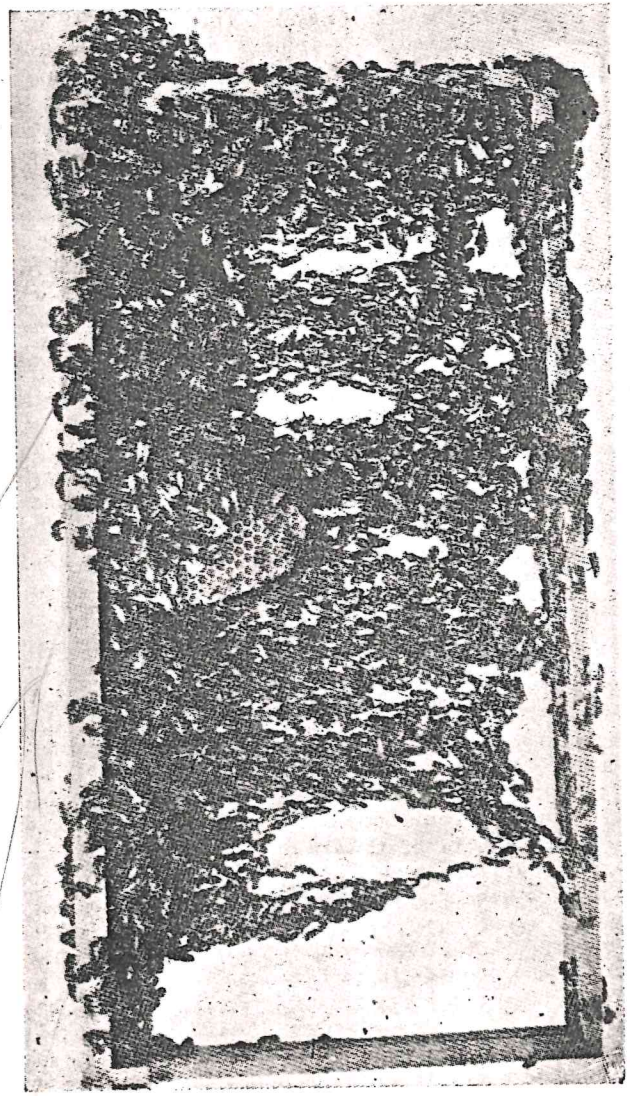
boil for some time, the wax rose, and when cold was removed in a cake. The new approved plan of rendering is by means of the solar wax extractor. The machine is placed in a sunny spot and filled with wax cappings or bits of comb; as the direct rays of the sun strike it, the melted wax trickles through a strainer and collects in a tin placed at the lower edge of the tank or melter. The cake is removed each morning. When the solar apparatus is not available, wax is rendered by steam heat.



Comb builders hanging in clusters secreting wax.

HOUTMAN'S ABROLHOS.

By R. Helms.

(Read before the Mueller Botanic Society, 6th June, 1898.)

Reproduced from the *Producers' Gazette.*

Historical.

The low-lying archipelago known as Houtman's Abrolhos is situated between 28 degrees 15 minutes and 29 degrees southern latitude, and 113 degrees 35 minutes to 140 degrees 5 minutes longitude east of Greenwich, or approximately 40 miles west of Champion Bay. It is divided into three distinct groups—namely, the Wallabi Group in the north, the Easter Group, and the Pelsart Group in the south.

With the exception of North Island, and East and West Wallabi Islands, which rise from 40 to 50 feet above the sea and in part are composed of rocks found on the mainland, all the other islands are formed of raised coral, are almost level on top, and in no instance higher than 15 feet.

Submerged reefs connect the greater number of the islands, and fringing reefs encircle, more or less perfectly, the two southern groups. The Pelsart Group shows the best example of such a reef, and imparts to it the appearance of an atoll, for here a continuous reef leans on to Pelsart Island and extends in a hyperbolic direction for over 20 miles, with the apex towards the south.

Historically, these groups are closely associated with the early events of Western Australia: from a utilitarian point of view, they are of great value to the agriculturist and the fishing industry; and scientifically, they are specially interesting in more directions than one.

The historical part has frequently received attention by writers, and quite recently old memories have been revived by several leading journals published in Australia. Special mention deserves to be made of the *Western Mail,* because in its Christmas number of 1897 for the first time appeared a translation of the unique and authentic diary of Francis Pelsart, who commanded the ill-fated *Batavia* at the time of her disaster. Many other valuable vessels, whose commanders neglected to "keep eyes open," have since left their timbers on the treacherous semi-submerged reefs so abundant in these waters, but the wreck of the *Batavia,* being the first of them, and on account of the terrible atrocities which followed her misfortune, will for ever remain a conspicuous phase in the earliest history of our immediate neighbourhood, the details of which cannot be read without producing a shuddering sensation.

The advent of white men for the first time dwelling on Western Australian territory has been inaugurated by horrible barbarities, such as have scarcely ever been recorded of its aboriginal inhabitants, who are considered one of the lowest types of humanity, and who do not rise socially above the most abject savagedom. When reflecting upon these events one cannot help arriving at the conclusion that, in spite of the boast civilised man makes of standing above the animal and savage races of his own kindred, the animal within him is the more powerful characteristic, and that self-preservation underlies the greater number of his actions, and usually domineers above all better feelings in times of danger.

It must be admitted that the Dutch of the XVI. century were as advanced in civilisation as any other European nation, and, in fact, a highly cultured race; yet, under stress of circumstances, a number of these men, never before known to have done a bad deed, could easily be induced by a designing scoundrel to commit the most revolting crimes in the face of a probable famine ensuing if the whole band were to remain alive. The atrocities witnessed on the narrow space of these small islands and committed by the greater number of a community composed of cultured beings, who should have shrunk from the least injustice towards each other under the adversity of circumstances they had been placed in, were as terrible and disgusting, if not more so, than the worst deeds committed by savage cannibals.

The Economic Value of the Islands.

After this reference to a portion of past historic events, which gave these islands a weird notoriety, we will take a glance at the industries which during late years have made them quite famous, and promise to be augmented by others. For thousands of years the barren rocks have been the haunt of various species of sea birds, who visit them in countless numbers during the summer months for the purpose of breeding. Many leave for other regions when their offspring are strong enough to fly long distances, but they re-visit their accustomed nesting places the following year, whilst several species stay permanently at their sea-girthed homes.

On the greater number of the level low islands the accumulated droppings of the many birds have formed a valuable guano, which now supports a stunted vegetation where the deposit is deep enough to give the plants a foothold. In some of the hollows and depressions, which are always met with in coral formation, a depth of several feet is found, but the average thickness of the deposits varies from 6 to 30 inches on the different islands. Considering that in spite of the immense numbers of birds which regularly visit these old nesting places, the season's addition of excreta to the deposit is imperceptible, the growth of the guano stratum must have been very slow, and after the last ton has been removed it will take several thousand years before sufficient has accumulated to make it worth while to gather it again.

