*J. mar. biol. Ass. India*, 1972, **14** (2): 578-608

# ISLAND ECOSYSTEMS AND CONSERVATION WITH PARTICULAR REFERENCE TO THE BIOLOGICAL SIGNIFICANCE OF ISLANDS OF THE INDIAN OCEAN AND CONSEQUENTIAL RESEARCH AND CONSERVATION NEEDS*

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ABSTRACT

The 'Islands Project' of the Conservation of Terrestrial Communities Section (CT) of the International Biological Programme (IBP) was launched by a Resolution of the Eleventh Pacific Science Congress, meeting at Tokyo in August 1966, following on the presentation of a paper by E. M. Nicholson (Convener of IBP/CT) and M. W. Holdgate. In the first instance, it was directed and confined to the oceanic islands of the Pacific Ocean, but the need to bring within its scope the Indian and Atlantic Oceans, including off-shore islands in all seas, and thus to complete world coverage by the Project, was clearly envisaged. The particular importance and problems of the Indian Ocean were, of course, highlighted during the ensuing months by the controversy aroused by proposals to establish an airfield at Aldabra.

The exposition of the special value of Pacific islands for biological research and of the conservation problems involved, the general and particular aims of the project, and the strategy for realising these aims, as originally put forward in 1966 and briefly recapitulated in this paper, have needed little modification in the intervening years and are equally applicable to the Indian Ocean and its associated seas. Inevitably, and largely for the usual logistic reasons—shortage of staff and funds, publication delays, etc.—implementation of the timetable laid down has in some respects fallen somewhat behind schedule, although otherwise proceeding according to plan.

In the particular case of the Indian Ocean, with which we are now concerned, a start was made with Stage I, the survey and inventory of oceanic islands with particular reference to their biological features and those islands or parts of islands which are still comparatively undisturbed by human activities, in a paper prepared by and presented on behalf of D. W. Snow at the 11th Technical Meeting of IUCN, held at New Delhi in November 1969, and covering the eastern half of the area. The annexe of the present paper, which will be tabled at the Cochin Conference, will review this material in the light of the Delhi discussions, re-assemble it in the form and under the headings established by the IBP/CT Pacific Islands survey, and extend its scope to cover the islands of the western Indian Ocean. It is emphasized that this only disposes of Stage I to the extent that the information reflects the literature and also some unpublished information, but it may well be that, where the material is long out of date, it will still be necessary to organize additional field work before the Stage can be considered as satisfactorily completed.

The present Conference affords an opportunity for carrying out, at least in part, Stage II of the Project, namely the circulation, critical analysis and revision of the Stage I material and, above all, the provisional selection of the 'islands for Science', for which some form of international recognition and guarantee is recommended.

Responsibility for Stage III, namely the measures necessary to secure such recognition and guarantees, rests with the International Union for Conservation of Nature and Natural Resources (IUCN). At the time of writing IUCN's programme in this regard is still under

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* Presented at the 'Symposium on Indian Ocean and Adjacent Seas—Their Origin, Science and Resources' held by the Marine Biological Association of India at Cochin from January 12 to 18, 1971.

discussion, the original proposal for the drafting of a Convention or Treaty, for which an excellent precedent exists in the Antarctic Treaty, and its consideration at the New Delhi meeting in 1969, having proved impracticable. Preliminary approaches have been made to certain Governments and, in the light of these, it is probable that the formula ultimately adopted will involve both international and bilateral agreements.

This in turn should facilitate the development of Stage IV of the project, although this is a continuing one, with which a start has already been made. In brief, it is to ensure that, when islands are set aside for science, the opportunities are not allowed to go by default, thus undermining the whole purpose of the exercise. In particular, it is to be hoped that the Association of International Biological Stations, recommended by a Resolution of the IBP General Assembly held at Rome on 2 October 1970, and which the IUCN has been formally invited to service, will number among its more important constituents the research stations established or to be established on islands. The present Conference could well consider what contribution can be made to this world-wide objective in the Indian Ocean area.

## INTRODUCTION

RECOGNITION of the scientific importance of island ecosystems dates back well over a century to the observations of Charles Darwin in the Galapages in 1835 and the published results of those observations over the next 25 years. Unfortunately, it had very little effect in instilling any greater care for those ecosystems than had earlier characterized man's treatment of the dodo and its haunts, witness the fact that over 90 per cent of the birds which have become extinct in the last 200 years were insular forms. The destructive pressure on fragile island biota, although probably reaching its peak in the 3 decades from 1880 to 1910, and to a lesser extent during the two world wars, has continued to the present day.

However, what one must hope was a turning point was perhaps reached with the publication of popular, highly readable and well-illustrated accounts of island Natural History such as that of Carlquist (1965), the strong and well-publicized reaction to the proposed establishment of an airfield on the Aldabra atoll and the launching by the Conservation of Terrestrial Communities section of the International Biological Programme (IBP/CT) of its project for the 'survey of undisturbed islands'. The last-named was initiated by the presentation at the Symposium on Island Ecosystems of the Eleventh Pacific Science Congress held at Tokyo on 25 August, 1966, of a paper by M. W. Holdgate and E. M. Nicholson, which discussed the reasons why Pacific Islands are valuable for biological research, analysed the problems of conserving them, and outlined an international programme for their conservation; in this the IBP/CT Survey would be the first stage, while responsibility for the follow-up would be vested in the International Union for Conservation of Nature and Natural Resources (IUCN). The consequential Resolution of the Congress drew attention to 'the unique significance for world science of a number of islands in the Pacific Ocean which have hitherto, wholly or in part, escaped man-made changes'; affirmed the urgent international scientific importance of securing early and effective conservation of natural habitats on such islands, 'in view of the irreplaceable endemic or rare species for which some of these islands form last refuges, and of the serious threats to the continuance of such natural conditions for research'; and called on member organizations of the Pacific Science Association to bring to the attention of their governments the need to exercise the strictest restraint in relation to such areas. It also called on all scientists concerned 'to co-operate with IBP and IUCN in developing jointly with the Association surveys and recommendations which will enable the authorities concerned to establish an adequate permanent series of natural habitats conserved as a base for research throughout the Pacific.'

## IBP/CT Islands Project

Although what can therefore be conveniently referred to as the IBP/CT islands project was in the first instance specifically directed to the Pacific Ocean, it was always regarded as only the first step in a world-wide survey, which itself is only one aspect of the overall IBP/CT aim of establishing a comprehensive and permanent basis for understanding and monitoring the care of the natural environment. Practically all the reasons put forward by Holdgate and Nicholson for attaching high scientific importance to Pacific islands are equally applicable to islands elsewhere and can be very briefly summarized as : variation in the origin, distance from continental areas, topography and climate of islands and the possibility of correlating these factors with colonization, genetic differentiation and endemism of fauna and flora ; known and possible successional changes from a wide but often verifiable variation in the degree, type or duration of human interference ; and the effects of deliberate and accidental introductions of alien plants and animals. Significantly, these points have been taken up and developed, with particular emphasis on the problems of human ecology involved, in the planning of UNESCO's Man and the Biosphere Programme (MAB), which is due to be established in 1971 : one MAB project under consideration concerns ' the ecology and rational use of island ecosystems ', the draft outline of which sums the matter up in a brief phrase : ' islands offer many advantages for the study of environmental quality '.

As already indicated, the first or survey stage of the ' islands project ' involves the preparation of a comprehensive inventory. In a situation where the pressures on island ecosystems, whether from increasing human populations or the exploitation of resources and other forms of development, including tourism, are rapidly increasing, it is essential to have a complete tally and as up to date as possible a description of islands, so that not only can the gaps in our knowledge be detected and steps taken to fill them, but there is also a sound basis of assessment and choice. Much of the trouble in the past has been due to the lack of information in a readily accessible form, so that island ecosystems have been a prey to the most haphazard, irresponsible and ill-considered action : there has been no way of selecting the right island to reserve for scientific study and the right island for rational development and use,—or indeed of ensuring that the use will be rational. Since it is the ' islands for science ' with which IBP/CT is particularly concerned,—the islands in which the natural ecosystem is still comparatively undisturbed and, for the reasons already outlined, particularly well adapted for research,—the survey has been specifically confined to oceanic and offshore islands, leaving inshore islands as a separate category, to be investigated in conjunction with the biomes of continental areas to which they pertain. Under the plan accepted for the Pacific Ocean, the subsequent stages of the project comprised the critical analysis and revision at a technical meeting of the preliminary results of the survey, the selection of the sites which it is recommended should be conserved for scientific purposes, the publication of the list and the taking up through IUCN with the Governments concerned of the problem of ensuring effective conservation of the selected sites,—preferably under an agreement or Convention which will provide for international recognition ;—and, finally, the organization of monitoring and research, which will make full use of the sites and justify their selection.

The implementation of the plan has for various reasons, largely connected with recruitment and training of staff, provision of adequate funds and delays in publication, fallen somewhat behind schedule, but the plan itself has required little modification. The position now reached is that for the oceanic islands of the

Pacific, the results of the survey having been duly considered at a Technical Meeting held at Koror in November 1968, and the selection of 39 ' islands for science ' having been completed, a definitive draft of the Check List is in the process of publication (Nicholson and Douglas, 1969) and the first approaches have been made to Governments. Meanwhile the survey of the offshore islands of the region is actively in hand.

## Islands for Science—in the Indian Ocean

Turning to the Indian Ocean, which logically follows as the next section of the project and is the concern of this Symposium, the position is that a preliminary review of the oceanic islands of the central and eastern zones was presented at the 11th Technical Meeting of IUCN held at New Delhi in November 1969 and has now been published (Snow, 1970). This has been revised and incorporated in the check list annexed to this paper, which with the help of the recently published and excellent review of the coral islands of the western Indian Ocean (D. R. Stoddart ed. 1970) extends the coverage to the whole of the Indian Ocean including the Red Sea and Persian Gulf. The opportunity afforded for circulation, criticism and revision of this preliminary list at the present Symposium will, it is hoped, serve the same valuable purpose as did the Koror technical meeting for the Pacific islands survey, namely, as the second stage of the Indian Ocean section of the islands project. In particular, it should provide a basis for identifying and eventually nominating islands which may be worth considering for reservation. In this connection it needs to be stressed that in many cases where an archipelago, atoll or even an individual island would at first sight seem to be so heavily populated and altered as to be hardly worth consideration, an island by island survey reveals that there are units within almost every cluster or group, including tiny islets or even inaccessible peninsulas, which have more or less escaped extensive and irreversible changes and still constitute invaluable samples of original ecosystems.

For the purpose of establishing the list, the wider of the two generally accepted definitions of the Indian Ocean and its adjacent or associated seas has been followed, namely the waters bounded on the north by Arabia, Iran, Pakistan, India and Burma ; on the west by Africa and the meridian of Cape Agulhas (20°E.) ; on the east by the western and southern limits of the shelf waters surrounding Thailand, Malaysia, Indonesia and Australia and the meridian of South Cape, Tasmania (147°E.) ; and on the south by the Antarctic circle and continent (rather than by the fortieth parallel of latitude, which would exclude St. Paul, Amsterdam, the Crozets, Kerguelen and other islands customarily regarded as pertaining to the Indian Ocean). Within these boundaries the oceanic and offshore islands (the latter defined as islands rising from the continental shelf—Madagascar being treated as continental for this purpose—but out of sight of or 30 km or more from the nearest mainland) have been grouped in three sections : those situated between 20° and 65°E., those between 65° and 80°E. and those between 80° and 147°E. (although in fact there is no island, within the oceanic limits adopted, east of 106°E.). The islands in each of these sections are further classified in from four to seven convenient sub-groups and reviewed in turn from north to south.

Altogether, 634 islands (295 in the western, 198 in the central and 141 in the eastern sectors) have been included in this preliminary review. It will be appreciated that this represents a rather small proportion, perhaps of the order of 20%, of the total number of land surfaces which in certain conditions of wind, weather and

tide emerge from the surface of the ocean : the Maldive archipelago alone is generally credited with over 2000 islands and islets, although rather less than half of them are of sufficient size to be of substantial significance for terrestrial as well as marine biology. Selection for the list has been based on the following principles, the application of which, in the absence of exact information, is often highly tentative :—

(*a*) Only islands which there is reason to suppose may be of interest from the point of view of the conservation of terrestrial as well as marine communities are included, although the interdependence of these communities has always to be borne in mind ;

(*b*) Where a group of islands (such as those of an atoll) is reported to be more or less completely subject to human occupation and disturbance, it is listed and numbered under the group name, and individual units are only mentioned if there is some evidence that they may still be relatively undisturbed (e.g., if known to be frequented by seabird colonies) ;

(*c*) Similarly, the sample of offshore islands included, such as those off the Malagasy coast, is limited to those on which some remnant of the native flora and fauna may survive.

