PHILOSOPHICAL TRANSACTIONS OF THE ROYAL SOCIETY B BIOLOGICAL SCIENCES

Introductory Remarks

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Introductory remarks

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In 1968, at the Discussion Meeting on the results of the Royal Society Expedition to the Solomon Islands, held in this room, Professor Corner in his introductory paper (1969) mentioned biogeographical relationships of the Solomons flora and fauna to those of adjacent island groups, and said, 'We shall realize that we ought to explore the New Hebrides'. The Expedition we come here today to discuss grew out of Professor Corner's suggestion, and came to fruition very largely by his efforts. At Corner's instigation the Southern Zone Research Committee of the Royal Society approved and supervised the planning of the Expedition. Financial support came from the Royal Society, the Percy Sladen Trust, Overseas Development Administration, Ministry of Agriculture Fisheries and Food, the Bentham-Moxom Trust, Royal Society of New Zealand, Paris Museum of Natural History, and O.R.S.T.O.M. and support for individual members from their employers. To all of these, to British, French and Condominium government servants and many other European and Melanesian New Hebrideans, and to our wives and families who stayed at home, we owe our thanks for the opportunity to explore those far away and beautiful islands. We thank the Royal Society also for its generosity in bringing us together to discuss and report on the results of our research, and I should like to add my personal thanks to the Society for entrusting to me the leadership of the Expedition.

We have already had three days' discussion of papers presented by Expedition members and others with special knowledge of the New Hebrides, and today we shall try to summarize in a few papers the work and preliminary conclusions of the Expedition. I shall begin by outlining the objectives of the Expedition, the environmental background against which our work was done, and the areas we visited.

The New Hebrides lie in the southwest Pacific Ocean, northeast and east of New Caledonia and the Loyalty Islands, and southeast of the Solomon Islands. The main islands of the group form a Y-shape, with the longer (western) limb of the Y extending from about 13° to about 21° south latitude. They are administered jointly as a Condominium by Britain and France. They lie between the Solomons to the northwest and Fiji to the east, are a distinct geographic entity, and from a biogeographic viewpoint would seem to be an island group that would well repay investigation.

Two hundred years ago, on 21 July 1774, James Cook in the *Resolution* sighted Ambrym Island, in the New Hebrides. He stayed in the New Hebrides for about six weeks, charting the coasts of the islands. With him were the Forsters, who made the first substantial scientific collections of New Hebrides plants. Others have followed, studying plants, animals, geology, and soils, in expeditions and more recently as employees of the British, French and Condominium administrations. Among them was the Oxford University Expedition of 1933–34, led by Professor Baker, which was financed partly by the Royal Society and the Percy Sladen Trust. There remains much to explore and discover, and it was the objective of our Expedition

to continue the study of the flora and fauna of the islands, in particular their biogeography and the ecology of representative plant communities. We began our field work on 1 July 1971, and all field work was completed by the end of October 1971. The 25 members and visitors who made up the Expedition came from eight countries and were the largest and most experienced group of biologists to have worked together in the islands. We visited the islands of Espiritu Santo, Malekula, Efate, Erromanga, Tanna, and Aneityum, the six major islands of the western chain (figure 1).

The climate varies from hot, very humid, and with little seasonality in the north of the group to warm, humid, and with well marked wet and dry seasons in the south of the group (figures 2–5). The climate of Espiritu Santo and the Banks Islands is similar to that of the Solomon Islands, though not so wet. Baker & Harrison (1935) commented on the low degree of seasonality at Hog Harbour, in Espiritu Santo, and calculated a seasonal index (rainfall in wettest month divided by rainfall in driest month) of 2.5. They compared this index with indices calculated for 113 stations, distributed throughout the tropical regions of the earth, and found that only three had an index lower than 2.5 and only 19 an index lower than 5.0. For the four stations in figures 2–5 the seasonal index is 2.24 at Port Patterson (Banks Islands, 13° 52′ S), 2.68 at Luganville (Espiritu Santo Is., 15° 51′ S), 4.03 at Vila (Efate Is., 17° 45′ S), and 4.77 at Aneityum Is. (20° 12′ S), illustrating the increasing though always low degree of seasonality of rainfall from north to south. Baker & Harrison (1935) measured air temperatures in the forest and in the open nearby. They found that minimum temperatures in the forest were about the same as those measured in the open, but mean monthly maxima were about 3° C lower. Tropical cyclones are a feature of the climate in the November to April period. They are extremely destructive, but each usually affects only a small area, and the frequency of occurrence at any one locality in the New Hebrides is about once every five years. Destruction of the rainforest by hurricanes has far-reaching effects on New Hebridean ecosystems and it is rare to find significant areas of high-canopy forest, except where kauri (*Agathis obtusa*) is dominant. Kauri trees are apparently able to withstand hurricanes.