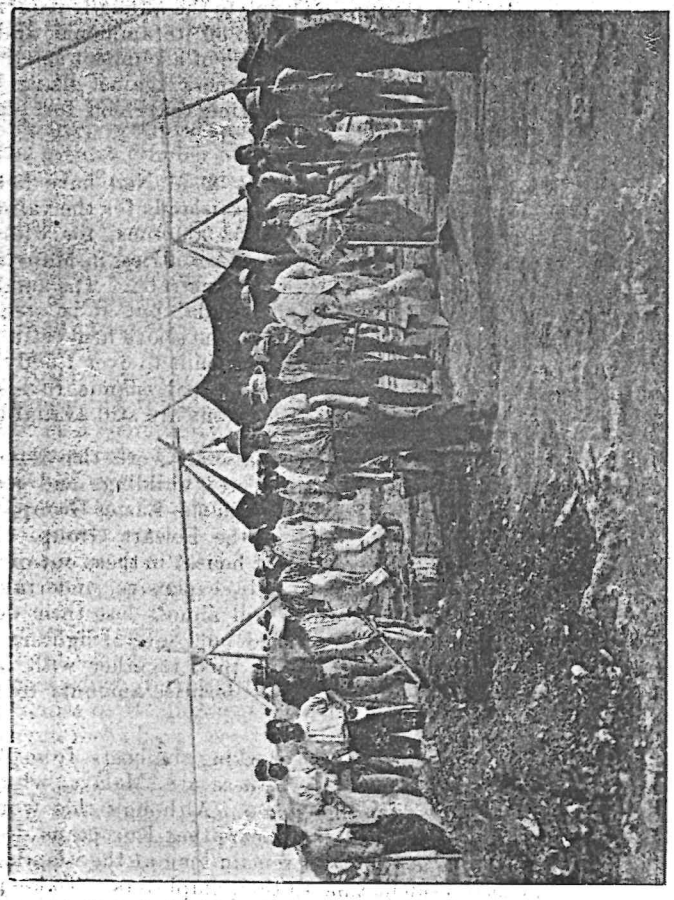
The guano of the Abrolhos is a greyish-brown odourless substance, containing a large amount of phosphates, varying from 50 per cent. to 80 per cent., or 60 per cent. on an average, which gives it a high value as a manure. Owing to the annually recurring rainfall, the fresh excreta has always given off its ammonia, and by this means become odourless. The absence of a pungent smell has somewhat prejudiced West Australian farmers against using this guano, because the greater number imagine that food for plants requires to smell offensively.

Since 1884 the firm of Broadhurst & McNeil have held a lease over the Abrolhos, and exploited these islands for the valuable guano. Up to date they have shipped 55,000 tons, for which a market has been found in several European countries, in Mauritius, the neighbouring colonies, and in Western Australia. The smallest consumption has been in Western Australia, but it is steadily increasing; and, according to information, the above firm estimates that the local requirements for 1899 will amount to over 1,500 tons. From the report on the deposits of the principal islands, furnished by A. J. Wells, L.S., I glean that 101,500 tons are still available.

In order to enable them to systematically work the deposits, Messrs. Broadhurst & McNeil have erected buildings and jetties on three islands—namely, on Rat Island in the Easter Group, and on Pelsart Island and Gun Island in the Pelsart Group. The building of the jetties and the erection of houses in these out-of-the-way places must have been a specially expensive undertaking. Besides these permanent works, which will almost lose their entire value when the islands have been worked out, several lighters and boats had to be provided, and for all this, together with other working plant, the capital sunk in the enterprise amounts to over £10,000.

For collecting the guano and for working the boats, from 40 to 50 men are employed. Some 30 of these are Malays, who are mainly engaged in collecting the guano. Although this work is easy and in no way unpleasant, it appears that Europeans do not care much for it, and as a rule never remain long at the islands, and often leave at an inconvenient time to their employers. To keep the concern going, the firm has been compelled to employ Malays under contract for two years, although these people are not as good labourers as Europeans, even at such easy work as scooping guano together, for they take matters as phlegmatically as possible and never hurry themselves over it, and at the same time they take advantage of the slightest deviation from the contracted stipulation to shirk work altogether. One of the points of agreement is that they shall have an abundant quantity of rice daily, and when during my visit the prevailing westerly winds prevented the schooner from leaving Champion Bay for a week, rice ran out, the work immediately ceased. The strikers declared that they could not work without rice, the other food—consisting of meat, fish, potatoes, and bread, etc., of which there was plenty—not being strong enough. It will be

seen from this that labour troubles may occur even at the most out-of-the-way places.



Group of Malays with their European Foreman.

The collecting of the guano is very simple work. After the stunted growth has been removed, the stuff is shovelled together and with hoes scraped out of the pockets and hollows found in the rock, which are finally swept with stiff brooms. It contains but little moisture during the summer when *in situ*, which, after being disturbed, soon leaves it almost entirely. Later the dried guano is thrown over screens to free it from roots and stones, which operation has to be done behind a wind-break made of canvas, in order to prevent large quantities of the light stuff being swept into the sea. The fine guano is put into bags and conveyed on trucks running on light rails to the jetties. From here it is shipped in crafts with a shallow draught to the larger vessels, which have to lie off a few

miles in one of the many channels, where enough water may be found to float the largest vessel.

Owing to the total absence of fresh water on the greater number of the islands, and because not sufficient rain water can be gathered from the roofs of the buildings to provide the workmen with it for more than a few months after the rainy reason is over, a small schooner has to be employed at regular intervals during the dry season for carrying water from Champion Bay. During the summer months the communication with the islands is therefore almost regular, and unless the wind is adverse the Abrolhos may be reached weekly in a comfortable little schooner.

As might be expected from the nature of the shallow sea in the neighbourhood of the reefs, and the food abounding therein, some excellent fishing grounds occur in many localities. This is specially the case in the inner margins of reefs where these are dissected by channels, and on certain shoals where currents meet. These opportunities for harvesting the living wealth of the ocean are taken advantage of by upwards of a dozen parties of fishermen, who, with boats adapted for the purpose, pay regular visits to these places as long as the weather permits it. The fishing industry is at present very remunerative to those engaged in it, on account of the market on the goldfields, where large quantities are sent, packed in ice.

In years to come the fishing industry promises to expand considerably, and to become, under better arrangements, a more profitable pursuit than it is already at present.

The export of eggs from these islands during the laying season would also be a lucrative venture. From at least three kinds of birds they can be obtained with ease and in abundance during ten weeks at the proper time of the year, and, what is important, they furnish excellent food, because tern and mutton birds' eggs are, in purity of flavour, equal to the best of fowls' eggs.

Before concluding this part of our discourse, I must mention another industry which may have a great future, namely, the culture of oysters and pearl-shells. Saville Kent, who, as we know, visited these islands and reefs, was so impressed with the suitability of the localities for these purposes that he has lately applied to the West Australian Government for some concessions, and is forming a company with the view of taking the matter systematically in hand. Splendid oysters occur now in places, especially in the Wallabi Group, but they are somewhat difficult to gather, consequently not often brought into market. The Sharks Bay pearl shell, *Meleagrina imbricata*, occurs already in these waters, but the submerged reefs and the lagoons are considered to be well adapted for the culture of *Meleagrina margaritifera*, the large species found further north.

Having alluded to the utilitarian value of these rocky islets and their surroundings, I come to the interesting aspect under which a scientist views this portion of the globe; and although fearing that I will not be able to do the subject full justice, I shall, in saying

something regarding its formation and about its flora and fauna, endeavour to bring at least the more striking features under your notice.

Physiography.