The synoptic information on each island (or group of islands, where not enough is known to enable it to be broken down and applied individually) is intended ultimately to be presented in the same form and under the six heads used in the Draft Check List of Pacific Oceanic Islands (Nicholson and Douglas, 1969), but a certain amount of modification and rearrangement has been felt necessary, at least at the present stage. The data are set out as follows :—

(1) Name of island (with any alternative names in brackets) and its numerical number within the particular section of the list. Where the units of a group (e.g. atoll) are worth listing individually, the group name given in capitals and small capitals may not be numbered or included as such in the list. If an island is known to be inhabited, its name is printed in capitals and marked + in the numerical summary which prefaces each section ; if known to be permanently uninhabited, it is given in italics and marked = in the numerical summary (of the 634 islands listed, about 21 % and 37 % respectively, fall into these two categories). The precise status of the remaining 42%, listed in ordinary type, has not yet been ascertained or cannot conveniently be differentiated, and they are marked ? in the numerical summary : they include islands formerly inhabited but now evacuated and islands believed to be more or less regularly visited. The category into which islands have been placed may well need considerable revision and it is probable that quite a number of those classified as uninhabited and therefore presumably relatively undisturbed will have to be transferred to the class of those which have been or still are being subjected to extensive alterations due to man-made disturbances.

(2) Under the letter (*a*) the position of each island, latitude and longitude and, in appropriate cases, distance from the nearest mainland coast, are given.

(3) Under the letter (*b*) the size of the island is indicated in hectares or square kilometres. In many cases, this can only be based on a rough estimate.

(4) Under the letter (*c*), a summary is given of the scientific data : geology and structure, including height above sea level ; vegetation (ultimately, the intention is to follow the classification designed for IBP/CT by Fosberg, 1967) ; and zoology ;

with special reference under both the last two heads to endemism and the danger of extinction.

(5) Under the letter (*d*) any information available on past and present land use and man-made or accidental disturbances is given, together with the latest estimate of the human population, if any ; particular reference is made to the impact of introduced species. Any conservation measures known to have been taken are mentioned.

(6) Finally, under the letter (*e*), the latest known published work on the island (in which references to earlier scientific work can be found), is quoted.

The heads of information (*a*) to (*e*) are not retained if the relevant data are lacking, in order to facilitate a quick assessment of what is known and what gaps still have to be filled. As will be seen, these gaps are still quite numerous and all contributions towards filling them, especially if based on recent observations, or quoting recent publications, would be most welcome. It will only be possible to consider the present stage of the Indian Ocean islands project as satisfactorily completed, when on the basis of a revised and definitive version of the list detailed recommendations on islands recognized by scientists as worthy of some kind of international scientific status, can be drafted. On the information so far available about fifty islands can be picked out as possibly qualifying for consideration, but confirmation as to which are really suitable or what others ought to be substituted or added, is urgently needed. Meanwhile, the provisional suggestions have been indicated by enclosing the relevant list numbers in brackets.

By the time that a final choice can be made and supported by fully documented citations, it is hoped that a clear *modus operandi* will have been established for stage III, in which IUCN has accepted responsibility for taking up with Governments the question of adequate assurances or, preferably, commitments in the form of a treaty or convention, under which the permanent and effective conservation of 'islands for science' can be achieved. This stage has now been reached in the case of the Pacific oceanic islands and the first approaches to Governments have been made. They are due to be followed shortly by the draft of the type of Convention which it is suggested might be appropriate, together with a list of the islands recommended for inclusion within its scope and the reasons for their selection. An international agreement of the kind envisaged is not entirely without precedent, since although the constitutional background is of a somewhat special character, some of the provisions of the Antarctic Treaty, which entered into force in June, 1961, seem to be capable in principle of adoption in the context of at least the oceanic islands in certain zones. In other cases it may prove more practical and convenient to aim for a declaration on the part of the Government concerned, supported by legal sanctions, which would invest a chosen island with a status comparable with, though differing in detail from, that required for the admission of a national park to the United Nations List of National Parks and Equivalent Reserves.

In whatever way the safeguarding of an adequate sample of island ecosystems to meet the needs of science is ultimately obtained, one thing is quite certain, namely that the position, once secured, can only be held if scientists make full and continuing use of the opportunities opened to them. It is becoming increasingly appreciated that such utilization is unlikely to be achieved without international co-operation, for reasons clearly indicated in a resolution adopted by the SCIBP General Assembly in October 1970, which referred to the 'requests of a number of Directors of eco-

logical research stations for international recognition of their problems in developing biome studies in remote situations and for aid in improving their finances, their recruitment of personnel and their communications'. The trend now definitely seems set in favour not only of research stations carrying out research either wholly or partly on a programmed (and therefore continuing) basis and with facilities for international participation, but also towards closer links between the directorates of such stations, serviced by an international agency. In the first list of stations, which are already or seem likely to come within this category, prepared by IBP/CT in September 1970, two were in the Indian Ocean region (Aldabra and Maroantsetra). It is much to be hoped that one of the results of the present Symposium at Cochin will be to promote a strong interest not only on the part of scientists but also of Governments, in the establishment of further research stations in the area. Only then can efforts to maintain the depleted but still exceptional scientific wealth of the island ecosystems of the Indian Ocean be justified and confirmed.

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## Annexe

### Preliminary list of Indian Ocean islands

(List numbers in brackets indicate that the islands thus marked may be suitable for consideration as scientific reserves.)

### A. WESTERN 30°E. - 65°E.

| Name of Group | Islands/Islets + | — | ? | | Total |
|---|---|---|---|---|---|
| (i) Red Sea | 4 | 33 | 17 | = | 54 |
| (ii) Persian Gulf | 6 | 2 | 6 | = | 14 |
| (iii) South Arabian | 4 | 5 | 1 | = | 10 |
| (iv) Seychelles/N. Mozambique | 49 | 37 | 53 | = | 139 |
| (v) Madagascar/S. Mozambique | 3 | 7 | 9 | = | 19 |
| (vi) Mascarenes | 10 | 19 | 23 | = | 52 |
| Totals | 76 | 103 | 109 | = | 288 |
| (vii) Sub-antarctic | 2 | 5 | — | = | 7 |
| Grand Total | 78 | 108 | 109 | = | 295 |

## A(i) RED SEA

1, 2. The Brothers (El Akhawein) : NORTH and *South* islands.
(*a*) 26° 18′ N. 34° 51′ E. 59 km from W. coast.
(*b*) North I. : 8.25 ha. South I. ; 2 ha.
(*c*) Low, coral : North I. is 7.2 m high.
(*d*) 31 m high lighthouse on North I. ; also a jetty.

3. ST. JOHN'S (Zabargad)
(*a*) 23° 37′ N. 36° 12′ E. 52 km S.E. of Ras Banas on W. coast.
(*c*) High (235 m), barren ; includes an offshore rocky stack.
(*d*) Inhabited in 1950.

PORT SUDAN/SUAKIN OFFSHORE GROUP

(4, 5). *Barra Musa Kebir* and *Bara Musa Saghir*
(*a*) 19° 12′ N. 38° 11′ E. and 19° 03′ N. 38° 12′ E. 70-90 km from W. coast.
(*c*) Sand and coral ; Kebir with some bushes ; about 18 km apart.

6, 7. Masamirit and Karam Masamirit
(*a*) 18° 51′ N. 38° 46′ E. 83 km from W. coast.
(*c*) Low ; sand and coral with bushes.

(8-15). *Dom es Shaikh* group
(*a*) 18° 37′ N. 38° 40′-45′ E. c. 20 km S.S.E. of Nos. 6 & 7 and 55 km offshore.
(*c*) Group of eight coral and sandy islands, the nominate one, plus *Dahrat Ghab, Ghab Abu Isa, Abu Isa, Dahrat el Dhakila, Miyur, Ghab Miyur* and *Darraka* : *Dom es Shaikh* and possibly some of the others have a covering of thin bush.

*Note* : None of the 65 islands of the Dahlak archipelago, extending from 12 to 112 km offshore of Massawa (Eritrea), nor of the 45 islands of the Farasan archipelago, extending from 30 to 75 km offshore of Qizan (Saudi Arabia)—between 16° and 17° N.—have been included in this preliminary survey. Several of the more outlying could well qualify in the 'offshore' category, are still covered with bush or trees and may well be sufficiently undisturbed to have considerable scientific interest and importance.

16. JEBEL TEIR (Jabal at Tair)
(*a*) 15° 33′ N. 41° 50′ E. 87 km from E. coast.
(*b*) 86 ha.
(*c*) Recent volcanic : sharp peaks, highest 244 m a.s.l., on 152 m plinth.
(*d*) Lighthouse, watertank, shed.

ZUBAIR ISLANDS ; ten islands and islets extending some 24 km north to south.
(*a*) Approx. 15° 04′-12′ N. 42° 03′-10′ E. 60 km from E. coast.
(*b*), (*c*) and (*d*), north to south.

17. *Quoin :* wedge-shaped rock, 30.5 m high.
18. Haycock : c. 50 ha, 166 m high.
19. Rugged : c. 35 ha, 155 m.
20. Table Peak : 17 ha, 160 m.
21. Saddle : 42 ha, 178 m.
22. Low : 7.75 ha, 38 m.
23. Saba : 167 ha, 116 m. Two hills, some stunted bushes.
24. *Shoe* : rock, 5.2 m.
25. Jebel Zubair : 1500 ha, 224 m.
26. Centre Peak : 220 ha, 173 m. Disused lighthouses.

ABU AIL ISLANDS

27. QUOIN
(*a*) 14° 05′ N. 42° 49′ E.
(*b*) 10.4 ha.
(*c*) High (104 m), barren : one off-lying stack.
(*d*) Lighthouse, watertanks.

28. *Pile*
(*a*) As for No. 27.
(*b*) 10 ha.
(*c*) Fairly high (87.5 m), inaccessible.

JEBEL ZUQAR AND HANISH GROUP : twenty-six islands and islets, strung out over 50 km, north to south : volcanic hills, with many old craters : loose granular black, brown or buffy earth and ashes, with sharp rocks, sparse vegetation : 33 km from E. coast.
(*a*) 13° 59′-27′ N. 42° 35′-49′ E.

29. Jebel Zuqar : 114 sq. km, highest point 624 m ; hilly, north point sandy with a few bushes ; no permanent inhabitants, but visited by fishermen from Feb. to June ; two stone huts, watertank.
30. *High :* 20 ha, 65.8 m.
31. *Shark :* 14 ha, 13° 58′ N., 42° 42′ E.
32. *Near :* 63 ha, 125 m.
33. *Tongue :* 12 ha, 51 m. Part of a crater rim.
34. Little Hanish : 8.6 sq. km, 191 m. Hilly, rugged, some grass cover.
35. *Low :* 42 ha, 14.6 m.
36. Great Hanish : 46 sq. km, highest point 407 m. Hilly and steep, with 4 deep valleys and a low sandy strip across S.W. end.
37. *Haycock :* 13° 47′ N. 42° 48′ E. 62 ha, 158 m.
38. *Peakey :* 8 ha, 35.6 m.
39. *Addar Ail :* 3.4 ha, 37 m.
40. *Mushājjara :* 1 ha, 7.3 m.
41. *North Round :* 60 ha, 110 m.
42. *Quoin :* 60 ha, 13° 43′ N. 42° 49′ E.
43. *Chor Rock :* 5 ha, 21.9 m.
44. *Round :* 8 ha, 26.5 m.
45. *Double Peak :* 60 ha, 136 m.
46. *Mid :* 21 ha.
47. *Suyul Hanish :* 31 ha, 116 m.

The Haycocks :

48. *North-East :* 3.4 ha, 43.9 m.
49. *Middle :* 14 ha, 94.5 m.
50. South-West : 21 ha, 60 m. Disused lighthouse.

Muhabbaka Islets :

(51). *High :* 13° 27′ N. 42° 35′ E. ' White with bird droppings '. 21 m high.
52. Flat : 12.2 m.
53. Harbi : 25 m.
54. Sayal : 15 m.

## A(ii) PERSIAN GULF

1. Farsi (Al Fārisīyah)
(*a*) 27° 59′ N. 50° 10′ E. 101 km N.E. of Ras and Ghār on S. coast.
(*b*) 16.5 ha.
(*c*) Low (3 m), sandy, covered with coarse shrubs and grass.
(*d*) Metal light-tower 27.4 m a.s.l., flagstaff, low concrete building.

(2). *Arabi* (Al 'Arabīyah)
(*a*) 27° 46′ N. 50° 10′ E.
(*b*) 6.6 ha.
(*c*) Low, sandy, covered with coarse shrub. Swarms with birds, especially cormorants, and ' in season is so thick with eggs and young that it is scarcely possible to avoid treading on them '.
(*d*) The guano deposit, once several inches thick, has been exploited and the island is visited by turtle-catchers.

3, 4. Al Qiran and Al Quraiyin
(*a*) 35 km W.S.W. of No. 2. The two islets are 6 km apart.
(*c*) Low (4.6 m and 0.6 m), flat, covered with brushwood ; the second islet in particular and its surrounding reefs swarming with birds.
(*d*) Frequented by fishermen.

5. Al Harqus
(*a*) In same general area as Nos. 1-4 : 63 km N.E. of Ras el Ghar on S. coast.
(*c*) Low (0.9 m), sandy : apparently not much frequented by birds.

6, 7. Nabiyu and Nabi Farur
(*a*) 26° 18′ N. 54° 30′ E. and 26° 08′ N. 54° 26′ E. 45 and 22 km from N. coast.
(*c*) High (399 m and 145 m) ; Nabi Farur, although inhabited, said to 'Abound with gazelle' ; in good fishing ground.
(*d*) Lighthouse (16.5 m high) on summit of Nabi Farur.

