conditions of temperature and activity in Antarctica. Low temperatures caused a marked and prolonged fall in excretion of these metabolites. The metabolism of the adrenal hormones is modified, but it cannot be stated whether this is due to variation in the level of adrenal secretion or to a change in catabolism. This specific reaction to cold must be regarded as part of acclimatization.

Session 3. Microbiology

Chairman: Dr W. J. L. Sladen (United States)

TITLE: Microbiological populations of Antarctic air, soil, snow and melt pools

AUTHOR: George H. Meyer, Department of Microbiology, University of Texas, Austin, Texas.

Air-collecting devices were employed for samplings made in the Antarctic, using media for the development of maximum numbers and types of different

organisms. Identification was made of the total catch whenever possible. Air samplings were made at various times during the year, and at seventeen different sites on the continent. At the same time, samples were obtained of flora, soil, snow, and melt pools. The air samples correlate quite well with the organisms isolated from soil samples. As compared with temperate climates, the representation of actinomycetes in aerial microflora is negligible. The yeasts also are a minor component. Penicillium and Aspergillus are the dominant molds; Alternaria and Hormodendrum were less prominent than they would be in comparable samplings from temperate climates. As expected, the numbers and kinds of air-borne microflora are fewer in the Antarctic. The majority of bacteria are pigmented rods and cocci; the rods are predominately non-sporeformers. During the austral winter the microbial content of the air drops markedly. Certain distinctive features were detected in the soil microflora in the rhizosphere of mosses and in association with lichens.

TITLE: Studies on respiratory pathogens in Antarctica

AUTHOR: William J. L. Sladen, Department of Pathobiology, Johns Hopkins University, School of Hygiene and Public Health, 615 North Wolfe Street, Baltimore 5, Maryland.

From November 1958 to May 1959 a study was made of the upper respiratory tracts and sera of volunteers on a naval icebreaker relieving Antarctic IGY stations, and of men coming out of winter isolation of up to 11 months. Sera have since been taken at 4- to 6-week intervals from men during winter isolation at Antarctic stations. Results of virus and serum analysis will be discussed. All coagulase-positive staphylococci were phage-typed, and tested for sensitivities to antibiotics. Over 60 per cent of the volunteers on the semi-isolated community of the icebreaker were regular coagulase-positive *Staphylococcus aureus* carriers. Quite a high percentage (10 per cent) of the same men were consistent carriers of *β-streptococcus* (mostly Group A). Isolation of potential pathogens such as *Staph. aureus* and β-streptococci were appreciably less from men at the IGY stations after 9 or 11 months of isolation than from the men on the icebreaker (*Staph. aureus* 20 instead of 60 per cent). This partly confirms the findings of McLean (1919) of the Australasian Antarctic Expedition, 1911–14. However, Sladen in 1948–51 found that *Staph. aureus* was consistently carried in the noses of men isolated in Antarctica for 9 months. Further data from a larger sample of isolated men on Operation "Deep Freeze IV" will be summarized.

In 1959 a series of 60 sera collected from Antarctic birds proved negative when tested (HI) in presence of Newcastle's disease virus, but some low titres were demonstrated from eight Adélie Penguins and two Silver-grey Fulmars when tested by indirect and direct complement-fixation tests in the presence of psittacosis antigen. Low titres were also demonstrated in a Crabeater Seal. The penguin and the seal are confined to the pack ice zone and rarely move away from it. These indications of ornithosis in such isolated populations present some very interesting ecological and epidemiological possibilities.

TITLE: Comparison of soil bacteria and their metabolic activities in Arctic and Antarctic regions

AUTHOR: William L. Boyd, Department of Microbiology, Ohio State University, Columbus, Ohio.

Polar regions may be characterized as having extremely cold temperatures for most of the year with a small amount of precipitation. However, land areas in the Arctic support relatively large numbers of different animals, including man, which live directly or indirectly on plants. In contrast, continental Antarctica supports no terrestrial animals as such, and no life exists except for lichens, mosses, and some of the lower plants and animals.

Studies of soils of the Point Barrow region of Alaska have shown that bacteria and other micro-organisms were present in the upper horizons in significant numbers; that a variety of physiological types could be identified; and that the soil microflora was active during the summer in carrying out metabolic reactions which contributed to soil fertility.

The materials which were studied in the McMurdo Sound area, Antarctica, could not be classified as soils in the classical sense. However, they were generally low in bacterial numbers, although in some cases they were able to support the growth of lichens and mosses. Thermophilic, mesophilic, and psychrophilic bacteria were present, and in many instances the former group was the predominant type. There was also some evidence that decomposition took place during the summer months.

Although temperature was a very important environmental factor in limiting the growth of certain members of the soil microflora, other factors associated with the physical and chemical environment were also studied to determine their role in the bacterial ecology of these regions.

TITLE: Bacteriological analysis of some contaminations with exposures in the South American Antarctic sector air

AUTHORS: R. Margni, Associate Professor of Microbiology, Faculty of Pharmacy and Biochemistry, University of Buenos Aires; and A. Corte, Instituto Antártico Argentino.

For the purpose of determining the type of airborne bacteria in the Antarctic bacteriological analyses have been conducted with samples from the South American Antarctic sector.

It is anticipated that the predominant types are: negative Gram bacilli, occasional micrococcus and dipteromorphous bacilli; a high percentage of same being psychrophilous. A full examination of these bacteria and their properties is made with a view to incorporate them to the microbiological systematic order.

Session 4. Biogeography and systematics—Botany

Chairman: Dr G. Llano (United States)

TITLE: Problems in the taxonomy and geographic distribution of Antarctic marine algae

AUTHOR: George F. Papenfuss, Department of Botany, University of California, Berkeley 4, California.

Many Antarctic marine algae have a geographic range which extends into the sub-Antarctic. It seems advisable, therefore, as far as the algae are concerned, to regard the Antarctic and sub-Antarctic as forming a single biogeographic province. A total of some 400 species, representative of more than 150 genera, have been reported from the following localities: Palmer Peninsula (Graham Land), Enderby Land, Commonwealth Bay (George V Land), the Terre Adélie coast, Victoria Land, Fuegia, Falkland Islands, South Georgia, South Orkneys, South Shetlands, Prince Edward Islands, Iles Crozet, Iles Kerguelen, Heard Island, Macquarie Island, Auckland Islands, and Campbell Island.

Large gaps exist in our knowledge of the morphology and taxonomy of Antarctic algae, and, at present, little can be concluded about the identity and distribution of many of the forms. A fairly large number have been referred to species erected on material from other parts of the world, including the northern hemisphere. These identifications require confirmation. More than thirty genera have been established on material from Antarctica. Several of these genera, including some of the largest of Antarctic algae, cannot be assigned to known families (or orders), nor are they sufficiently understood to justify the creation of new families. Examples illustrating the current confusion will be discussed.

The greatest advance in knowlege not only of Antarctic algae but of phycology in general would accrue from: (1) detailed study of properly prepared new material obtained preferably in the areas at which previous collections were made; (2) comparison of these specimens with the types of the species to which they are presumed to belong; and (3) a restudy of all the published material from Antarctica.

TITLE: The Oscillatoriaceae and their distribution in Antarctica

AUTHOR: Francis Drouet, Research Fellow in Limnology, Academy of Natural Sciences, 19th and the Parkway, Philadelphia 3, Pennsylvania.

In the course of the work on a revision of the Oscillatoriaceae (blue-green algae), the materials collected by the US Navy expeditions and by those recently from New Zealand, together with all available preserved collections of the earlier British, French, Belgian, German, and Swedish expeditions to Antarctica, have been studied exhaustively. Most of the samples taken in the past have been scanty and preserved at least initially in liquid; these have been examined microscopically with the aid of special techniques. Some fifty

species of the family have been reported in the literature on the Antarctic flora. Among these about twenty, along with numerous subspecific taxa, have been described as new. Most of these novelties prove to have been described from material of the three most common terrestrial species of the continent, *Microcoleus vaginatus* (Vauch.) Gom., *M. chthonoplastes* (Mert.) Zanard., and *Plectonema Nostocorum* Born., or of the considerable number of other widely distributed species found there. The distribution of the various taxa in Antarctica, with notes on ecology and life histories, will be presented.

