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Some Aspects of the Ecology of the Aboriginal Inhabitants of Tasmania and Southern Australia (1)

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INTRODUCTION

In choosing my subject for this Lecture, I have been influenced by several considerations and it is fitting that they should be briefly indicated. Clive Lord, in memory of whom this Lecture has been established, was essentially a naturalist in the good old sense of the word and as the lives of the Australian and Tasmanian aborigines were so intimately associated with the natural history of their surroundings, such a subject as their reactions to this environment seemed specially appropriate in a Memorial Lecture to him. Under the conditions laid down, the Lecture must deal with some aspect of Tasmanian history or Tasmanian science. Now I cannot claim any special knowledge of Tasmanian natural history or of the records of the Tasmanian natives, but these natives have again assumed a position of very considerable importance in connexion with the present aboriginal inhabitants of the mainland of Australia. Do these latter, or do they not, show any features which may indicate an admixture of Tasmanian blood?

Amongst recent workers, Dr. Wunderly (1938) maintains that there are characters in the present Australian which indicate a Tasmanian admixture. Messrs. Birdsell and Tindale in a recent expedition, organized by Harvard University and the University of Adelaide, with the aid of a grant from the Carnegie Corporation of New York, have been studying the half-caste Australian and Tasmanian populations. Their study necessarily embraced data from Australian full-bloods as well. Their results have not yet been published, but I have been privileged to read the typescript of their proposed first paper in which they bring evidence to show that there is a very definite Tasmanoid element in the Australian native, in those parts of Australia which may be looked on as peripheral regions. One of such peripheral regions is in the Cairns district and another is along the southern coast of Australia. It is highly probable that their conclusions are correct.

(1) Portion of the Clive Lord Memorial Lecture, 1939.

If it is true that there is an admixture of a Tasmanian type in the Australian native, then the study of the ecology of the latter has a very intimate relationship with Tasmania. In the Southern and Central Australian native we may see traits manifested which are derived from their Tasmanian ancestry, and their methods of procuring a living may be in many points similar to those of the recent Tasmanians as of the forerunners of these who dwelt in Australia.

Having had a number of opportunities for studying the natives of the interior of South Australia and of Central Australia in their natural surroundings, I propose to lay before you some of the results and experiences of these expeditions, having in view more particularly how such can be applied to the native inhabitants of Tasmania.

I cannot resist introducing here the description given by La Billardière (*vide* Ling Roth, 1890) in 1792 of his meeting with the inhabitants of Van Diemen's Land to compare it with a recent experience in the Musgrave Ranges of South Australia. So similar was the behaviour of the natives in each instance that one is almost tempted to suggest that it was more than a mere coincidence, such as might happen with any group of indigenes, and that it was based on a natural disposition inherited from a common ancestry. La Billardière had met with a party of natives who then accompanied him for some distance.

> 'The attentions lavished on us by these savages astonished us. If our path were interrupted by heaps of dry branches, some of them walked before and removed them on either side: they even broke off such as stretched across our way from the trees that had fallen down. We could not walk on the dry grass without slipping every moment; but these good savages, to prevent our falling, took hold of us by the arm and thus supported us. They continued to bestow on us these marks of kindness: nay, they frequently stationed themselves, one on each side, to support us the better.'

A year or so ago, now nearly 150 years after the above incident, Sir Stanton Hicks was engaged in carrying out at Ernabella some physiological observations on Australian natives living under natural conditions in the Musgrave Ranges in the extreme north-west of South Australia. Professor Goldby was with him and, this being the first experience with unsophisticated natives, Sir Stanton was anxious for him to see if possible a corroboree. At dusk one evening, after the day's work, they walked over to the natives' camp and were met by the old men. One of the leaders, anticipating the request they were about to make, asked them if they would like to see one of these ceremonies. Nodding their appreciation of this offer, fire-sticks were quickly got ready and the party moved off in the direction of the ceremonial ground. As the Europeans stumbled along, trying to avoid boulders and fallen branches and the débris that collects at the foot of these mountains, the younger men, most of whom could not speak English, held their fire-brands so as to light the difficult way as far as possible, turned aside the flexible branches in their path and broke off the dry ones, and even moved stones aside. Then in one place, where the light was particularly dim and a boulder lay in the way, Sir Stanton felt something tugging at his feet and discovered that this was a native lifting his leg off the ground to place it in a crevice of the rock to prevent his slipping!

Human Ecology

Ecology has been defined as 'that branch of biology dealing with living organisms' habits, modes of life and reactions to their surroundings.' We can

go further, however, and say that the ecology, for instance, of the aboriginal inhabitants of Southern Australia and Tasmania, comprises not only all aspects of *their* reaction to their surroundings but also the reactions of their surroundings to *them*.