Anyone who has seen the excavations on the railway line between Perth and Fremantle does not require to be a geologist to gain the conviction that the prevalent limestone formation is due mainly to coral growth. Wherever the sand has been removed from the surface of the rock, the cores of coral clusters stand forth like pinnacles of abraded stalagmites, or, as it were, like trunks of trees denuded of their branches, alternating with hollows and ridges. The overlying stratum of sand, which unquestionably is of æolian origin, has protected the coral pillars from denudation, which otherwise must have taken place, and as is the case on elevated positions where the limestone has been exposed. I mention the peculiarity of the sandfreed surfaces not so much on account of their rare and almost unique appearance, as with the object of showing that scarcely anything could more strikingly amplify their origin.

When corals in our seas could grow in such a luxuriant manner as to cover large areas with the huge deposits we can everywhere observe in close proximity to our domicile, as well as along the whole coast and beyond the southern extremities of Australia, the climate must have been much warmer than it is at present in our latitude, and then the shores of our continent were evidently washed by a tepid ocean. It is assumed by all geologists that during the eocene period the temperature of the earth must have been more uniformly warm and altogether higher than at present, and in our latitude at this time was probably greater than it is to-day in the tropics. Through succeeding periods, which are not sharply limited, as in Nature no sudden changes of any magnitude occur, the climate grew cooler from the poles towards the equator, and the more sensative marine life became extinct in a degree as the ocean's temperature became lower in consequence of this change of climate.

The massive monument left some hundreds of thousands of years ago by millions upon millions of active polypes in the place upon a portion of which we stand at present, which then, just as they do now further towards the equator, extracted and consolidated the lime from the ever-moving ocean to build their solid or delicate but always grotesque dwellings, materially adds to the evidence that Nature works very uniformly under even conditions.

It is highly probable that the elevated islets and the greater portion of the submerged reefs constituting Houtman's Abrolhos belong to the same formation that furnished the material for the Fremantle Harbour Works; but the reefs surrounding them are still forming. This feature conveys special interest to the locality, because here occurs, so to say, a transition from bygone times into the still living. Moreover, the Pelsart Group marks the southernmost limit at which reef-building coral-polypes at present exist. The curve made by the reef fringing the Pelsart Group extends but

slightly beyond the 29th deg. of southern latitude, and nowhere else in the southern hemisphere do living coral reefs occur at that parallel. In the northern hemisphere living reef-forming corals are found as far north as 32° 15′, namely round the Bermuda Islands, which is their limit of extent towards the north, their occurrence here being attributed to the warm currents of the Gulf Stream. With the exception of these two outposts and a few other isolated positions, the area of coral reefs is limited between the 24th deg. to the north and 26th deg. to the south of the equator.

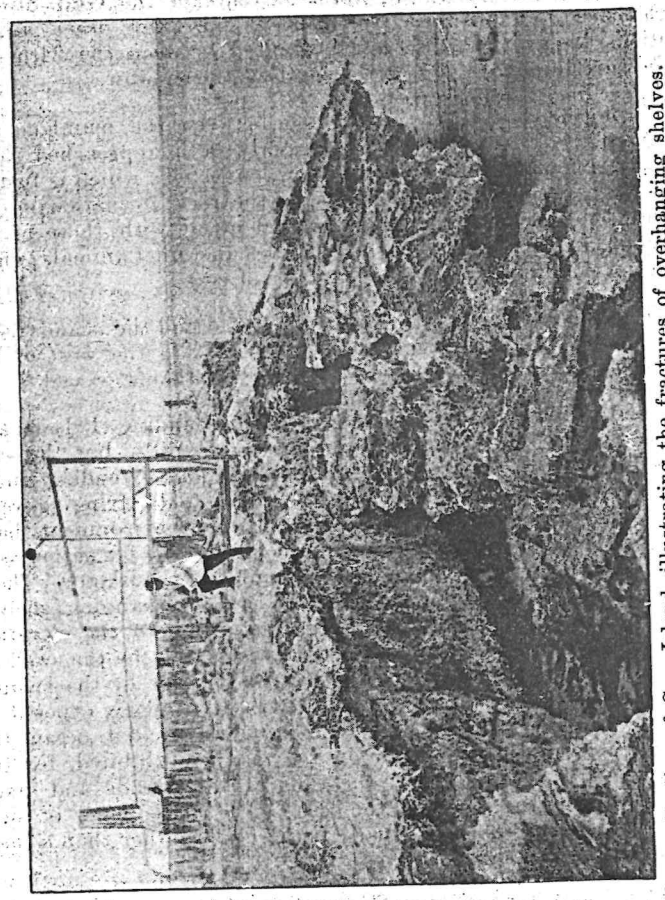
From the shallow sea intervening between the mainland and the Abrolhos, it is evident that formerly both approached closer towards each other, or were altogether connected; which is further supported by the fact that portions of the rock formation on the Wallabi Islands are non-coraline, and identical with those of the mainland, and by the existence of wallabies and other animals, which could not possibly have crossed 35 miles of sea.

The greatest depth between the mainland and the islands is 30 fathoms, and on an average about 22, whilst to the west of the group the sea rapidly deepens to beyond 100 fathoms.

As previously observed, the reefs surrounding Pelsart and Easter groups give them the appearance of atolls, but the submerged reefs connecting many of the islands, and extending under shallow water to the outer reefs, prove these to be fringing reefs which, since the elevation of the islets and their environment, have expanded. There is nothing remarkable about this formation as a whole, except the shape of the greater number of the islands. These are more or less eroded at the base, and have overhanging shelves several feet in thickness on top, varying according to the elevation of the whole. The erosion has been caused mainly by the swell of the tide, sometimes strengthened by winds, but not by the lashing of tempest-stirred breakers. Had they been regularly exposed to the full brunt of breakers or the fury of an excited ocean, the erosion could not have gone on in the manner exhibited, for the waves would have risen above the rims of the islands and taken away more from the top than the base. The consequence of such action would have been a gradually rising beach rather than a basal erosion with overhanging shelves.

To account for the existing peculiar features, a more or less vertical escarpment is required in the first instance. It is inconceivable that these islets could have been elevated suddenly with vertical walls, and therefore the whole area of the groups must have risen more or less above the sea when the portion between it and the present shore subsided. During the elevation, which, it must be remembered, has been steady and, may be, imperceptibly slow, vertical fissures appeared in the formation where the tension was greatest, and this, with the continuous subsidence and a simultaneous rise in other parts, will account for the characteristic features the islands now present.

What I have attempted to explain as having taken place in ages past and in a larger measure, repeats itself, or at least is exemplified in miniature around the islets at the present time. In a number of places the overhanging shelves have broken off, and the detached rock lies at the base or rests slantingly against the escarp-



Portion of Gun Island, illustrating the fractures of overhanging shelves.

ment, and in this manner the fractures represent the fissures, and the detached rocks the subsided formation. It is not an exact comparison, for the rupture and detachment of the rock have been rather sudden, owing to the space produced by erosion below it; but the juxtaposition and appearance is so similar that, in order to conceive the working of natural laws on a larger scale, one requires merely to substitute subsidence for erosion and banish the idea of suddenness from one's mind.