TITLE: Ecology and geographic distribution of Antarctic lichens

AUTHOR: Carroll W. Dodge, Henry Shaw School of Botany, Washington University, St Louis, Missouri.

After 25 years of intensive study of Antarctic lichens and those of the sub-Antarctic islands, based on more than 7,500 microscopic preparations, the sampling error for a study of geographic distribution is still high. I have seen no specimens from the Norwegian sector, the south coast of Weddell Sea and the coast of Antarctica from Eights Coast to the Ross Ice Shelf and only very few specimens from the base of the Palmer Peninsula (Graham Land) and the Queen Maud Mountains.

The morphology of Antarctic species, apparently reactions to a cold, dry climate, often with high winds, is compared with that of similar species of the South Temperate Zone.

So far as known, the Iles Kerguelen have a completely endemic flora showing no close relation with that of Antarctica. The Macquarie Island flora shows a close relation to the alpine flora of the South Island of New Zealand, the Aucklands and Campbell Island. The flora of Tierra del Fuego shows some relation to the flora of the northern half of the Palmer Peninsula (Graham Land) via the South Shetlands, with several genera which have not penetrated farther into Antarctica. Other genera perhaps have penetrated Antarctica by the same route so long ago that they have differentiated many species and species groups in various regions of Antarctica. The evidence is quite clear for *Usnea* subg. *Neuropogon* and *Buellia* and probably accounts for the diversity of endemic species found in the Lecideaceae, Lecanoraceae and Blasteniaceae.

TITLE: A preliminary review of Antarctic bryophytes

AUTHOR: William C. Steere, Director, New York Botanical Garden, Bronx Park, New York, New York.

This review is not restricted to Antarctica itself but covers also Antarctic islands whose climate approaches or equals that of the continent in its severity because so many collections have come from these islands.

The much greater severity of the Antarctic climate over the Arctic climate, latitude for latitude, is demonstrated dramatically by the plants present in both areas, especially the bryophytes. About 150 species of bryophytes are found in Greenland, north of 80° N. and an equal number in the vicinity of Alert on Ellesmere Island, northward from 82° N. At latitudes southward from

60° S., the bryophyte flora is already very much reduced, and even on the much explored South Shetland Islands, South Orkney Islands, Palmer Archipelago and Palmer Peninsula (Graham Land), the number of species found is far below that of much higher Arctic latitudes. A maximum of 75 species of mosses and hepatics has been reported from Antarctica, including those areas outside the Antarctic Circle in which an Antarctic climate prevails. Of these 75 species, several eventually may turn out to be synonymous with other species, thereby reducing the number. Whereas one finds many species and genera endemic to Arctic regions, and widely distributed therein, the Antarctic mosses and liverworts show a low percentage of endemic species and a surprisingly large percentage of species with a broad, almost cosmopolitan, distribution, especially in the Northern Hemisphere.

The first mosses brought back from Antarctica were the collections of Joseph D. Hooker, surgeon and naturalist to Captain Ross's Antarctic Expedition in the *Erebus* and *Terror*, 1839–43. He reported five species, of which two are proposed as new. No further collections were made for over a half century. Then a long series of Antarctic voyages began for the discovery of the South Pole, in the course of which some mosses were obtained.

Jules Cardot produced an excellent review of Antarctic mosses in 1908, ostensibly to report the collections of the Swedish South Polar Expedition, 1901–03, but in fact it was a comprehensive report on all previous collections, most of which had passed through Cardot's hands. More than a half-century after Cardot's report just cited, the literature and species of bryophytes of Antarctica and of South Georgia were again compiled and reviewed.

After the attainment of the South Pole by Amundsen in 1911, attention turned to geographic exploration of a more scientific nature, with greater emphasis on the acquisition of data and of collections of plants and animals. The long series of expeditions to Antarctica, and the attitude of scientific discovery and international co-operation established by the International Geophysical Year, have added and will continue to add important knowledge to the mosses and other plants of Antarctica.

Important background information is available in two important papers. Siple has given us an excellent first-hand account of the habitats and of the nature of the environment under which Antarctic bryophytes exist. Llano has provided a helpful recapitulation of the several expeditions that have collected plants in Antarctic regions, and has brought the literature up to date.

This review of the systematics, geographical distribution and ecology of the mosses and hepatics of Antarctica is entitled "preliminary" because it can be only an approximation of the true situation. The vastness of the Antarctic region, the difficulties of travel, and the incomplete collecting of bryophytes by non-specialists combine to give us an imperfect picture of the bryological flora and its distribution. Collections made in the field by competent experts will bring about a much better understanding of the true nature and distribution of the species concerned—and such collections are much needed, indeed. Moreover, many collections from Antarctic regions are still

unidentified and unpublished, especially those resulting from the relatively recent activities of the International Geophysical Year. IGY collections are now being studied in Sweden, Russia, Great Britain, Japan, the United States and elsewhere. The published results of these investigations will materially supplement our present knowledge, as reviewed here.

TITLE: Experimental taxonomic studies in Antarctic floras

AUTHOR: D. M. Moore, Botany Department, University of Leicester, England.

The application of the methods and concepts of modern taxonomy to the problems posed by the disjunct floras circling the Antarctic continent has lagged far behind their use in other regions. Data on cytology, hybridization, breeding systems, etc., comparable to those available to students of, for example, the Arctic, are required before further useful progress can be made in understanding the evolution and distribution of the southern circumpolar floras. The small amount of available data, particularly on chromosome numbers, will be evaluated with regard both to the relationships of species within the sub-Antarctic floras and also to their affinities with relatives in other parts of the world.

TITLE: A mycological study of the Antarctic air

AUTHOR: A. Corte and C. A. N. Daglio, Instituto Antártico Argentino, Cerrito 1248, Buenos Aires, Argentina.

Disks have been exposed containing special nutrients, and 169 colonies of microfungi have been isolated from airborne spores, corresponding to the Bahía Esperanza area (lat. 63° 23′ S.; long. 56° 59′ W.), in the 1958–59 summer; Estación Científica Ellsworth (lat. 77° 39′ S.; long. 41° 02′ W.) in 1959 and Cabo Primavera (Danco Coast) (lat. 64° 10′ S.; long. 60° 57′ W.) in 1960–61 summer.

Eight microfungus genera were identified, i.e. *Penicillium*, *Aspergillus*, *Mucor*, *Cladosporium*, *Curvalaria*, *Helminthosporium*, *Phycomyces* and *Miceliae sterilia*, of which only the first three were known for the Antarctic continent and the rest, together with their species, are for the first time recorded for the south-polar environment.

TITLE: Study on Antarctic basidiomycetes

AUTHORS: R. Singer, Professor of Botany, University of Tucumán, San Miguel de Tucumán; and A. Corte, Instituto Antártico Argentino, Cerrito 1248, Buenos Aires, Argentina.

A systematical ecological investigation has been conducted on the first basidiomycetes to be known to the present belonging to the aboriginal mycological flora of the Antarctic continent.

In all, they make a total of five species and one variety of the genera *Omphalina* and *Galerina*; two of them are new to science and have not been found on

other continents or sub-Antarctic islands. The said species may be divided as follows: (1) proper to the Antarctic; (2) found in the Antarctic and also on sub-Antarctic islands (Macquarie); and (3) Antarctic, sub-Antarctic and Arctic.

TITLE: The distribution of vascular plants in Iles Kerguelen

AUTHORS: A. Lourteig and P. Cour.