8. TUNB (Tanbe Borzorg)
(*a*) 26° 16′ N. 55° 18′ E. 28 km from N. coast.
(*b*) c. 16 sq. km.
(*c*) Rather low for its size (53.3 m), covered with coarse grass and shrub ; small venomous snakes ; good oyster beds on coast.
(*d*) Village ; goats and some cattle ; lighthouse, 22 m high, on summit.

9. SIRRI
(*a*) 25° 53′ N. 54° 33′ E.
(*c*) Medium (31.4 m) ; some large trees (? planted).
(*d*) Village, small date-groves, two large wells.

10. BU MUSA
(*a*) 25° 50′ N. 55° 03′ E. 65 km from S. coast.
(*b*) c. 12 sq. km.
(*d*) Village, ruins of large building ; date grove.

11. HALUL
(*a*) 25° 17′ N. 51° 37′ E. 90 km E.N.E. of the Qatar peninsula.
(*c*) Barren ; av. rainfall 100-200 mm, winds mainly W. to N.W. ; highest point 62 m.
(*d*) Oil installations, meteorological station.

12. *Sir Abu Nair* (Nu'ayr)
(*a*) 25° 12′ N. 54° 15′ E. 82 km N.N.W. of Abu Dhabi on S. coast.
(*b*) 12 sq. km.
(*c*) Pear-shaped, medium height (77 m), volcanic hills with a sandy plain ; wild cats, snakes, scorpions, birds (two spp. of tern nesting in large colony in July 1965) ; signs of fresh water below ground.
(*d*) Signs of former occupation and mining (? guano).

13. DAS
(*a*) 25° 09′ N. 52° 52′ E. 90 km from S. coast of gulf.
(*d*) Large oil installations.

14. DALMA
(*a*) 24° 30′ N. 52° 19′ E.
(*b*) 30 sq. km.
(*c*) Low hills (max, 93 m), long sandspit.
(*d*) Village of 60 inhabitants. Former pearling centre.

## A(iii) SOUTH ARABIAN

KURIA MURIA GROUP, off-shore of Oman, in a chain over about 50 km lying west to east as follows :

(1). *Hasikiya*
(*a*) 32 km E.N.E. of Ras Hasik, nearest point on Oman coast.
(*c*) High (153 m), with plateau and conical peaks ; watercourses ; no vegetation ; *Sula dactylatra* nests, but guano deposits small.

2. *Suda*
(*a*) 24 km E. of No. 1.
(*c*) Very high (399 m), barren except for some tamarisks, grass and moss in the summit area.

3. HALLANIYA
(*a*) 17° 32′ N. 56° 05′ E.
(*b*) 57 sq. km.
(*c*) Highest point a sheer limestone cliff on the north (502 m), otherwise granite peaks rising to 458 m ; some tamarisk, a little grass at the eastern end ; inshore waters with many stingrays, barracuda and sea-snakes.
(*d*) Population 55 (1955) ; cable station established when islands were ceded to Britain by Sultan of Muscat in 1854.

4. Qibliya
(*a*) 24 km E. of No. 3.
(*c*) High (168 m) limestone peaks.

5. *Ghargant*
(*c*) 70 m high rock stack.

SOKOTRA GROUP

6. SOKOTRA
(*a*) 12° 30′ N. 54° E. 225 km E. of Cape Guardafui.
(*b*) 3640 sq. km (115 km long from E. to W., width c. 35 km).
(*c*) Cretaceous and tertiary beds, superimposed on crystalline rocks, forming a 300 m plateau with on W., S. and E. granitic mountains to over 1500′. Desiccating climate, max. rainfall of c. 200 mm on plateau, 600 mm on the mountains. 3% of plant genera and 30% of the species endemic. 1 genus, 3 species and six subspecies of birds are endemic (out of the 27 listed species of land bird). 3 genera and 14 out of 22 spp. of reptile are endemic. The mollusc fauna is of special interest.
(*d*) 10,000-12,000 inhabitants ; large numbers of cattle, sheep and goats ; aloes and *Dracaena* have been much exploited. Some cultivation.
(*e*) H. O. Forbes (1903), G. B. Popov (1957) *J. Linn. Soc.* 55, R. E. Moreau (1966), M. D. Gwynne *Act. Phytogeogr. Suec.* 54 (1967). A suitable conservation area has been proposed by Gwynne (*loc. cit.*).

(7). *Kal Farun*
(*a*) 12° 27′ N. 52° 08′ E. 24 km N.N.E. of No. 8 and c. 110 km E.N.E. of C. Guardafui.
(*c*) Twin rocky islets, rising to 86 m, white with guano from the great numbers of seabirds that frequent them.

8. ABD EL KURI
(*a*) 12° 09′-15′ N. 52° 04′-24′ E. 98 km E. of C. Guardafui.
(*b*) c. 155 sq. km.
(*c*) Rising to two peaks of 621 and 601 m, between which there is a plateau ; sandy beach on north, cliffs on south. Arid ; fauna similar to that of No. 6, except for some endemic land molluscs and scorpions.
(*d*) 200 inhabitants (1967), mainly engaged in pearl fishing and turtle hunting. Main town Tamarida (pop. 400) on north coast.
(*e*) Not scientifically explored since H. O. Forbes, Ogilvie-Grant and others landed in 1898-99.

9, 10. The Brothers : SAMHA (Semha) and *Darsa* (Darzi)
(*a*) 12° 10′ N. 52° 58′-53° 06′ E. and 12° 07′ N. 53° 17′ E. 64 km E. of No. 8 and 35 km from No. 6 ; 17 km apart, N.W./S.E.
(*b*) c. 47 sq. km and 8 sq. km.
(*c*) High, table-topped (779 m and 392 m) : Semha has rocky shores and used to abound in turtles, Darsa is surrounded by perpendicular cliffs. Semha has a permanent stream.
(*d*) Population of Semha 40 (1967) ; Darsa uninhabited but full of rats.

## A(iv) SEYCHELLES AND NORTH MOZAMBIQUE CHANNEL

(1). *Latham* (Fungu Kizimkazi)
(*a*) 6° 54′ S. 39° 56′ E. 43.5 km E. of Ras Kimbiji on coast S. of Dar es Salaam.
(*b*) c. 1.2 ha.
(*c*) Sand and coral ; highest point a.s.l. 3 m. About a quarter covered by a creeping plant. Large numbers of *Sula dactylatra* and *Sterna* spp. breed and flat surface of islet is about a foot deep in guano.
(*d*) Landings by fishermen and others occasional, but islet is protected by local superstition as well as difficult landing conditions.
(*e*) R. E. Moreau (1940). *Ibis* 14.

ALDABRA atoll comprising 17 islands and islets, from N.W. clockwise as follows :

(2-18). WEST (=Picard), *Polymnie*, *Middle*, *South* (=Grand Terre, the largest unit, comprising three-fifths of the total), the nine small *Mannian* islets in the western channel and, in the lagoon, *Coconut* (=Michel), *Euphrates* (=Esprit), *Moustique* and *Chabu*.
(*a*) 9° 21′-29′ S. 46° 12′-32′ E.
(*b*) c. 155 sq. km.
(*c*) Raised atoll, about 64 km in circumference, mainly rugged coral rock and limestone, with some sand-dunes (max. elevation c. 20 m), densely covered with vegetation (mangrove lining lagoon) : fairly high proportion of endemism in both flora and fauna (of 17 species of resident land birds, two species and nine well-marked and three poorly-differentiated subspecies are endemic) ; large population of *Testudo elephantina*.
(*d*) West island inhabited for well over a century by transient immigrants from the Seychelles (max. population c. 130) ; with consequent introduction of coconut palms, casuarina, goats, cats and rats ; sea turtles heavily exploited and much reduced ; atoll surveyed for establishment of airbase 1965-7, but plans abandoned in 1968 ; scientific research station established in West island in 1970. Nevertheless, disturbances have had only limited effect.
(*e*) Stoddart, Wright, Benson and others (1967), *Atoll Res. Bull.* 118 ; *Nature* 213 etc.

19. ASSUMPTION
(*a*) 9° 40′ S. 46° 31′ E.
(*b*) 10.5 sq. km.
(*c*) Raised reef-limestone island, max. height c. 7 m except for sand dunes, which especially along S.E. coast may be up to c. 30 m a.s.l. Low scrubby vegetation comprising eight distinct plant associations, several of which are very patchy, though *Plumbago* and *Sarcostemma* form a matted ground cover in places, and around the original and present settlement sites there are some casuarinas, coconut palms etc. These introduced or common tropical ruderal species seem to be increasingly dominant, though altogether c. 100 species have been recorded on the island, including 3 endemics.
(*d*) Exploitation of guano began in 1908 and still continues under a lease from Seychelles Government, although activities were suspended in 1967 due to low prices. Green turtle, once heavily exploited, now virtually extinct although given ineffective protection. *Sula abbotti* (surviving only on Christmas Island—q.v.) became extinct c. 1926 and it is doubtful if any seabirds still nest, except perhaps *Gygis alba*. The endemic subspecies of rail, *Dryolimnas*, and most other land-birds except the sunbird and crow, have also disappeared. In these losses introduced rats, cats, dogs and goats (though the latter now seem to have died out) have no doubt played a part.
(*e*) D. Vesey-Fitzgerald (1941) *Ibis* 14 ; Benson (1967) *Atoll Research Bull.* 118 ; D. R. Stoddart *et al.* (1970) *Atoll Research Bull.* 136.

20-34. COSMOLEDO, atoll with 15 islands and islets, from N.W. clockwise as follows : W. North, E. North, du Trou, Goelette, Polyte, Petit Polyte, Wizard, Pagoda, South, Moustique, Bat, MENAI, Manaque, Observation and Middle.

(*a*) 9° 41′ S. 47° 35′ E.
(*b*) 5.2 sq. km. (Wizard 1.6, Menai 2.3) ; dunes rising to max. of 17 m.
(*c*) Low elevated coralline limestone reef-rock (max. to tops of mangroves and dunes about 18 m) ; apart from cleared and planted areas, the reef-rock, dune and mangrove vegetation has probably been little disturbed in the last 150 years since the first intermittent settlement began ; much ' Aldabra-like ' thicket but fewer species. Green and hawksbill turtles appear to be still quite plentiful, though exploited. W. North, E. North, Polyte and South Island are frequented by breeding seabirds, as however are parts of the inhabited island of Menai and the still often visited Wizard island (where at least 150 pairs of *Sula sula* were nesting in 1968). A well-marked subspecies of *Nectarinia sovimanga* (shared with Astove) and *Cisticola cherina* are the commonest land-birds ; other species such as the rail and turtledove, otherwise extinct, may possibly survive on South island.
(*d*) Extensively planted with coconuts and casuarinas ; maize and other crops cultivated on Wizard and Menai ; a fishing station established on the former now used only as a temporary camp by the lessee of the atoll (which belongs to the Seychelles).
(*e*) D. R. Stoddart *et al. Atoll Research Bull.* 136 (1970).

35. ASTOVE

(*a*) 10° 06′ S. 47° 45′ E.
(*b*) 4.25 sq. km.
(*c*) Raised atoll, with only one break in the rim ; highest point is sandhill on the east (18.0 m) : flat coralline limestone with stunted shrubby cover and patches of taller and denser thicket with *Pemphis*, *Scaevola* and *Tournefortia* dominant and eleven distinctive plant communities ; endemic races of two or three land-bird species survive (possibly including the rail, previously reported as extinct) and the lagoon swarms with herons, terns and migrant waders ; land crabs, lepidoptera and marine life of reef are notable. Green turtle still breed plentifully.
(*d*) Settled intermittently since 1895, latterly under lease from Seychelles government ; one large house, huts, c. 12-20 inhabitants : coconuts and casuarina introduced, 100 hectares of former being planted up in 1960. Turtle catching and rearing practised. Small airstrip.
(*e*) D. R. Stoddart *et al.* (1970) *Atoll Research Bull.* 136.

36, 37. GLORIOSA (Glorieuse) and *du Lys*

(*a*) 11° 34′ S. 47° 18′ E.
(*b*) Gloriosa c. 4.9 sq. km.
(*c*) Low coral and sand (height a.s.l. of trees on du Lys 10.7 m).
(*d*) Settlement (pop. 20 in 1926) at N.W. end of Gloriosa : green turtle exploited but said to be still abundant. Landbirds include both a sunbird and a white-eye.

COMORO ISLANDS

38. MAYOTTE

(*a*) 12° 52′ S. 45° 11′ E.
(*b*) 370 sq. km.
(*c*) Volcanic, highest point 660 m ; a few remnants of primary forest, including two or three hundred hectares on Mt. Outsongui (*Albizzia* and *Mimusops* dominant) ; much secondary forest, with clumps of bamboo ; more extensive mud-flats, sandy beaches, mangrove swamps and a larger number of small islets than in the rest of the Comoros ; there are c. 18 islets and rocks, of which 12 are worth listing as follows, clockwise beginning on N.W. (an indication of the size is the height quoted in metres) :

39-50. Zamburu (270 m), Andrema (25 m), Dzugoma (18.3 m), Buzi (163 m ; still wooded), PAMANZI (208 m ; main town of Comoros, Zandzi, is on a connected islet at its western foot ; in the summit cone a crater lake of c. 60 ha), MONNIAMESI (38 m), CACAZON (28 m), VATON (13 m), Bandeli, Bambo, Sandy (1 m), Choazil islands (two ; 50 & 70 m).