On a few low-lying islets in the southern groups situated near the deeper channels, and exposed to the direct wash of the ocean, sandy

beaches occur. In the Wallabi Group they appear more frequently, and there, on North Island, a dune encircling the whole area rises between 20 to 40 feet from the beach, whilst the interior is level and only a few feet above the sea. With this exception, sandy beaches are the least characteristic features in the archipelago, and do not extensively contribute to the formation of land. Much solid ground, however, is added by dead coral. Large and small fragments of living coral are constantly being detached by the waves from the outer margin of the reefs, and especially so during heavy weather, which, being washed over them, help to enlarge these on the inner side; or they are piled up on low islets and semi-submerged reefs, are consolidated into compact rock in these places, or, may be, moved off again to more sheltered situations.

On Pelsart Island the narrow northern extension is entirely formed of dead coral resting on a solid foundation, and is constantly being added to. This portion, therefore, differs in its structure from the southern part, which belongs to the previously-described type of islands, although the characteristic shape of these is here somewhat obscured through being in part exposed to the open sea. Pelsart Island, as mentioned in the outset, is placed in direct connection with the large outer reef which encloses the group named after that island, and thus it has to bear on one side the brunt of the south-eastern gales.

These gales are responsible for large quantities of coral detritus and dead shells being washed against its shore; here these masses are alternatively heaped up and swept away again to be ultimately piled up on the northern extension. The six to seven miles long shore of this part, in consequence of the heavy wash, is more or less sloping below, and towards the crest is overlaid with ridges of loose coral, which underneath becomes solidified by degrees through percolation.

The study of the Abrolhos offer many more interesting facts connected with coral-reef formation, but the more salient points having been noted, we will proceed to discuss the other subjects of natural history.

The Flora.

In shallow water, where moderate currents prevail, the bottom is in places covered with different species of seaweeds, which, plainly seen through the clear fluid when the surface is not ruffled by the oars, produce by their fresh colours an exhilarating sight. It becomes very attractive, when leaning over the side of a drifting boat, to watch the gently-moving blades of the algæ bunches, interspersed with coral and other growth, and observe fish darting from under them, and other marine life moving over the reefy bottom. A considerable collection of algæ could no doubt be made in these waters and on some of the shores, where occasionally large quantities get piled up after strong winds.

Regarding the terrestrial flora, the season was too far advanced to allow a detailed conception of it being obtained. Everything,

except the salinacious plants and a few other species, was withered up, and this could hardly be expected otherwise, considering the shallowness of the soil. But so much could be seen that on the whole it is very poor in species, and that among them there are none specially indigenous to the islands. Only one species, a *Trithema*, found abundantly on Rat Island, I have not met elsewhere, but I have no doubt that it occurs in other places also. *Nitraria Schoberi*, which is a littoral plant yielding an edible berry, was very common on most of the islands; and on Gun Island, for example, fringed the north and western side entirely. Wooded Island, in the Easter Group, derives its name from the mangroves found there; and on Pelsart Island several copses of old trees of the same species are growing, many with stems over a foot in diameter, and upwards of 15 feet high, which are the largest specimens of vegetation to be met with; every other scrub is small and stunted, except on some parts of the Wallabi Islands, where the deeper soil is conducive to a vigorous growth, and then the brush becomes tall and dense.

Two species of saltbush are common everywhere, and predominate over the whole area on the guano deposits to such an extent that where the surface is still undisturbed other plants are, so to say, merely scattered among them. *Salicornia* (the false samphire) and *Mesembrianthemum* are found on all the larger islands. On Middle Island, the largest except Pelsart Island, in the southern group, which, strange to say, is not visited by many birds, and has no deposit of guano upon it, I found *Sarcostemma Australe* fairly abundant and also a *Myoporum* and an *Eremophila*. The latter species was also met with on Gun Island and on Pelsart Island.

Several exotics have found their way to the islands which are being worked for guano. No doubt the seeds of these were brought there mainly with chaff, as a horse is kept for pulling the trucks. The commonest of the introductions is the sow thistle (*Sonchus oleraceus*), which was also noticed on several of the smaller islands, where the seeds have evidently been carried by the wind. *Sonchus arvensis* was also seen here and there, and the spurry (*Spergula arvensis*) quite commonly. On Rat Island the nettle-leaved goosefoot (*Chenopodium murale*) has spread to every available part. It seems that Europeans, wherever they may go, are followed by noxious animals and weeds.

Marine Life.

In coming to the discussion of the animal kingdom, the coral polypes claim our attention in the first instance, being the most numerous and having left such colossal evidences of their presence through bygone epochs. They stand very low in the scale of animated nature, and by their life history one is reminded as much of a plant as of an animal, because they possess the appearance of both. Their chief characteristic manifests itself in being a compound animal, meaning that the single individuals are not quite independent, but connected to each other and able to feed conjointly, and in this

manner they may be compared to branches of a tree, and although feeding in the manner of animals by swallowing their food they are, like plants, tied to their habitat and lack perfectly independent motion.

An orifice which serves for feeding as well as for the rejection of refuse leads to an expanded sac, which, answering to the stomach of the higher animals (because here the nutrient substances are separated from the refuse), is at the base connected by a duct or root-like process to that of the neighbouring individuals.

Round the mouth radiating tentacles are situated, which serve to arrest the nutriment floating in the water. The number of these tentacles vary in the different species, are variously coloured with them, and somewhat fold together when the animal contracts into the tubular pore it inhabits. The body is composed of several membraneous layers, from the cells of the outer one the carbonate of lime is secreted that forms the framework of their habitation.

Their production is by ova from which ciliated larvæ are born, which in this state possess a completely free motion. The individuals are sexually different, although hermophrodites also occur, and in a few cases the species are entirely hermophroditic. But the more prevalent mode of reproduction is by gemmation or budding, which, as the term implies, is by one individual growing out of another in the manner of a branch from a tree. By fissiparation the individual may be thrown off from the colony and then become the nucleus of another colony. It must be understood that a coral stock is not all one colony, but generally includes a great many.

The colour of the upper part of the body, and mainly that of the tentacles, impart the exquisite tint to the living corals. The most diverse shades, from brown and yellow to pink, rose, lavender, and purple, are displayed over the variable growths, and form a veritable flower garden below the water. Among the very characteristic and best known *Madreporæ* or "staghorn" corals bluish and purplish colours prevail, whilst *Meandrinæ* or "brain" corals are generally yellowish or brownish. The skeleton, or what is commonly known as coral, consists of carbonate of lime, and is quite white with the reef-building and other true corals, except in rare cases, among which the beautiful pink coral of the Mediterranean Ocean is the best known, because it furnishes such charming material for pretty ornaments.

It would require several weeks of special attention to find all the species that may occur on the Abrolhos, which seem to me, although from their geographical position against my expectation, exceptionally favourably situated for their growth, as the luxuriant production of several species of staghorn and brain corals are indisputable evidence, of which probably none larger could be found in the tropics. But one can see a great deal by walking at ebbtide over the dry reef, which is from a quarter to half a mile wide and almost level on top, with a very gentle slope inwardly. There are a number of hollows and depressions of various sizes and depths

found upon it, teeming with life of every description common to the ocean. These pools afford better opportunities for the study of marine life than most other places, and here in the placid and transparent water the beauty of the corals can readily be observed, although one does not meet with such large stocks as in deeper water and at the margins of the reef, where they are continuously swept over by the never-resting waves.