The authors have revised the species of vascular plants found in the Iles Kerguelen, on the basis of older collections in the herbarium of the Muséum National d'Histoire Naturelle, Paris, and more recent collections made by botanists of different expeditions.

The distribution of each species is mapped, both in the Iles Kerguelen and in the Antarctic zone as a whole. These examples are particularly interesting because, in some cases, as the range of a species increases, the degree of endemism for the archipelago disappears.

The authors have been unable to revise collections in other countries, but used some standard works in making their distribution maps.

The distribution maps are not definitive, but the authors hope to complete them after examining collections from Iles Kerguelen, and other sub-Antarctic islands, preserved in herbaria all over the world.

Session 5. Biogeography and systematics—Marine zoology

Chairman: Dr N. A. Mackintosh (Great Britain)

TITLE: The distribution of Antarctic Chaetognaths

AUTHOR: P. M. David, National Institute of Oceanography, Wormley, near Godalming, Surrey, England.

The Antarctic convergence is normally regarded as the northern boundary of the Antarctic zone, but the Chaetognath fauna is limited more distinctly by the sub-tropical convergence, and the distribution of the species in the sub-Antarctic and Antarctic regions together shows that they contain a discrete faunal entity little affected by the conventional Antarctic boundary. The high percentage of endemic species in such a small fauna suggests a considerable period of isolation. The lack or diversity of the fauna may in a large part be a reflexion of the relatively simple hydrological conditions.

TITLE: On biogeographical division of pelagial zones of the southern hemisphere according to the distribution of *Calanus* species (Copepoda)

AUTHOR: K. Brodskiy, Zoological Institute, Academy of Sciences, Leningrad, USSR.

In 1959, at the First International Oceanographical Congress, there was reported the scheme of division of south Pacific Ocean pelagial based on data which were obtained by the third cruise of the Soviet Antarctic expedition on board the research ship *Ob*.

The analysis of plankton samples has been gathered by the first and second cruises of that expedition and critical review of published data confirmed the supposition that zones established for the south Pacific Ocean are the same for all the oceans around the Antarctic.

The characteristics of the typical species of biogeographical zones have been studied by means of biometrical treatment of some morphological features. This analysis has shown that the variability of these species has a smaller amplitude as compared with the species of similar northern latitudes.

It is connected with the less degree of the underspecific differentiation of the southern species. Nevertheless, biometric analysis has revealed the distinct clinal variability of the body size of adult females of the southern *Calanus* species.

This clinal variability is postulated by the geographical position of the investigated specimens. We stress now that the "real" Antarctic species have the features as from the geographical point of view (the Area) so from the ecological (the character of the variability). Both sides of this aspect are very close together and it is very difficult sometimes to separate the influence of geographical and ecological factors.

So the areas of *C. propinquus* and *C. acutus* well define the Antarctic zone or biogeographical region. The body length of ripe females of these species decreases regularly from south to north from 5·53 and 5·20 mm., in lat. 70 to 65° S. and from 5·34 to 4·70 mm. in lat. 65 to 60° S. The limit of areas of these species and of the Antarctic zone are the same: the coast of Antarctica and Antarctic convergence. The area of *C. simillimus* defines "interzonal region" of the Antarctic divergence up to lats. 45 to 50° S. and sometimes to lat. 40° S. to the so-called sub-Antarctic divergence. Variation in body length of females of this species is quite different from the two preceding species. In the central part of the area (Antarctic convergence) females of *C. simillimus* are smaller. Notal or Austral zone (lats. 50 to 55° S. and 35 to 40° S.) is well defined by the areas of *C. tonsus* and *C. australis*.

TITLE: On the composition and origin of the Antarctic pelagic fish fauna

AUTHOR: A. P. Andriyashev, Zoological Institute, Academy of Sciences, Leningrad, USSR.

As a result of the three-year investigations of the Soviet Antarctic Expedition on board the R.V. *Ob*, 1955–58, valuable additional collections on the Antarctic pelagic fishes were obtained. Some families, genera and species found were new ones for the Antarctic Zone and some were new to science. At present about 60 pelagic species and 25 families of fishes are known from the water south of the Antarctic convergence. This pelagic fauna consists of three groups, each of which is cold-adapted but different in its origin. (1) The largest group is formed by species of the widespread bathypelagic families, the most specific variety of which is observed in tropical and temperate parts of the oceans. Some of them constantly live and breed in cold Antarctic water and have a number of endemic species (species of Bathylagidae, Gonostomatidae,

Paralepididae, Myctophidae, probably Scopelarchidae and Trichiuridae). Other representatives of the bathypelagic families are unlikely to live constantly in the Antarctic zone, but nevertheless are known from the water southward of the Antarctic convergence (some species of Sternoptychidae, Astronesthidae, Idiacanthidae, Stomiatidae, Notosudidae, Anotopteridae, Melamphaidae, Oreosomatidae, Ceratiidae and some anguilliform families). All species of the first group are not connected with the continental shelf as they have pelagic eggs. (2) A separate small group consists of bathypelagic species, belonging to the bottom deep-water families, e.g. *Cynomacrurus piriei* (Macruridae) and *Melanonus gracilis* (Moridae). (3) A very peculiar group of pelagic fishes originates from the coast fish families, some representatives of which are secondary adapted to the temporary or constant life in the pelagial. These are many nototheniids (*Pleurogramma antarctica*, some species of *Trematomus*, *Notothenia* and *Dissostichus*), some of so-called "white-blooded" fishes or Chaenichthyidae (species of *Cryodraco*, *Neopagetopsis*, *Champsocephalus*, *Pseudochaenichthys*, etc.) and even such true bottom fishes as Bathydraconidae (*Gymnodraco*). All these species belong to the aboriginal ancient elements of Antarctic fauna. They are distributed less widely in the Antarctic pelagial than are bathypelagic species because they are connected with the Antarctic shelf and islands during their spawning time. Their adaptation to the pelagic mode of life is due to the use of the rich feeding resources of the "krill zone".

TITLE: Some convergences between the benthic fishes of polar seas

AUTHOR: N. B. Marshall, British Museum (Natural History) London.

Three-quarters of the ninety-odd species of benthic fishes in Antarctic waters belong to the Nototheniiformes, a division of percoid fishes of the order Percomorphi. Two minority groups in the Antarctic, the Zoarcidae (eel-pouts) and Liparidae (sea-snails) are among the most diverse families in Arctic seas. Other dominant Arctic fishes include the Salmonidae, Gadidae, Cottidae, Agonidae and Pleuronectidae. All of these groups of arctic fishes are remotely related to the Nototheniiformes.

The convergences between Arctic and Antarctic benthic fishes are: (1) no species is a permanent mid-water fish; all spend some or all of their adult life near the sea floor; (2) they lay relatively large eggs on the bottom, which hatch into comparatively advanced kinds of larvae; (3) many of the notothenioid fishes have the following features: a large, bull-like head, with capacious gill chambers, rather poorly developed lateral muscles, large, broad-based pectoral fins, and a square-cut or rounded caudal fin. Certain notothenioid fishes are reminiscent of the northern Hexagrammidae, etc.

The implications of these convergences are discussed from functional and ecological aspects.

TITLE: Zoogeography of Antarctic benthic mollusca

AUTHOR: R. K. Dell, Dominion Museum, Wellington, New Zealand.

The Antarctic faunal region is difficult to define because earlier writers have included amongst its forms those found around the Antarctic continent itself as well as those recorded from the islands of the Scotia Arc and from the sub-Antarctic Islands. Most boundaries have been based on geographical, hydrological or climatic barriers but the only valid methods of subdivision should be based upon faunal analysis. Such analysis cannot at present be considered to be anywhere complete.

