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**House of Representatives
Standing Committee on
Environment and Conservation**

**Report on
Conservation of Endangered Species
on Christmas Island**

OCTOBER 1974

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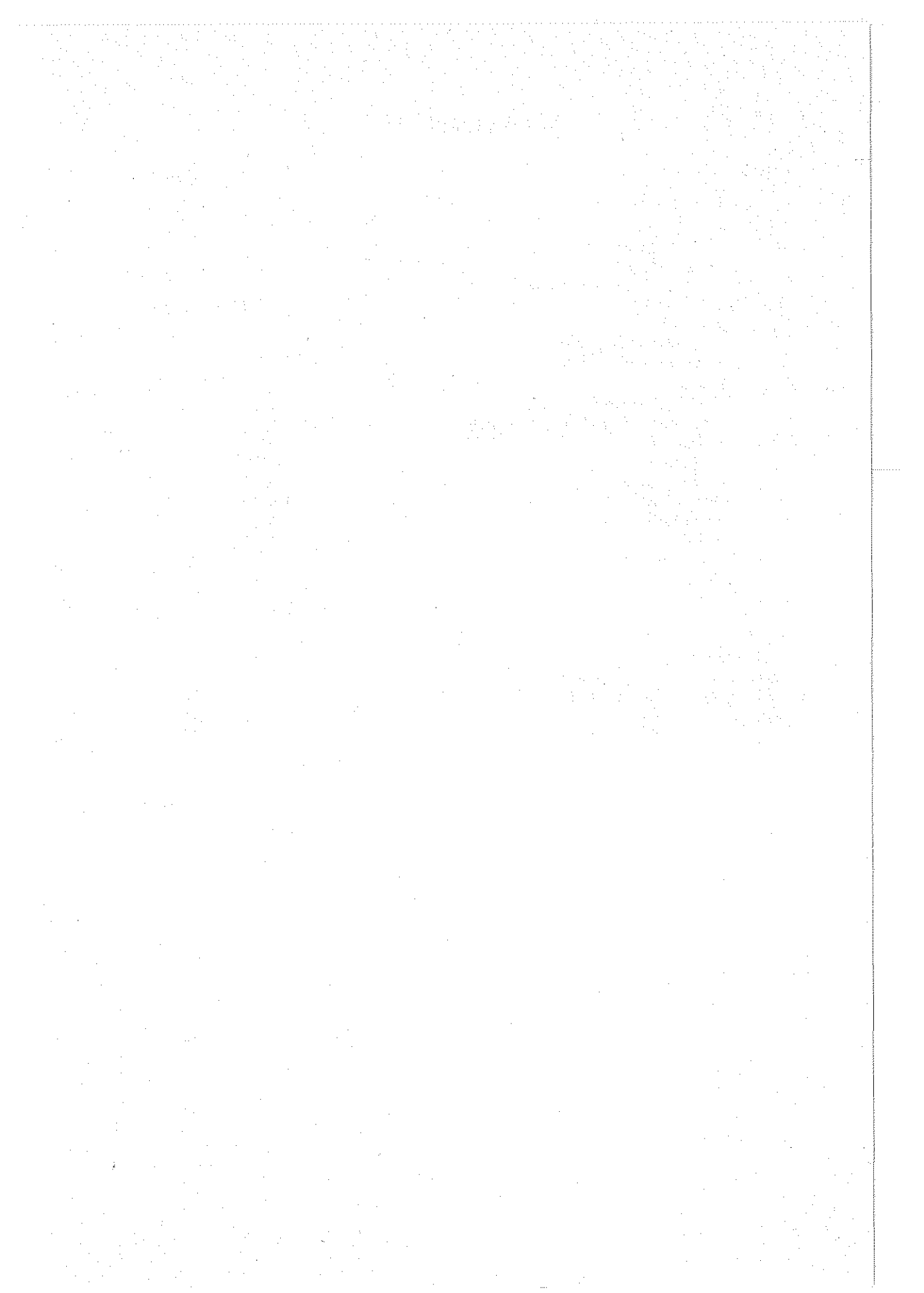
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HOUSE OF REPRESENTATIVES STANDING COMMITTEE ON ENVIRONMENT AND CONSERVATION

The Committee was appointed on 23 July 1974 by resolution of the House of Representatives on the motion of the Hon. Moss Cass M.P., Minister for the Environment and Conservation, to inquire into and report on—

- (a) environmental aspects of legislative and administrative measures which ought to be taken in order to ensure the wise and effective management of the Australian environment and of Australia's natural resources, and
- (b) such other matters relating to the environment and conservation and the management of Australia's natural resources as are referred to it by—
 - (i) the Minister for the Environment and Conservation, or
 - (ii) resolution of the House.

The terms of reference are identical with those of the Standing Committee on Environment and Conservation of the Twenty-eighth Parliament which ceased to exist when the Parliament was dissolved on 10 April 1974.

THE REFERENCE

(a) To examine the effect of mining and other activities on the flora and fauna on Christmas Island with special reference to bird species which are reported to be in danger of extinction especially Abbott's Booby (*Sula abbotti*) and the Christmas Island Imperial Pigeon (*Ducula whartoni*).

(b) To examine the adequacy of present attempts at rehabilitation of rainforest following mining and to advise on any further measures which may be necessary to protect the quality of the environment.

RECOMMENDATIONS

The Committee recommends:

1. That clearing for mining of phosphate not take place in proposed mining areas 22A, 22B, 22C, 23A, 23B and Murray Hill and that these areas be set aside as permanent reserve areas for Abbott's Booby. (Paras. 81, 82)
2. That the portions of proposed mining areas 26 and 27 which infringe on Abbott's Booby habitat should not be cleared and mined. (Para. 86)
3. That any clearing of areas of Abbott's Booby habitat take place between late November and early March when minimum numbers of birds are on the Island. (Para. 80)
4. That the Christmas Island Agreement be amended to vest ultimate control over land use in the hands of the Administration rather than the British Phosphate Commissioners. (Para. 21)
5. That an overall multi-use plan of management be drawn up for the Island including provision for the establishment of wildlife reserves secure against alienation. (Para. 13)
6. That a Conservator and staff be seconded to the Administration from the Australian Department of Environment and Conservation to oversee implementation of the plan of management, ensure the security of areas recommended for

preservation in this report and recommend additional areas for permanent preservation against mining. The Conservator should also examine the environmental implications of any mining proposals put forward by the Commission to the Administration. (Para. 13)

7. That the prohibitions against poaching particularly in the case of rarer species be enforced more rigidly; and that all firearms be licensed and the import of ammunition be strictly supervised. (Para. 67)

8. That an education program be initiated by the Administration aimed at instilling conservation values and dissuading people from poaching, particularly of the rarer species. (Para. 67)

9. That the absolute minimum of clearing for access roads, dumps and stockpiles be carried out. (Para. 48)

10. That burning of felled timber in immediate proximity to rainforest be prohibited. (Para. 47)

11. That 'C' grade phosphate deposits be used immediately to backfill mined areas and the process of backfilling and replanting continuously accompany the progress of mining. (Para. 113)

12. That the existing tree nursery be greatly expanded and that the practice of planting of trees in mined out areas be implemented on an extensive scale. (Para. 59)

13. That the export of Robber Crabs from Christmas Island be prohibited. (Para. 98)

14. That restriction on the exploitation of turtles and turtle eggs be rigidly enforced. (Para. 100)

15. That any proposed facility for Radio Australia be established in an area of the Island which does not infringe on Abbott's Booby habitat. (Para. 103)

16. That a fire fighting service with adequate equipment and training be established. Forest fires should be extinguished as soon as feasible. (Para. 49)

17. That the importation of birds and other animals by air should be prohibited and their importation by sea should be subject to the same quarantine regulations as are in force in Australia and New Zealand. (Para. 107)

18. That a systematic attempt be made to eliminate exotic fauna species preying on native fauna. (Para. 107)

19. That power lines be not strung over open water areas. (Para. 66)

20. That vehicular access be denied to transect and survey lines and tracks which are no longer used in mining operations. (Para. 50)

21. That investigations be carried out into a more desirable form of solid waste disposal. (Paras. 101, 102)

22. That the Australian Government encourage the scientific survey of the biological resources of the Island. (Para. 111)

23. That persons and organisations be encouraged to consider and participate in measures to conserve the Island's endemic species of wildlife. (Para. 65)

I INTRODUCTION

THE REFERENCE

1. On 25 October 1973 the Minister for the Environment and Conservation referred to the Committee of the Twenty-eighth Parliament the matter set out earlier in the preface.
2. On 28 September 1973 the Committee resolved that the Inquiry be conducted by a Sub-committee consisting of Mr Lamb (Chairman), Mr Bouchier and Mr Kerin.
3. On 23 July 1974 the Committee of the Twenty-ninth Parliament resolved that the Sub-committee be reappointed and that it resume the unfinished Inquiry.