Most of the oldest rocks in the New Hebrides probably date from the early Miocene, although some limestones at Maewo Island are possibly of Eocene age. Uplift of nearly all the present land surface of the islands is post-Pliocene, and the majority is post-Pleistocene (Mallick, this report). Active volcanoes have persisted to the present day and though leaching and weathering are very rapid, because of the heavy rainfall and high temperatures, continuous additions of unweathered materials have maintained high fertility in many soils. Quantin (1971) describes a fertile soil formed in 30 years on a basaltic lava flow with a superficial layer of volcanic ash at Ambrym Island, and compares this with soils on surfaces about 1000 years old in the Banks Islands, which are strongly desaturated of bases, with high levels of secondary amorphous silicates and gibbsite, and of low fertility. In steep mountainous regions, such as western Expiritu Santo, the slopes are unstable, soils are thin, and much of the land surface is covered by scree slopes. On more gentle mountain slopes, e.g. at Tanna, Aneityum, Erromanga Islands, soils are deep and frequently mantled with basic volcanic ash which has accumulated a little at a time over a long period, maintaining a high level of fertility. The New Hebrides soils contrast with soils in the mountains of the Solomon Islands, where there has been a long period without volcanic activity, and strong leaching and weathering have resulted in very impoverished soils (Lee 1969).

Floristic and faunistic studies necessarily made up much of the Expedition's work, but

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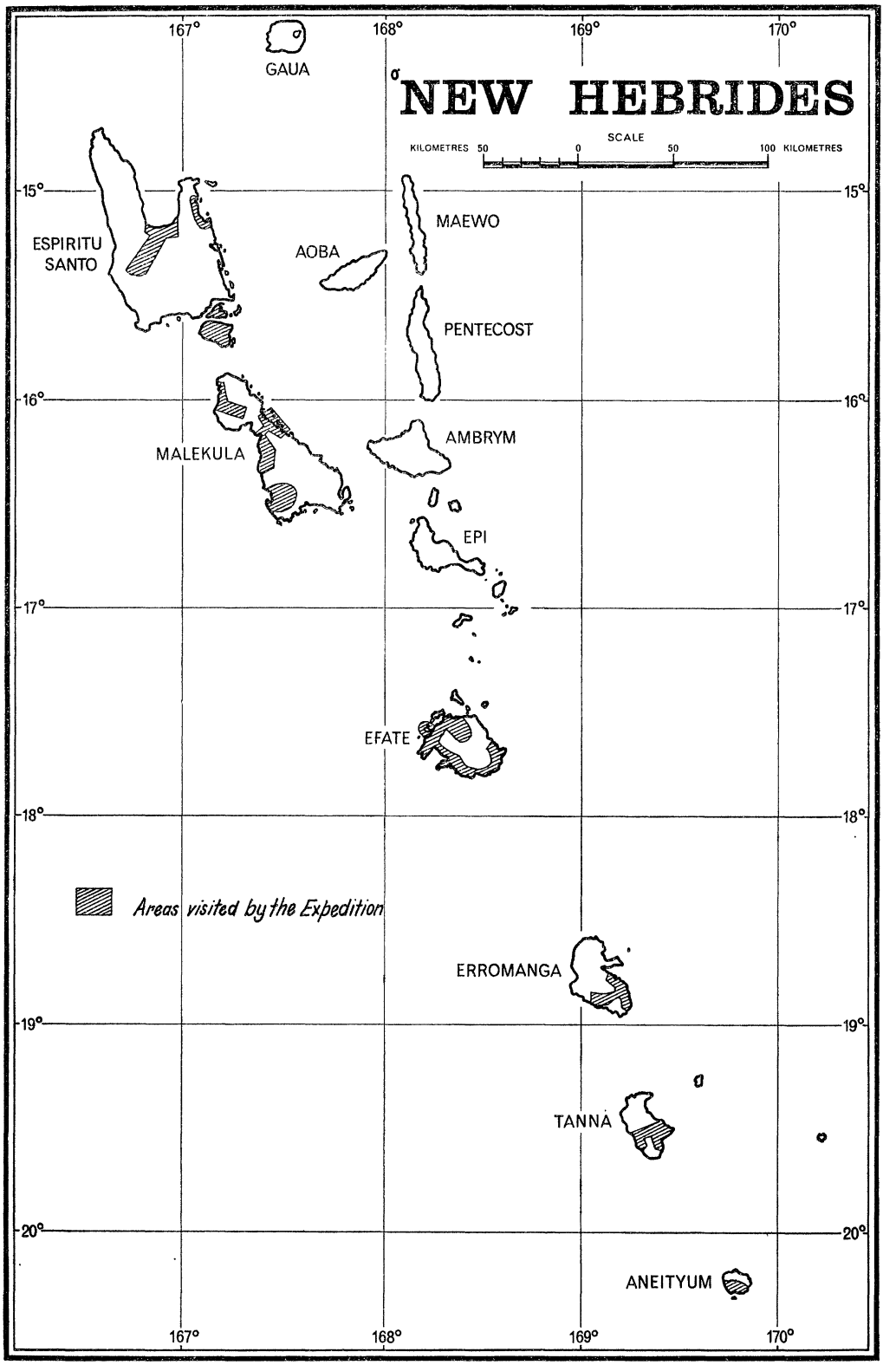

