Only exactly comparable observations in the two communities could validate the apparent differences. But I am inclined to think that the differences under discussion are neither artifacts nor accidental. There has been greater pressure on trapping lands at Pikangikum as a result of greater population density. (In 1955 there was approximately one person per 12 square miles at Pikangikum and one per 18 at Round Lake.) This has resulted in greater restriction upon the individual use of trapping lands at Pikangikum. Is it not also likely that this pressure has resulted in a strengthening of the functions of patri-kin groups there? Such a development may not have been stimulated at Round Lake without conflict resulting from scarcity of trapping lands. It is thus significant that overcrowding of some trapping grounds at Round Lake can still lead to sharing of lands with brothers-in-law, whereas the same thing may no longer be possible at Pikangikum.

There are other data of considerable significance in Rogers' study, such as the breakdown in authority patterns within the Round Lake group, and the impasse in self-confidence resulting from competing religious ideologies. This is described in considerable detail, and the description is particularly useful because it focuses upon the tangle of actual present beliefs, and is not limited to a discussion of the survivals of aboriginal belief.

To the reviewer, however, one of the most significant features of the present study is the clear portrayal of the consequences of a radical shift in the ecology-technology equation in a hunting-gathering group. Increasing involvement in a cash economy, the removal of restrictions on subsistence brought about by Government subsidy, and population increase have resulted in a radical change in settlement patterns and in relations between bands, patri-kin groups, and nuclear families within the community. At Round Lake, however, unlike Pikangikum, there has been no strengthening of patri-kin groups, and no new forms of social organization have emerged to stabilize and give value to the "social facts" latent in the new arrangements. In most acculturation studies, such a result would be attributed to greater acculturative pressures. But the facts in the present case belie any such explanation. Acculturative pressures have not been any greater at Round Lake. As the author says, the change "has in many ways been quite superficial," and the people have not "even moved in the direction" of becoming like Euro-Canadians. Moreover, the author makes clear that there has been very little opportunity for acculturation through contact with Euro-Canadians at Round Lake. Rather, the explanation of the differences, if they are real, would appear to lie in slight variations of the ecological circumstances, and the cultural reaction to them. Such a conclusion points up the importance of ecological factors in cultural change.

STEPHEN T. BOGGS

NORTH ATLANTIC BIOTA AND THEIR HISTORY. A symposium at the University of Iceland, Reykjavik, July 1962, under the auspices of the University of Iceland and the Museum of Natural History. Sponsored by NATO Advanced Study Institutes Program. Askell Löve and Doris Löve, editors. *London: Pergamon Press. 1963. xii + 430 pages. £5. (Distributed in the U.S. by Macmillan Co., New York; in Canada by Collier-Macmillan Canada, Ltd., Galt, Ont.).*

For over a century biologists have been aware of marked resemblances between European and American arctic and subarctic plants and animals. Detailed studies have directed attention to problems of Pleistocene history, evolutionary rates and other fields on which biogeography impinges. This symposium, appropriately held at the centre of the North Atlantic dispersal arc, provides a stimulating review of firm results, divergent hypotheses, and unsolved problems.

The papers are grouped mainly about

two topics: how, where, and when amphiatlantic organisms made their crossings; and the location of ice-free areas during the last glaciation and their value as refugia. Within each field there was a considerable diversity of viewpoints, with the geologists and biologists frequently in opposition. We cannot review the papers in detail. A few, which present good background accounts in their fields, scarcely touch upon the areas of controversy and will not be discussed.