PUBLIC HEARINGS

4. Public hearings were held on Christmas Island on 1 November 1973 during the Sub-committee's visit to the Island. The Sub-committee also carried out an extensive on-ground inspection and held informal discussions with interested parties.
Other public hearings were held in—
 - Melbourne on 5 April 1974; and
 - Canberra on 5 and 16 August 1974.
5. A list of witnesses appearing before the Sub-committee is given at Appendix I. Evidence given at public hearings is available in Hansard form at Australian Government Publishing Service bookshops and is available for inspection at the Committee Office of the House of Representatives and at the National Library.

THE NEED FOR CONSERVATION

6. Many species of flora and fauna found on Christmas Island are extremely rare and some are found only on this Island. Evolution of Island flora is at an early stage when compared with much of the rest of the world providing a rare opportunity to study plant species at this stage of development. Lack of a systematic description of Island flora may have resulted in some species being destroyed before they were known to exist. In addition, knowledge of the habits and life cycle of Island fauna, particularly bird life, is limited.
7. The International Union for Conservation of Nature and Natural Resources (I.U.C.N.) has listed the Abbott's Booby and the Christmas Island Goshawk as endangered and evidence led the Committee to conclude that the Christmas Island Frigatebird, the Christmas Island Owl and the Christmas Island Imperial Pigeon are also threatened with extinction. As a member of I.U.C.N. Australia should ensure the survival of these species.
8. Further research on Island bird species, particularly Abbott's Booby, could increase our understanding of the Indian Ocean and in locating new phosphate reserves, possible in Northern Australia.
9. Protection of rare species of life from extinction may prove beneficial in the study of genetics, evolution and population dynamics. Many witnesses have stressed the importance of maintaining a diverse genetic pool. A decrease in the number of species existing would mean a reduction in size and, more importantly, in diversity of the gene pool.
10. Article 2 of the UNESCO Convention for the Protection of the World Cultural and Natural Heritage defines 'Natural Heritage' as inter alia 'geological and physiographical formations and precisely delineated areas which constitute the habitat of threatened species of animals and plants of outstanding universal value from the point of view of science or conservation'. Australia has recently ratified the Convention.

11. The Convention goes on to say that each State party to the Convention should take all possible steps to ensure the transmission of the Natural Heritage situated in its territory to future generations.

12. The Committee was aware also of the comments on Christmas Island by the House of Representatives Select Committee on Wildlife Conservation. That Committee made a recommendation that sufficient natural vegetation should be preserved as would ensure the survival of the endangered species; though what was 'sufficient' was not defined.

13. For all these reasons the Committee was convinced of the need of the measures recommended in this report and the urgency of their implementation.

II BACKGROUND

14. Christmas Island has a total area of about 135 sq. kilometres and is located in the Indian Ocean approximately 1000 kilometres north-west of Perth.

15. The Island is the summit of a submarine mountain and has a central plateau generally 150 to 250 metres above sea level with several prominent rises, the highest of which, Murray Hill on the western side, is 361 metres. From the plateau the land falls away to the sea in a series of steep slopes alternating with terraces formed during repeated elevations and subsidences in the formation of the Island. Cliffs, sometimes over 200 metres high, run along a considerable portion of the coastline; in a few places breaks in the cliff have allowed small sand and coral shingle beaches to form. The natural vegetation of Christmas Island consists of the rainforest on the plateau area where phosphate is mined.

16. The Island's population consists of employees of the British Phosphate Commissioners (B.P.C.) and the Administration officers and their families. About 3000 people live on the Island of whom 1800 are long-term residents—some having lived there for up to 50 years, including about 500 Malays from Cocos Island. The remainder are employees engaged on short-term contracts. A program has been drawn up for the resettlement of long-term inhabitants of the Island before all the phosphate deposits are exhausted. In a survey carried out last year some 80 per cent of these people expressed a wish to move to Australia.

17. The legal status of the Island is that of an Australian external territory. Australia has not reported to the United Nations on its administration of the Island as there are no indigenous inhabitants.

18. The principal Island activities are the mining of phosphate and the provision of Government services. The establishment of a radar station with directional recording equipment is being considered.

19. Christmas Island was uninhabited when annexed by Great Britain in 1888. A small settlement was established there by George Clunies Ross of Cocos (Keeling) Islands and he and a partner were granted a 99 year lease of Christmas Island. This lease was later transferred to the Christmas Island Phosphate Company which worked the deposits. *Christmas Island then formed part of the Straits Settlement (later—1946—the Colony of Singapore).*

20. In 1949 Australia and New Zealand bought the assets of the Christmas Island Phosphate Company and formed the Christmas Island Phosphate Commission as equal partners pursuant to the Christmas Island Agreement 1949 (later consolidated in the 1958 Agreement and Act). This Agreement provides for the appointment of a Commissioner each by Australia and New Zealand and a third Commissioner jointly by the two Governments to control the mining of phosphate on Christmas Island.

21. Under the Christmas Island Agreement the B.P.C. are constituted the managing agents for the C.I.P.C. (the B.P.C. consisting of three Commissioners representing each Australia, the United Kingdom and New Zealand was constituted in 1920 to mine phosphate in Nauru and Ocean Island and still does so on Ocean Island).

22. The sovereignty of Christmas Island was transferred from the United Kingdom to Australia in 1958. The Christmas Island Act 1958-1973 provides for the Government of the Island by Australia. The Island's administration was initially the responsibility of the Minister for External Territories. On 1 December 1973 control was transferred to the Special Minister of State. The Act is the basis of the territory's legislative, administrative and judicial systems.

23. As a matter of practical convenience the Act continued the laws of the Colony of Singapore in force at the time of the transfer to Australia. Australian Acts do not apply unless expressed to do so. The Governor-General may make Ordinances for the peace,

order and good government of the territory. The Administration Ordinance 1968 provides for the appointment of an Administrator and staff.

24. The basic policy for the Island is set out in the Christmas Island Agreement. This provides for the Island to be used primarily for mining phosphate and for phosphate to be distributed to Australia and New Zealand at the lowest possible cost. The Agreement makes no provision for permanent inhabitants or for the conduct of any activity on the Island after the phosphate deposits have been exhausted which is estimated to be in 20 years. The estimated reserves for each mining field on the Island are set out at page 25. The assumption presumably was that once phosphate deposits on the Island were worked out there would be no other economic or Government activity to sustain a permanent population. The Agreement makes provision for the establishment of a fund to meet the cost of discharging the obligations towards the inhabitants of the Island when phosphate operations cease. A detailed scheme has been formulated for the progressive resettlement of long-term residents ahead of the exhaustion of phosphate. It is intended to use the fund for this purpose.

25. Although Australia has the sovereignty of the Island, Australia and New Zealand administer the phosphate mining operations jointly. Subject to directions on policy given by the Australian and New Zealand Governments jointly the management and control of the working of the mining operation is left in the hands of the C.I.P.C.

26. Under the Agreement the C.I.P.C. has a full licence and authority to cut timber and take all phosphate and other minerals in and from Christmas Island and all powers necessary for the enjoyment of that licence. New Zealand has expressed no interests in the Island other than as a source of phosphate. That country must be consulted in the exercise of administrative authority over the Island in any matters including the construction of an aerodrome or defence or other works which materially affect the working of the phosphate mining operation. Australia is required, unless the Governments otherwise agree, not to promote the establishment of an industry on Christmas Island which is likely to affect adversely the phosphate industry.

27. Australia and New Zealand share equally in any distribution of surplus funds of the Commission. The net expenditure incurred by Australia in administering the Island is met by the Commission. In practice this means that the expenditure forms part of the cost of Christmas Island phosphate.

28. All land on the Island is Crown Land. It became unalienated Crown Land in 1958 following the assumption of sovereignty by Australia and the surrender of a lease by the United Kingdom to Australia and New Zealand as joint owners of the Christmas Island Phosphate Company.

III MINING

29. The conservation issues at Christmas Island naturally arise from the effects of mining and the activities associated with mining in the form of surveying, road construction and the human impact of those involved in exploiting the phosphate resources.

30. The phosphate deposits on Christmas Island are of varying composition and have been classified by the Commission into three main grades:

Grade

- 'A' Contains 36.5 per cent P_2O_5 (phosphorus pentoxide) and not more than 5 per cent iron and aluminium expressed as mixed oxides.
- 'B' Contains between 27 per cent and 36.5 per cent P_2O_5 and between 5 per cent and 27.5 per cent iron and aluminium expressed as mixed oxides.
- 'C' Contains varying percentages of P_2O_5 below 27 per cent and iron and aluminium expressed as mixed oxides, ranging from 27.5 per cent to 40 per cent.

31. The extent, composition and location of the varying grades of reserves of phosphate on Christmas Island, has been determined through a comprehensive program of grid drilling and chemical testing of bore samples.

32. The program was completed in 1969 and an assessment of the results produced the following figures of reserves:

Tonnes

- 'A' 20 million
- 'B' 56 million
- 'C' 151 million

The reserves figure is updated annually and then reviewed and amended where necessary in the light of actual mining experience and processing results, compared with assessment figures.

Reserves remaining at 30 June 1973 were:

Tonnes

- 'A' 18.36 million
- 'B' 59.16 million
- 'C' 150.96 million

CURRENT MINING PLAN

33. The Commission currently plans to mine, process and ship the 'A' and 'B' grade phosphate reserves.

34. 'A' grade phosphate is suitable for direct shipment (after crushing and drying) for superphosphate manufacture.