FIGURE 1. New Hebrides, showing areas visited by the Expedition.

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within the limitations imposed by frequent movements plant and animal community analyses were made wherever possible. Methods of structural classification of rainforest developed in Australia, mainly by Webb and Williams (Webb 1968), were used by the forest ecologists, who established and studied 49 sites. Twelve principal forest types and a number of seral and man-modified vegetation types were recognized. The ornithologists used mark-recapture methods to assess bird populations and species diversity in 4 ha plots at 11 sites, in all the major islands visited by the Expedition. Soil and litter fauna were extracted from samples taken at about 40 sites, and wherever possible they were located at forest ecology sites. As in the Solomon Islands and other high rainfall forested regions, many earthworms are found in logs, up trees,

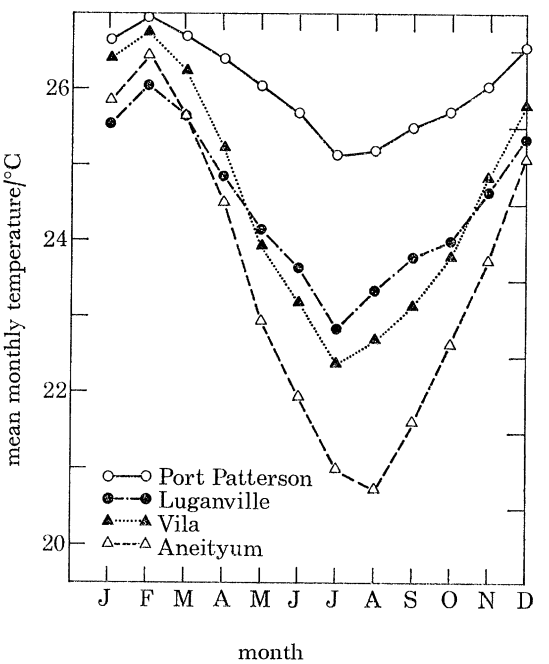

FIGURE 2. Mean monthly temperatures at four stations in the New Hebrides. (Data from Giovanelli 1966.) Port Patterson, Banks Is. 13° 52′ S; Luganville, Espiritu Santo Is. 15° 51′ S; Vila, Efate Is. 17° 45′ S; Aneityum Is. 20° 12′ S.

and especially in the leaf bases of Pandanaceae, but they are also frequently found in the soil, unlike the Solomons where this is very rare. Some common soil animals, such as Collembola, have not previously been recorded from the New Hebrides. About 50 species of Collembola were collected during the Expedition. The predominant invertebrates are species that are widely distributed throughout Pacific islands or more widely in tropical regions, but some quite distinctive faunal elements were discovered, for example, the highlands of Espiritu Santo have an assemblage of previously unknown Lepidoptera.