31 species of land-birds reported as breeding : a local race of the Scops owl *Otus rutilus* is still common. Terns and tropic birds may nest on cliffs and islets.

(*d*) Population 20,000 : drier, thicketed, north end of island with few people. Original vegetation extensively cleared in 1860-1900, for a sugar industry which is now extinct.

(*e*) C. W. Benson (1960). *Ibis* 103b.

51. MOHELI

(*a*) 12° 20′ S. 43° 45′ E.

(*b*) 216 sq. km.

(*c*) Single volcanic ridge, composed of small cones along a major fissure (max. height 500 m), covered with evergreen forest above 300 m, formerly degraded but now well recovered, with some areas of short grass and bracken ; ferns and orchids plentiful ; coastal areas with *Albizzia, Ficus, Tamarindus* and *Adansonia*, 8 ha lake surrounded by *Mimosa* thicket, mangrove swamp areas ; two groups of offshore islets, in south and north-east, barren, rocky and precipitous : S : Bateau, Plates,

52-64. Moa, Foro, *Magnuni* (tropic birds and frigate birds reported nesting), Kanzuni, Djumadjini, Sanzi and Mbhuhu ; N.E. : Samia, Miangoni, Muchaco (Blanc : 31 m) and Mianja. Endemism of fauna as illustrated by land-birds of Comoros (which are mainly of Madagascar origin) : out of 56 species, including at least five introductions, exactly half are well differentiated ; 39 species reported to breed on Moheli.

(*d*) Population 5,000, mainly living on coast ; cultivation and coconut plantations less in evidence than on other islands.

(*e*) Benson (1960). *Ibis* 103b.

65. ANJOUAN (Johanna)

(*a*) 12° 10′ S. 44° 29′ E.

(*b*) 378 sq. km.

(*c*) Subcircular basaltic dome, greatly eroded and upper part very precipitous (max. height 1578 m) ; forests greatly degraded by human activity and 1950 cyclone ; some coastal thicket and mangrove. Excluding introductions, about 35 land-birds are known to breed ; they include the endemic species of sunbird *Nectarinia*

66. *comorensis*, confined to Anjouan. One islet only, La Selle (height 122 m).

(*d*) Population 62,000 ; severe habitat destruction ; cultivation of hill rice and other crops on steep slopes (erosion) ; banana, coconut, mango, kapok and sisal plantations. Many cattle (as on all the islands). One endemic race, of the owl *Otus rutilus*, is probably extinct.

(*e*) Benson (1960). *Ibis* 103b.

67. GRAND COMORE (Angaziga)

(*a*) 11° 10′ S. 43° 15′ E. 280 km from the coast of Africa.

(*b*) 950 sq. km.

(*c*) Volcanic, dominated by still active Mt. Karthala (2600 m), on slopes of which and elsewhere considerable areas of mostly degraded forest survive, with one untouched area of 1700 ha on south-eastern slope of mountain ; summit area is a heath-zone dominated by *Philippia* ; grass and bracken areas ; remnants of thicket on coast ; no perennial streams. No islets offshore. Highest rainfall in whole group, c. 2600 mm. In keeping with larger size and more varied habitats of the island, 39 species of land-bird are believed to breed.

(*d*) Population 83,000 ; extensive habitat destruction especially in coastal areas, main products being timber, cacao, bananas, coconuts etc. Grass fires frequent, though those in summit area may be due to volcanic activity.

(*e*) Benson (1960). *Ibis* 103b.

68. CERF (South Banks)

(*a*) 9° 31′ S. 51° 00′ E.

(*c*) Sandbank planted up with coconut palms (top of trees 10.7 m a.s.l.).

(*d*) Huts, periodic human occupation.

69. ST. PIERRE

(*a*) 9° 19′ S. 50° 43′ E.

(*c*) Metamorphic limestone, low but varying from 4.6 to 9 m a.s.l. Some trees.

(*d*) Houses, huts and jetty built by Guano Company, whose activities appear to have terminated the nesting of *Sula sula* and reduced other seabird colonies.

(*e*) D. Vesey-Fitzgerald (1941) *Ibis* 14V.

70. PROVIDENCE
(*a*) 9° 13′ S. 51° 10′ E.
(*c*) Sandy cay, low (tops of trees 15 m a.s.l.). A few *Gygis alba* nest.
(*d*) Village : densely planted with coconut palms and some casuarina. Centre for turtle-catching January/March.
(*e*) D. Vesey-Fitzgerald (1941). *Ibis* 14V.

FARQUHAR group, atoll comprising seven islands, clockwise from north :

(71-77). NORTH, *Manaha* (split into 3 sections), South, *Goelette, des Déposés, du Milieu, Lapin.* These enclose a lagoon described as one of the most complex in topography in the world.
(*a*) 10° 11′ S. 51° 07′ E.
(*b*) North Island 3.2 sq. km, South Island 3.9 sq. km ; total 7.5 sq. km.
(*c*) Flat, metamorphic limestone, affected by periodic cyclones and in some cases, e.g. Goelette, where *Sula sula, Anous stolidus, Sterna fuscata* and *Sterna sumatrana* breed, overlaid with deposits of coarse sand. None of the islands is higher than about 3 m, except for North and South Islands where the dunes reach 12 m a.s.l. 96 species of plants have been recorded and provisionally classified in nine communities. No indigenous land-birds are definitely known, but ten species of seabirds have been recorded.
(*d*) Main settlement on North I. (39 inhabitants in 1968), but I. des Déposés and South I. are intermittently occupied. This has resulted in a strong gradient in the number of introduced species of plants southwards through the atoll, although South I. has extensive coconut palms and casuarinas.
(*e*) D. Vesey-Fitzgerald (1941). *Ibis* 14V ; D. R. Stoddart *et al.* (1970) *Atoll. Res. Bull.* 136.

78-80. ALPHONSE, S. FRANCOIS & BIJOUTIER
(*a*) 7° 05′ S. 52° 45′ E.
(*c*) *Gygis alba* still manages to breed on Alphonse, a low sandy cay like the other two islets in the group.
(*d*) Completely planted up with coconut palms.

81-(98). AMIRANTE group, a group of eighteen well scattered islands, some of them subdivided at high water or forming the visible part of mainly submerged atolls : from N. to S. : *North* and *South* islands of the African Banks, Remire (Eagle) (depopulated in 1968), D'ARROS, Ressource, Fouquet (main breeding place of *Puffinus pacificus*), ST. JOSEPH, *Cascassaye, Benjamen,* Pelican, Poule and Chien (part of an atoll), DESROCHES, POIVRE (3 sections of one atoll, the southernmost and largest being uninhabited), *Etoile Cay, Boudeuse Cay,* MARIE LOUISE and *Desneufs.*
(*a*) 4° 50′-6° 10′ S. 52° 50′-53° 45′ E.
(*b*) Remire 80 ha ; Desroches 324 ha.
(*c*) Low sandy cays, none higher than 6 m, but often visible from a considerable distance due to the height of the coconut palms and casuarinas (some 20-25 m a.s.l.) with which they are mostly planted. The original vegetation of low bushes is found mainly on some of the islets, which are still uninhabited and unplanted with palms, e.g. North I. of the African Banks, Cascassaye and Benjamen. Seabirds are numerous, notably *Sterna fuscata* (some 3½ million nest at Desneufs) and *Anous tenuirostris* (Remire).
(*d*) Nearly all the islands are planted up with coconut palms, except for North island, Etoile, Boudeuse, Remire, and Desneufs, where the largest breeding colonies of seabirds occur. These colonies have been very heavily exploited for eggs and have suffered accordingly. Recommendations for controlling this exploitation on a sustained yield basis, made in 1958, have not yet been fully implemented. Guano has been worked on Remire.
(*e*) D. Vesey-Fitzgerald (1941). *Ibis* 14V ; D. R. Stoddart *et al.* (1970) *Atoll. Res. Bull.* 136.
*Foudia madagascariensis* introduced and common on Remire, D'Arros, Ressource and St. Joseph, also *Passer domesticus* on the three last-named islands.

SEYCHELLES group of mainly granitic islands and islets : from N. to S. :

99. BIRD
(*a*) 3° 43′ S. 55° 12′ E.
(*b*) c. 70 ha.

(*c*) Low (highest point 4.5 m), flat coralline limestone ; c. 36 species of plants, including dense shrub layer in interior, good sand-dune flora and some open swards ; very large colony (now c. a million pairs) of *Sterna fuscata* ; a few other seabird, heron and wader species.
(*d*) Small settlement since 1950 ; planted up with 10,000 coconut palms ; also some casuarinas ; island now strictly protected by its owner. Three species of land-bird and two species of tortoise formerly introduced ; some rats, no cats.
(*e*) P. Loustau-Lalanne (1963) *Seychelles Soc.* No. 2.

100. DENIS
(*a*) 3° 48′ S. 55° 40′ E.
(*b*) c. 150 ha.
(*d*) Lighthouse and settlement ; planted up with coconut palms and casuarinas.

101, 102. ARIDE with *Booby* islet.
(*a*) 4° 12′ S. 55° 40′ E.
(*c*) High (135 m ; the islet 28 m), granitic hills.
(*d*) Booby (Ile aux Fous) is a declared nature reserve under the Wild Animals and Birds Protection Ordinance 1961.

103. CURIEUSE
(*a*) 4° 16′ S. 55° 44′ E.
(*c*) High (179 m), ridge of granitic hills covered with trees and scrub ; a remnant of mangrove vegetation on the coast ; reefs stretching towards Praslin of exceptional biological interest.
(*d*) Palms planted on south and east ; pond for captured turtles ; the Coco de mer tree *Lodoicea sechellarum* introduced from Praslin. Vegetation of eastern peninsula totally destroyed by fire in 1967.

104, 105. West Sister and East Sister (Les Soeurs)
(*a*) 4° 16′ S. 55° 51′-52′ E.
(*c*) Small but quite high (106 and 113 m.).

106. St. Pierre
(*a*) 4° 17′ S. 55° 45′ E.
(*c*) Very small islet on a reef of exceptional interest.

107, 108. PRASLIN with Round Islet at E. end
(*a*) 4° 17′-22′ S. 55° 41′-46′ E.
(*b*) 67 sq. km.
(*c*) High (384 m, islet 76 m), granitic ; sole remaining natural refuge of Coco de mer *Lodoicea* and black parrot *Coracopsis*. All the six native species of palm are found in the Vallée de Mai, and five of them in the Fond Ferdinand and other localities in the island.
(*d*) Much damage to vegetation by fires.

109, 110. *Albatross Rocks* and *Ave Maria Rock*
(*a*) 4° 18′ and 19′ S. 55° 51′ and 49′ E.
(*c*) Ave Maria rock is 17.4 m high. Albatross rocks lie offshore of No. 99.

111. FELICITE
(*a*) 4° 19′-20′ S. 55° 52′ E.
(*c*) High (227.7 m) ; a pair or two of the nearly extinct black paradise flycatcher *Tchitrea corvina* (elsewhere confined to No. 115) survived until 1936 and may still do so and Scops owl and *Bebrornis* have also been reported. The flora contains many endemics.
(*d*) Very disturbed ; cats and rats.

112. COUSIN
(*a*) 4° 20′ S. 55° 40′ E.
(*b*) 24.3 ha.
(*c*) Rather low (66 m), granitic, some remaining low bush and mangrove, which is the only haunt of the endemic Seychelles *Bebrornis*. Both local shearwater *Procellaria* species nest.

(*d*) Planted up with coconuts ; but now established as a reserve, with a resident warden. Introduced barn owls are controlled (6 birds and 2 nests destroyed in 1970), having become a pest species.

113. COUSINE (South Cousin)
(*a*) 4° 21′ S. 55° 39′ E.
(*c*) Quite high (77 m), granitic. Vegetation and fauna similar to No. 100.
(*d*) Attempts are being made to secure this island also as a reserve, where experimental 'controls' of management methods on Cousin could be sited.

114. Marianne (Mary Anne)
(*a*) 4° 20′-21′ S. 55° 55′ E.
(*c*) High (130 m), granitic.

115. LA DIGUE
(*a*) 4° 20′-23′ S. 55° 50′ E.
(*b*) 10.4 sq. km.
(*c*) High (326 m), granitic ; only certain remaining refuge of *Tchitrea corvina*.
(*d*) Largely planted with coconut palms, *Terminalia*, *Calophyllum* and fruit trees and interspersed with houses.

116. NORTH
(*a*) 4° 23′ S. 55° 15′ E.
(*c*) Bare, desolate with a few straggling trees, though quite high (215 m).

117. SILHOUETTE
(*a*) 4° 28′-31′ S. 55° 12′-15′ E.
(*b*) 21 sq. km.
(*c*) High (752 m), mountainous, with some of the best high intermediate and mountain moss-forest still surviving and also a sample of mangrove vegetation on the Grande Barbe 'plateau'.
(*d*) Extensive coconut palm plantations ; fire damage.

118. Les Mamelles
(*a*) 4° 29′ S. 55° 32′ E.
(*c*) Rather low (43 m) ; breeding place of many birds.
(*d*) Lighthouse on highest point. Declared nature reserve under the 1961 Ordinance.