35. 'B' grade phosphate, although unsuitable for superphosphate manufacture in its natural state, is capable of beneficiation through a washing/screening technique yielding approximately 60 per cent 'A' grade material. An alternative calcination process is presently under investigation which ultimately may give a higher yield.

36. The remaining material is 'C' grade phosphate. The Commission has no immediate plans to mine 'C' grade reserves. So far the economics of various ways of utilising 'C' grade phosphate, which have been investigated by the Commission, have not proved favourable.

37. Deposits of 'A' grade phosphate are overlaid by 'B' and/or 'C' grade deposits which must be removed. The 'B' and 'C' grade phosphate is stockpiled separately against future use. In other areas deposits of 'B' grade are overlaid with 'C' grade and in addition there are some areas containing only 'B' grade or only 'C' grade.

38. The areas of 'A' grade phosphate remaining to be mined plus 'A' grade areas already worked out represent approximately 3159 hectares or 23 per cent of the total area of Christmas Island.
39. The area of 'B' grade deposits (not overlaying 'A' grade phosphate) to be mined is approximately 891 hectares, about 7 per cent of the total area of Christmas Island. Together, the area of the 'A' and 'B' grade deposits already mined plus the areas to be cleared and mined, total approximately 4050 hectares or about 30 per cent of the total area of the Island. If, in the event 'C' grade phosphate (in areas additional to those where 'C' grade overlays 'A' or 'B' grade phosphate) were mined, then the total area comprising 'A', 'B' and 'C' grade deposits either worked out or to be cleared and mined would add to an overall total of 6278 hectares or 46 per cent of the area of the Island.
40. As at March 1974 the Commission has embarked on a program to increase output to 2 million tonnes per annum and adequate areas will need to be opened up on Christmas Island to permit mining to proceed at this greater level. Areas presently cleared and available are principally in the Central Fields and Ross Hill Terrace in addition to areas at South Point and Phosphate Hill. (See Figure 1 Page 23)
41. The Commission regards as necessary to clear the jungle and strip the 'C' grade and 'B' grade phosphate overburden from 'A' grade deposits well in advance of planned mining operations to ensure ready availability of material from a number of areas. This is because blending of 'A' grade ores of varying composition often become necessary to maintain the standard of ore for shipment.
42. Currently, the world shortage of phosphate supplies is increasing the importance of Christmas Island as a source of phosphate requirements for Australia and New Zealand.
43. The choice of areas to be mined is assisted by the knowledge of the deposits gained from the results of the grid drilling and assay of further samples. Virtually the entire Island that is accessible by any form of transport has been test drilled. The knowledge of the extent, composition and location of the phosphate deposits gained from the grid and production drilling and assays provides a basis for selection of the ground to be cleared.
44. Mining has been carried out on the Island since the turn of the century and has resulted in a forbidding rugged landscape, called 'moonscape', particularly in the older areas which were worked by hand. (See photograph 3) Limestone pinnacles dominate the 'moonscape' from between which the phosphate has been extracted. Vegetation regrowth in these older areas is extremely sparse, principally taking the form of small shrubs and ground cover.
45. Current mechanical means of extraction which are now practised do not remove the phosphate between the limestone pinnacles as thoroughly as hand mining and, as a result, greater natural vegetation occurs and greater potential exists for reforestation programs on those areas subjected to mechanical exploitation.
46. In general terms the richest areas of phosphate occur in what is termed the 'plateau', roughly corresponding with the 183 metre contour. Lesser deposits occur on terraced areas. (See photograph 4)
47. The Commission's aim has been to clear designated areas as cheaply and quickly as possible. Usually the aim has been to minimise the distance that felled timber needs to be bulldozed into heaps. Clearing begins well in advance of mining operations with timber being heaped and burned. Such burning can cause serious damage to adjoining forest especially when production demands or burning control problems result in cleared material being pulled to the outside of the field and burned adjacent to natural forest.
48. There are marked differences in the health of the rainforest around the edges of clearings made for mining purposes. Along old survey tracks or roads the trees were healthy with luxuriant undergrowth and festooned with creepers and epiphytes, but

where logs and debris are burned on the edge of a clearing, extensive dying off, decay and collapse occurs.

49. The effect of clearing and mining could be minimised by leaving an interval of at least a year between bulldozing a track around a clearing and removing the trees from a clearing. If trees cannot be used for timber or pulped, they should be burnt but not adjacent to the forest.

50. The prospecting tracks have provided easy access by four wheel drive vehicles to all plateau and terrace areas of the Island.

51. Following clearing and burning, top soil is removed and stockpiled as 'C' grade phosphate. The sub-soil is then removed and stockpiled as 'B' grade phosphate. Pure, or 'A' grade phosphate, is then removed and processed in preparation for export.

52. The 'B' grade phosphate is washed with fresh water to remove impurities at a washing plant located at South Point. The wastes are removed from the plant by flotation into a nearby quarry. There is a shortage of fresh water at Christmas Island and this limits the rate at which 'B' grade phosphate may be refined and presumably will be mined. If more rapid and economic means are found to remove impurities from 'B' grade and possibly even 'C' grade phosphate, then much more of the Island will be mined, with resultant greater and faster fauna habitat destruction.

REVEGETATION OF MINED AREAS

53. Mr B. A. Mitchell of the Australian Forestry and Timber Bureau, visited Christmas Island in 1968 to survey the Island's timber resources. He told the Subcommittee that the main effects of mining on vegetation have occurred since the scale of operations greatly increased from 1965 onwards.

54. The extent to which revegetation of mined areas will proceed unaided, and the resultant vegetation type, is not known at present. The soil has developed over millions of years and it would be optimistic to expect anything remotely resembling the present undisturbed rainforest to redevelop on mined-out land.

55. Early in the century phosphate mining was carried out by hand. Mechanical means of extraction which are practised now, do not remove the phosphate as thoroughly. As a result, vegetation regrowth in the early hand mined areas is extremely sparse, principally taking the form of small shrubs and ground cover. Those areas are frequently referred to as 'moonscapes'. In regions more recently machine mined greater natural revegetation occurs and greater potential exists for reforestation programs.

56. Complete resoiling of mined areas would not be practical. Neither is it technically possible to add trace elements to assist with regrowth. It was suggested to the Committee that nuclei of soil areas be left intact, strategically located within mined expanses and assistance given to establishing stands of trees in these areas.

57. These groves of trees should be sufficient to encourage fruit eating birds to frequent the area and spread seed from the forest nucleus to the surrounding areas. Crabs also assist in the revegetation process by aerating the soil and carrying organic matter deep into the top soil.

58. To date, the Commission has not acted to establish nuclei areas of replaced soil for planting. Some planting of recommended species has been carried out in mined areas with reasonable success.

59. Measures of this kind cannot be expected to recreate natural habitat; although these measures do seem important as a means to improve the visual effect of mined areas and in the long-term could aid in the conservation of some species.

IV FAUNA

60. Christmas Island is small and isolated and has become a refuge for some species unable to adapt to changing conditions elsewhere. This ecological pocket constitutes a reservoir of plant and animal life. The species involved are more than normally vulnerable to contact with man as a result.
61. The larger birds and crustaceans are at the top of their food chains having no natural predators. Behaviour as a result does not include patterns for protection from man and domestic animals. In addition, Christmas Island, as a confined area, can only support a relatively small population of any species, making it more susceptible to habitat destruction.
62. Christmas Island is the home of several rare and endangered species of birds. They include (in descending order of threat):
- Abbott's Booby, *Sula abbotti*
 - Christmas Island Frigatebird, *Fregata andrewsi*
 - Christmas Island Owl, *Ninox squamipila natalis*
 - Christmas Island Imperial Pigeon, *Ducula rosacea whartoni*
 - Christmas Island Goshawk, *Accipiter fasciatus natalis*
 - Christmas Island Silvereye, *Zosterops natalis*
 - Christmas Island Thrush, *Turdus poliocephalus erythropleurus*
 - Christmas Island Green-winged Pigeon, *Chalcophaps indica natalis*
 - Golden Bosunbird, *Phaethon lepturus fulvus*
63. All wild bird species on Christmas Island are in theory protected with the exception of the Kestrel. No other fauna is legally protected but the Administrator may, by order, prohibit the killing or taking of any specified animal or bird. The major problem is a cultural one with the Malay population in particular having a long tradition of exploitation of birds for food.
64. Although accurate information was not available members of the Sub-committee saw evidence of poaching on a wide scale during the inspection of the Island. There were strong suggestions made to the Committee that police were not prepared to enforce the poaching laws since cultural background and custom held stronger sway. The Committee was told that only four prosecutions had been made in the three preceding years.
65. Threat to various species arises from a variety of sources. The Christmas Island Frigatebird, of all the sea birds, is the most endangered from poaching due to relatively easy access to its nests. The Committee was told that such poaching may lead to the bird's extinction.
66. Some birds are killed when they hit electric power lines situated near open expanses of water.
67. There is widespread exploitation of the Christmas Island Imperial Pigeon, the Brown Booby, the Red-footed Booby and, to a lesser extent, the Emerald Dove and Island Thrush. Such exploitation is effected in a number of ways, some birds being lured close to the poacher and struck down with sticks; many others being brought down with firearms.