When studying the molluscan fauna of the whole southern region it is possible to distinguish several distinct faunas. These in general are:

(1) species found around the Antarctic continent;

(2) species confined to one or other group of islands in the Scotia Arc;

(3) species obviously reaching the Antarctic continent only in the vicinity of the Scotia Arc;

(4) species characteristic of the sub-Antarctic islands.

For purposes of zoogeographic discussion, the fauna of the Antarctic proper is taken to be those species which occur around the shores of the Antarctic continent outside the area of the Weddell Sea, Graham Land and the Bellinghausen Sea; used in this sense, the Antarctic fauna comprises 91 families of benthic mollusca, containing 154 genera and 309 species. This is a highly restricted fauna, each family containing an average of 1·7 genera and 3·4 species.

This restricted Antarctic fauna has been derived from the following sources:

(1) an "old" Antarctic fauna;

(2) a group which has been derived from South America through the islands of the Scotia Arc;

(3) a deep water group, probably derived from deep water faunas in the South Atlantic, South Indian and South Pacific Oceans.

To a certain extent the Antarctic species are spreading outwards from the continent by means of the islands of the Scotia Arc, and thence probably to some of the sub-Antarctic islands by means of the West Wind Drift.

The Antarctic fauna is essentially a deep water fauna, and a high percentage is probably distributed right around the continent. Obviously much more extensive collecting requires to be done to supply sufficient evidence.

Faunal comparison between the sub-Antarctic and the Antarctic has usually been made between the known sub-Antarctic fauna which is largely littoral-shallow water while the fauna of Antarctica is essentially deep water. Before such comparisons are accepted as valid, we need to know much more of the deep-water fauna of the sub-Antarctic islands. This is practically unrecorded, even the littoral faunas of some areas are poorly known, especially for the Iles Crozets.

Session 6. Biogeography and systematics—Terrestrial zoology

Chairman: Dr L. Harrison Matthews (Great Britain)

TITLE: Antarctic petrels

AUTHOR: Robert C. Murphy, The American Museum of Natural History, New York, New York.

(Because the climatic Antarctic prevails over a much greater area than the climatic Arctic, biotic phenomena are best related to the Antarctic convergence rather than to a mathematical Antarctic Circle.)

Distribution of the Procellariiformes coincides with ocean water, including that of enclosed seas. Of the approximately 100 species, 19 normally range in Antarctica.

Antarctic breeders number 11 species of 11 genera; every natural group of the Order is represented. Respective zonal ties, however, vary widely. Only *Pagodroma*, the Snow Petrel, is restricted to Antarctica. Other species reproduce there but may migrate to milder zones, or even across and beyond the tropics. This diversity has evolutionary significance because the species which make the farthest seasonal departures have temperate or subtropical relatives. Strictly Antarctic petrels belong to a group which in both north and south polar areas is associated with water of minimum temperature.

Even such fulmarine petrels as *Pagodroma*, *Thalassoica*, *Fulmarus* and *Daption* exhibit unexplained discrepancies in their respective climatic controls. All four nest in icy highlands, sometimes far from open water, but only *Pagodroma* is virtually unknown north of the convergence. *Thalassoica* crosses this boundary to a limited extent; *Fulmarus* and *Daption* follow cool-current areas well toward the equator.

Pagodroma may be unique among birds in that it appears to lack "standard size". Variation transcends that of other homoiotherms, yet has defied racial interpretation.

Food of Antarctic petrels, both endemic forms and seasonal invaders, is of notable uniformity, primarily crustaceans of a single group and cephalopods. Physiological problems relate to the transport of undigested food in the stomach over long distances before it can be transferred to fledglings.

The rigorous Antarctic environment is reflected in high egg and chick mortality, whereas adult viability is exceptionally favourable. Recoveries have been made after intervals of one or more years of numerous marked petrels linked with their original mates and nest sites. Although control by predators and the severe physical milieu is weighted against immature stages, a single egg, coupled with single annual egg production, is sufficient to maintain populations estimated to be among the largest in the Class Aves.

TITLE: Distribution patterns of birds in the Antarctic and high-latitude sub-Antarctic

AUTHOR: R. A. Falla, Dominion Museum, New Zealand.

It is considered that, in spite of gaps, the distribution pattern of the breeding birds of Antarctica is sufficiently well known to justify some theorizing on the nature of the controlling and limiting factors. It is, however, clear that the testing of such theory now depends on extended knowledge of the composition of the bird fauna in the areas unknown or imperfectly studied. This applies to considerable sectors of Antarctic continental coastline and hinterland, and to several island groups.

The marked absence of sub-speciation or of intrageneric speciation within the Antarctic Circle is considered to be due to the uniformity of habitat. Freedom of circumpolar movement is likely, but remains unproved. The status and ecology of the few species (one penguin, one petrel) that are not circumpolar requires more study.

Non-breeding range beyond the polar zone is found only in the more omnivorous of the scavengers (skua, giant fulmar, Cape Petrel, and Wilson Petrel), three of which also breed beyond the polar zone.

The distribution pattern in the high latitude sub-Antarctic foreshadows the much more complex pattern of isolated populations characteristic of low-latitude breeding areas, and examples are cited to illustrate this.

Finally considered are the significance and effectiveness of current programmes of banding and of field studies in relation to the problem.

TITLE: Distribution of the Pygoscelid Penguins

AUTHOR: William J. L. Sladen, Department of Pathobiology, Johns Hopkins University, School of Hygiene and Public Health, 615 North Wolfe Street, Baltimore 5, Maryland.

Evidence will be presented for what is believed to be a general increase in numbers and spread of the Pygoscelid Penguins (Adélie, *Pygoscelis adeliae*; Chinstrap, *P. antarctica*; and Gentoo, *P. papua*). The most striking is the Chinstrap Penguin which, up to 20 years ago, was considered to have a strictly segmental distribution centred on the Scotia Sea area, and which can now be considered almost circumpolar. Three possible reasons for this change—climatic, reduced predation from man and the vast increase in potential food supply as a result of the whaling industry—are discussed.

Our knowledge of penguin distribution and numbers is still fragmentary. Opportunities for co-operation with other disciplines (e.g. cartography, photography) are available to the Antarctic ecologist. Suggestions are made for unifying methods, and for international co-operation.

TITLE: The distribution and host relationships of fleas in the sub-Antarctic

AUTHOR: G. M. Dunnet, Cultery Field Station, Newburgh, Aberdeen.

Twenty-one forms of fleas belonging to two distinct phylogenetic groups are now known from both penguins and flying birds in the Southern Ocean. There are nineteen forms of Parapsyllinae (18 of *Parapsyllus* and 1 *Listronius*), Rhopalopsyllid fleas derived from rodent fleas of South America, and 2 species of *Notiopsylla* a Pygiopsyllid flea presumably derived from the stock of *Pygiopsylla* now represented by many species on ground-dwelling rodents and marsupials mainly in the Australian region. Detailed knowledge of these parasites may well provide new information regarding the origin of their hosts.

Since the review by de Meillon in 1952, one new species of *Notiopsylla* and at least 5 new species of *Parapsyllus* have been found in the southern Australia–New Zealand–Macquarie Is. area, and a new species of *Parapsyllus* from western South America; and the first collection has been made on the Antarctic continent. A great deal of collecting remains to be done on other Antarctic and sub-Antarctic areas. Current interpretation of distribution patterns and host relationships is clearly risky in view of our imperfect knowledge.

Notiopsylla species are found on a large variety of flying birds, but not on penguins; *kerguelensis* is circumpolar but *enciari* has so far been found only at Antipodes Is., Macquarie Is., Stewart Is., and Auckland Is. in the Australia–New Zealand area.