119. *Recif*
(*a*) 4° 35′ S. 55° 46′ E.
(*c*) Quite high (48 m) for its small size : important breeding place for seabirds.
(*e*) P. Loustau-Lalanne (1963) *Seychelles Soc.* occ. publ. No. 2.

120. FRIGATE (Frégate)
(*a*) 4° 35′ S. 55° 56′ E.
(*c*) High (122 m), granitic ; last remaining refuge of magpie robin or pie chanteuse *Copsychus sechellarum*, which feeds mainly in bushy under-growth surrounding the island plateau, and has one of the richest land-bird populations of the whole archipelago.
(*d*) Coconut palms have been introduced and little remains of the indigenous habitat ; privately owned ; no rats, few cats.
(*e*) P. Loustau-Lalanne (1963) *Seychelles Soc.* occ. publ. No. 1.

121. MAHE
(*a*) 4° 37′ S. 55° 27′ E. (Port Victoria).
(*b*) 137 sq. km.
(*c*) Granitic, steep, seven summits over 600 m (highest 912 m) ; once densely forested, well-watered. Sixteen islets around the coast, most of them inhabited and planted with coconut palms, but two or three rocky and uninhabited and affording some refuge for seabirds and other species :—

122-137. ST. ANNE (highest point 253 m, bushy), *Beacon* (31 m), Moyenne (61 m), LONGUE (84 m), CERF (106 m), Round (27 m), Anonyme (40 m), Rat (12 m ; scanty scrub), SOUTH-EAST, Souris (14 m), Chauve Souris (8 m), *I. aux Vaches* (56 m), *Sèche*, THERESE (165 m), CONCEPTION (132 m), North (51 m).
Reefs surrounding St. Anne, Sèche, Moyenne, Longue and Cerf are under consideration as a marine national park.
(*d*) Much disturbed, many introduced species (including at least six birds), but due to the very mountainous terrain most endemic species survive (e.g. the Bare-legged Scops Owl *Gymnoscops insularis*, until recently thought to be extinct) and there are still good conservation opportunities in the main Morne/Seychellois massif. Sèche (Beacon Island), Vache and three other unlisted islets (Boudeuse, Etoile, Lamperiaire (or King Ross) are declared nature reserves.

138. PLATTE
(*a*) 5° 52′ S. 55° 23′ E.
(*c*) Low, sandy cay.
(*d*) Planted up with coconut palms ; guano has been exploited.

139. COETIVY
(*a*) 7° 06′-13′ S. 56° 15′ E.
(*b*) 25 sq. km.
(*c*) Low (12 m to top of trees) cay, with sandhills.
(*d*) Planted up with coconut palms ; turtles exploited.

## A(v) MADAGASCAR AND SOUTH MOZAMBIQUE CHANNEL

1. EUROPA
(*a*) 22° 20′ S. 40° 26′ E. 350 km from nearest point on Madagascar coast.
(*c*) Atoll, sandy with low hummocks, rocky on western and low cliffs on eastern side (max. elevation 24 m). Has one of largest Green Turtle, *Chelonia mydas*, colonies in world, over 4,000 females nesting in 1970.
(*d*) Meteorological station. Introduced goats. Turtle Reserve since 1923.
(*e*) G. H. Hughes (1971). In *Marine Turtles* : IUCN Suppl. Paper No. 31.

2. *Bassas da India*
(*a*) 21° 28′ S. 39° 45′ E. 350 km from west coast of Madagascar.
(*c*) Mostly submerged atoll, with a few coralline rocks rising to 2-3 m above sea-level.

3. JUAN DE NOVA
(*a*) 17° 04′ S. 42° 43′ E. 140 km from west coast of Madagascar.
(*c*) Coral and sand ; covered with trees ; numerous seabirds nesting.
(*d*) Houses and istallations of Guano Company with about 80 employees ; island also visited by fishing boats from July to February.

4. MADAGASCAR and its inshore islands : the ecosystems and conservation problems are continental in scale, although the characteristics of the flora and fauna are generally insular e.g. in respect of the high degree of endemism, vulnerability etc. Although there are considerable numbers of islands around the coast, particularly in the western sectors, they are all inshore and none of them more than about 12 km from the coast of the main island. Nevertheless, there are indications that some of these small islands and islets are sufficiently inaccessible and undisturbed to be worth consideration and further investigation as possible sites of scientific value and worth conserving as such. They include, starting with the west coast from north to south and ending with the east coast from north to south :
Section (1) : Cap d'Ambre to Pointe d'Angadoka : c. 70 islands and islets.

5. e.g. Nosy Anambo : nr. Cap Voailava ; casuarinas, stunted undergrowth, guano deposits.

(6). *Nosy Fisaka :* nr. Cap St. Sébastien ; ' covered with guano '.

7. Nosy Antaly : nr. Jio Jio, Baie d'Ampamouty ; 144 m high, ' covered with trees '.
Section (2) : Pointe d'Angadoka to Cap St. André : c. 17 islands and islets.

8. e.g. *Nosy Kivinjy :* nr. Pte d'Angadoka ; conical, perpendicular and inaccessible sides, summit (103 m) covered with bush.

9-12. Nosy Kalakajoro, N. Ovy, *Antany Mora* and N. Valiha (the Radama Islands), of which Mora, 144 m high, is covered with grass and trees.

13. Nosy Makamby : 15° 43′ S. 45° 55′ E. ; long narrow plateau 70 m a.s.l.

Section (3) : Cap St. André to Cap Ste. Marie : c. 23 islands and islets.

14. e.g. *Nosy Maroantaly* : low (5 m), stunted vegetation.

15. Nosy Androtra : thickly wooded, trees up to 31 m a.s.l. (both these are part of the 7-island Barren Islands group).

16. Nosy Andrahombava : off Cap Tsingilofilo ; sandhills covered with bushes and a few clumps of trees.

17. *Nosy Vé :* nr. Pointe d'Anakao south of Tulear ; low, covered with brushwood ; clump of trees and remains of old settlement ; the island has been a reserve for green and hawksbill turtles since 1923.

Section (4) : North-eastern coast : c. 32 islands and islets.

18. e.g. Leven islands, nr. Pointe Owen, of which there are about a dozen, several of them wooded ; they are flat and low (about 2.7 m max.).

(19). *Nosy Marosy :* nr. Pointe Antsiraka ; one of a group of rocky, wooded and uninhabited islands at the head of Antorgil Bay ; 210 m in height.

Section (5) : Eastern and Southern coast : c. 9 islands and islets.

## A(vi). MASCARENES

1, 2. MAURITIUS and REUNION, although once of the greatest interest and importance to science, as island sites, are somewhat outside the scope of this inventory because of their size (1840 and 2500 sq. km), large populations, intensive human activities and species introductions; only vestiges of the original ecosystems have survived because of inaccessibility or through a few reservations, although in the case of Mauritius virtually nothing is left of the coastal forest and its species. Reunion has no islets off its coast, but there are some off Mauritius. Most of these are close inshore and from the north, clockwise, comprise—

3-12. Gunners Quoin (Coin de Mire) (158 m high ; 3.7 km north of the north point of the main island, Cap Malheureux), Amber islands (3), Cerfs islands (7), Marianne, Fouquets islands (3), Aigrettes (28 ha), Two Cocos, Brocus, Fourneau and Benitiers.

More isolated and in at least one case of the greatest scientific interest are the outlying islands of the reef stretching northwards some 25 km from the main island, namely from north to south—

(13). *Ile aux Serpents*
(*a*) 19° 49′ S. 57° 48′ E.
(*c*) Bare rounded cone (161.5 m high) ; only two spp. of plant, a grass and a *Portulaca* ; nesting place of numerous terns, type locality of the gecko *Gymnodactylus serpensinsula*.
(*e*) J. Vinson (1950, 1953) *Proc. Roy. Soc. Arts & Sci.* Mauritius Vol. 1.

(14). *Round* (Ile Ronde)
(*a*) 19° 51′ S. 57° 47′ E.
(*b*) 151 ha.
(*c*) Volcanic tuffs, with coralline intrusions and porphyritic basalt debris in summit area, which is c. 300 m high ; vegetation includes the endemic palm *Mascarena revaughanii* (nearly extinct), *Latania loddigesii* (confined to Mauritian offshore islands) and half a dozen other trees. The fauna is remarkable, especially for its reptiles, among which are two unique snakes of the boa family *Bolyeria multicarinata* and *Casarea dussumieri*.
(*d*) Introduction of goats and rabbits between 1840 and 1865, has led to extensive erosion and habitat destruction. Plans for getting rid of these animals and the better

supervision of the island as a scientific reserve have long been under discussion but frustrated by physical and financial difficulties.

(*e*) J. Vinson (1964) *Proc. Roy. Soc. Arts & Sci* Mauritius Vol. II Part 3.

15. FLAT (Plate)

(*a*) 19° 52′ S. 57° 40′ E.

16, 17. (*c*) Fairly high (91.4 m) : one islet Gabriel (21 m) and an isolated rock, *Pigeon House* rock (52 m) offshore.

(*d*) Lighthouse 19 m high on island summit.

18. RODRIGUEZ

(*a*) 19° 41′ S. 63° 23′ E.

(*b*) 108 sq. km.

(*c*) Volcanic, hilly, rising to 396 m, formerly densely forested ; the western reef has many islets, some of which acted as last refuges, especially for seabird colonies, when the main island was overrun with rats and cats by about 1760 ; the same applies to the group of islets on the south-east. Twelve islets are worth listing :—

19-30. On W. : Crab (46 m high), Frigate (37 m), Catherine (28 m), *Cocoa* (=Cocos) and *Sandy* (cays 4.6 m high), *Booby* and Diamond (basaltic, 17 m and 15 m). On S.E. : Hermitage (26 m rock stack), Misel, Gombrani (=Moubrani) and Pierrot (both low and flat with max. height 6 m), and Flat (Plat) (also 3 m).

(*d*) Population 20,000 ; clearing and burning had largely destroyed the forest by 1860, together with nine out of twelve unique bird species. Only two of the latter, *Foudia flavicans* and *Bebrornis rodericana* survive today, the warbler now very scarce.

(*e*) F. B. Gill (1967). *Ibis* 109 ; W. R. P. Bourne (1968). *Ibis* 110.

31. TROMELIN

(*a*) 15° 52′ S. 54° 25′ E.

(*b*) 175 ha.

(*c*) Extremely isolated, flat, low (max 6 m), coral and sand ; northern end covered with bushes of *Tournefortia* 1.5 m high : elsewhere this species, *Boerhavia*, *Sida* and *Portulaca* form matted vegetation. Green turtles *Chelonia mydas* nest on the northern beaches and possibly also hawksbill turtles *Eretmochelys imbricata*. Boobies and frigates nest.

(*d*) Meteorological station established in 1954 ; airstrip ; rabbits, recently, and rats and mice introduced ; turtle breeding colonies protected.

(*e*) F. Staub (1970) *Atoll Res. Bull.* 136 ; G. H. Hughes (1971) IUCN Suppl. Paper No. 31.

32, 33. N. and S. AGALEGA

(*a*) 10° 25′ S. 56° 35′ E.

(*b*) North island about 2.6 sq. km, South island about 10 sq. km.

(*c*) Flat sandy, with some low bushy areas. Temperature range 67-92° F.

(*d*) Population 330 (in 1948) ; both islands with buildings and planted up with coconut palms. Guano deposits have been exploited.

CARGADOS CARAJOS shoals (St. Brandon), a coral reef complex stretching over 40 km from N. to S., in a crescent varying from 2 to 8 km in width, between 16° 15′ and 50′ S. and 58° 30′ and 59° 42′ E. Excluding half a dozen sandbanks and cays devoid of vegetation, there are 19 islands and islets, from N. to S. as follows (the group as a whole, and those marked e.g. in particular, meriting consideration as scientific reserves) :—

(34-52). *Albatros* (101 ha : height a.s.l. 6 m) ; coral sand and guano ; at one time infested by wild cats, but these are said to have been eliminated.

e.g. *Ile du Nord* (20.3 ha : 3.5 m) ; coral sand and guano.

e.g. *Puits à Eau* (30.4 ha : 3 m) ; coral sand, with upraised coral reef rock in N.

e.g. *Poulailler* (12.2 ha : 1.7 m) ; coral sand ; like previous one swarming with birds.

RAPHAEL (Establishment) (10.1 ha : 2 m) ; coral sand ; meteorological station and main settlement.

*Sirène* (9 ha : 5 m) ; coral sand, upraised reef rock, guano (latter exploited).

*Tortue* (0.54 ha : 1.8 m) ; coral sand.

*Perle* (20.3 ha : 6 m) ; coral sand, upraised reef rock, guano ; was inhabited during quarrying of the guano about 1944.

*Frégate* (30.4 ha : 6 m) ; coral sand, upraised reef rock, guano (exploited about 1920) ; swarmed with rats 1939.

e.g. *Paul* (Mapare) (20 ha : 3.5 m) ; coral sand.

AVOQUER (Avocaré) (8 ha : 1.7 m) ; intermittently inhabited ; water-tanks and huts ; coral sand.

I. aux Bois (?).

*Courson* (4.1 ha : 1.7 m) ; coral sand.