ABBOTT'S BOOBY

68. The main nesting areas of Abbott's Booby overlap substantially with deposits of 'A' grade phosphate (see Figures 1 and 2 Pages 23 and 24), making it the most vulnerable to mining activity of all bird species on Christmas Island. Other endemic bird species are not threatened by mining operations to the same extent, and their conservation is more a matter of straightforward protection. Abbott's Booby is not only rare, it is of exceptional interest, for it differs in several major respects from all

other members of its family and is therefore even more important than a species with extremely close relatives.

69. Abbott's Booby apparently once had a wider distribution, nesting on one or more islands in the Western Indian Ocean. It is regarded therefore as a relic species. Its absolute numbers are low.

70. Dr Nelson believes that there are no external factors such as food or available nesting sites keeping its numbers down and that this in turn, implies that the population is simply maintaining itself and has no chance of recouping losses in numbers. In this case, if mining operations heavily reduce the population of Abbott's Booby, the reduced population is unlikely to rise again. If there should happen to be a threshold of viability for the population as a whole the species could thus be seriously endangered whilst a proportion of it still remained alive.

71. Abbott's Booby is the slowest breeder in its entire family. It lays one egg every two years. Taking into account the loss of eggs and of young birds before they first breed, probably when five or six years old, it is evident that a breeding pair will take many years to replace themselves.

72. A small, slow breeding, population is clearly vulnerable if large numbers of adults are killed. It follows that conservation of mature birds is vitally important.

73. The distribution of Abbott's Booby is patchy, almost entirely above the 153 metres contour and largely in the dissected western part of the Island plateau. The general distribution as contained in the map prepared by Dr Nelson in 1967 (see Figure 2 Page 24) reflects the main features but obscures the important fact that there are small pockets of concentration within the generally favoured areas. This fact means that a greater fraction of the total population of Abbott's Booby will be destroyed by the clearing of a particular tract, than would be apparent from the mere proportion of total 'favoured' area cleared, as judged from the generalised distribution map.

74. Between visits by Dr Nelson to Christmas Island in 1967 and 1974, a number of significant changes relevant to Abbott's Booby occurred.

75. The clearing of jungle areas on Fields 19, 20 and 21, mainly in 1970 and 1971, destroyed much of the most favoured Abbott's Booby area on the Island. This has resulted in a substantial loss of nesting adults and next contents. The exact number is not known, but is thought to have been about 120 nests and possibly a higher number.

76. Dr Nelson's visit to Christmas Island in 1974 sought to answer a number of basic questions for which answers are prerequisites to sound conservation management. The first concerns the distribution of Abbott's Booby and whether on the basis of the distribution it is possible to say with certainty that the same areas were used each year for breeding and thus to base conservation on this distribution pattern. Representative transects over various parts of the Island showed that the Abbott's Booby was staying extremely close to the areas used in 1967. The 1967 distribution details can thereby be used as the basis for conservation.

77. Another basic question was what happens to birds displaced by clearing operations. Unfortunately, there is no evidence of any tendency of Abbott's Booby to move into the 'safe' area of lower and sparser trees below the 153 metres contour. The 1967 map depicts a few pairs on the southern terraces, which were, even then, below the 122 metres contour, and there are likewise pairs in this area now (1974). Similarly, in 1967 pairs were located fairly low on the northern slope and there are pairs there now. However, in neither case is it possible to detect an increase in the proportionate share of the total population held by these areas. It cannot be assumed that more birds will never move into marginal areas but, so far, the considerable disturbance endured has not precipitated such a move on any detectable scale.

78. The displaced birds have settled on the fringes of the devastated areas, despite all the noise and dust and alterations in topography. They have also taken advantage of the belts of trees left between Fields 20 and 21 and in the vicinity of 21. Thus, a heavy

concentration was located on the fringes of Field 19, and between and around Fields 20 and 21. This removes any doubts about the value, to the birds, of residual pockets of tall trees and leaves only the question of the long-term viability of such stands. Extremely narrow belts of timber can be expected to dry out and die due to environmental changes including mining but it is not necessary to think in terms of very extensive areas before survival of stands becomes possible.

79. The total population is extremely difficult to assess. In 1967, Dr J. B. Nelson estimated there were 5000 to 5500 free-flying individuals, which probably included less than 2000 breeding pairs. A survey taken in 1973-74 indicated a lesser number.

80. However, it is important to monitor the population fairly frequently. The technique which has been used involving counts of incoming birds depended for its accuracy on the tendency of Abbott's Booby to return to the Island in the evening from one direction only, i.e. between north and west. This is still the most valid method, since there is no indication that behaviour has altered. It appeared to result from foraging behaviour. It appears that regular counts, between 4.00 p.m. and 6.00 p.m. would provide a valuable indication of the total population and could be used to monitor changes. Dr Nelson using this method in 1974 counted 577 birds, compared with 865 in 1967.

81. The present population is sufficient for survival and effective conservation is still possible. Its status is such that it is not a question of saving a handicapped remnant but of maintaining a small and healthy population. However, its small population and extremely slow reproductive rate make the loss of breeding adults extremely serious.

82. It would appear that some form of compromise involving maximum conservation of Abbott's Booby habitat consistent with minimum adverse effect on mining operations is possible.

83. In order rationally to assess the most beneficial compromise the Committee considered all those areas which are being or will be cleared and mined if the proposed mining program goes ahead. (Figure 1 Page 23)

Figure 1 Phosphate Fields on Christmas Island.
Source: British Phosphate Commissioners
(Map not drawn to scale)

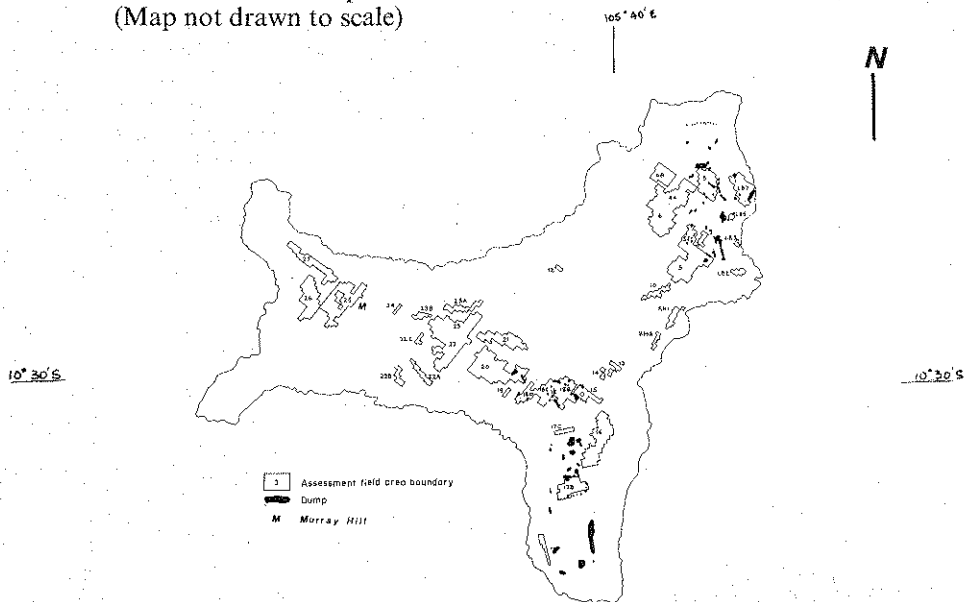
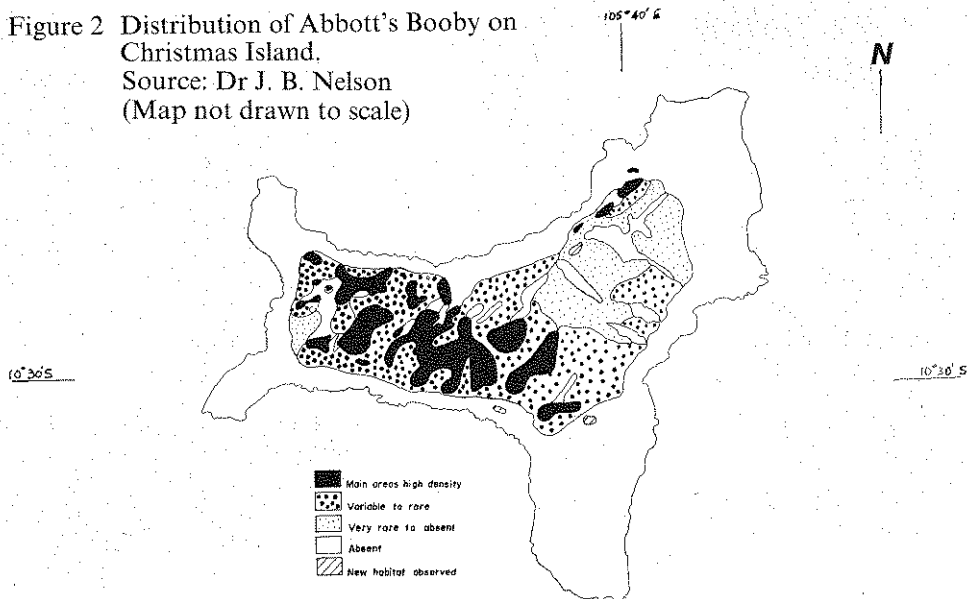