Trausti Einarsson, discussing Tertiary geology and palynology, concludes that even in the Eocene Iceland was separated from both Europe and Greenland. Similarly Martin Schwartzbach, discussing past North Atlantic climates, finds no evidence of Tertiary or interglacial land connections. Bruce Heezen and Marie Tharp, dealing with the Atlantic floor, favour the possibility of a continental connection in Paleozoic and early Mesozoic time but not later: even if a late land connection were countenanced, it must have been during extreme sea level depression in a maximum glaciation, with access to each end of the corridor probably blocked by continental ice sheets. The geology of the Faeroes was summarized by Johannes Rasmussen, whose most pertinent conclusion was that the islands had their own ice-divide rather than being overrun by the Scandinavian ice; glaciation seems to have been heavy, but some peaks may have protruded. Among the biologists Eric Hultén, Henrik Walden, and Knut Faegri present evidence supporting the view of the geologists and, incidentally, of Philip Darlington: if there had been recent land connections the biotic similarities should have been much greater than they are. Pietro Omodeo postulates that most extant families of earthworms were established in early Mesozoic time, and their distribution suggests more extensive intercontinental connections then. As far as Tertiary and Quaternary patterns are concerned the data are harmonious with the geological evidence if we recognize man's role in transporting earthworms. I understand that there are arctic earthworms other than those treated by Omodeo. Eythór Einarsson emphasizes that the affinities of the Icelandic flora are overwhelmingly European, with boreal species outnumbering the arctic-alpine and with continental species practically absent.

Other contributors discussing amphiatlantic dispersal insisted on interglacial or postglacial land bridges. Some of the data employed must thus be examined if we are to achieve a realistic picture of amphiatlantic history. As Ernst Mayr recently stated, "the basis of all scientific interpretation is the rule of parsimony, which demands in each case the simplest explanation consistent with the facts". A human weakness for the spectacular is apt to overshadow this rule. Applying it to the case in point, let us try to avoid raising land bridges. In several papers we find inadequate appreciation of some facets of arctic ecology and especially of the effectiveness of arctic dispersal mechanisms. Carl Lindroth postulates a land bridge east of Greenland but not west of it where the water is deep. His distinction between normal and brachypterous beetles is of limited use, for there are degrees of brachyptery in some species and long-winged populations occasionally lack flight muscles. The repeated adoption of flightlessness in these northern beetles that are sluggish fliers at best emphasizes that they have other means of dispersal. Davis Strait is indeed an effective barrier to beetles and to plants. Now Hudson Strait is the second most effective nearctic barrier for plants, and distribution maps prepared by W. J. Brown show the same to be true for beetles, which otherwise cross relatively freely from island to island. This pattern corresponds closely with the distribution of unbroken winter sea-ice. Throughout much of the archipelago the cover is complete between islands, except for localized tide-rips, and among the western islands the tides are too small even to disturb the shore ice seriously. Off southwest Greenland, however, we find essentially permanent

open water north nearly to Disko Bay, and loose ice generally much farther. In Hudson Strait, with its immense tides and strong currents, the ice is always loose. Where the ice is essentially intact from mid winter to late spring, wind-packed snow levels out irregularities at the shore and around pressure ridges, leaving great expanses smooth and firm. Seeds or larger plant parts blow great distances over such a surface in a single gale as Simmons and the reviewer have indicated. Many arctic plants release their seeds gradually during the winter, ensuring that they are available for such dispersal. It seems clear that arctic beetles, which normally winter as adults and must often be shaken out of their winter cover, are carried successfully by this means. Such winter dispersal seems to have a high degree of success because the seeds or insects tend to come to rest at the bases of hills or cliffs, where ample moisture favours their establishment. In the Canadian Arctic Archipelago this type of dispersal is apparently predominant over aerial wind dispersal, for many plants and most beetles occur generally within their total range, rather than haphazardly as on islands in ice-free seas. Winter dispersal almost certainly is effective between Peary Land and Spitzbergen, Spitzbergen and Novaya Zemlya, and Novaya Zemlya and the mainland. It has possibly operated between Iceland and Greenland at times when ice conditions were severer than today. Nevertheless typical aerial dispersal cannot be disregarded for small organisms. Aerial trapping has revealed the occurrence, not only of flying insects but of seeds and small flightless beetles, at great heights and far from land. I have seen dust clouds and cirrus anvils, indicative respectively of mechanical and thermal updrafts, at 81°50′ north. Thus organisms may be picked up at almost any latitude. C. S. Elton's report of temperate insects being carried alive to Spitzbergen shows that insects will survive the treatment.