Cocos (Coco) (12.2 ha : 4.6 m) ; coral sand ; planted with coconuts.

Grand Dagorne (?)

Petit Dagorne (?)

e.g. *Grand Capitaine* (4.1 ha : 3.5 m) ; coral sand.

e.g. *Petit Capitaine* (2.8 ha : 3.0 m) ; coral sand.

I. DU SUD (14 ha : 1.9 m) ; coral sand ; fishing establishment ; reservoirs.

(*c*) The two dominant species of the sand-dune shrubbery around most islets are *Tournefortia* and *Scaevola*, which often grow 2-3 m in height and on which many birds depend for nest-sites; this is succeeded and replaced in the centre of the islets by the low tangled so-called 'herb-mat' vegetation of *Boerhavia*, *Achyranthes* etc.

(*d*) Population c. 100 ; mainly engaged in fishing and turtle catching ; collecting of seabirds and their eggs for export to Mauritius recently prohibited ; five islands—I. du Nord, Ile Paul, Poulailler, Puits à Eau and the two Capitaines have been recommended as reserves, giving shelter to most of the breeding birds.

(*e*) F. Staub & J. Gueho (1968). *Proc. Roy. Soc. Arts & Sci.* Mauritius Vol. III part 1.

## A(vii). SUBANTARCTIC

(1). *Prince Edward*

(*a*) 46° 38′ S. 37° 55′ E.
(*b*) 99 sq. km.
(*c*) Volcanic, highest point 720 m.

2. MARION

(*a*) 46° 54′ S. 37° 43′ E.
(*b*) 280 sq. km.
(*c*) Volcanic ; highest point 1186 m, under permanent ice ; many lava fields interrupt the coastal plain, which is from 100 to 300 m in width ; woody *Acaena* dominant on lower eastern ridges ; the plain is covered with a soggy layer of grass and moss-like *Azorella*, with numerous pools and lakes ; elephant and fur seals abound ; c. 25 spp. of seabirds breed, including 4 penguins.
(*d*) Meteorological station established 1948, following sporadic occupation by sealers over the previous 150 years ; mice and a few feral cats introduced, but birds now fully protected and not much disturbed.
(*e*) R. W. Rand (1954) *Ibis*, 96.

CROZETS : excluding about a dozen rock stacks, comprise—

3. Grande Ile des *Iles des Apôtres*

(*a*) 45° 57′ S. 50° 26′ E.
(*b*) 20 sq. km. Highest point 332 m.

4. *I. aux Cochons*

(*a*) 46° 06′ S. 50° 12′ E.
(*b*) 143 sq. km. Highest point 910 m.

(5). *I. des Pingouins*

(*a*) 46° 28′ S. 50° 21′ E.
(*b*) 20 sq. km. Highest point 350 m.

6. I. DE LA POSSESSION

(*a*) 46° 25′ S. 51° 47′ E.
(*b*) 240 sq. km. Highest point 934 m.

Meteorological and scientific research stations at Crique du Navire on E.

7. *I. de l'Est*
   (*a*) 46° 26′ S. 52° 13′ E.
   (*b*) 200 sq. km. Highest point 1200 m.
   (*c*) Volcanic.

## B. CENTRAL 65° E - 80° E

| | | + | — | ? | | Total |
|---|---|---|---|---|---|---|
| (i) Laccadives | .. | 10 | 12 | — | = | 22 |
| (ii) Maldives | .. | 17 | 54 | 29 | = | 100 |
| (iii) Chagos | .. | 8 | 23 | 22 | = | 53 |
| (iv) Subantarctic | .. | 2 | 12 | 9 | = | 23 |
| Totals | .. | 37 | 101 | 60 | = | 198 |

### B(i). LACCADIVE ISLANDS

(*a*) Coral atolls, arranged in three lines running from north to south and situated c. 190 km west of the Malabar coast of India. They fall into two main groups : the northern, known as the Amindivis, comprises :

(1). *Baliapanni* (=Cherbaniani) : 12° 20′ N., 71° 50′ E. ; large tern colonies on low atoll.
2. CHETLAT : 11° 41′ N. 72° 41′ E. (100 ha) ; sandy beach frequented by waders.
3. BITRA : 11° 33′ N. 72° 09′ E., together with two small islets ; 10 ha.
4, 5. *Tree* and *Sandy Cay*
6. KILTAN : 11° 29′N. 73°E.
7. KADAMAT : 11° 13′N. 72° 46′E.
8. AMINI : 11° 07′N. 72° 43′E.
9. ANDROTH : 10° 50′N. 73° 40′E. ; still has some of the original type of bush.
10. AGATTI (=Agathy) : 10° 48′N. 72° 09′E., together with three islets ; 280 ha ; still has some of the original type of bushy vegetation.
11-13. *Kalputhi, Bingaram* and *Tinnakara.*
14. *Kalpitti* (=Pitti) : 10° 47′N. 72° 36′E. ; coconut trees have been planted but the island is uninhabited.

The southern group comprises :

15, (16). KAVARATTI (=Kavrathi) : 10° 33′N. 72° 36′E. : (350 ha) ; together with the 0.8 ha islet of *Pitti*, a sandbank noted for its tern colonies.
17, 18. *North Suheli Par* and *South Suheli Par* : 10° 05′N. 72° 15′E.
19-21. KALPENI : 10° 04′N. 73° 38′E., together with two islets, one of which is named *Cheriyam.*
22. MINICOY : 8° 16′N. 72° 16′E. (3.24 sq. km), together with
23. *Wiringili.* The Minicoy atoll is c. 220 km S. of the rest of the group. The islet of Wiringili was used for quarantine purposes and is often referred to as Smallpox islet.

(*b*) The total area of all the islands : 27.86 sq. km.
(*c*) The elevated parts of the atolls, constituting the islands, are generally on the eastern side of the ring. The natural vegetation of which only remnants survive, e.g. on the two Suheli Par islands and Kadamat, was apparently a dense low scrub with only five arboreal species, but the coconut palm now planted on almost all the islands may be indigenous and the reason for human settlement, which dates from at least the 16th Century. Two spp. of tern, *Sterna fuscata* and *Anous stolidus* breed and possibly also *Sterna bengii* and other species of seabirds ; a few Indian land-birds and the Indian form of *Mus musculus* have been introduced.
(*d*) Population : 24, 108 (1961 census), fairly evenly scattered through the inhabited islands, though Bitra only had 76 inhabitants in 1951. The Laccadives form part of the Indian Union.
(*e*) D. W. Snow (1970), IUCN publications new series No. 17 ; R. S. Bailey, this Symposium. *J. mar. biol. Ass. India*, 14 (2).

## B(ii). MALDIVE ISLANDS

(*a*) A double chain of coral atolls stretching south from the latitude of 7°N. and about 450 km W.S.W. of Cape Comorin. The 19 atolls together with several isolated islands are reputed to total about 2,500 islands and islets, but only 996 (indicated by the totals given for each atoll in the list) are of significant size and dry at high water. The following need to be considered or are worth further investigation, with a view to the choice of suitable conservation areas ; from north to south :

IHAVANDIFFULU : 7°N. 52° 50′E. ; 24 islets, of which 6 are permanently inhabited mainly in connection with the bonito fishing industry ; they include :

1. On North : Wagaru (18 ha) : well-wooded.
2-4. East : Murdu (19 ha) and Beramundu (19.5 ha), both densely wooded ; Gumali (17 ha).
5. S.E. : Gallandu (12.5 ha).
6. S.W. : HAUWANDU (54 ha).
7-10. West : Hurafuri (3 ha ; densely wooded), Seybirfuri (7 ha), Mafinur (11 ha), Heronasi (1.6 ha).
11, 12. N.W. : Kandufuri (15 ha, densely wooded), MATARI (9 ha).
13, 14. Lagoon : *Manafuri* (12.5 ha) ; Medufuri (7.5 ha).
15. TILADUMMATI : 6° 40′N. 73°E. ; 41 islets, which are among the largest of any of the atolls and mostly heavily populated.
(16). *Kandute* : 6° 26′N. 72° 54′E. 170 ha.

MAKUNUDU : 6° 20′N. 72° 37′E. ; small population. 5 islets including :

17. Faro Doru (43 ha), once covered with high bushes.
18. MILADUMMADULU : 6°N. 73° 10′E. ; 101 islets of which only 16 in the south part of the atoll were inhabited in 1926, the local industry being basket-making.

FADIFFOLU : 5° 25′N. 73° 30′E. ; 48 islets of which only 4 were inhabited in 1926 ; among the uninhabited islands were :

19. On North : *Fehingili* (40 ha).
20. South : *Aligau*.

MALOSMADALU, NORTH : 5° 40′N. 72° 50′E. ; 75 islets, including —

21, 22. Powell islands (two) ; beyond the north point of the atoll, and well to the north :
23. *Etinghi* : 5° 57′N. 72° 55′E.
24. MALOSMADALU, SOUTH : 5° 10′N. 73°E. ; 70 islets ; cloth-weaving industry.
25. KARIDU (Kardiva).

HORSBURGH : 4° 52′N. 72° 55′E. ; 6 islets, including—

26, 27. On South : *Mafuri*, *Fehenfuri* ; both very small.
28. North : FURUDU : 43 ha ; western end covered with scrub (1945).
(29). *Inafuri* : 10.7 ha ; exceptionaly high (14.6 m) ; bushy.

MALE : 4° 25′N. 73° 30′E. ; export trade in cowries, tortoise-shell etc. ; 53 islets including—

30. On North : Gaha Faro ; off-lying the atoll.
31, 32. East : Helengili : 86 ha ; low, wooded. Mirufuri : 65 ha.
33. HULULE : 107 ha ; airstrip.
34. South : Willingili ; variously reported as ' well-wooded ' and ' devoid of all vegetation '.

SOUTH MALE : 4°N. 73° 25′E. ; government headquarters, 30 islets, only three inhabited in 1926 ; differentiated subspecies of waterhen. *Amaurornis* occurs in both the Male atolls.

35. On West : *Warigili* : 10.7 ha ; bushy sandbank.
36, 37. North : *Vilas* : 40 ha ; bushy. Wadu : 65 ha.
38, 39. East : Hembudu : 40 ha. *Haru Hura* : dense scrub.

ARI : 3° 55′N. 72° 50′E. ; turtle-catching and sail weaving ; of the 85 islets only 22 were inhabited in 1926 ; they include—

40. On South : *Ariyaddu* ; off-lying (3° 30′N. 72° 51′E.) : 130 ha.

41-43. West: Malos: 214 ha. *Weha Faro*: 80 ha. *Gangehe*: 29 ha and an *unnamed*
44. islet of 40 ha south of Mativari, covered in low bush (1945).
45, 46. North: RASDU ATOLL: off-lying (4° 17′N. 72° 58′E.), with 3 islets and TODDU.
47, 48. East: *Kadibudu*: 58 ha. *Dugati*: 130 ha.

49. FELIDU: 3° 30′N. 73° 25′E.; net-making centre; 22 islets of which only 7 were inhabited in 1926.

50, 51. WATURU REEF: 3° 16′N. 73° 25′E.; includes *two unnamed* islets, on the south of the reef, which were covered with low bushes plus a few palms.

MULAKU: 3°N. 73° 30′E.; cloth-weaving centre; 48 islets (8 inhabited in 1926) include—

52, 53. On South: *Mahufuri*: 170 ha; *Delufuri*: 20 ha.
54. West: *Tuvaru*: 130 ha.
55, 56. North: *Digaru*: 86 ha. *Maduwaru*: 40 ha.
57-59. East: *Muli*: 129 ha. *Maraweli*: 20 ha. *Mafuli*: 130 ha.
60, 61. *Buru*: 20 ha. *Irafuri*: 20 ha.

NILANDU NORTH (co-ordinates unverified); 19 islets including—

62, 63. *Ari Faro*: at north end of atoll; *Mawafuri*: on east side.

NILANDU SOUTH: 2° 50′N. 72° 55′E.: 48 islets include the two Jewellers Islands in the N.W. corner of the lagoon, one of which is:—

64. *Dures*: uninhabited in 1926: 80 ha.
65. On N.E.: *Furi*: 20 ha.
66. South: *Huluwalu*: 40 ha.

KOLUMADULU: 2° 20′N. 73° 10′E.: 59 islets, including—

67, 68. On south & west: *Kimbudu*: 130 ha. *Weligandu*: 85 ha.
69. North: *Kandufuri*: 20 ha.
70, 71. East & S.E.: Fahala: 300 ha. Kanimidu: 210 ha.

HADUMATTI: 2°N. 73° 30′E. 64 islets, including—

72, 73. On N.E.: *Dambidu*: 170 ha. *Dekunu*: 20 ha.
74-76. S.E.: Kadu: 170 ha, with *two* small bushy *islets* to the south of it.

SUVADIVA/HUVADU: 0° 51′N. 73° 12′E.: mat making industry; 173 islets include—

77-81. On N.W.: *Mahuta, Fulangi, Atamandu, Lusa* and *Kandugili*, all bushy.
82-85. East: *Mametu*: 65 ha. *Kudu*: 170 ha. *Mandu*: 85 ha. *Diaddu*: 170 ha.
(86-89). In lagoon: north end: *Hibadu* (no palms; 'magnificent trees of luxurious growth and great height'); *Huradu*: 40 ha; and at the south end: *Hakaru*, with *an islet* which has high tree cover.