Figure 2 Distribution of Abbott's Booby on Christmas Island.
Source: Dr J. B. Nelson
(Map not drawn to scale)



84. The Committee then considered these proposals in the light of the map prepared by Dr Nelson in 1967. In 1974 Dr Nelson confirmed the map as being valid and indicating all major areas of Abbott's Booby nesting. (Figure 2 Page 24)
85. In areas 15, 18ABC, 18D, 20 and 21 mining operations have already destroyed substantial Abbott's Booby habitat.
86. Areas 13/14, 16, 17C, 19, 24, 26 and 27 do not appear to pose a serious threat to major Abbott's Booby areas. Careful clearing and a preparedness to forgo small portions of Fields 26 and 27 for mining would further assist conservation.
87. On the basis of value for conservation, the following areas would not be cleared or mined at all: Fields 22A, 22B, 22C, 23A, 23B and Murray Hill.
88. Areas 22, 23 and 25 pose the greatest dilemma involving as they do direct conflict between rich phosphate fields and valuable or significant Abbott's Booby habitat.

CHRISTMAS ISLAND IMPERIAL PIGEON

89. The Christmas Island Imperial Pigeon is endemic to Christmas Island. It roosts and nests in the tall jungle trees on the plateau and terraces of the Island. It required a fresh water supply and in dry seasons the birds flock around watering spots where they are very easily taken by shooting and snaring. There is little precise information about the breeding habits of this bird. The breeding season is considered to be November-April but it is not known how many chicks are reared in a clutch or whether a bird breeds more than once in a season.
90. The Pigeon's numbers appear to have been affected seriously by the colonisation of the Island. As far back as 1949 it was reported as by no means common, occurring along the north coast and being virtually non-existent in the immediate neighbourhood of the settlement.
91. Increased mobility of the human population and greatly extended access to the jungle afforded by survey lines and other mining operations has deprived the birds of much of their sanctuary. It is believed that considerable poaching of the Pigeon continues both in and out of the breeding season.
92. In addition, the birds' natural habitat and food supply is being reduced in area by the clearing of the jungle for phosphate mining.
93. The present state of the population of this bird is not known.

ESTIMATED RESERVES OF PHOSPHATE ON CHRISTMAS ISLAND 1973

Field	'A' Grade (tonnes)	'B' Grade (tonnes)	Other Grades (tonnes)
4A	341 631	761 111	2 202 459
4B	105 815	423 259	831 402
4C	16 628	288 723	179 885
5	424 367	703 781	848 397
5F1	68 024	296 281	92 210
6	278 142	684 017	3 342 236
9	273 607	925 124	2 188 855
10	125 470	343 040	1 341 581
11	184 420	556 284	2 366 098
12	96 745	68 024	198 025
13/14	156 455	495 062	1 467 047
15	323 491	1 176 056	1 768 619
16	453 492	1 589 489	2 972 640
17C	48 372	66 512	318 956
18ABC	1 085 358	2 435 252	5 313 415
18D	87 675	228 258	323 490
19	75 582	110 350	107 326
20	1 665 071	2 205 482	7 918 726
21	718 860	752 041	3 248 514
22	913 192	1 712 046	3 553 866
22A	137 559	145 117	829 890
22B	60 460	113 373	615 237
22C	46 861	116 396	340 119
23	516 981	876 751	3 392 120
23A	122 443	315 933	1 089 892
23B	81 629	213 105	492 794
24	108 792	89 187	610 702
25	3 005 140	2 213	5 079 866
26	695 354	1 457 221	448 957
27	716 517	1 340 825	195 006
Murray Hill	25 698	31 744	385 468
RH 1 & 2	775 431	1 144 311	1 275 824
LB2	255 467	386 980	39 302
LB3	210 118	166 280	3 023
LB5	96 745	208 606	1 511
Totals	14 297 598	24 639 062	55 383 458

Source: British Phosphate Commissioners

BROWN BOOBY AND RED-FOOTED BOOBY

94. Christmas Island supports large populations of these non-endemic birds which feed on fish in the waters around the Island. The Brown Booby roosts and nests on the exposed cliff edges and the Red-footed Booby in the low trees of the shore terrace and intermediate terraces. Each breeding pair rears one chick per year.

95. These birds are extensively poached, either when nesting or taken on the wing when, in windy conditions, they are beaten down with sticks. Reports of bags full of these birds being brought back to the settled areas by boat and four wheel drive vehicle were brought to the Committee's notice.

96. The Cocos Malays have always eaten sea birds and, even before Christmas Island was settled, expeditions from the Cocos Islands took back large numbers of booby birds from Christmas Island for consumption. It has been claimed that the relatively high cost of meat for the income of most Asian people contributes to the high incidence of poaching. It is certainly true that most of the fishing done on the Island is for food and often if a fish catch is low it may be supplemented by booby birds or frigatebirds.

ROBBER CRAB

97. This crab is widely distributed on the Island. It is taken by man for three main purposes:

- (a) eating;
- (b) bait for fishing; and
- (c) preservation by injection with formalin and lacquering for use as ornaments and curios.

98. These preserved specimens are sold or presented to Island residents or to the crews of visiting ships, but in addition they are exported to Singapore for sale there. The curio market tends to lead to the selection of the larger specimens and is often wasteful of individual crabs in that, if a limb falls off during the preservation process, a common occurrence, the animal is discarded. The practice of transporting the crabs, live, to Singapore to be preserved there has increased the wastage. Control measures are required.

GREEN TURTLE

99. The turtles nest on beaches on the east and north coasts. There is some evidence to indicate a decline has occurred in numbers over the last few years. Improved access to their breeding areas has increased the number of turtles being killed when they come up on the beach to lay their eggs. The improved access makes it possible for them to be transported to the settled areas where the meat is sold. The Chinese regard turtle flesh as a delicacy. The only turtle captured is the fertile female. Both Malay and Chinese people eat the turtle eggs, and once again easier access to the nesting beaches means that more people go there.

100. There is world-wide concern for the survival of this reptile which is believed to be threatened with extinction by extensive harvesting for human consumption and the destruction of nesting beaches by coastal development in many countries. The Green Turtle is classified by the I.U.C.N. as an endangered species. As a member of this International Union, Australia should take measures to ensure its survival.

V OTHER CONSIDERATIONS

GARBAGE DISPOSAL

101. At present the primary method of garbage disposal is to tip it over the cliff edge at a point half a mile beyond the settlement along Waterfall Road. This practice, apart from creating an eyesore, has, from time to time, led to the deposition of rubbish along much of the foreshore. The beach at the settlement is the only area where the community can bathe in safety. Certain tides tend to bring the rubbish into the beach. Also a number of unofficial dumps and the existence of a metal storage dump have been criticised.

102. It is understood that studies have been initiated to see whether incineration or sanitary landfill methods can be used as alternatives to the present practice. At present both these methods seem very expensive and landfill may affect water supplies. Garbage is now only tipped over the cliff when tidal conditions are such that it will not float onto the shoreline. All convertible material is burnt.

RADIO AUSTRALIA

103. In 1972 the Australian Postmaster-General's Department supported by the Department of Foreign Affairs investigated the possibility of a \$32 million facility as a relay station. The area of land involved would be about 400 hectares. The site tentatively chosen is in the Abbott's Booby habitat. The area is in the region of Hill 28 and is not rich in phosphate so represents an additional threat to the Abbott's Booby.

CEMETERIES

104. The Australian Government took over responsibility for the Chinese and Malay cemeteries some 8 years ago. During the inspection, the Sub-committee noticed the rundown and overgrown nature of both cemeteries. The Chinese and Malay representatives appearing before the Committee requested regular maintenance by the Government and an expanded area to cope with future demand.

DUST

105. The Sub-committee heard evidence concerning dust pollution and visited the site of the Technical School at Drumsite where, it was claimed, dust from the nearby drying facilities was adversely affecting the school.

106. Evidence given by the Commission was that little could be done about the dust problem which only occurs when the wind blows from the south and south-west, said to be an unusual occurrence.

EXOTIC ANIMALS

107. Evidence was given of problems associated with domestic dogs and cats preying on native fauna; although the extent of their impact on native fauna is not known. Goats and rats were also mentioned as a potential threat to native fauna.

VI CONCLUSIONS

108. Conservation of Christmas Island and particularly the endangered species Abbott's Booby presents a classic conflict between a highly valuable resource which will be exploited only over a relatively brief time (Christmas Island is expected to be mined out within 20 years) and a unique species which occurs nowhere else and which has evolved over millions of years. The Abbott's Booby, in common with most other forms of wildlife, has no readily assessable value. To some its value is incalculable—to others it is without value.