Parapsyllus magellanicus has one sub-species on the Falkland Is. and another recorded from Marion Is., Iles Kerguelen, Heard Is., and Macquarie Is.; it occurs on both penguins and flying birds. *P. longicornis* now has 7 sub-species, each localized at relatively low latitudes all round the Southern Ocean. They occur on both penguins and flying birds. *Parapsyllus taylori*, *P. cardinis* and 4 undescribed *cardinis*-type species from New Zealand are all found on flying birds, and only one from penguins as well. The new South American species is from a petrel. Thus the opinion that *Parapsyllus* are primarily penguin fleas is open to doubt, they may have taken to penguins via the petrels.

Much of the life of a flea is spent in the nest, not on the body, of its host. Geographical distribution depends partly on the ability of the fleas to survive the Antarctic winter, and very interesting ecological problems are involved.

It is hoped that more general collections will be made and special attention should be given to collecting fleas from all sea-birds in the following places: Falkland Islands Dependencies, South Georgia, Graham Land and its associated islands, islands in the New Zealand area, and all parts of the Antarctic continent.

Session 7. Marine productivity

Chairman: Prof. J. T. Ruud (Norway)

TITLE: Marine bottom productivity at McMurdo Sound, Antarctica

AUTHOR: Willis L. Tressler, U.S. Navy Hydrographic Office, Washington, D.C.

During the winter of 1960–61, a series of oceanographic stations was taken over a period of nearly a year at an icehole located three miles south of "NAF McMurdo". The icehole was covered by a 24 × 20 ft. insulated hut which provided a warm field laboratory for oceanographic and biological observations. A large generator supplied current for two oceanographic winches.

Systematic sampling of the bottom was carried out with a Peterson grab sampler and by the use of bottom tangles and fish traps. The bottom was found to harbour a rich and wide variety of invertebrate forms and at least five species of fish. Because of the steady movement of the ice, the hole and hut moved over a portion of the bottom which was determined to be about 350 ft. in length. For this reason the bottom sediments and associated organisms showed great variety.

At intervals of about two weeks routine observations were made of sea water temperatures, salinity and dissolved oxygen. Subsurface currents were measured with an Ekman current meter. Oceanographic samples and current measurements were made at eighteen different levels from the surface to the bottom (580 m. depth). Oceanographic factors were very constant during the winter but by early summer micro changes in the upper waters became apparent. Temperatures rose, dissolved oxygen increased markedly while salinity decreased. There was little change in the deeper water. Currents averaged about one-half knot of drift and were of tidal origin. The maximum observed currents occurred at 500 m. and amounted to 1·83 knots.

TITLE: Seasonal variations in the distribution of plankton biomass in the Southern Ocean

AUTHOR: P. Foxton, National Institute of Oceanography, Wormley, Godalming, Surrey, England.

One of the most important features of the commoner zooplankton organisms of the Southern Ocean is their marked seasonal cycle. It will be shown using plankton displacement volume as a measure of standing crop, that these seasonal changes are reflected in marked variations in the distribution of the biomass. During the summer months the bulk of the zooplankton is concentrated in near surface waters by day and night, but in winter many of the commoner species migrate into deeper water where they overwinter. During the winter months therefore there is a decrease in the biomass of the near surface waters and an increase in the biomass of the deeper waters. Seasonal variations in biomass can be seen at each depth horizon sampled between the surface and 1,000 m. but when the whole water column is considered it is

found that the data show little seasonal change. This is attributed to the effects of the pronounced winter vertical migration into the warm deep current.

TITLE: Productivity in waters north and south of the Antarctic convergence in the American sector

AUTHOR: Paul R. Burkholder, Lamont Geological Observatory of Columbia University, Palisades, New York.

Observations on productivity of waters in the Gerlache and Bransfield Straits, Scotia Sea, and Antarctic convergence between long. 60° and 120° W. were made on the research ships *Vema*, *Eltanin*, and *Chiriguano* in the period 1958 to 1962. Observations were made on the quantitative occurrences of species of phytoplankton present in samples collected at different depths in the photic zone at numerous stations. Plankton was collected with Clarke-Bumpus No. 20 nylon nets and by means of a water pump that permitted straining the plankton from large measured volumes of water. Chlorophyll *a* was determined by Millipore filtration of 1-litre samples of water and measurement of pigment absorption in acetone extracts using a Beckman spectrophotometer. Photosynthesis was determined by ^{14}C fixation and by oxygen production in dark and light bottles kept in an incubator equipped with neutral density filters that allowed adjustment of light values approximately equivalent to the light penetrating to the sampling depths, as measured with a submarine photometer.

The results indicate that primary productivity of phytoplankton in Antarctic waters is unevenly expressed, in response to variable factors imposed by the fluctuating cold climate, ice conditions that influence the penetration of light, and dissolved nutrients that are available. Near islands or in certain regions of mixing and relatively high intensities of light in the waters, heavy blooms of phytoplankton occur during the Antarctic summer. In regions of prolific ice and less satisfactory conditions for CO_2 fixation and growth, the plankton is scarce. Data will be presented in charts to show geographic distribution of phytoplankton, chlorophyll, nutrients and light penetration, and some explanations for the varying primary productivity will be offered, with supporting data, calculated from the quantitative observations.

TITLE: Benthos in Antarctic waters

AUTHOR: N. A. Holme, Marine Biological Association, Citadel Hill, Plymouth.

Around the Antarctic continent the sea bed slopes rather steeply to deep water, so that a continental shelf is virtually absent. Such shallow-water faunas as exist are separated from the nearest shallow-water forms in lower latitudes by many hundreds, or thousands, of miles of deep water. This isolation results in a higher proportion of endemic species and genera than in the Arctic. The Antarctic fauna is surprisingly rich in species, with a high proportion of echinoderms and sponges in particular, although decapod Crustacea are poorly represented.

Our knowledge of the fauna is based on dredgings carried out as circumstances permitted during past expeditions, but more recently a start has been made on more quantitative investigations, using grabs and underwater cameras, by Bullivant in New Zealand, and in the productivity studies which are the subject of Dr Tressler's paper.

The importance of the benthos in the economy of the sea is very roughly inversely proportional to depth. It is unlikely that the abyssal fauna of the Antarctic, although of great zoological interest, plays any significant part in the economy of the area. The only region in southern latitudes where a shallow shelf fauna plays any significant role in the economy is on the Patagonian Shelf, some 600 miles long and 250 miles wide, which was surveyed by Gunther and written up by Hart in a *Discovery* report.

Session 8. Ecology of invertebrates

Chairman: Dr J. B. Cragg (Great Britain)

TITLE: Ecology and biogeography of land arthropods in Antarctica

AUTHOR: J. L. Gressitt, Bernice P. Bishop Museum, Honolulu, Hawaii.

Land arthropods are probably the southernmost living animals (lat. 84° S.). Thus they are of interest in terms of survival, limiting factors, food-cycles, physiology, dispersal and establishment. Data are meagre on climatic tolerance and detailed ecology. Indications are that both mites and springtails tolerate temperatures below −60° C. Above-ground summer air temperatures in their environments are rarely above freezing, but existence is possible by absorption of solar energy by exposed rock situations where plants and animals exist. Moisture from snow-melt or glaciers is essential as the air is dry.

The land arthropods of Antarctica include about 13 species of mites, 2 ticks, 11 springtails, 17 biting lice on birds, 6 sucking lice on seals, and 2 flies. The ticks, lice and part of the mites being closely associated with their hosts will not be discussed in detail.

As a rule, springtails and free-living mites occur in the same environments as the plants, which are likewise primitive forms. The insects are found where lichens, moss, algae and liverworts occur. Sometimes they occur where only algae appear to grow. Being the most widespread plants, lichen and algae appear to be the most important food. Feeding has been observed on lichens. A few of the mites are predacious, primarily on eggs of springtails. Thus, food chains are extremely simple. There appear to be no other predators.

Activity is controlled by temperature, but there is evidence that some development takes place at temperatures below freezing during "hibernation". In general, the insects are hidden under rocks when weather is cold and windy, but they move about on the plants on upper surfaces of rocks in good weather. There is apparently more than one generation per year in northern parts of the continent. The two flies breed in fresh or brackish water with organic material, in the northernmost areas only.