90. FUA MULAKU: 0° 18′S. 73° 26′E.; population over 2000, coconut palms.

ADDU: 0° 40′S. 73° 10′E. 20 islets, including ten of some size, namely—Mahira,
91-100. MIDU, Heratera (75 ha), Mulikadu, Wilingili, GAN (Airfield and base, leased from Maldives Government by the U.K.), MARADU, Abuhera, HITADDU (airfield installations), FEDU.

(*b*) The total land area of the archipelago is put at 298 sq. km.

(*c*) Interrupted peripheral reefs of recent geological origin; monsoon climate, but that of Addu atoll in the extreme south less seasonal and with higher rainfall; original vegetation-high forest, pandanus brakes, reedy wetlands and rank grass, with apparently no endemism; but two endemic subspecies of flying foxes, *Pteropus giganteus* and *hypomelanus* and two out of four native land-birds differentiated. About a dozen species of seabird breed and probably three species of turtle.

(*d*) Most of the original vegetation destroyed and replaced by coconut palms, which are the economic mainstay of the population of 96,400 (1963), though, as noted above, several other, 'cottage industries' exist. Numerous species introduced, intentionally and by accident.

(*e*) D. R. Stoddart (1966) *Atoll Res. Bull.* No. 116 ; D. W. Snow (1970) IUCN publications new series No. 17 ; R. S. Bailey, this Symposium. (*J. mar. biol. Ass. India*, **14** (2) : 628-642.)

## B(iii). CHAGOS ARCHIPELAGO

Extending about 200 km from north to south and 100 km in maximum width, 1450 km S.S.W. of Cape Comorin and about the same from the southern coast of Ceylon. S.E. trade winds dominant from April to October, which is the dry season ; variable winds with rain (c. 2500 mm annually) November-March. Original vegetation (largely replaced by coconut palms) was thick *Scaevola* scrub or quite high forest, in which *Intsia bijuga* may have been the main species. No endemism recorded among plants and only two poorly differentiated subspecies of introduced land-bird have been described. The main atolls and other islands comprise, from north to south—

PEROS BANHOS : 5° 12′-27′S. 71° 44′-58′E. ; about 30 islands and islets, with a total land area of 1160 ha and maximum elevation of 3.4 m, of which the more important are (clockwise from north) :—

1-24. de la Passe, *Moresby* islands (4 in number : large seabird colonies in 1961), Parasole, *Longue* (tern colonies), Manoel, *Yeye* (two species of shearwaters and five species of terns breeding), *Petite* and *Grande Coquillage*, *Coin du Mire* (shearwaters and brown boobies nesting), *aux Vaches Marines*, Fouquet, Mapou de l'ile du Coin, DU COIN (principal settlement), Anglaise, Monpatre, POULE, PETITE and GRANDE SOEUR, PIERRE, Mapou, DIAMANT. Total population on the inhabited islands c. 200.

SALOMON : same longitude as and c. 19 km E. of previous atoll ; total land area of the 11 islands 518 ha ; the islands are—

25-35. de la Passe, Mapou, TAKAMAKA (still with remnant forest), Fouquet, Sepulture, Jacobin, du Sel, Poule, BODDAM (main settlement ; original high forest totally destroyed), Diable (no coconut palms), Anglaise. Total population c. 150.

(36). *Nelson* (Legonne) : 5° 41′S. 72° 20′E. : area 129 ha ; low, bushy ; large seabird colonies which are periodically exploited for eggs and young (a hut has been erected).

37-39. *Three Brothers* : 6° 07′-10′S. 71° 32′-35′E. ; formerly inhabited but abandoned since 1935, though planted up with palms ; largest of the three is c. 100 ha in area ; they are believed once again to have become important seabird stations.

(40-41). *Eagle Islands* (two) : 6° 10′-15′S. 71° 19′-22′E. ; the second islet is known as the *I. aux Vaches Marines* ; formerly inhabited and main settlement of the western group, abandoned 1935 ; planted with palms.

(42). *Danger* : 6° 23′S. 71° 16′E. ; 280 ha ; still some forest patches ; settlement abandoned in 1935.

EGMONT (Six Islands atoll) ; 6° 38′-41′S. 71° 20′-24′E. ; settlement abandoned 1935 ; formerly over-run with pigs, cats, dogs and rats and planted up fully with coconut palms. The islands are—

43-48. *des Rats*, *Sud-est*, *Tattamucca*, *Carre patte*, *Lubine* and *Sipaille*.

DIEGO GARCIA : 7° 13′-27′S. 72° 21′-30′E. ; total area c. 160 sq. km ; comprises five islands and islets, maximum elevation of 1.5 m :

49-53. MAIN, West, Middle, East and *des Oiseaux* ; population 569 (1953) ; former airbase and likely to become one again ; heavily developed, fully planted with coconuts, though still some scrubby areas where the shade-loving *Asplenium* fern is plentiful ; half a dozen species of land-bird, notably the Madagascar fody (also established in Salomon and Peros Banhos), have been introduced ; also cats and rats.

(*e*) P. Loustau-Lalanne (1962). *Ibis* 104 ; D. W. Snow (1970) IUCN Publications new series No, 17 ; *Atoll Res. Bull.* (1971) No. 149 ; D. R. Stoddart and J. D. Taylor eds.

## B(iv). SUBANTARCTIC ISLANDS

1. AMSTERDAM
   (*a*) 37° 49′S. 77° 35′E.
   (*b*) c. 60 sq. km ; highest point 910 m.
   (*c*) Volcanic ; at lower levels some dense thickets of *Phylica arborea* survive, but mainly grassland ; upper parts covered with wet heath and bog.
   (*d*) First settlement, in 1871, lasted only 8 months ; now only a meteorological station; cats, rats, mice and c. 2000 head of cattle, which have become feral, have seriously altered the habitat and adversely affected seabird populations, though the island has now been constituted as a sanctuary.
   (*e*) M. W. Holdgate and N. M. Wace (1961) *The Polar Record.*

(2). *St. Paul*
   (*a*) 38° 43′ S. 77° 33′E.
   (*b*) c. 650 ha ; highest point 271 m.
   (*c*) Volcanic, still slightly active ; bare, treeless, only *Spartina arundinacea* grass and some rushes, which have now recolonized most of the island ; two offshore islets, *Ilot Nord* and *Rocher Quille.*
   (*d*) Continuously inhabited only from 1927-1932 and 1938-1947, but there are now no shore-based installations for the fishing industry, which is still operational. Many species introduced, but only rabbits, rats and mice and small numbers of sheep remain ; some recovery from habitat devastation reported.
   (*e*) M. W. Holdgate and N. M. Wace (1961) *The Polar Record.*

3. KERGUELEN
   (*a*) 48° 30′-49° 30′S. 68° 30′-70° 35′E.
   (*b*) c. 3600 sq. km. Highest of the six major peaks reaches 1865 m.
   (*c*) Volcanic, still slightly active ; tussock grassland of *Poa cookii* ; some areas once dominated by the unique cabbage *Pringlea antiscorbutica* ; inland areas with associations dominated, respectively, by *Azorella* heathland and matted *Acaena* ; mean annual temperature 39°F., wet and stormy climate ; there are at least 80 islets, mostly close in-shore, including—

4, 5. On N.W. : Crow, Roland.

6-10. North : Saint Lanne, Castries, Howe, Foch, du Port.

11-14. S.E. : Australia, *Longue* (briefly inhabited by shepherds), Gaby, *Carrington.*

15. West : Ile de l'Ouest.
   'The archipelago is so large and complex that good examples of the natural flora and fauna almost certainly remain in the outlying and smaller islets and less frequented parts of the group. A detailed study of these is much to be desired.' 37 species of seabirds and one duck, the Kerguelen race of the pintail, *Anas acuta eatoni*, have been recorded. Invertebrate fauna with many peculiar forms.
   (*d*) Spasmodic settlement, now confined to the large Weather Station at Port aux Francais, with 110 persons (1960). Introductions of rabbits (1874), sheep, mules (died out), ponies, pigs, cattle and reindeer (1955-56), and also of cats, rats, dogs and mice, have contributed to wide habitat destruction and further introductions, e.g. of mink, have been planned ; but see quotation under (c) above.
   (*e*) P. Milon and C. Jouanin (1953) *L'Oiseau et R.F.O.* V. XXIII ; M. W. Holdgate and N. M. Wace (1961) *The Polar Record.*

16. *McDonald*
   (*a*) 53° 02′S. 72° 35′E.
   (*b*) c. 110 ha. Highest point 211 m.
   (*c*) There are four rocky stacks or islets off the coast, rising very precipitously—

17-20. *Needle, Flat* (53 m), *Meyer Rock* (149 m) and *South* (79 m).

21. Heard
   (*a*) 53°S. 73° 30′E.
   (*b*) c. 500 sq. km. Highest peak 2744 m.

(*c*) Only small areas ice-free ; vascular plant flora of 7-8 species ; large sea-bird colonies ; two small islets 16 km off the north coast :

(22), 23. *Shag* (c. 500 ha ; 92 m high), *Drury* (37 m).

(d) A hut has been established at the base of a long low spit on the east.
(*e*) M. W. Holdgate and N. M. Wace (1961) *The Polar Record*, Vol. 10 : 68.

## C. EASTERN. 80° - 147°E.

| | + | — | ? | | Total |
|---|---|---|---|---|---|
| (i) Andamans & off-lying islands .. | 9 | 20 | 48 | = | 77 |
| (ii) Nicobars .. | 6 | 3 | 11 | = | 20 |
| (iii) Mergui archipelago .. | — | 3 | 18 | = | 21 |
| (iv) South-eastern oceanic islands .. | 6 | — | 17 | = | 23 |
| Totals .. | 21 | 26 | 94 | = | 141 |

### C (i). ANDAMANS AND THEIR OFF-LYING ISLANDS

1. **Preparis**

(*a*) 14° 51′N. 93° 37′E.
(*b*) c. 200 ha ; max. elevation 80.8 m.
(*c*) Fairly low and flat, covered with stunted tree jungle (no endemics reported) ; extensive fringing reefs.
(*d*) Occasionally visited by fishermen and pearlers, but virtually undisturbed.
(*e*) D. W. Snow (1970) IUCN Publications new series No. 17.

COCO ISLANDS : 14° 11′N. 93° 23′E. ; six islands and islets—

2, 3. TABLE (Mingalakyun) : 3 sq. km ; off-lying *Slipper* islet (7 ha) ; densely wooded, some clearings (Slipper I. grassy with a few trees near summit) ; lighthouse on summit (59 m. a.s.l.) ; presence of a few small deer recorded ; pigs and cattle introduced.

4. *Great Coco :* 39 sq. km ; highest point 112 m ; freshwater lagoon ; two off-lying islets
5, 6 *Rat* (38 m) on east and *Jerry* (9 m : 15 ha) on south ; remains of former habitation (small clearing, coconut palms, possibly introduced), but mainly forested ; pigs, dogs and domestic fowls running wild ; no endemic plants or animals.

7. *Little Coco :* 3 sq. km ; highest point 75 m ; feral pigs ; forest ; a small freshwater lagoon at south end ; no endemics.

(8). Narcondam

(*a*) 13° 25′N. 94° 17′E.
(*b*) 11 sq. km ; highest point 710 m.
(*c*) Truncated volcanic cone ; dense forest, numerous figs and fruit-eating birds, including an endemic hornbill (population estimated at 200 in 1902).
(*d*) Plantains and pineapple introduced, and also goats and fowls but the latter appear to have died out and island was until recently virtually undisturbed ; but the establishment of a police post has been reported.
(*e*) D. W. Snow (1970) IUCN Publications new series No. 17.

9. *Barren*

(*a*) 12° 16′N. 93° 51′E.
(*b*) c. 8 sq. km ; highest point 353 m.
(*c*) Volcanic crater and cone, still slightly active ; forest on flanks ; no endemics ; pigeons numerous.
(*d*) Infested with rats and also flocks of feral goats.
(*a*) and (*b*) ANDAMANS, main chain : 10° 30′-13° 30′N. 91° 92° E. ; about 270 km S.W. of C. Negrais on Burmese coast ; comprises 210 islands and islets, totalling 6475 sq km in area, of which about 145 are of significant size : the more important

10-12. off-lying islets of the NORTH, MIDDLE and SOUTH ANDAMAN are—
West coast, from north to south : (i) off N. Andaman :

13-19. Landfall : East (13° 38′N. 93° 04′E.) ; West (178 m high) ; Reef or Boa Pong (low, wooded, tops of trees 43 m) ; Paget ; Snark or Shark) (sandy, low—6 m—and covered with bush) ; North Reef (low, flat, wooded and marshy).

(ii) Off Middle Andaman :

20-23. INTERVIEW (large island 16 km long and 113 m high) ; Flat, Petrie, Sandy.

(iii) Off South Andaman :

24-29. LABYRINTH GROUP (includes Tarmugli, Boat, Red Skin and Hobday : cliffy and rocky) ; NORTH SENTINEL (inhabited by 'stone-age' Jarwas : wooded ; 122 m high ; 11° 35′N. 92° 13′E.) ; RUTLAND (very large ; inhabited by Ongwes).