109. The threat to the Abbott's Booby is accentuated by the fact that its main breeding grounds are nearly all in areas rich in phosphate. The value of phosphate has risen from \$17.33 per tonne up to 30 June 1974 to \$55.95 per tonne from July 1974. This trend is likely to continue and to place the Abbott's Booby remaining habitat under greater threat.

110. It seems probable, from the evidence, that the long-term viability of the Abbott's Booby can be assured if sufficient habitat is preserved for it. Unfortunately, study of the Abbott's Booby behaviour indicates that it is unlikely to readapt to new breeding areas. A choice between two clear alternatives has to be made—a choice between phosphate or the Abbott's Booby. The question that has to be answered is whether some proportion of the phosphate reserves should be foregone in order to preserve a viable population of Abbott's Booby.

111. The condition of the other species which the Committee was asked to consider, the Christmas Island Imperial Pigeon, gives cause for concern. It is poached in large numbers, but insufficient information exists on which to assess its status. Measures recommended for the Abbott's Booby may assist the Pigeon.

112. With regard to restoration of mined out areas, pilot projects on a small scale have been undertaken to assess whether some form of revegetation can be achieved. It is certain that the tropical rainforest can never be restored to its original condition. However, it would seem desirable and feasible to leave greater areas in the form of clumps of forest between mined areas and to minimise the clearing of forest and the damage caused by burning felled timber. Every effort should be made to re-establish vegetation in areas already mined not only in the hope of establishing habitat for wildlife but to demonstrate environmental responsibility and a desire to leave the Island in the most attractive condition possible.

113. The Sub-committee found that the landscape of mined areas has been left rugged, irregular in relief and exposed to erosion with the consequence that regeneration of vegetation cover is difficult. Large reserves of 'C' grade phosphate should be used to backfill these mined areas to achieve a more subdued landscape and enriched soil from which forest regeneration can take place.

114. The form of the present Act under which mining operations take place needs to be reviewed. The Christmas Island Agreement effectively provides for all land use decisions on the Island to be made by the Commission in its exploitation of phosphate at the lowest possible price.

115. The Committee believes that land use is the most significant area in which the Administration should be involved. The Commission should submit its mining proposal to the Administration for approval. The approval of the Administration should be given to any proposal once it is satisfied as to its environmental responsibility. The fundamental conflict over whether to exploit or conserve a particular area puts unreasonable pressure on an organisation which is primarily a business undertaking.

116. The Committee places on record its appreciation of the significant contribution to its work and dedication of the Clerk to the Committee, Mr T. J. P. Richmond, during this and other early Inquiries.

H. A. JENKINS
Chairman

APPENDIX I

LIST OF WITNESSES

- BARRETT, Mr P. J., Member, Christmas Island Environment Advisory Committee and Geologist, British Phosphate Commissioners.
- BYTOL BIN ZANLEY, Mr, Assistant Head of Malay Community, Christmas Island.
- COOKE, Mr N. H., Assistant General Manager (Production), British Phosphate Commissioners.
- EVATT, Mr F. S., Administrator, Christmas Island.
- FLYNN, Mr K. J., Member, Christmas Island Environment Advisory Committee and Headmaster, Christmas Island Teaching Service.
- FRIEND, Mr J. L., Superintendent of Police, Christmas Island.
- HOHNEN, Mrs J. I., Chairman, Christmas Island Environment Advisory Committee.
- HOOGLAND, Dr R. D., Senior Fellow in Taxonomy, Research School of Biological Sciences, Australian National University.
- KERSHAW, Mr A. P., Christmas Island Manager, British Phosphate Commissioners.
- MITCHELL, Mr B. A., Officer-in-Charge, South Australian Research Station, Forestry and Timber Bureau.
- MOSD ISA BIN SULAIMAN, Mr, Head of Malay Community, Christmas Island.
- NELSON, Dr J. B., Aberdeen University.
- POWELL, Mr D. A., Senior Surveyor, British Phosphate Commissioners.
- RESEIGH, Mr C. E., Assistant Secretary, Island Territories Branch, Department of the Special Minister of State.
- TEO BOON HOW, Mr, Administration Clerk and Interpreter; also President, Chinese Literary Association and Poon Saan Club, Christmas Island.
- van TETS, Dr G. F., Division of Wildlife Research, C.S.I.R.O.

APPENDIX II

LIST OF EXHIBITS

- 'A' Map of Christmas Island.
- 'B' *The British Phosphate Commissioners:*
Map of Proposed Town Planning of Roads and Workshops/Store.
Copy of the Christmas Island Agreement Act No. 69 of 1958.
Four overlay maps of Christmas Island showing:
—areas which have been mined;
—areas cleared for mining;
—areas proposed to be mined;
—distribution of phosphate reserves by grade;
—distribution of Abbott's Booby habitat.
- 'Coastal Erosion Christmas Island (Indian Ocean)—Report on Investigations' by Delft Hydraulics Laboratory.
- 'Reafforestation Fields 15, 17, 20', 21 March 1974 (Set of photographs).
- 'C' van Tets, G. F. and P. A., 'A Report on the Resident Birds of the Territory of Christmas Island'. *The Emu* Vol. 66, part 44, June 1967, pp. 309-319.
- van Tets, G. F., 'A Report on the Conservation of Resident Birds on Christmas Island' (Report prepared for the XVI World Conference of International Council for Bird Preservation held in Canberra, August 1974).
- van Tets, G. F., 'A Report on the Status and Conservation of Birds at Christmas Island, Indian Ocean'.

APPENDIX III

LIST OF BIRD SPECIES FOUND AT CHRISTMAS ISLAND

by G. F. van Tets

Division of Wildlife Research C.S.I.R.O.

The birds of Christmas Island fall into three categories:

Residents which breed there;

Waders which are shorebirds that breed in northern Asia, Alaska or Australia and seek refuge on the Island during northern frosts and southern droughts;

Vagrants comprising a large variety of stray birds which are only occasionally sighted on the Island and which are blown in by prevailing winds during the wet summer, mainly from Java and Sumatra, and during the dry winter, mainly from Australia.

Residents

White-tailed Tropicbird, *Phaethon lepturus*

Nests in tree cavities dispersed all over the Island. Only on Christmas Island do most of the adults have a golden sheen which gives rise to the local name of 'Golden Bosunbird'. It could be threatened by large scale destruction of the jungle.

Red-tailed Tropicbird, *Phaethon rubricauda*

Nests in cliff cavities around the Island. Adults do not have a pink sheen as on Lord Howe and Norfolk Islands. Locally it is known as the 'Silver Bosunbird'. Poaching is the only threat to its survival.

Abbott's Booby, *Sula abbotti*

Nests on the central part of the Island in tall trees with open crowns. On the perimeter of the Island crowns of trees are too dense because of wind-pruning. Christmas Island is its last surviving breeding colony. It may be threatened by large scale destruction of the rainforest.

Red-footed Booby, *Sula sula*

Nests in trees on the shore terraces and cliff sides around the Island. Many juveniles are taken by poachers, but otherwise there is no immediate threat to its survival.

Brown Booby, *Sula leucogaster*

Nests on cliff ledges and edges around the Island. Many juveniles and some adults are taken by poachers, but otherwise there is no immediate threat to its survival.

Christmas Island Frigatebird, *Fregata andrewsi*

Nests in small colonies in trees on the shore terraces around the Island. Some are killed when they hit electric lines near pools of water and many are killed by poachers. This species could become extinct because of poaching. It is known to breed only on Christmas Island.

Greater Frigatebird, *Fregata minor*

Nests in small colonies in trees on the shore terraces around the Island. Some are killed when they hit electric lines near pools of water and many are killed by poachers. This species could be wiped out locally by poaching.

Reef Heron, *Egretta sacra*

Nests in isolated localities along the shore. Forages along the shore and inland in clearings and along tracks. Although numbers are small there is no immediate threat to its survival.

Brown Goshawk, *Accipiter fasciatus*

Rarely seen. It has been severely persecuted by persons who keep poultry but it is now protected by law and its chances for survival are probably better than they have been in the past. It may also benefit from the diversification of habitat due to clearing and regeneration of the forest.

Nankeen Kestrel, *Falco cenchroides*

It is very abundant along edges of roads and clearings. As more of the Island is cleared for mining and other activities it is likely to increase in numbers. It will probably decrease in numbers when the Island is reforested after the completion of mining. It is the only bird not protected by law, because of a mistaken belief that it feeds on young chickens. Its main food is grasshoppers.

Noddy, *Anous stolidus*

Nests in trees and on cliff ledges along the coast. Large numbers are taken by poachers and it could be locally wiped out by poaching.

Island Imperial Pigeon, *Ducula whartoni*

Lives in the top story of the jungle and is more often heard than seen. It was formerly threatened by shooting and poaching. The main threat to its survival is clearing of rainforest.

Island Owl, *Ninox squamipila*

It is frequently heard at night around the settlement but it is seldom seen. There is probably no immediate threat to its survival.