In studying the ecology of any race of human beings, the following factors will all have to be considered. First, their capacity, mental and physical, to do this and that. Secondly, the nature of the surroundings. In the course of time, a third factor may come in and that is the capacity to meet changes in environment. Man has been singularly successful in his evolutionary ascent for two reasons. First, in his bodily make-up he has never become unduly specialized in any important direction. Secondly, man's brain has so developed that he has in many ways mastered his environment and is now to some extent independent of it.

I do not propose to dwell on the mental and physical capacities of the natives of Tasmania and Australia. The few tools used by the Tasmanians and the primitive nature of these tools indicate that these people were not particularly inventive or ingenious. But then in any European community quite a number of people lack mechanical ingenuity though they may quite readily employ devices invented by others. Moreover such people may possess other mental qualities of a high order. What seems to have been lacking in the Tasmanians who were few in numbers were men of genius outstripping their fellows in inventions which, once discovered, could become common property. One might infer that the Tasmanians did not advance far because the mutations amongst them that produce individuals of superior mental attainments did not unfortunately take the form of mechanical geniuses, at least of mechanical geniuses who could take the occasions presented to them by the hand and lead on to higher things. The Australian, on the other hand, was more inventive with his boomerangs and spear-throwers, and there is no doubt, from his large vocabularies, the construction of his language, his mythology, his explanations of natural phenomena and so on, that he possessed a mental make-up of quite a high order. Obviously intermixture of races should facilitate the variety of advantageous mutations that might be expected, for each race will tend to vary along its own particular lines and with the intermixture all these are pooled. Once a discovery is made, many can use it who could not have invented it. Perhaps one reason why the present day Australian native seems to have been superior to the Tasmanian is, as seems now probable according to Birdsell and Tindale, that he is a mixture of Tasmanian with two or perhaps three other strains as well. The Tasmanians and Australians were clearly physically capable of doing all that Europeans can do, as witness the excellent work done by those who came under white influence. The mental make-up of the Tasmanians probably was deficient in mutations useful to them in their surroundings, but it was in some directions, such as observations in natural history and tracking, of a high order.

Discussion of the second factor, the nature of their surroundings, will occupy most of what I have to say. It may be as well, however, here to dispose of the third factor, the capacity to change with changing environment The appearance of a hostile race is a factor of supreme importance in this connexion. The autochthones may have to fight these, or may amalgamate with them to a greater or less extent, or may get driven into less desirable regions where conditions are more difficult and fresh experience has to be gained. The Tasmanians probably were driven before the invaders, amalgamating with them to some extent, probably through captured women, along the lines of junction. Those that reached Tasmania were relatively secure. Still another aspect has to be considered. The

blood groups found, only A and O, indicate that the Australian native must have occupied this continent for a very long period of time. It is probable that, during this, great changes in the vegetation have occurred and that a richer fauna and flora were present in the interior of Australia in these early days. Man may have had to modify his activities in many ways as the difficulties in securing food increased with increasing aridity. His existence to-day shows that he overcame these difficulties successfully.

The Environment in Which the Native Inhabitants of Australia and Tasmania Found Themselves

The first and most important ecological factors for all races of mankind are necessarily food and water. Under primitive conditions, when much time must be consumed in procuring the necessary food, other aspects of the ecology sink into comparative insignificance. It is only later in man's development that geographical features, apart from food supply, play a prominent part as in trade. It thus comes about that our chief subject under this heading deals with the food available to these people and the means they adopted to secure it when it was difficult to come by.

J. W. Bews (1935) has classified mankind in somewhat ascending order into the Food Gatherers, the Plant Cultivators, and the Herdsmen and Pastoral Nomads before we come to the differential activities of highly civilized man. Both the Tasmanians and the Australians belong to the first and most primitive category, that of the Food Gatherers, without any evidence at all of any tendency to pass into the more evolved types. Is their position on the lowest rungs of the human evolutionary ladder purely the result of their mental capacity not having as yet progressed sufficiently far for them to have reached a higher stage, or is this failure to develop in part at least due to the environment in which they found themselves?

Now the mainland of Australia and Tasmania are singularly devoid of edible plants that might lend themselves to plant cultivation, and of animals that could be domesticated so as to develop a race of Herdsmen and Pastoral Nomads.

Though European settlement has now been in existence in Australia for over 150 years, not a single species of plant, with one or two trifling exceptions, has been taken into cultivation as a food plant. Turning to animal sources of food, there is no mammal that could be a source of milk, and the natural pastures would be a much more suitable field for the multiplication of kangaroos and wallabies than any process of domestication and control could be. In other words, the Tasmanian and Australian natives reached a land that gave them no opportunity whatever to practise the arts of plant cultivation or of animal husbandry, even had they possessed a knowledge of such before their arrival.