Internal seed transport by birds was dismissed by Doris Löve as inadequate for dispersal across the north Atlantic channels on the basis of times cited by Ridley for passage through the intestinal tract. But, as Ridley emphasized, these are minimum times and seeds may lodge in the gizzard for days. No mention was made by any speaker of the spectacular and well-documented postglacial migration pattern that carries many thousands of land, sea and shore birds each spring with a predominantly favourable wind from Scotland through the Faeroes and Iceland to Greenland and in some instances right across the Canadian Arctic. Pink-footed and White-fronted Geese, by unselective grazing on overwintered vegetation in spring, must carry many ingested seeds in the Atlantic arc, as do the Brant and Snow Goose in Canada. It would be strange if they and other birds on this route did not occasionally introduce plants by internal or external carriage of seed.

A statistical treatment can be no sounder than its data; and Eilif Dahl's data are unsatisfactory. He classifies plants by the possession or lack of devices for long-range dispersal; and, applying temperate concepts to arctic plants, he "proves" that the latter are deficient in dispersal aids. But winged or plumed seeds are of minor value in a region where all seeds drift easily over snow and ice; and hooked or fleshy fruits are a waste of substance where wind is effective and geese graze indiscriminately. Clearly there is no substitute for familiarity with the natural history of the region being studied.

Emil Hadac's paper is unconvincing in several respects. He uses the concept of plants migrating as associations rather than as individual species, to which numerous exceptions may be cited even in temperate regions. To apply this concept in the arctic, where reduced competition makes associations weak or non-existent, is impossible. I trust that some of Hadac's data are more reliable than his glacial map, which shows Peary Land wholly glaciated and much of the Canadian arctic, including Devon and Somerset Is., unglaciated.

Two glaciological papers were presented. J. D. Ives showed that although the maximal glaciation was essentially complete in Baffin I. and northern Labrador, detritus on some high peaks strongly suggests that they were not overridden by Wisconsin ice. He believes that some of these areas may have had shallow, stationary ice-caps, which, as we see from the one now receding on Meighen I., preserve rather than destroy the detritus. These areas are largely at altitudes such that, when surrounded by icefields, the July means must have been substantially below the limit for all arctic vascular plants. Gunnar Hoppe uses data from glacial Antarctica to interpret events in glacial Scandinavia. It is deduced that the Scandinavian ice sheet during the Würm glaciation was 1700 to 1800 m. thick, with a concurrent eustatic drop in sea level of 105 to 123 m. A surprising finding from seismic studies in Queen Maud Land is that overriding ice under certain conditions actually sharpens the subglacial relief. Hoppe thinks it probable that small nunataks with an extremely severe climate existed high on the Scandes in the Würm glaciation. He is emphatic that the Norwegian coast and islands were completely glaciated, and that foreland refugia were impossible.

In opposition to Hoppe's views are papers by J. A. Nannfeldt, Rolf Nordhagen and Olav Gjaervoll indicating two separate alpine refugia in the Scandes, demonstrated by marked disjunct patterns and some degree of endemism. We must admit that some of the endemics may be recent, e.g., those in the polyploid *Poa arctica* complex, which seems prone to abrupt variation through chromosomal changes. It is also possible that a few of these plants reached Scandinavia at the end of the Pleistocene and were eliminated from intermediate lowland areas in the Hypsithermal. Yet surely not all the plants are postglacial immigrants. Possibly the foreland areas were not all glaciated simultaneously and the species that survived precariously near the shore retreated to the mountains as the climate ameliorated. I cannot believe that some of these species, e.g., *Carex scirpoidea*, a predominantly subarctic plant of mossy pockets, could have survived on the exposed mountain nunataks. We have here a parallel to the Queen Charlotte Is., declared fully glaciated by geologists, but with a rather oceanic flora on the west coast that contains various pronounced endemics as well as extremely wide disjuncts.