As, however, for three parts of the day the waves are forced over the outer margin of the reef, and by their wash, flowing inwardly, these pools are supplied with a current of water at regular intervals at the period of half-tide, and because at high water the whole reef is covered several feet deep, plenty of food reaches them, and it is evidently not for the lack of it that the corals do not thrive so well in these pools; but their lesser growth may probably be accounted for by the greater shelter they offer to their enemies. The shelter from a rough wash, combined with a regular renovation of the water, must be conducive to the development of a varied representation of marine life, which is borne out by the abundance met within their limits. Sea anemones, ascidians, crabs of all descriptions, including the large edible crayfish and prawns, and many species of "hermit" crabs, which occupy dead shells, starfish, sea urchins, holothurias, shells, and fishes, may be found in the greater number. The life is so multifarious, vari-coloured and interesting in these pools that it would take me hours if I attempted to describe or even only to enumerate all the species that may be seen in the time between low water and flood tide.

Varied as the colours are to be met with among life on the reefs, they are yet surpassed, both in brightness and softness of tints, by those of many fishes of the somewhat deeper water. Among them the different species of parrot-fishes deserve special mention, and anyone who has seen these fishes in their element will agree to the propriety of their being so named. At Rat Island, where the jetty is built with rock, these fishes, as well as other brightly-coloured species, used to be always present in considerable numbers near the end of the structure, feeding among the stones. An opportunity was here afforded me to admire with leisure their beautiful tints, which, in the brilliant sunlight, appeared to the greatest advantage, as they slowly glided through the transparent brine.

Occasionally turtles may be seen in the southern portions of the archipelago and sometimes more numerously in the Wallabi Group, where they are known to lay on the sandy dune of North Island. On two occasions I observed a specimen about two feet in length, when rowing in shallow water near the islets in the neighbourhood of Gun Island, which appeared to be small specimens of *Chelone midas*, the hawk's-bill turtle.

But we must leave the briny element and roam a while over the solid again, for there we will find yet some of the most interesting phases of animal life to record.

The Terrestrial Fauna.

Proceeding step by step, I must, in passing, allude to the insects, which, depending on plants, like these, are scantily represented. Neither are they very varied, although the greater number of orders are represented; nor are the species different from any found near the shores of the mainland in that latitude.

Reptilia are much in evidence, although specifically not numerous, including, so far as is known, only four lizards and two snakes. The lizards are found everywhere, but most abundantly on the guano islands; the snakes are confined to the Wallabi Group. One of the ophidians is the well-known carpet snake, which occurs frequently, and the other the small ringed snake, which hitherto has been recorded only once.*

The avifauna of the archipelago is, however, so profuse in numbers of individuals, and although not comparable as to number of species with the other productions of the animal kingdom, vies with them through the prominence of their multitudes. Owing no doubt to the moderate distance of these islets from the shore to the mainland, several land birds are met with which could not be expected to occur on islands farther in mid-ocean, where also shore birds endowed with lesser flying powers than the true ocean roamers, as a rule, are not found. Through the moderate distance from the continent, together with the evident connection with it of certain portions at no distant geological date, it happens that many of these islands harbour a greater number of species than generally is the case with sea-girthed rocks.

The scene of the immense numbers of birds enlivening the air by flying to and fro over the nesting places, with an equally large number crowding the low bushes and the ground beneath them, sitting on their nests, together with the din of their incessant screeching and calls, which may be heard during the greater part of the night as well as in the day time, is beyond description. Such phenomena require to be witnessed in order to receive a conception of them; but when once beheld and listened to, will leave an impression that cannot be forgotten.

The birds found in greatest numbers are merely visitors of these islets during the summer for the purpose of breeding thereon, and leave after the season to spread themselves again over the vast ocean in the south. From the beginning of September to the middle of October these at other times roving species arrive in large flocks, and, taking up their old nesting places during several months of settled conditions, pursue the interesting object of life, the reproduction of their kind.

Birds and their Nests.

Anous stolidus, the noddy tern, occurs in greatest numbers, and, owing to its habit of building on top of the low bushes, is brought

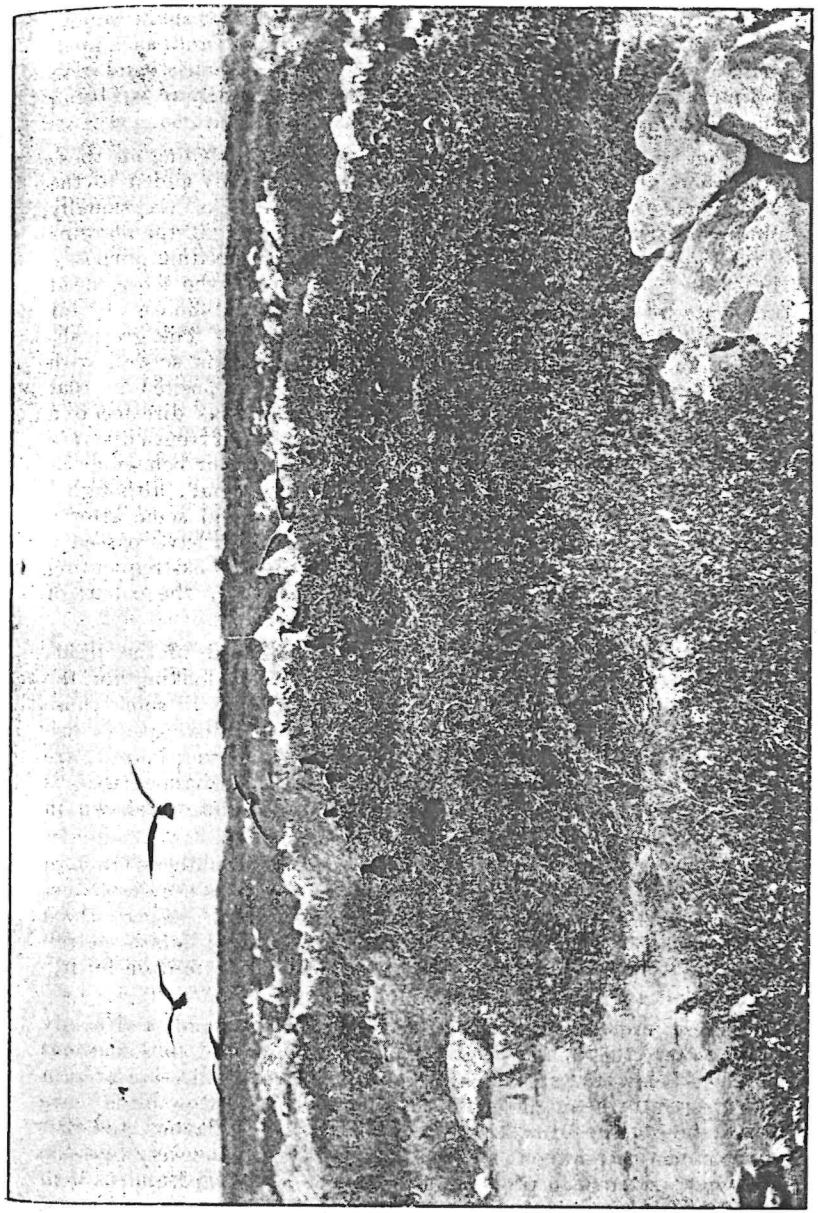
* According to the British Museum catalogue, four species of frogs occur on the Abrolhos, which, no doubt, means on the Wallabi Group. *Vide* appendix.

most prominently into evidence. On the dense low scrub it depresses the entangled branches, and covering these depressions with a thin layer of twigs and seaweeds, lays a single egg upon them. These nests are crowded close together over the rounded bushes, and frequently are seen also on protruding rocks. But it is interesting to note that on a portion of Pelsart Island, where for the collection of guano the shrubs had to be removed from a large tract, these birds have nevertheless not deserted their habitual nesting place, and now lay on the ground, which is not their usual habit to do. Here I found an immense colony sitting over an area of several acres, so close together that I had to take care when walking over the ground not to step on the birds or their eggs. They do not readily desert their nests on the approach of man, but energetically defend their offspring by pecking at his hands or legs, and make violent darts at his head whilst flying round him.