We are, therefore, in the position to say that, when man reached Australia in those far-off days, he reached a land highly unsuited for the development *ab initio* of a race of Plant Cultivators or one of Herdsmen and Pastoral Nomads, and equally unsuitable for the continuance of such practices had they been acquired elsewhere, unless he had brought with him the necessary plant seeds or roots and the appropriate domestic animals.

Moreover, when they did arrive in the northern coasts of Australia, as castaways or as coastal voyagers, or by a now submerged land bridge, whatever may have been their former status they became Food Gatherers as soon as the

small supply of food they brought with them became exhausted. On such an inhospitable coast, all their energies would be necessarily directed to an incessant daily search for something to eat. Local supplies being soon exhausted, they had to move further afield and no time could have been spared to stay in one place and await the growth of any seed they had planted.

Thus Food and Water at once became the primary factors in their Ecology. All else sank, temporarily at least, into insignificance. Let us first consider their environment from this point of view.

Foods

Ling Roth (1890) and Brough Smyth (1878) give full accounts of the known and possible foods of the Tasmanian natives, whilst many have written on those of the Australians. Time does not permit me to consider these in any detail. I shall merely give a few examples where the collecting of food has unusual ecological relationships or where its preparation may have values which at first sight might pass unnoticed.

Grains. Of the fifty species of Tasmanian grasses given by Leonard Rodway (1903) not a single one of them would be likely to yield grain that could be collected in any quantity, winnowed and ground for food. The same remarks apply to the temperate southern parts of Australia and probably to its eastern coast. These are not the regions for grain production. If the Tasmanians during their wanderings had become acquainted with the use of these grains—and doubtless they had, in parts of Australia—such knowledge was of no further use to them in Tasmania. On the other hand, grasses, differing almost entirely specifically from those in the southern parts, are abundant in the drier interior and some of these, such as several species of panic-grasses, yield a suitable seed.

The grains from grasses and the minute seeds obtained from such plants as species of *Chenopodium* are collected in various ways. Some, such as the seeds of *Portulaca oleracea*, (the munyeroo), are obtained by pulling up the plants and placing them on a rock surface when the upper part of the capsules come apart, setting free the minute black seeds which then can be swept together and transferred to a coolamon for winnowing. The grass seeds may be gathered by hand, but at Macdonald Downs in Central Australia, we were witnesses of a very interesting method of collecting. The panic-grass had been growing on an extensive flat after the summer rains; the grass had become much dried up and beaten down. The grass seeds, however, had been collected together by small black ants and arranged in heaps round the entrances to their nests. To these the native women immediately made their way and filled their coolamons or dishes in a very short time with a mixture of grain, chaff, sand, dust and débris. A hole about one foot in depth was dug with a digging stick in the ground at the base of a mulga tree. Into this the contents of the coolamon were thrown and the native woman then stepped in and de-husked the grain by twisting and turning with her feet, meanwhile supporting herself in part by holding on to the mulga tree (Plate I, fig. 2). This, of course, added much more dirt to the mixture which was now taken out and rocked in the coolamon up and down and to and fro, handfulls being taken up from time to time and let drop, blowing away some of the chaff and dust. By means of these interesting and complicated movements the grain was rapidly separated from the chaff and sand and foreign particles so that, aided by skilful movements of the hand, a sufficiency of grain was soon collected fit for grinding. The grinding was done between two stones, the upper one held in the hand and the grain being in a groove in the larger lower one. A little water

was added as the grinding proceeded. The paste, when ready, was poured into a space in the hot ashes. Several glowing sticks were now suspended over the upper surface of the damper, these being so laid as to form by their heat a protective film on the surface. As soon as this was sufficiently firm the ashes were heaped over so as to cover the damper completely.

One of the most interesting ecological associations was witnessed by Dr. Hackett and Mr. Tindale south of the Musgrave Ranges. Desert currajong seeds were collected by the natives in numbers around the rock holes in the Ranges. The desert currajong (*Brachychiton Gregorii*) grows well out in the sandy country to the south. Crows feed readily on the softer tissue surrounding the seeds, swallowing the seeds as well. The crows make back to watering places and there discharge the seeds in sufficient abundance for them to be collected by the natives and ground between stones to form a meal. One is reminded strikingly of Elijah being fed by the ravens.