A major question is whether the existing free-living species represent a remnant of the temperate fauna which must have existed on the continent with the known fossil flora before periods of greater ice coverage. If none of them do, then they probably have come as wind-borne immigrants from south temperate or sub-Antarctic areas. Recent dispersal investigations suggest that this is quite possible.[1] Other evidence of air dispersal is found in some of the situations inhabited by the insects, such as recently de-glaciated areas and moraine on glaciers. Another possibility is that the fauna consists of both remnants of an old fauna and new immigrants.

A number of the species of mites and springtails occur both in Antarctica and on sub-Antarctic islands, and some are even more widely dispersed. Workers disagree on the zoogeographical significance of these groups, because some species are so widespread, but more can be said on this question when the taxonomy and distribution are better known. Both of the flies (one wingless and one sometimes winged) occur in sub-Antarctic areas on the South American side. One of the sub-families concerned does not occur in New Zealand. This suggests re-invasion of the continent.

TITLE: Feeding preferences and the ecological role of Antarctic pycnogonida

AUTHOR: William G. Fry, Assistant to the Director, Pacific Marine Station, University of the Pacific, Dillon Beach, Marin County, California.

During the austral summer of 1961–62 a study was made of the feeding preferences of two morphologically similar species of pycnogonids of the genera *Austrodecus* and *Rhynchothorax* which are present in large numbers in the McMurdo Sound area on one particular type of substrate.

The different feeding preferences demonstrated can certainly be correlated with morphological differences in the proboscides of the two species. Two other instances of food specificity or preference were noted in the same area.

These findings suggest a modification of the theory that the preferred foods of pycnogonids are Hydroid or Actinozoan tissues. In addition, the food preferences demonstrated suggest one possible reason for the great relative abundance and wide morphological and systematic diversity of the Antarctic pycnogonid fauna. This fauna is also unusual in the high frequency of occurrence of two phenomena which have been the cause of discussion for a long time; namely, gigantism and polymery.

Over most of its range the details of pycnogonid morphology are well documented, but such documentation does little to clarify the intra-relationships of the group. Continued work on the ecology and functional morphology of Antarctic forms will provide important insights into such relationships, and in so doing demonstrate the ecological importance of pycnogonids in Antarctic waters.

TITLE: Annual zooplankton cycles beneath McMurdo Sound sea ice

AUTHOR: Jack Littlepage, Department of Biological Sciences, Stanford University, Stanford, California.

Annual changes in the lipid content of two marine crustaceans have been studied to determine the effect of the polar winter upon the amount of stored food reserves. Specimens were taken through holes cut in sea ice at the southern end of McMurdo Sound in the Ross Sea.

A copepod, *Euchaeta antarctica* Giesbrecht, and a euphausiid, *Euphausia crystallorophias* Holt and Tattersall, illustrate two different effects of the Antarctic winter upon lipid storage in marine crustacea.

Lipid content was measured by total ethyl ether extraction with modified microsoxlet extractors.

Euchaeta antarctica, a large copepod averaging 10 mm. in total length, which contained a relatively high lipid content throughout the period of study, had lowest lipid values in the early winter followed by a lipid increase during the remaining winter months. In contrast to this gradual increase, a gradual decrease in lipids occurred in *Euphausia crystallorophias* as the winter progressed.

The difference in lipid content is directly related to available food supply during the winter months. *Euchaeta antarctica* is a large predacious carnivore feeding on smaller zooplankton, while *Euphausia crystallorophias* is a phytoplankton filter feeder. Chlorophyll analysis and visual examination indicate the complete absence of pelagic diatoms from May to October. Diatom production is high only during two summer months; therefore, storage of lipids by *E. crystallorophias* is directly related to available summer phytoplankton. Since small zooplankton were found in great abundance at all depths during the winter months, a continual source of food existed for the predacious form *E. antarctica*.

Any *a priori* hypotheses suggesting a general decrease of stored lipids in marine animals during the winter months must take into account possible food organisms and their seasonal availability.

TITLE: Ecology on the Antarctic fringe

AUTHOR: M. W. Holdgate, Scott Polar Research Institute, University of Cambridge, England.

In the Antarctic zone, plant growth and invertebrate activity depend primarily on incident radiation. Signy Island, in the South Orkney group is typical of the "outer Antarctic" zone and has a fairly rich flora of bryophytes as well as two species of flowering plant. This vegetation is distributed in accordance with exposure, ground wetness, insolation and soil stability, and the two flowering plants are especially concentrated in flushed, lowland, "radiation traps". Measurements show that the surface layers of moss mats are quickly warmed by the sun and may reach over 10° C. even when the air temperature is near to freezing point. This capacity to absorb radiation is probably related to the structure of the mat and its large air-space, and

different moss species, in different situations, vary both in temperature and air space at any one time. These conditions are of great importance to the terrestrial fauna of mites and Collembola, whose abundance varies from level to level in a moss mat and from vegetation type to vegetation type. Comparison with other areas leads to the belief that these features are likely to be of ecological importance throughout the Antarctic region. Observations made in the isolated South Sandwich island are suggest further that ecological rather than distributional difficulties underly the barrenness of many Antarctic regions, for in this group, much of which is strikingly barren, active fumaroles on two recent volcanoes are surrounded by rich vegetation mats.

TITLE: Ecology of the ectoparasites of seals and penguins

AUTHOR: M. D. Murray, McMaster Animal Health Laboratory, C.S.I.R.O., Parramatta Road, Sydney, Australia.

Seals and penguins can live both on land and in the sea. However, the physiological adaptations which enable them to live in these habitats differ. One consequence is that the environmental hazards to which their permanent ectoparasites are exposed are considerably greater on seals than on penguins. Thus the lice of seals differ in many respects, morphologically and physiologically, from the lice of other mammals, whereas penguin lice are very similar in their ecology to the lice of other birds.

Temporary ectoparasites, such as fleas and ticks, have not been reported from seals in Antarctic and sub-Antarctic regions, whereas they may be abundant on certain penguins, particularly on those which build nests repeatedly in well-drained situations. The main factors which limit the distribution of ticks and fleas on penguins appear to be cold temperatures and water, the former freezing and the latter drowning the overwintering stages.

The data to be presented will be mainly from studies carried out and in progress on Macquarie Island and at Wilkes station on the Antarctic continent supported by relevant information from elsewhere.

Session 9. Ecology of vertebrates

Chairman: Prof. F. Bourtière (France)

TITLE: Population studies of Antarctic seals and birds

AUTHOR: Carl R. Eklund, Polar Research Branch, Environmental Sciences Division, Arlington Hall Station, Arlington, Virginia.

Population studies of seals and birds have never been attempted over an extensive area of Antarctica prior to the IGY. This paper describes systematic censuses carried out on the Crabeater, Leopard, and Ross Seals, and the south polar skua. Some observations are made on penguin numbers.

Seal counts were made in the Ross Sea area and the Knox–Budd coast sector of the Indian Ocean in December 1956 and January 1957. The skua

census was carried out from Wilkes station in the Windmill Islands over a 13-month period in 1957 to 1958.

Visual counts were made from icebreakers during 330 miles of traverse through the pack ice. Distances of seals at right angles to the ship were estimated and these observations were used as basis for determining width of the strip censused over the pack. Numbers per square mile were then calculated for the various species. Attempts were made to correlate density of the pack ice with population densities.

Crabeater Seals averaged 13·0 per square mile in the Indian Ocean sector and 1·9 in the Ross Sea area, while Leopard Seals averaged 0·5 in the Indian Ocean and 0·03 in the Ross Sea. A population of 0·3 Ross Seals per square mile was estimated in the Indian Ocean area. Total extent of the Antarctic pack ice during the period of the census was calculated on the basis of present ice charts, and a total species population estimate is made.