Much of the Expedition's collections are now sorted and distributed to specialists. Some papers are published, many more are in preparation, and we shall hear some of the preliminary results in the papers that follow.

There is much evidence that Indo-Malaya and New Guinea were populated largely by plants that spread from southeast Asia. The flora and fauna of the Solomons relate closely to those of New Guinea, though much impoverished in numbers of species, and the papers that follow will

show that the New Hebrides illustrate some extension of these relationships further into the Pacific, and further attenuation of the fauna and flora, but that there are also influences from other directions, as well as a true Pacific islands element, strongly represented in the flora and fauna.

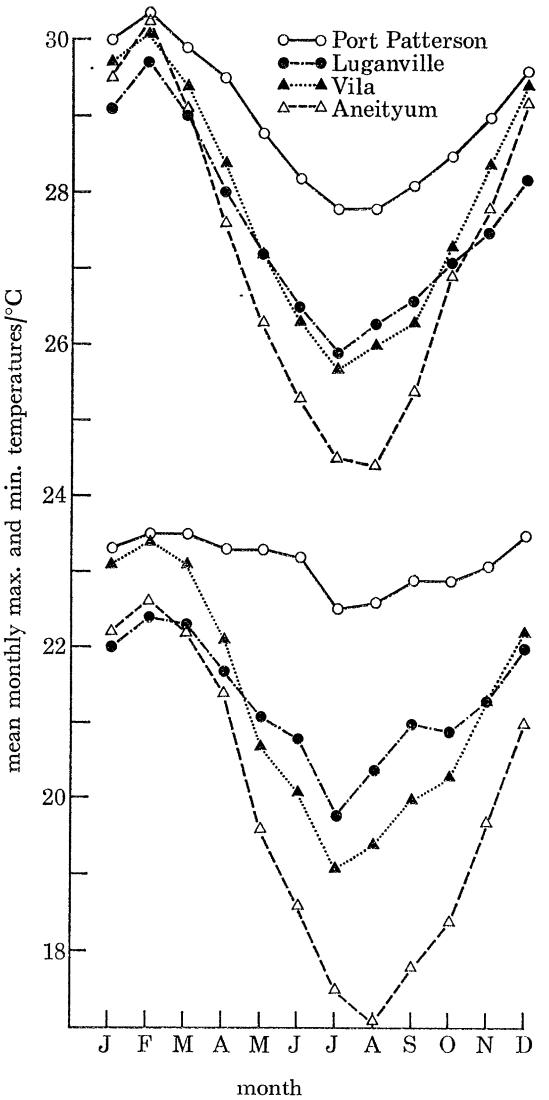

FIGURE 3. Mean monthly maximum and minimum temperatures at four stations in the New Hebrides. (Data from Giovanelli 1966.)

Attempts to explain the dispersal of terrestrial plants and animals to Pacific islands fall into three groups. Some biologists hypothesize former land connexions over which plants and animals could migrate between islands; Whitmore (1973) has recently attempted an explanation in terms of plate tectonics; others maintain that chance dispersal by wind, drifting of logs, seeds, and larger aggregations of trees and other plants, with accompanying animals, in ocean currents and during storms, are sufficient to explain the present situation. There is little basis for believing that the New Hebrides islands have ever been physically connected by extensive

land bridges to any other present or former land areas. On the contrary, there is good evidence that they are isolated oceanic islands of very recent origin, whose flora and fauna probably derive from chance colonization across the ocean. Accidental and deliberate dispersal by man may account for many of the most widespread distribution patterns. Brookfield & Hart (1971) mention the 'Lapita' pottery, which is known from the New Hebrides as well as other Melanesian islands, and has been dated at between 1000 and 500 B.C. It is likely that there were people in the region before that time (Shutler 1970) and these people have moved about, carrying their food and other plants and plant products important to their culture, with accompanying fauna, for 3000 years or more. Even European man, in the 400 years since first contact was made with the Pacific islands, has accidentally introduced plants and animals, sometimes over