Southwards of the main chain :

30-39. N. Cinque (twin peaks of 161 and 173 m) ; South Cinque, Passage (11° 11′N. 92° 41′E. ; 107 m high) ; East and West Sister (highest point 93 m) ; North and South Brother (10° 59′N. 92° 41′E. ; flat-topped and wooded, tops of trees 27 m a.s.l. ; South Brother has large numbers of breeding pigeons) ; West and East Twin (48 and 44 m ; wooded) ; *South Sentinel* (tree tops 44 m above sea, flat, noted for turtles and crabs).

East coast, from north to south : (i) off N. Andaman :

40-52. Pockock (74 m ; wooded) ; TABLE GROUP, which includes Excelsior (55 m), Trilby and Delgarno or Chirume (13° 25′N. 93° 06′E. ; 610 m high ; mangroves along shore) ; *Smith* (large, 147 m high, commands entrance the Stewart Sound Port, the main town of N. Andaman, 12° 56′N. 92° 59′E.) ; the two *Little Turtle* islands (13° 22′N. 93° 05′E. ; wooded) ; Chatham (61 m ; jungle) ; Sound ; and many small islets, e.g. Orchid (52 m), Curlew, Egg and Dotterel.

(ii) Off Middle Andaman :

53-59. LONG (large island, over 7 km in length, densely wooded, lumber industry and settlement) ; Guitar (98 m ; the possible presence of musk-deer has been recorded) ; Porlob, N. Passage (also 7 km in length), Strait, Colebrooke, Baratang (very large).

(iii) Off S. Andaman :

60-66. North, Middle and South Button (12° 19′N. 93° 05′E. ; 63, 50 and 36 m high, respectively, and combining low spits, covered with trees, cliffs and rocks) ; Duncan (90 m to the top of the dense tree cover) ; Petman, Kyd (a large densely wooded island ; 11° 58′N. 92° 47′E. ; 238 m high) ; Snake ; and the—

RITCHIES ARCHIPELAGO, lying well to the east, densely wooded, abounding with pigeons and pigs, uninhabited except for occasional visits from local hunters and fishermen, consisting of 10 islands—

(67-76). *Outram* or Tar Mugu (12° 14′N. 93° 05′E. ; c. 10 sq. km ; 90 m high) ; *Wilson* or Boroin (c. 15 sq. km ; 216 m) ; *Nicholson* or Kaichawa (c. 3 sq. km ; 119 m) ; *Sir William Peel* or Ta (c. 22 sq. km ; low, mangroves) ; *Havelock* (large, about 6 km in length and 55 sq. km in area ; highest point 198 m) ; *Neill* (142 m) ; *Sir Hugh Rose* (11° 47′N. 93° 06′E. ; 73 m ; well-forested) ; *John Lawrence* or Parkit ; *Henry Lawrence* or Charka (173 m ; mangroves ; a thickly forested islet off the eastern shore) ; *Inglis*, Jail or East island (forested).

(*c*) Tertiary sandstones, with limestone, calcareous sandstone and indurated clay, and intrusive metamorphic rocks ; highest point 732 m (Saddle Peak, N. Andaman) ; monsoon climate ; evergreen tropical forest, mainly of Malayo-Burmese type ; dipterocarps prominent, some endemics ; fauna also S.E. Asian in character, with considerable endemism, e.g. 3 species and 8-14 subspieces among the 23 recorded mammals, and 7 out of 80 species of breeding birds (2 shared with the Nicobars and excluding the Narcondam hornbill, see No. 8) ; among over 40 species of reptiles, a gecko *Phelsuma andamanense* is of special interest because its affinities are with Malagasy rather than Oriental species.

(*d*) Population has rapidly increased in last 20 years from about 19,000 to a total variously estimated at 35,000-49,000, due to resettlement of refugees ; forest clearing and forestry operations have consequently tended to increase (25,000 tons of timber

exported annually); but large areas are still fairly undisturbed, due partly to the rather hostile attitude of the aboriginal Jarwa people; many plants have been introduced in settled areas, but not coconut palms; recent attempts by tourist interests to boost the 'pursuit' of turtle, crocodile, pig and deer; pig, possibly, and deer (*Axis axis*), certainly, are introductions, and there have been several others, including *Macaca nemestrina*, *Felis chaus*, *Mus musculus* and a number of birds, such as mynah and sparrow, as well as domestic stock (numbered at c. 40,000 head in 1961).

(*e*) D. W. Snow (1970) IUCN Publications new series No. 17.

77. LITTLE ANDAMAN
(*a*) 10° 13′-25′N. 92° 50′E.
(*b*) c. 1000 sq. km.
(*c*) Except for extreme north, nearly flat.

## C (ii). NICOBARS

(*a*) & (*b*) 6° 45′-9° 12′N., 92° 30′-94° E.; 130 km N.W. of the north-western tip of Sumatra; total area c. 1900 sq. km; excluding a couple of rocky islets, there are twenty islands (12 inhabited), falling into two groups, as follows:

1-8. (i) Northern: CAR NICOBAR (main centre of population); Batti Maly (46 m high; upper part densely wooded; c. 12 sq. km); Tillangchong (8° 35′N. 93° 36′E.; only occasionally visited; c. 10 sq. km; 323 m); TERESSA (70 sq. km; 273 m; sparsely inhabited); BOMPOKA (15 sq. km; 193 m, sparsely inhabited); TRINKUT, KAMORTA, Nankowry.

9-20. (ii) Southern: Little Nicobar (7° 26′N. 93° 42′E.; 160 sq. km; two peaks of c. 430 m; dense forest, swamps); GREAT NICOBAR (860 sq. km; max. elevation 642 m; only about 50 inhabitants in 1941), with three small islets *Pigeon*, *Megapod* and *Walker*; Katchall, Meroe, Trak, Treis, Pulo Mulo, Kabra and Menchal.

(*c*) Low lying, with hilly ridges and plateaux, northern group being plutonic, metamorphic and alluvial, southern group mainly calcareous sandstone; monsoon climate, rainfall from 2290-3430 mm annually; vegetation—northern group more open and heathy, southern group heavily forested; mangrove and dense beach or dune forest in 1 km belt round most coasts; incidence of endemism in flora not yet determined; fauna not very rich: of mammals *Macaca irus* and *Sus scrofa*, both probably introduced, may be differentiated and there are 13 native insectivora and bats; two endemic species and a further two shared with Andamans among 50 species of breeding birds, and subspeciation apparent in a further 29 species plus 14 species shared with Andamans; 25 of 33 reptiles are endemic forms.

(*d*) Population census 14,565 (1961); most live in villages round coast, with coconut plantations; interior especially of Great Nicobars still undisturbed (inhabited by a few aboriginals).

(*e*) D. W. Snow (1970) IUCN Publications new series No. 17.

## C (iii). MERGUI ARCHIPELAGO

Several of the very large group of islands in this archipelago qualify for consideration, as being more or less isolated and off shore (well out of sight of the mainland) in character. The greater part of them are surrounded by mangroves and themselves densely forested and, except for visiting fishermen and turtle-egg, pearl and shell-collectors, seem to be fairly undisturbed. In the absence, however, of any up to date information on the scientific interest and conservation status of individual units, the following list is no more than an arbitrary selection based on remoteness and, in some cases, an indication of dense and, therefore presumably, natural vegetation.

(i) Burma:

The two main islands of Great Western Torres, about 7 km west of Fletcher I. which is over 60 km west of the mainland coast (11° 47′N. 97° 28′E.):

1-2. Cabusa and West Canister (12° 47′N. 97° 53′E.; 65 km off shore at north end of chain; high, H 396 m, and wooded).

3-6. Little Torres : N.E. Little Torres & 3 islets (11° 45′N. 97° 29′E.).

(ii) Thailand :

7-10. Chance (70 km off shore) : 9° 26′N. 97° 43′E. ; high, 369 m, and densely wooded), together with Torilla (117 m), Pachumba (163 m) and Stork (100 m).

11. Middle or Ko Tasai (67 km off-shore ; 226 m high ; densely wooded ; 9° 04′N. 97° 49′E.).

12. Perforated or Ko Boon (8° 51′N. 97° 47′E. ; 65 km off-shore ; small, wooded ; highest point 142 m).

SAYER ISLANDS or Similan (8° 33′N. 97° 38′E., comprising about nine islands and islets in a chain 20 km long and nearly 100 km off-shore) :

13-21. Bharugu (96 m) ; Similan (flat-topped plateau 260 m a.s.l) ; Pabu (120 m) ; Miang (128 m) with 2 *rocky islets* of 48 and 20 m ; *Payan* (bare conical rock with scrub on summit, 42 m) ; Payang (126 m) and Huyong (twin peaks of 110 m). Most of these islands are reported to be thickly wooded—at least until quite recently.

## C (iv). SOUTH-EASTERN OCEANIC ISLANDS

1. CHRISTMAS
   (*a*) 10° 30′S. 105° 35′E. 350 km from Java.
   (*b*) 135 sq. km : max. elevation (Murray Hill) 356 m, but two other hill tops are higher than 300 m.
   (*c*) Raised coral atoll, with central plateau above a series of cliffs and terraces : much of the surface covered with blocks and fragments of nearly pure phosphate of lime, probably derived from fossil guano ; whole island once forested, the 150-160 species of the flora including about 17 endemic species and a fairly large number of local varieties ; of five endemic mammals only a sub-species of fruit bat *Pteropus melanotis natalensis* and the bat *Pipistrellus murrayi* survive ; six endemic subspecies and one endemic species of land-bird, but most important are three of the nine breeding species of seabird, *Sula abbotti*, *Fregata andrewsi* and the distinctive race of yellow-billed tropicbird *Phaethon lepturus fulvus*, which nest nowhere else in the world (*Sula abbotti* became extinct on Assumption I. about 40 years ago). Four of the six reptile species are endemic.
   (*d*) Population 3,400 (1966), employees and dependants of the phosphate mining company established in 1897 ; areas cleared for open cast mining, buildings, tracks and cultivation still fairly limited, but plans for eventual extension into undisturbed western half of the island threaten the survival of the fauna, particularly the rare seabirds, though all birds are legally and effectively protected ; introduced species both of plants and animals following settlement, especially rats, mice, the Java sparrow, a gecko and many invertebrates, also constitute a threat.
   (*e*) D. W. Snow (1970) IUCN Publications new series No. 17; J. B. Nelson, this Symposium *J. mar. biol. Ass. India*, **14 (2)** : 643-662.

COCOS-KEELING ISLANDS : archipelago, 960 km S.W. of Java, in two sections :

2. *North Keeling*
   (*a*) 11° 49′S. 96° 49′E.
   (*b*) 100 ha ; max. height about 5 m.
   (*c*) Low coral atoll, nearly enclosing a central lagoon with opening on east ; seaward beaches steep ; main seabird breeding place, with eight out of the twelve species which nest in the group restricted to it ; stronghold of the endemic rail *Rallus philippensis andrewsi*, the only native land-bird, which in the main atoll of the archipelago is only common on Pulo Luar.
   (*d*) Undisturbed.
   (*e*) D. W. Snow (1970) IUCN Publications new series No. 17.

   *South Keeling*
   (*a*) The main atoll, comprising 34 islands and islets, including sandbanks ; 15 miles S. of North Keeling and extending to 12° 12′S. 96° 56′E.
   (*b*) Total land area only 14 sq. km, though the south-western island Pulo Panjang is 10 km in length ; highest point is about 13 m (a sand dune).

(*c*) Low coral atoll, with steep seaward beaches and gentle slopes to shallow central lagoon ; no true soil, but thin layer of decayed vegetable matter and powdered sand ; the 21 named and more substantial islands and islets are from north clockwise :—

(3). *Pulo Luar* or Horsburgh (somewhat separated from main atoll and with natural vegetation ; seabird colonies and population of the endemic rail scarcely disturbed, despite erection of a few buildings).

4-18. On east and south-east :

PULO TIKUS or Direction I. (relay telegraph station) ; P. Bras or Prison I. ; P. Gangsa ; P. SELNA or Home I. (main settlement) ; P. Ampang Kechil ; P. Ampang, P. Waidas, P. Blukok, P. Kambung, P. Cheplok, P. Pandang, P. Siput, P. Jambatan, P. Labu ; and P. Atas or South I.

19-22. In south entrance of lagoon :

P. Blan, P. Klapa Satu, P. Blan Mader, P. Maria.

23. On south-west :

Pulo Panjang (largest island : abandoned airstrip, road, jetty and pipeline to terminal in lagoon).

Most of these islands are covered with coconut palms, which existed prior to settlement, but have been artificially encouraged to spread by clearing of dense thicket of bush and shore trees ; mangrove round lagoon of Pulo Luar ; two species of turtle, *Chelonia mydas* and *Eretmochelys imbricata*, were breeding in 1941.

(*d*) Population 684 (1966) ; cultivation for coconuts and one or two other crops ; introduced species include *Rattus rattus*, *Mus musculus*, four land-birds (a jungle fowl, thrush, white-eye and sparrow) and possibly the three geckos and a snake *Typhlops braminus* ; introduced deer on Pulo Luar have been eliminated. These, and other disturbances connected with the wartime airfield, have doubtless much reduced the seabird colonies of the atoll.

(*e*) D. W. Snow (1970) IUCN Publications new series No. 17.