Glossy Swiftlet, *Collocalia esculenta*

Nests and roosts in vast numbers in caves. It feeds along roads and in clearings. There is no immediate threat to its survival.

Island Thrush, *Turdus poliocephalus*

It is very abundant in all vegetated areas including jungle, overgrown clearings, road sides and gardens. There is no immediate threat to its survival. It could suffer if other species of thrushes are introduced or if pigs are allowed to go feral and spoil their habitat. The use of insecticides in gardens may cause many deaths.

Christmas Island Silvereye, *Zosterops natalis*

It is very abundant in all vegetated areas including jungle, overgrown clearings, road sides and gardens. There is no immediate threat to its survival, although the use of insecticides in some gardens may cause many deaths.

Java Sparrow, *Padda oryzivora*

Occurs in small flocks confined to the vicinity of chicken runs. If grasses with large seeds are sown on the airfield, it may rapidly increase in numbers. It is the only introduced cage bird that has established a feral population. It may decline in numbers if poultry-raising is discontinued.

Waders

Masked Plover, *Vanellus miles*

A rare visitor from northern Australia. It frequents beaches, ponds, clearings and grassy fields.

Eastern Golden Plover, *Pluvialis dominica*

A regular migrant from north-eastern Siberia and northern North America. It frequents clearings and grassy fields.

Mongolian Dotterel, *Charadrius mongolus*

A regular migrant from central and eastern Asia. It frequents clearings with flat open ground.

Large Dotterel, *Charadrius leschenaulti*

A regular migrant from central and eastern Asia. It frequents clearings with flat open ground.

Oriental Dotterel, *Charadrius veredus*

A rare migrant from central Asia. It frequents clearings with flat open ground.

Ruddy Turnstone, *Arenaria interpres*

A regular migrant from the arctic shores of Eurasia and North America. It frequents rocky shores and clearings.

Pintail Snipe, *Capella stenura*

A regular migrant from northern Asia. It frequents wet grassy clearings.

Whimbrel, *Numenius phaeopus*

A regular migrant from north-eastern Siberia. It frequents rocky shores, beaches and clearings.

Redshank, *Tringa totanus*

A regular migrant from Europe and central Asia. It frequents beaches and ponds.

Greenshank, *Tringa nebularia*

A regular migrant from northern Eurasia. It frequents beaches and the edges of ponds and pools of rain water.

Common Sandpiper, *Tringa hypoleucos*

A regular migrant from northern Eurasia. It frequents the edges of still and running water including pools of rain water and sea shores.

Wood Sandpiper, *Tringa glareola*

A rare migrant from northern Eurasia. It frequents grassy and muddy edges of ponds and pools of rain water.

Grey-tailed Tattler, *Tringa brevipes*

A rare migrant from the mountains of eastern Siberia. It frequents rocky shores and reefs.

Red-necked Stint, *Calidris ruficollis*

A regular migrant from north-eastern Siberia and western Alaska. It frequents beaches and bare flat clearings.

Long-toed Stint, *Calidris subminuta*

A rare migrant from eastern Siberia. It frequents beaches and the muddy edges of ponds and rain water pools.

Bar-tailed Godwit, *Limosa lapponica*

A regular migrant from the arctic regions of Eurasia and Alaska. It frequents beaches and clearings.

Pratincole, *Glareola pratincola*

A rare migrant from Asia. It roosts on bare flat open ground and forages on the wing on the edges of tropical cyclones.

Australian Courser, *Stiltia isabella*

A rare visitor from inland Australia. It frequents flat open clearings.

Vagrants

White-faced Heron, *Ardea novaehollandiae*

A rare visitor from Australia.

White Egret, *Egretta alba*

A rare visitor from either Asia or Australia.

Plumed Egret, *Egretta intermedia*

A rare visitor from either Asia or Australia.

Little Egret, *Egretta garzetta nigripes*

A rare visitor from Australia.

Chinese Egret, *Egretta eulophotes*

A rare visitor from eastern China.

Nankeen Night-Heron, *Nycticorax caledonicus*

A rare visitor from Australia.

Mangrove Heron, *Butorides striatus amurensis*

A rare visitor from Asia.

Black Bittern, *Dupetor flavicollis*

An adult male was seen at Ross Hill Gardens 25 September 1972. It could have come from either Asia or Australia.

Grey Teal, *Anas gibberifrons*

A rare visitor from either Indonesia or Australia.

White-breasted Sea-Eagle, *Haliaeetus leucogaster*

An immature was seen 29 September 1972 with D. Powell who said it was first seen October 1971.

Peregrine, *Falco peregrinus*

A rare visitor from either Asia or Australia.

Ruddy Crane, *Prozana fusca*

A rare visitor from Asia.

Water-cock, *Gallicrex cinerea*

A number were first seen December 1972 and were still present January 1973.

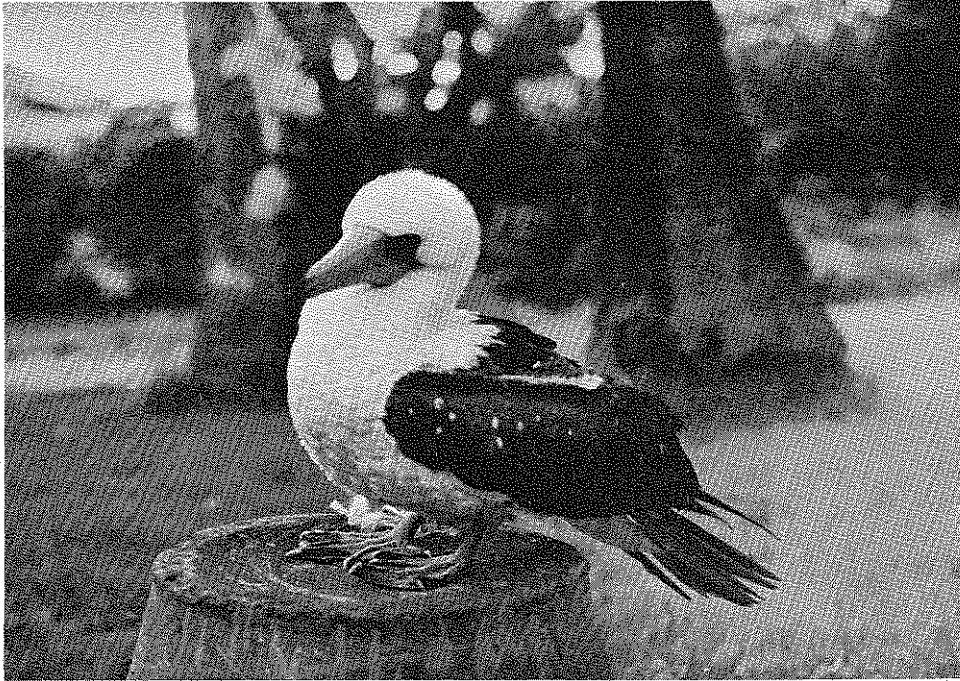
Pied Imperial Pigeon, *Ducula bicolor*

A rare visitor from Indonesia.

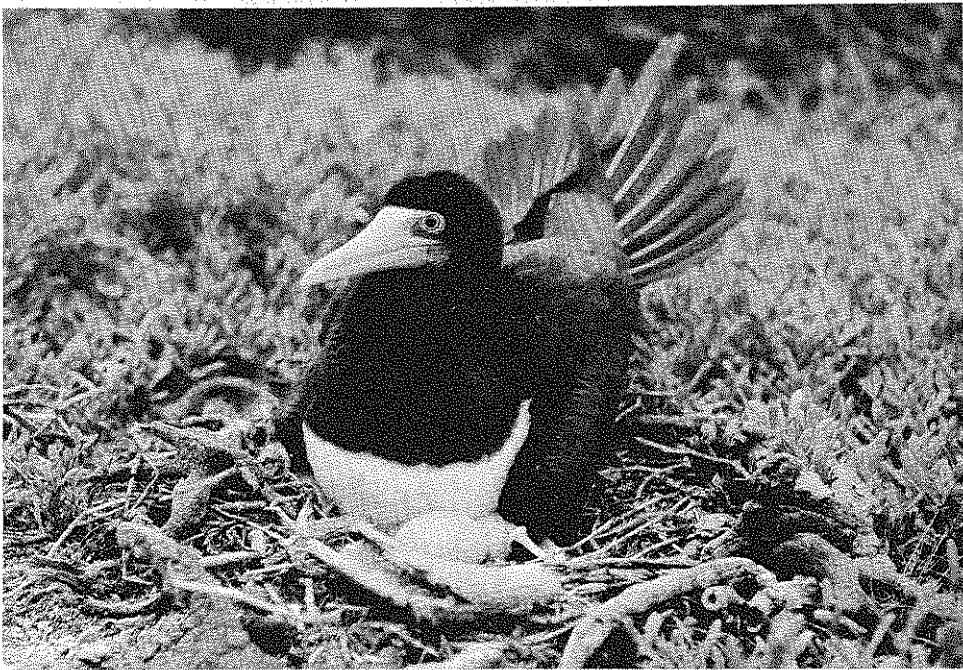
Horsfield Bronze-Cuckoo, *Chrysococcyx basalis*

A rare visitor from Australia or Indonesia.