South polar skua populations were estimated through use of the Lincoln Index applied to 258 banded and unbanded birds captured with a cannon projectile net. Approximately 2500 adult skuas are estimated to occupy a 500-mile sector of the Knox–Budd Coasts during the summertime.

It is proposed that the various nations consider adoption of standard wildlife census techniques applicable throughout Antarctica. In this way meaningful estimates of animal populations in this area may eventually be determined.

TITLE: Feeding preferences of the albatrosses *Diomedea melanophris* and *Diomedea chrysostoma* at South Georgia

AUTHOR: W. L. N. Tickell, Department of Pathobiology, Johns Hopkins School of Hygiene, Baltimore, Maryland.

In South Georgia breeding populations of *Diomedea melanophris* and *D. chrysostoma* total about 100,000 pairs. Rookeries of both species are situated at the north-west and south-east extremities of the island, and on Annenkov Island to the south. They may be segregated or contain varying proportions of both species.

Nestlings of these albatrosses readily regurgitate their stomach contents, a facility offering an excellent opportunity for quantitative investigation of food types and their relation to plankton distribution which, in the south Atlantic and Scotia Sea, is well documented as a result of the *Discovery* investigations.

A total of almost 240 lb. of regurgitated food was collected from 220 nestlings of both species during the seasons 1958–59 and 1960–61. In the field, samples were examined and identifiable fragments preserved. When sorted these were found to comprise the following groups: lampreys, fish, tunicates, decapod, amphipod, isopod and euphausian crustacea. Evidence of marine carrion in the form of seal hair and bird feathers was present as well as artifacts originating from ships' refuse.

In examining the relative proportions present in *D. melanophris* and *D. chrysostoma* there are indications that although fish and squid are staple to

both species euphausians may be taken more by *D. melanophris*. *D. chrysostoma* on the other hand accounts for more tunicates, decapods and amphipods as well as the southern lamprey *Geotria australis* which is never found in the *D. melanophris* samples.

The analysis is quantitative only in respect to the identified classes taken and not to the relative biomass of each consumed.

TITLE: Population increase and breeding space competition in the South Georgia Fur Seal

AUTHOR: W. N. Bonner, British Antarctic Survey, Falkland Islands Dependencies.

The Fur Seals of the Scotia Arc were destroyed soon after their discovery in the early part of the nineteenth century by the commercial sealers. Sporadic expeditions prevented any repopulation during that century but today, one and a half centuries after their discovery, the herds show a measure of recovery.

A residual stock was found to persist on the rocky islets to the west of South Georgia. A colony on Bird Island visited in the thirties numbered but a few individuals. Subsequent yearly visits from 1956 onwards have shown a very great increase, the main colony producing about ten thousand pups in the last season.

Besides the local increase in South Georgia, breeding colonies, albeit small ones, have been reported in the last five years from the South Sandwich, South Orkney and South Shetland Islands. These are believed to represent overspill from the South Georgia colonies.

The main colony at South Georgia now has a very high population density and breeding seals are found over a wide range of beach types, varying from rocky coves to open sandy beaches and even the muddy tussac-covered ground behind the beaches. Preferences are shown by the cows for definite beach types and the reproductive success of the breeding bulls is related to their position on the beaches.

TITLE: Birds and mammals of Ardley Island, South Shetland Islands

AUTHOR: R. Novatti, Instituto Antártico Argentino, Cerrito 1248, Buenos Aires, Argentina.

The present paper reports on birds on Ardley Island, South Shetland Islands, lat. 62° 12′ S.; long. 58° 56′ W., with biological complementary notes on pinniped mammals in the same area. Details are given on the habitat of species nesting there and visiting the place, as well as an account of biological observations of the nesting and the ringing of skuas (*Catharacta* sp.) and giant petrels (*Macronectes giganteus*); a map is enclosed showing the distribution of colonies of nesting birds registering the disturbing influence of the reiterated human presence in the neighbourhood. The investigations were conducted in the 1959–60 summer.

TITLE: A contribution to the study of *Trematomus bernacchii* Boulenger

AUTHOR: J. C. Hureau.

This study was carried out in 1961 on the coast of Terre Adélie, Antarctica, in 66° 36′ S., 140° 01′ E. Two hundred individuals, of which about 60 per cent were females and 40 per cent males, were examined. Investigation of the relationship between gonad weight and body weight, and between liver weight and body weight, allows the development of the gonads in both sexes to be traced and the breeding period determined. The cycle of hepatic weight agrees with the sexual cycle, as described in *Mullus* by Bougis.

Problems in the growth of the species include the allometric growth of the head and age determination by examination of otoliths.

Examination of stomach contents shows that the food of the species is very varied, including algae, crustacea, molluscs, annelids and the eggs and young of other fish.

Session 10. Ecology of vertebrates

Chairman: Dr W. H. Thorpe (Great Britain)

TITLE: Territory and individual recognition in the Adélie Penguin

AUTHOR: Richard Lee Penney, Department of Zoology, University of Wisconsin, Madison 6, Wisconsin.

From February 1959 to January 1961 an intensive study of the behaviour of the Adélie Penguin was carried out at Wilkes station, Antarctica. In a rookery of 3,000 breeding birds, over 1,000 adults were flipper-banded and their nesting territories marked and mapped during the 1959–60 breeding season. Nearly 300 chicks and one-year-old juveniles were also banded and/or marked.

Working with a return percentage of 75 per cent in the next season, the male breeders were found to be characterized by an extreme fidelity to nesting territory, whereas females were primarily attached to the previous season's mate. Faithfulness to nest and mate was studied in relation to breeding success, location of nest within the colony, and general behaviour.

Under experimental conditions, as when switching incubating birds between neighbouring nests, it was found that a bird of either sex returning to take over incubation would first go to the correct nest but would then move over to and relieve the correct mate on the adjacent nest. Vocalizations at this time were found to provide the diagnostic cues for recognition of mates.

Recognition based upon vocal sounds was also demonstrated to exist between parent birds and their chicks during the creche stage of the life cycle. A parent returning to feed creche chicks calls with components of the loud mutual display when it arrives at the abandoned nest site. The chicks responding to this particular voice come running from the creche to be fed. In the confusion of a creche containing up to thirty chicks the playback of a recording of a

particular parent's voice led to response by only those chicks belonging to the voice concerned. The specificity of this response insures selective feeding of the parent's own chicks.

TITLE: Aspects of the breeding behaviour of the procellariiformes

AUTHOR: John Warham, c/o Barclays Bank Ltd, 28 Market Place, Retford Notts, England.

Like penguins, petrels and albatrosses show a marked tendency to remain faithful to the same partner and to the same nest site once they have survived a long period of immaturity.

A single egg is laid and incubated by each sex in turn for shifts lasting from 1 to 15 days during which time considerable deposits of depot fat are lost. The males usually take the first incubation shifts. The chick is brooded for a comparatively short period, particularly in burrowing species where it is abandoned by day at 2–4 days old. It is then fed (by night in burrowing species) by both parents with decreasing frequency to fledgling or, in certain migratory species, to its desertion.

Incubation periods are very long for the sizes of the birds, starting at 43 days for *Oceanites* and reaching 70–80 days for *Diomedea*. Fledgling periods show a greater range from 50 to 60 days for small petrels like *Oceanites* to 210 to 270 days for *Diomedea exulans*.

With at least eight species there is a pre-egglaying exodus in which the breeding females and sometimes the whole breeding population deserts the nesting island. This activity may be correlated with the high-energy demands involved in producing eggs that may amount to 16–25 per cent of the adult body weight.

Natural losses seem to occur mostly during incubation and mainly because one bird fails to return before its partner leaves to feed. Losses are comparatively slight during the chick stage.

Young birds either add to their nests any plant debris they can reach (burrowing species) or may actually build new nests of their own (Giant Albatrosses). In *Macronectes*, what are believed to be immatures build nests at the end of the breeding season but do not lay then.