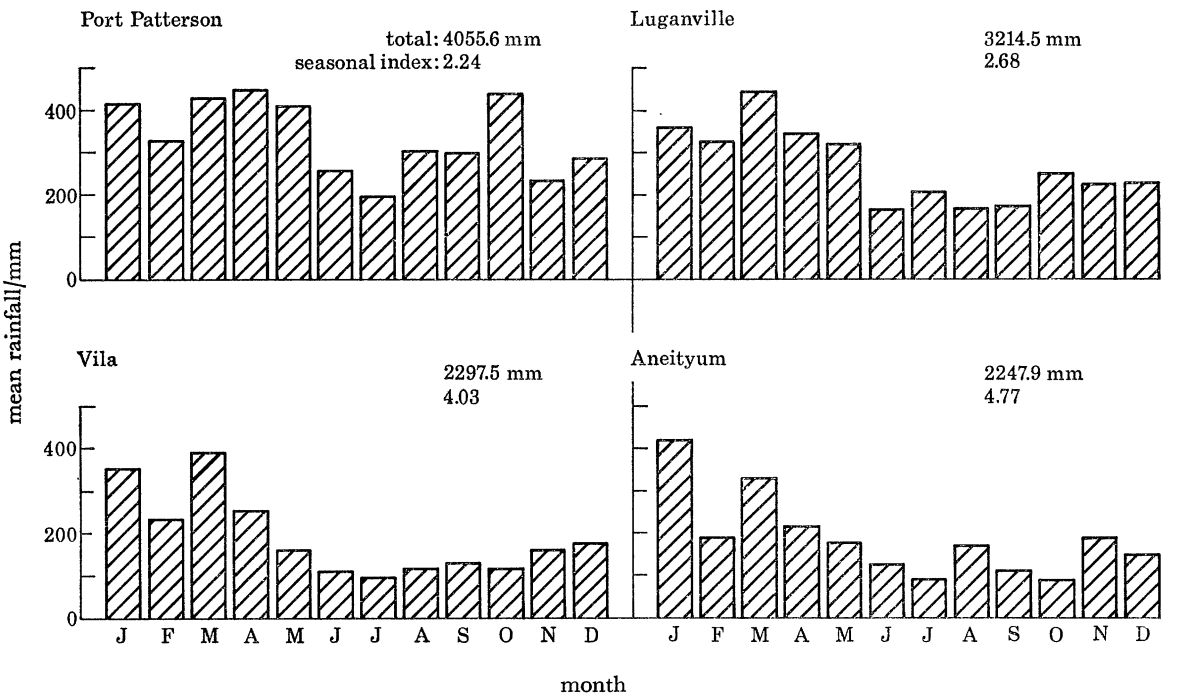

FIGURE 4. Mean monthly and annual rainfall, and seasonal indices calculated by the method of Baker & Harrison (1935), at four stations in the New Hebrides. (Data from Giovanelli 1966.)

vast distances. For example, two species of earthworms, *Pontoscolex corethrurus* and *Dichogaster bolaui*, both of which are widespread in the New Hebrides and the Solomons and now have a pantropical distribution, were almost certainly spread by European man from equatorial Africa or South America, and there are many other similar examples.