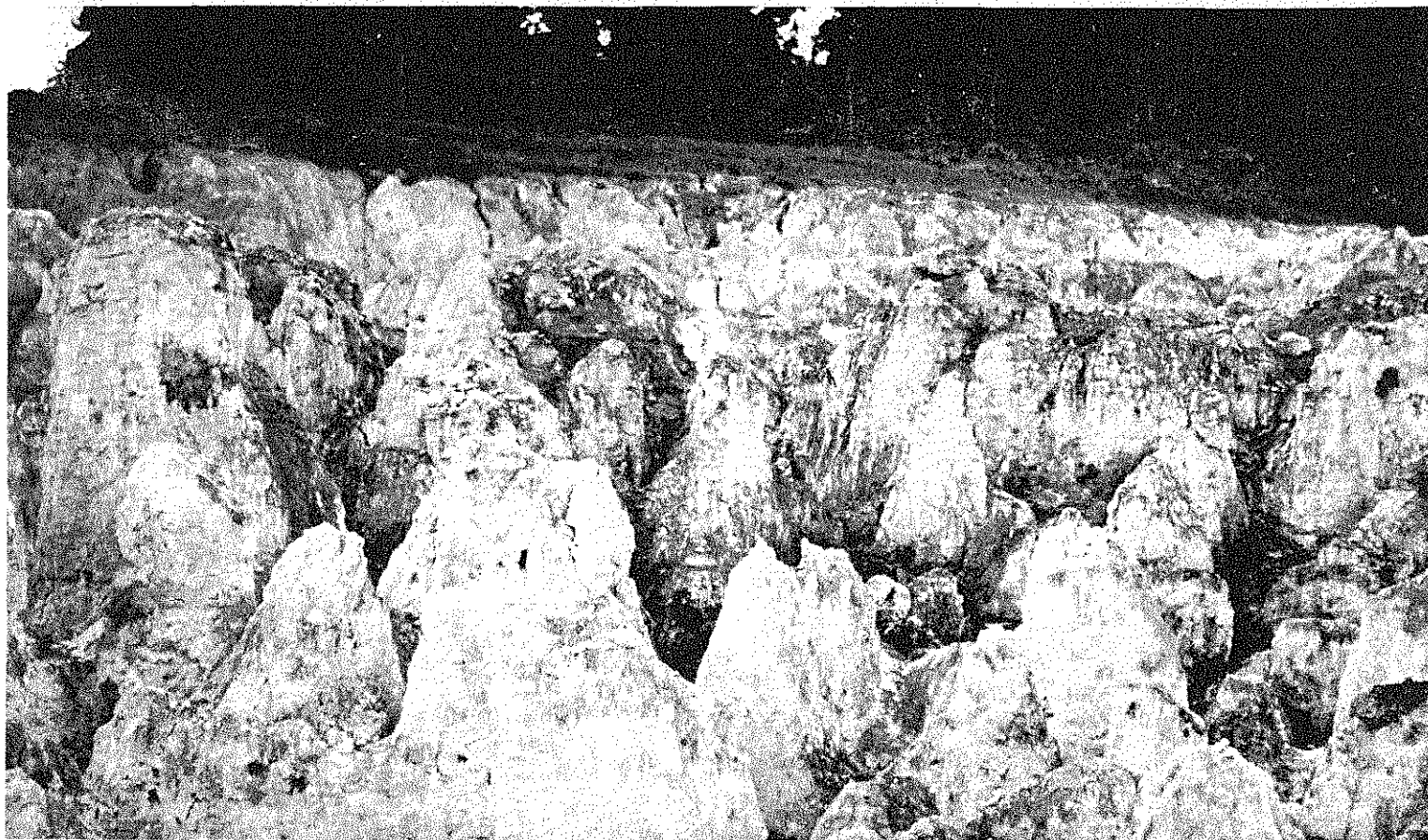
- Mangrove Kingfisher, *Halcyon chloris*
A rare visitor from either Asia or Australia.
- Dollar-bird, *Eurystomus orientalis*
A rare visitor from either Asia or Australia.
- Blue-winged Pitta, *Pitta moluccensis*
A rare visitor from Asia.
- Barn Swallow, *Hirundo rustica*
A regular visitor between September and November from Asia.
- Grey Wagtail, *Motacilla cinerea*
A rare visitor from Asia.
- Yellow Wagtail, *Motacilla flava*
A rare visitor from Asia.
- Tawny Pipit, *Anthus campestris*
A rare visitor from Asia.
- Brown Shrike, *Lanius cristatus*
A rare visitor from Asia.



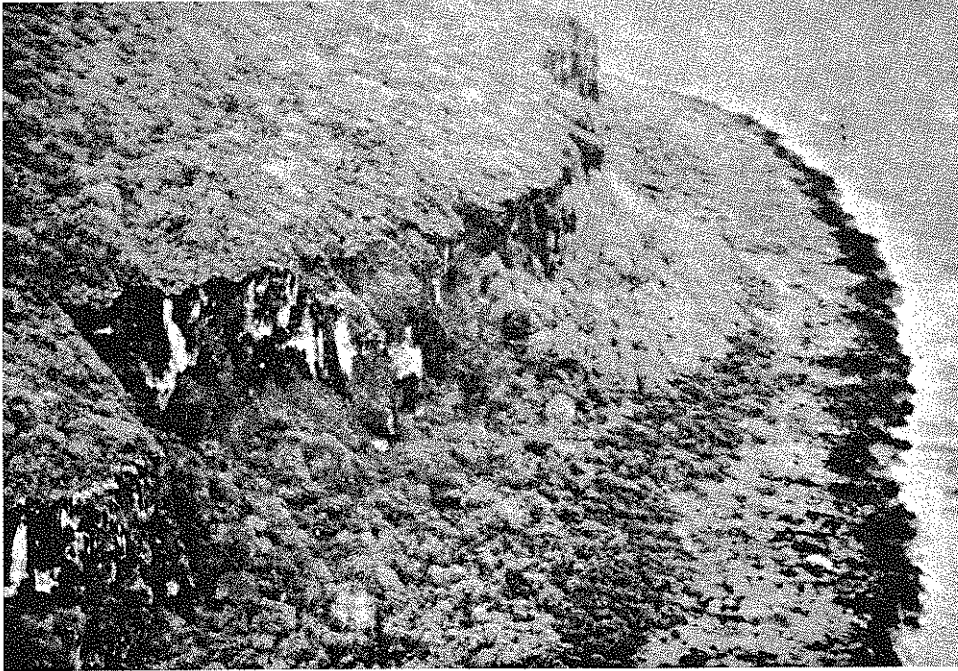
Photograph 1 Abbott's Booby (*Sula abbotti*)



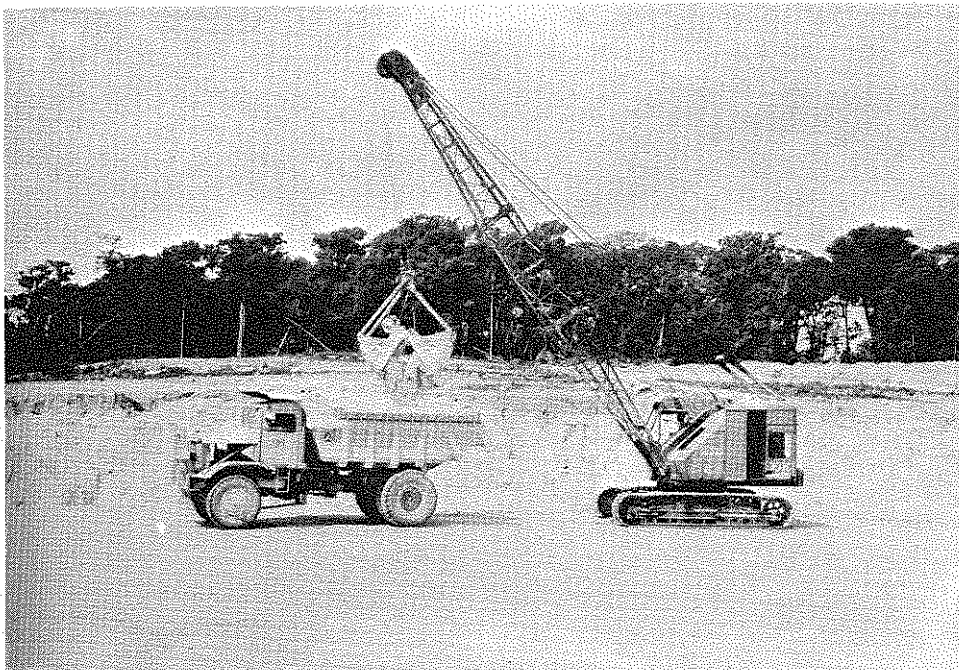
Photograph 2 Brown Booby (*Sula leucogaster*)



Photograph 3 - Limestone pinnacles remaining after extraction of phosphate.



Photograph 4 South Point on Christmas Island illustrating terracing caused by uplift.



Photograph 5 Phosphate mining on Christmas Island.