Surface-nesting and a few burrowing species spit proventricular oil in defence. The ability is most marked in newly unguarded chicks and declines as they grow. Most adults cannot eject oil; exceptions are discussed.

The problem of how burrowing petrels find their own nests in large colonies is discussed. It is suggested that a simple search and memory technique acquired through the long acquaintance with the territory during the years of immaturity suffices to explain the observed facts.

Session 11. Conservation

Chairman: Dr J. Dorst (France)

TITLE: Acclimatization and conservation of nature in French sub-Antarctic islands

AUTHORS: J. Dorst and Ph. Milon, Musée d'Histoire Naturelle, 55 rue Buffon, Paris.

The authors briefly review the characteristics of the French sub-Antarctic islands: Kerguelen, Archipel Crozet, Saint Paul and Amsterdam and emphasize the poverty of their ecosystem with its delicate and unstable equilibrium. The long-established fauna was clearly not in a condition to resist the impact of foreign elements introduced by man, deliberately or otherwise, active as competitors or predators.

They retrace the history of the artificial introductions resulting from human activity, and they divide these into three periods: first landings with accidental introductions; then the period of intense exploitation by sealers and whalers with deliberate introductions of certain mammals—pigs, rabbits, cattle, etc.; and finally the contemporary period of attempts to acclimatize animals and exploit them—sheep, reindeer, mink....

They analyse the effects of these various acclimatizations on native species and point out the considerable dangers of all attempts in this field.

Session 12. Animal physiology

Chairman: Dr L. Irving (United States)

TITLE: Extra-renal salt excretion in the Adélie Penguin

AUTHOR: Donald S. Douglas, Department of Zoology, Duke University, Durham, North Carolina.

It is well known that ingested sea water is toxic to most of the higher vertebrates because the body fluids of these animals have a lower salt concentration than sea water, and their kidneys are unable to eliminate the excess salt. Thus animals which spend much of their lives foraging in the ocean are faced with a chronic water shortage unless they possess some auxiliary excretory mechanism. Marine birds have met this problem by means of an extra-renal salt-secreting gland which is usually found near the orbit of the eye.

The penguins are a family of birds which is probably second to none in the amount of their lives actually spent at sea. One interesting aspect of the salt and water balance of these birds is the development of the ability of the salt glands to handle salt loads in the growing chicks.

Adélie Penguin chicks were found to be able to secrete from the salt glands at the time of hatching. This matches with the observation that within about 48 hr. of hatching the chick's residual yolk supply is exhausted, requiring that it be fed by about this time.

In order to study the development of the salt secretory capacity, chicks ranging in weight from 90 to 3,000 g. were given salt loads as 10 per cent NaCl solutions. Following each experiment the chick was killed to permit correlation of the size of the gland with total body weight and with secretory capacity.

It was found that, while the maximum concentration of the gland's secretion bore no correlation to gland size, there was a distinct relation between the weight of the gland and the rate of flow of the secretion. The results indicate that the secretory capacity of the gland develops as an ability to secrete increasingly large volumes of fluid rather than as an ability to produce increasingly concentrated solutions, and that the juvenile penguin is ready to forage at sea as soon as it has the size and strength to navigate.

TITLE: Respiratory metabolism and growth of some Antarctic fishes

AUTHOR: Donald E. Wohlschlag, Associate Professor, Department of Biological Sciences, Stanford University, California, U.S.A. and Project Leader, U.S. Antarctic Research Program, 1958–1962.

The purpose of this study is the comparison of metabolic levels with reference to ecological variations among Antarctic fishes. Metabolism has been determined by measurement of oxygen uptake rates within enclosed plastic chambers. Under controlled temperature and swimming velocity conditions, oxygen consumption rates may be related by means of multiple regressions to body weight, temperature, and, where possible, swimming velocity.

Fishes appear to be rather strongly stenothermal. The benthic fishes, *Trematomus bernacchii*, *T. centronotus*, and *T. lonnbergii*, can be but slowly acclimated from natural temperatures of −1·9° C. to one or two degrees above freezing, although a zooarcid species was successfully acclimated to +3·5° C. The oxygen consumption–temperature coefficients range from 0·02 to 0·06 log units oxygen per degree. The significance of this range to those for more temperate fishes will be discussed.

Oxygen consumption–weight coefficients of the order of 0·8 log oxygen units consumed per unit log weight are of the same nature as for fishes generally.

The oxygen consumption–swimming velocity coefficient for the very stenothermal *T. borchgrevinki*, the only pelagic and actively swimming fish studied, is about 0·04 log units oxygen consumed per each metre per minute increase in swimming velocity. This value compares favourably with fishes elsewhere. All species so far observed directly seem to be slow swimmers with most propulsion provided by the pectoral fins.

All species studied have relatively high metabolism (cold adaptation) at freezing temperatures. Slight differences among species and between sexes in metabolism and growth rates will be discussed in terms of the relatively high productivity of Antarctic waters.

TITLE: The morphology and histophysiology of the pituitary in the Weddell seal, *Leptonychotes weddelli*

AUTHORS: J. Racadot, J. Prévost and Y. Barbarin.

A number of cell types have been identified at the level of the anterior pituitary gland in male and female seals in several physiological states, including pregnancy. The data are compared with what is known of other mammals, especially rodents and carnivores.

TITLE: Some aspects of the thyroid cycle in the Adélie Penguin

AUTHOR: J. Prévost, Nouvelle Laboratoire d'Histologie, Faculté de Médecine, Paris.

This study is based on specimens of thyroid glands of male and female Adélie Penguins collected in January 1961.

Determinations made on part of the thyroid gland demonstrate the presence of variable amounts of a calcium salt. Iodine determinations on the remainder of the gland do not permit any conclusion on possible antagonism or synergism between these two substances. The role of the calcium in the thyroid, previously found in the Emperor Penguin, *Aptenodytes forsteri*, remains obscure.

Histological examination of thyroids from breeding and non-breeding birds demonstrate the activity of this gland during the chick-rearing period. The results are compared with those previously found for *A. forsteri*. They emphasize the differences and the similarities between these two species, one of which has a purely summer breeding cycle and the other a distinctive winter cycle.

TITLE: The sexual cycle and the development of the ovigerous setae in females of *Jasus paulensis* (Palinuridae)

AUTHOR: P. Grua.

The annual sexual cycle in the crayfish of Ile Amsterdam was determined on the basis of samples made at the landing-stage in 1960–61. The first ovigerous females appear at the beginning of May in water at 15·5° C. Hatching, shown by the reduction in the percentage of ovigerous females, takes place in late winter during August and September, at the same time as the water temperature rises to 13·5° C. During the summer the ovigerous setae seem to be shortened, but are very variable in individuals of the same or different size. The reason for this is discussed in relation to behaviour. A method new to Crustacea is used for *Jasus paulensis*: the condition of the setae is expressed by the relationship between their length and the width of the setigerous segment of the endopodite, in order to relate the pilosity to the size of the animal, an elementary statistical calculation being used. From this it appears that the length of the setae increases progressively, according to a roughly sigmoid curve, until March, when the pilosity is maximal. In *J. lalandi*, which has many close affinities with *J. paulensis*, the annual moult which immediately precedes egg-laying has usually been considered the only one. The change in the setae can be explained by an inconspicuous moult, taking place between October and March and varying between islands and between different sizes of animal.

NOTICE

The SCAR Bulletin is published in England in January, May and September each year as part of the *Polar Record*, the journal of the Scott Polar Research Institute.

Contributions are invited, and should consist of factual notes on the membership, equipment and activities of Antarctic parties; articles on matters of particular interest in connection with these activities are also welcome. Contributions should be sent to the Editor, Scott Polar Research Institute, Lensfield Road, Cambridge, England.

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