Below the bushes on which the noddy tern is hatching, the sooty tern, *Sterna fuliginosa*, builds its nest, that is to say, scoops out a hollow in the guano, to deposit its egg in; also only single one, as with the majority of sea birds. In places the sooty tern occurs in as large numbers as the noddy tern, but it is not nearly such a plucky bird. When being approached it generally sets up a screech of alarm, and the greater number scramble from beneath the decumbent branches and hurriedly decamp. If, however, the young is near hatching, or already present, the anxiety to defend it is heightened, and then they may make attempts at pecking at the aggressor.

The lesser noddy tern, *Anous tenuirostris*, occurs most numerously next to the two species just mentioned. Its habitat is the mangrove copses, wherein it nests in crowded colonies. Almost every available position adapted for the purpose is occupied by a nest in these places, and some are built on branches so limp that they bend under the weight. In the mangrove thicket on the northern part of Pelsart Island I counted in some of the stunted trees from 20 to 30 nests. They are constructed entirely of seaweeds, and repeatedly serve the same purpose, after having new material added to them; the droppings of the young have, in consequence of the repeated occupation, covered the outer portions with a white crust, giving the nest a calcareous appearance. Of all sea birds known to me this species builds the most artistic nest, although even then it cannot be compared with many of the simpler kinds constructed by land birds.

At the time of my visit I had the pleasure of observing a great number of these birds engaged in relining some of the old nests and constructing a few new ones. For this purpose they gathered a long-bladed green seaweed that was growing plentifully in the shallow lagoons in close proximity. They either sat on the water and pulled it, or in their flight swooped down and picked up the floating blades some other birds had detached. These long pieces are hung fringe-like over the nest, whilst the centre is lined with shorter and finer material.



Nests of the Noddy Tern on Rat Island.*

In common with the greater number of sea birds, this tern hatches only a single egg at a time, but it probably breeds three

* The illustrations have been prepared by Mr. E. James McKagie from photographs taken by Mr. O. Lipfert, who was my companion during the visit to the Abrolhos.

times during the season, because young able to fly, small young, eggs about to hatch, and fresh eggs were present, and, as stated, building was pursued. The bird pluckily pecks at one's hand with its thin beak when being approached, and energetically resists being removed from its nest.

None of the other six species of terns found breeding on these rocky islets are numerous enough to have materially added to the guano beds. They generally appear in small flocks, occasionally numbering from thirty to fifty, and as a rule frequent the margins of the larger and the smaller barren islets for breeding purposes. Here they lay their eggs on the bare rock or on the loose, dead fragments of coral, washed together on certain shores, as, for instance, on the northern portion of Pelsart Island. The greenish-grey ground colour of the speckled eggs corresponds so well with the surroundings of the locality they are usually deposited in that it becomes difficult to see them. My attention was directed to a flock of graceful terns, *Sterna Dougalii*, I had noticed from a distance to be sitting on a ridge of dead coral, and from their behaviour at my approach I felt certain that eggs were lying about; although I happened to come right amongst them, I only found some after a prolonged search, and am convinced that I must have passed a number unnoticed. The downy young of these rock-frequenting birds are, like the eggs, equally well protected by the colour of their plumage.

As with the noddy and sooty terns, several of the light-coloured species often congregate together. When looking for the eggs of the graceful tern, I found in close proximity to some those of the little tern, *Sternula nereis*, proving that these two species also live in friendship together. All sea birds, it is well known, are prominently gregarious, but with the terns this characteristic is stronger developed than with any other group, and, as shown in several instances, extends beyond the species.

Three visitors appearing in considerable numbers, though somewhat later in the season than most of the others, are the wedge-tailed petrel, *Puffinus sphenurus*; the allied petrel, *P. nugax*, which prefers the Wallabi Islands; and the white-faced storm petrel, *Procellaria fregatta*. The first two are known as "mutton birds," and the last as "Mother Carey's chickens."

These birds frequent the edges of the guano islands and sandy places, where they make deep burrows in the ground to sometimes two feet below the surface. Here, on a scanty collection of thin twigs, they lay a single egg. Those of the "mutton birds" are nearly the size of a duck's egg, and of a delicious flavour, and that of the storm petrel about as large as a pigeon's. In every case the eggs are very large in proportion to the size of the bird, and, as with all eggs deposited in hollows, whether under ground or in trees, white, because they do not require a protective colouring. It is a marvel how birds possessing feet apparently so ill-adapted for burrowing can manage to excavate these warrens, which, it deserves noticing, they pluckily defend.

During the day one can see the petrels only when they are dragged forth from their dens, but at night they come out by themselves, and then the weird, mournful howling calls of the "mutton birds" are constantly heard. The habit of seeking food by night, as it is generally believed they do, is very peculiar, and it is evident that they must be able to see in the dark; that to some extent it is so cannot be denied, and probably through passing part of the time under ground, their sight has become adapted to crepuscular vision; but that this characteristic should have developed to the extent of enabling the birds to find food in the dark appears to me doubtful. As the birds are only found singly in each burrow, and none are seen flying about during the day, it seems to prove that the other sex is away at a considerable distance and does not come home till after sunset to relieve its mate, which would have to remain on the nest for twenty-four hours on a stretch. The homing birds would then require to see in the dark merely sufficient to find the warren containing their mates, and no doubt are assisted in being guided to them by the reply to their mournful calls, whilst they could seek food in daylight during their absence. Nevertheless, they may almost deserve to be termed night birds when on their breeding stations, as they are neither seen nor heard in daylight; but no sooner is it dark than they fly about, and their doleful calls are continually heard till after midnight.

The peculiar crepuscular habits of the petrels, and still more their burrowing propensity, characterises this family of sea birds in a striking manner. It is true that the terns and gulls do not go entirely to rest at the fall of night, and especially in moonlit nights, a babel of their cries is heard over their nesting places, but this is merely a continuation of their day habits, and probably to a great extent may be accounted for by repeated disturbances.

A bird totally different from the preceding, and nothing like so numerous, although constantly coming under observation, is the pied cormorant, *Graculus varius*. It is closely allied to the cormorant or shag of the Swan River, and cannot be distinguished from it when flying, except by its slightly larger size. On close examination it is, however, found to differ also by its longer beak, the naked parts about the head, and the speckled plumage of the back; moreover it is an extremely shy bird.