It was a primary objective of the Expedition to study the kauri (*Agathis obtusa*) forests of the New Hebrides and to record something of their biology before all substantial stands of the species are destroyed by sawmillers. Almost from the beginning of European exploration of the resources of the Pacific, kauri timber was eagerly sought and indiscriminately exploited, mainly for ship building but also for many other uses. There was no thought of conservation, and most of the Pacific species of *Agathis* are now rare and valuable, and are strictly conserved. In the New Hebrides the exploitative phase was late to begin and has continued up to the present day. The last remaining extensive stands of *A. obtusa* are at Erromanga Island, but during the last

few years these have been subjected to a highly mechanized milling operation. Damage of the kind done to the forest and landscape of Erromanga would not be tolerated were it done in any civilized country, but Erromanga is far away, and few people live there or see what is done. Kauri forest areas studied by the Expedition in 1971 have by now been reduced to ruins, but fortunately there remains one stand of kauri west of the exploited area where it is not at present

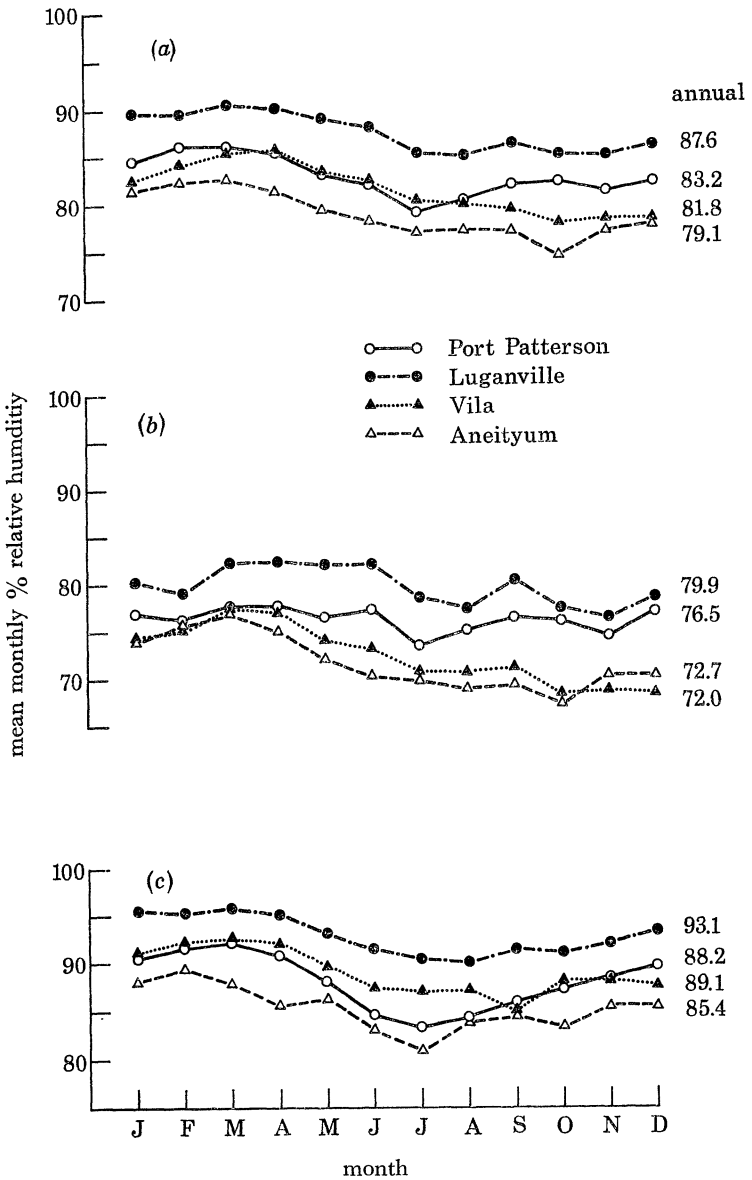

FIGURE 5. Mean monthly relative humidity at four stations in the New Hebrides, (*a*) average of seven daily observations, (*b*) observations at 11 a.m. daily, i.e., at about the minimum for the day, and (*c*) observations at 11 p.m. daily, i.e., at about the maximum for the day. (Data from Giovanelli 1966.)

profitable to extract the timber. Members of the Expedition have submitted a proposal to the British and French administrations in the New Hebrides for the preservation of this area, and the proposal has been supported by the Royal Society and by the International Union for the Conservation of Nature. We hope that this area can be preserved as a reference point for

studies of rational silvicultural methods, for scientific study of the kauri community, and as a vestige of a unique and magnificent vegetation type, formerly widespread but now rare.

In the papers that follow we shall try to cover the Expedition's work in the field and the results so far available of studies of the specimens and samples we collected.

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