Tyge W. Böcher speaks of a substantial unglaciated area in middle west Greenland, which some geologists may question. He says nothing of a refugium in Peary Land, the distribution centre for many high-arctic plants (some, as studies at Lake Hazen show, with their own parasites) and the most convincing Wisconsin refugium north of the mainland. He divides the Greenland flora into a widespread continental arctic element of American origin, and an oceanic subarctic element of European origin dominant only in the southeast and south. He suggests that spruce is absent from the southwest because the climate is too oceanic; but I suspect it is absent only because open water makes the immigration of seed impossible. In Olaf Rönning's paper on the phytogeography of Svalbard, most of the data have alternative interpretations. His failure to appreciate the power of winter dispersal over sea ice, whose importance is emphasized by the low degree of endemism in Spitzbergen, invalidates his conclusion on the great age of the flora. Steindór Steindórsson presents interesting examples of localized distribution patterns for Icelandic plants. Doubtless some of these are endemic populations still confined to their refugia. But without topographic and ecological data the reader unfamiliar with the country cannot judge. As has been shown, one area positively stated by specialists to be unglaciated is known to have supported a stagnant ice-cap until 1850. Thus great care is needed in designating refugia, as we have found in Canada.

Inevitably some readers will disagree with some conclusions in Askell Löve's summary. However, there must be full

agreement with his declaration that "we are in the happy situation of still being confronted by unsolved problems" and that future work in Iceland must provide the key to many of them.

D. B. O. SAVILE

KEOEEIT — THE STORY OF THE AURORA BOREALIS. By W. PETRIE. A Pergamon Press Book. *Toronto: Collier-Macmillan Canada, Ltd. 1963. 10 x 7½ inches, xii + 134 pages, 46 plates, 23 text figures. $5.95 (in Canada).*

The author, Dr. W. Petrie, can rightly be acknowledged as an expert on the subject and it is gratifying that one of his experience should attempt the rather difficult feat of telling its story in relatively simple language. In the prologue there is an inference that the book is written for children and indeed the language and the inclusion of footnotes is such that highschool students who have an interest in the northern lights they see could get a great deal out of it. On the other hand, the subject seems to me to be covered more in a way that it would give adults, with little scientific training, a picture of why the aurora is so important in understanding the atmosphere in which we live.

To scientists concerned with upper atmosphere physics, particularly over Canada, the "Aurora" and the "Ionosphere" go together as important subjects for research so that we may understand radio communication from a practical point of view and know something about the wondrous phenomenon we see in the sky; only occasionally at southern parts of our country but practically every night in higher latitudes.

Dr. Petrie has drawn together a picturesque historical approach (and there were plenty of early superstitions about the aurora), an explanation of what we know about the aurora, how it effects communications and its relation to other geophysical phenomena, such as spots on the sun and magnetic storms. He has done this without the use of mathematics and with few relatively simple diagrams. To a physicist of his standing it would probably have been easier to write a treatise designed to impress his scientific colleagues who carry out research in the upper atmosphere. Incidentally, the book includes groups of well selected references at the end of each chapter for the reader who may have more than an amateur's interest.

It is extremely difficult to get a photograph of an aurora that is anywhere nearly as impressive as seeing the real thing. Even colour photographs are not very impressive. The book contains eight reproductions of paintings, which do far more than any photograph could do. They are very good indeed, not only in presenting the desired effect but as works of art. These were painted by Mrs. Petrie and the reproduction appears to be good.

The printing is good. The arrangement of pictures and diagrams which are too often not on the page where reference is made to them, makes reading a little awkward. This may be excused in the case of the eight reproductions of paintings as these required special paper and are mounted together, but the other plates might have been better arranged even if they had to be placed less artistically.

The last chapter on the "Cause of the Aurora and its Relatives" is rather diffuse. It would perhaps be difficult to make it otherwise because there is so much in upper atmosphere physics that is not understood. In writing scientific papers and treatises of this sort, authors naturally tend to emphasize achievements in the advancement of knowledge with little explanation of the weaknesses or the fields where knowledge is lacking or where more work is required. It is this last that is challenging to scientists. The author recognizes this in his epilogue, as anyone must whose interest and duties involve the furthering of research in upper atmosphere physics.

D. C. ROSE