When breeding it congregates in large colonies, and builds its nests on the overhanging edge of some of the lonely islands. Such a shaggery generally consists of several hundred nests, closely placed by the side of each other and constructed of twigs, piled together from five to ten inches above the rock, and lined with seaweed. Considerably more pains is taken over the construction of these nests than is absolutely needed, and as the bird cannot find many broken twigs lying about, it has to break down the low salt-bushes for the purpose, as proved by leaves being still attached to the building material.

From three to five greenish-blue eggs, covered with more or less extensive blotches of a calcareous crust, are found in these

nests, the normal number being four; but frequently only one or two are met with, which must be attributed to the long-billed gull, or silver gull, *Larus longirostris*, having destroyed the others. This gull is an inveterate enemy of the cormorant, and watches for every opportunity to devour their eggs. It probably also eats other eggs when an opportunity is offered, but I have not observed another instance, and as the eggs of birds laying in open nests generally are sheltered by protective colouring, they are certainly, when left by their parents, not so readily espied by these predatory birds as is the case with those of the cormorants.

On the occasion of my visit to their habitat, the cormorants hastily departed, and before I could approach the nests a flock of gulls had pounced upon them, and in a very short time devoured several dozen of eggs. As there were over 800 nests along the margin of the island, I could not keep these robbers from the eggs, for when I disturbed them at one end they immediately flew to the other, and did not cease their predatory work till I departed and the cormorants, who had settled on the water some distance away, returned to their nests on seeing my boat leaving.

In the midst of this colony of cormorant nests I found an osprey *(Pandion leucocephalus)* nest, with two almost fully-grown young. It is evident from this that the osprey lives very peacefully with the cormorants. This osprey nest was the only one, beside another I found built on the rock; usually they were found on top of stout bushes, and invariably the densely intertwining *Nitaria Schoberi* is utilised for this purpose.

In starting a nest, as I had the opportunity to observe in one place the bird flattens the top of the shrub by pressing and breaking the thin protruding branches down upon the body of the entangled shrubby growth. The nest above is formed of stout sticks and branches, which frequently are found to be mixed with pieces of coral, appearing as if intended to impart solidity to the structure, over which a layer of seaweed is spread. The finished nest is very flat and from four to five feet in diameter, or large enough to comfortably hold half a dozen full-grown birds, which is an out-of-proportion dimension for the requirements, as a clutch never exceeds two.

Osprey nests are frequently met with, and occur on nearly all the islets. By the heads and other parts of fish found lying over their margins and in the immediate vicinity, it is shown on what food the bird subsists. Fish swimming near the surface rarely escape this hawk when it swoops down upon them. On two occasions I observed one of these birds dart from the air and, after a heavy splash, rise with a fish in its powerful talons.

A still larger bird of prey, the noble white-bellied sea eagle, *Haliaetus leucogaster*, is much rarer, but it was seen several times. The Wallabi Group is its favourite habitat. Its nest can scarcely be distinguished from that of the osprey. It feeds, however, greatly on birds and mammals, and the wallabi, on the Wallabi Island, may have a special attraction for it.

Another characteristic bird of this and similar localities is the reef heron, *Demiegretta sacra*, which generally is met with in pairs. It is a small-sized species of the family, and the common variety has an ashey-bluish plumage; but the rare variety, which is pure white, is also met with occasionally. The nest is made of sprigs under ledges overhanging the water.

Among the birds of rarer occurrence the tropic birds, *Phaeton candidus* and *Ph. rubricauda* deserve mentioning. The latter, with its red beak, its two long scarlet feathers protruding from the tail, and its beautifully rose-tinted white plumage, is probably the finest-looking sea bird in existence.

The gigantic pelican is also met with in these waters, but generally only in small flocks. Its favourite nesting places appears to be the islands North of Sharks Bay.

Of the land birds common to the continent, the welcome swallow, *Hirundo neoxena*, and the green-backed silver-eye, *Zosterops Gouldii*, are seen in many places, although not in large numbers, and during my stay on Gun Island a specimen of the Australian lark, *Anthus australis*, was secured, a bird not previously recorded from the Abrolhos.

I must further mention a few of the birds confined to the Wallabi Group, and which on this account are of special interest. They are—*Numenius cyanopus*, the Australian curlew; *N. uropyzialis*, the wimbrel; *Turnix cintillans*, the freckled turnix quail; and *Hypotœnidia philipensis*, the pectoral quail; *Phaps chalcoptera*, the bronze-wing pigeon; and *Anas castanea*, the Australian teal.

The first two, shore birds, belonging to the snipes, are bad fliers, and it is very doubtful whether these and the teal have migrated to the group since it was separated from the mainland, still it is possible; but such can scarcely be the case with the two species of quails, as they could not well fly 35 miles at a stretch; nor is such a feat known of the bronze-wing pigeon.*

The presence of these birds, together with the existence of the carpet snake and four species of frogs, is proof that this group cannot have been separated from the continent till recent geological times, when Australia possessed its present fauna.

Mammalia.

A more unmistakable proof affirming this statement, however, exists in the occurrence of the wallabi, *Halmaturus Derbianus*,

* These remarks were taken exception to after the reading of the paper by an ornithologist who was of opinion that quail could fly such a distance, because they are known to do so in Europe. This, no doubt, is correct, but it must be considered that the old-world species are migratory birds and regularly make their flights impelled by climatic changes and commensurate food supply produced thereby. The Australian quails are not migratory and only change the locality of their habitat to a limited extent, except, perhaps, under extraordinary stress of drought. Moreover, it would be unlikely for them to seek the small islands of the Wallabi Group under such circumstances, and, had they done so they would have found their way back to the mainland after a time. This question, however, will scarcely affect my argument, as it is not based solely upon the peculiarity of bird-life in this group. *See* also, regarding the bronze-wing pigeon, the remarks of Mr. Beddoes appendix to this paper.

which could not have reached the group except by a land route, unless they were brought there by the agency of the blacks, which is a most unlikely thing.

At present these marsupials are so abundant on the East and West Wallabi Islands that there is no need for using a gun to secure them, as they come across one's path frequently enough to be knocked down with a stick or a stone.

Of other indigenous mammalia frequenting the Abrolhos, the seal, although not occurring very numerously, but found in all its groups, deserves mentioning. It is a species of *Enotaria*, growing to a considerable size.

Rat Island obtained its name from the great number of rats formerly found there, and it is not known whether it was an indigenous species or whether it had been brought there by a shipwreck. The latter seems to me the more probable.

They were so extraordinarily numerous at the time the collecting of guano was first started on the island that they would even run over the table when the men were having their meals, and unless the provisions were kept in iron tanks nothing was safe from them. A considerable number of cats was brought from Champion Bay for their suppression, and these have now entirely destroyed the rodents. But the cats in turn have multiplied to such an extent that they at present commit great havoc among the birds, which fall an easy prey to them. Especially the sooty terns suffer from their aggression, because they lay on the ground beneath the bushes. Hundreds of these and numbers of noddy terns were lying about dead, many with only the head bitten off, proving that the cats kill a greater number than they require for their sustenance, and that they must be still more destructive to the young birds. The slaughter is assuming such serious dimensions that unless something is done to destroy the cats they bid fair to exterminate the birds or drive them off the island.

Another introduced animal is found on Pelsart Island, namely, the rabbit. Some sixteen or twenty years ago a schooner was wrecked on the island. I have forgotten the exact time and the name of the master, but he had a coop with a couple of pairs of these interesting notorieties on board, which he liberated. It is, perhaps, as well that things happened as they did, for at this isolated spot the pest cannot do any mischief. Together with the mutton birds, the offspring of the originally-introduced pairs have undermined the whole Northern part of the island, where it is covered with shell-sand, and one cannot walk over this part without every now and again breaking through up to the knees.

Concluding Remarks.

An area in every respect suited to and offering the greatest opportunities for comprehensive biological studies, situated a short distance from the shore of the mainland and to be reached from Perth, with existing means of conveyance, in 36 hours, should be more frequently visited by students of nature than at present is the case. When our adopted country has advanced to the stage when higher education becomes an obligatory duty of the State, I have no doubt that much material for investigation will be furnished by these islands and their surrounding seas and reefs, and it may then be that one of them will be chosen for a biological station, as probably few spots on the surface of the globe would be better suited for such a purpose.

Having reviewed, though by no means exhaustively described, the more striking features presented to a visitor to Houtman's Abrolhos, I now close this address, in the hope that I have not wearied you with my discourse. But before parting, I would wish to add a suggestion, namely, that in my opinion this society should expand its sphere of labour to some extent and not stop at investigating and protecting our indigenous flora, but bestow a vigorous attention to our native fauna also, and prevent the existing law for its protection becoming a dead letter.

In modern days acclimatisation has become a kind of fashionable fad, and in all directions societies for this purpose spend large sums of money on their pet endeavours and induce and obtain the assistance of governments. I do not mean to deprecate the fundamental idea of the object in view; on the contrary, I am fully alive to the fact that from an economic standpoint great good may be achieved by the judicious introduction of useful animals of many kinds, and that it is laudable also if the æsthetic receives consideration by the acclimatisation of feathered songsters; but everybody who has given the matter only the most superficial attention must admit that hitherto acclimatisation in Australia has on the whole been a lamentable failure, and that it has done far more mischief—in many instances disastrous mischief—than good. We have bought our experiences at enormous expense, and yet continue experimenting in the same uncertain directions. I will just choose one instance in support of my statement affecting Western Australia.

For years past settlers in agricultural and pastoral areas have clamoured for the destruction of indigenous marsupials, on the ground that they harm their crops and eat much pasture, and whilst in a number of districts the production of scalps is rewarded by a fee, we have the hope presented to us soon to see deer acclimatised in our midst.

To be moderate in my expressions, I will call such endeavours misdirected good intentions, often caused, no doubt, through the innate folly of man to overlook the good around him and seek it at a distance.

I am convinced that the protection of the greater part of our indigenous fauna is more important to the future welfare of our country than appears on the face of it, and far more promising of salutary results than injudicious acclimatisation; and for this reason I felt constrained to point out the errors of it, with the view of

drawing your attention to, and in order to emphasise the necessity of a close and careful study of Nature.

Without dilating further upon the subject at present, I will merely add that there is nothing so mean that would not be deserving of critical observation, as it can never be known to what further results it may serve as a stepping stone.

To make our society a real living institution worthy of its name, and as I know for a fact that there are many amongst us who will agree with me that we can do good work in more than one direction, I have taken leave to bring the field of protecting our native fauna under your notice.

Appendix.

A list of the mammals, birds, reptiles, and frogs occurring on Houtman's Abrolhos:—

**Halmaturus Derbianus*	Derby's wallabi
Euotaria sp.	Seal
Mus sp.	Rat (? introduced)
Lepus cuniculus	Rabbit (introduced)
Felis domestica	Cat (introduced)
Haliaëtus leucogaster	White-bellied sea eagle
Pandion leucocephalus	White-headed osprey
Hirundo neoxena	Welcome swallow
**Sericornis maculatus*	Spotted scrub tit
Zosterops Gouldii	Green-backed silver eye
Anthus australis	Pipit
**Phaps chalcoptera*	Bronze-wing pigeon
**Turnix cinctillans*	Freckled turnix quail
**Hypotænidia philipensis* ...	Pectoral quail
Hæmatopus longirostris	White-breasted oyster catcher
Hæmatopus unicolor	Sooty oyster catcher
Aegialitis ruficapilla	Red-capped dottrell
Tringa albescens	Little sandpiper
**Tringa subarquata*	Curlew sandpiper
Strepsilas interpres	Turnstone
Limosa uropygialis	Barred-rumped gatwit
**Numenius cyanopus*	Australian curlew
**Numenius uropygialis*	Wimbrel
Demiegretta sacra	Reef heron
**Porzana tabuensis*	Tabuan crake
**Anas castanea*	Australian teal
Larus pacificus	Pacific gull
Larus longirostris	Long-billed gull
Sterna caspia	Caspian tern
St. Bergii	Common tern
St. Dougalli	Graceful tern
St. anaestheta	Panazon tern
St. fuliginosa	Sooty tern
Sternula nereis	Little tern
Sternula inconspicua	Master's tern
Anous stolidus	Noddy tern
Anous tenuirostris	Lesser noddy tern
Puffinus nugax	Allied petrel
Puffinus sphenurus	Wedge-tail petrel
Procellaria fregatta	White-faced storm petrel
Phaeton candidus	White-tailed tropic bird

Appendix—*continued.*

Phaeton rubicauda	Red-tailed tropic bird
Graculus varius	Pied cormorant
Pelecanus conspicillatus	Australian pelican
**Morelia variegata*	Carpet snake
** ?*	Ringed snake
Egernia Kingi	Lizard
Egernia Stokesi	Spine-tailed lizard
Ligosoma Lesseuri	Lizard
Ligosoma proepeditum	,,
**Lymnodynastes dorsalis*	Frog
**Crinia signifera*	,,
**Myobatrachus Gouldii*	,,
**Hyla rubella*	,,

The list of the hitherto known special inhabitants of the Wallabi Group (the species are marked with an *) may yet receive some further additions, if these islets were carefully exploited in search of them. Mr. G. R. Beddoes, to whom I wrote with the object of ascertaining more about the subject, and whether he thought that the bronze-wing pigeon breeds at these islets, kindly writes as follows:—"Besides the birds common to all the Abrolhos, there are in the Wallabies the bronze-wing pigeon, three sorts of quail—stubble quail, red quail, and button quail—and curlew. I am not sure whether the pigeons breed on the islands or not; the bush is quite large enough for them to nest in, and we have always found them, no matter the time of the year of our visit. Snakes are very numerous, mostly good-sized carpet snakes. I have also seen two different kinds of little fellows about a foot or eighteen inches long. There are some lizards on these islands that I have not found on any of the others."

BROWN ROT

(Monilia fungus).

From Albany the following letter accompanying specimens of fruit attacked was received by the Department:—

Stirling Terrace, Albany, W.A., 11th December, 1901.

By post to-day, I have forwarded to your department one small box containing a few plums, two of which are green and in their natural state; the rest are a sample from the same tree. The fruit grow and bloom splendidly and attain the size of the green ones, then wither and drop off in hundreds. The soil is a strong black and heavy clay subsoil, mulched every year; in fact, every attention is given to them. Kindly, if possible, let me know the best course to pursue. The two trees are about eight years old. This is the second year the fruit has dropped.

Yours, etc.,

JAMES EDWARDS.

To the Secretary, Agricultural Department.