Animal Foods. Time does not permit of considering in any detail the animal foods used or the methods employed in obtaining them, important though they be in their ecological relationships. Mammals and birds and birds' eggs formed a most important part of the food of both races. The natives of the Warburton Ranges in Western Australia, when a large kangaroo has to be carried on the head any distance, make a small incision in the abdomen with a sharp stone, take out some coils of intestine, skewer up the opening with a piece of stick, and then truss up the carcass with its limbs and tail into a compact burden using as thongs the intestines after rolling them in the dust. The hair is singed off and the carcass partly buried in and partly covered by hot ashes. In this way all the natural juices with their containing salts are retained and much relished. Such a carcass is rapidly cut up with a stone implement fastened by a gummy substance to the end of a spear-thrower. Each person has his allotted share, depending on tribal relationships. The bones are smashed open and the marrow and pounded bone eaten, the latter helping to maintain the supply of phosphates and calcium.

The Tasmanians, for some unknown reason, did not eat fish, but used shellfish. The Australians utilized every possible source of animal food. The Tasmanians relished the large white grubs found in dead and dying trees and the eggs of large ants. These large grubs, the larvæ of beetles or moths, known as 'witchitty' grubs or 'bardi' amongst the Australians, were equally relished by the latter. In addition the mainland natives ate lerp scales, coccid secretions from the mulga ('mulga sugar'), large female coccids (*Apiomorpha*?) in apple-sized galls on eucalypts, termites at the time of swarming, the honey of the honey-ant and other insects and insect products.

Honey. Sweet substances must have been lacking in the diet of both the Tasmanians and the Australians. Various plants, such as Hakeas, Banksias and Grevilleas, often yield abundant honey when the racemes of flowers are drawn through the mouth. The blossoms of Eremophilas may be sucked. Fibre from the Liliaceous *Dianella revoluta* may be rolled up in the hand and then drawn up over the honeyed flowers of the Grass-tree (*Xanthorrhoea*), the honey adhering to the fibres. The Australian native bees are stingless and native honeycomb is a great delicacy to the natives of Central Australia. At MacDonald Downs we were shown the method, which proved unusually interesting, of detecting the presence nearby of a native bees' nest. When we had reached a likely locality the natives, instead of looking up in the trees to see the bees possibly entering or departing, got down on their knees and began searching minutely amongst

the sand and particles on the relatively bare earth (Plate I, fig. 1). Soon they were rewarded by finding several very minute, dark particles which had been carried away by the bees from the proximity of their nest and dropped. As it was now certain that there was a bees' nest in the neighbourhood, likely trees were tapped to see if they were hollow and, if necessary, these were climbed, until finally the one harbouring the comb was discovered. After chopping open the hollow a piece of bark was knocked off a neighbouring projection on the tree to form a receptacle into which the honeycomb and entangled bees were placed by the native before he descended. According to tribal custom all those present shared equally in the repast.

The bees that supply honey in any quantity sufficient to be an article of food for man belong to the family Apidae, embracing the Social Bees or Honey Bees. Tillyard (1926) states that all the nine Australian species of this family belong to the genus *Trigona*, very small bees devoid of stings. These bees build in hollows of trees. Rayment adds a single species of the genus Apis (*A. aenigmatica*) found by him in Gippsland, which built three tiny combs the size of the palm of one's hand in the open on a verandah. The honey supplies of the Australian natives were obtained from species of *Trigona*. Round Brisbane, Hockings (1884) gives the native name for *T. Cassiae* Ckll. as 'kootchar' and that for *T. carbonaria* Smith as 'keelar' or 'karbi'. Tillyard says that the commonest species *T. carbonaria* is found 'almost everywhere' (i.e. in Australia), but Rayment says our species of the genus are confined to the warm north, *T. carbonaria* being found as far south as Sydney. Ling Roth (1890) does not mention honey as one of the foods used by the natives of Tasmania, but Brough Smyth (1878) says 'they climbed trees . . . to procure honey, the women carrying with them grass baskets in which they placed their spoil.' The honey-bee, *Apis mellifera* L, was introduced into Australia in 1822 and probably was taken to Tasmania not much later. Brough Smyth's reference therefore possibly may apply to this introduction, though one could hardly imagine an unprotected native attempting to rob the nest of this bee. If a native bee, to what genus does it belong? According to Rayment, it should not be a species of *Trigona*. Is it another species of *Apis*? Are specimens of the bees and their comb available?

The species we met with in Central Australia was almost certainly a *Trigona*. What is the nature of the small particles left by the bees at a distance of many yards from the site of their comb and searched for on the ground by the natives? These are about 1 mm. in size, irregularly spherical with a mulberry-like surface and very dark, almost black, in colour. I have five of these but do not like to sacrifice any for a possible identification by chemical analysis. Their appearance suggests that they may be resinous. Mr. Womersley thinks it likely that they are particles of propolis, the cement-material used by the bees. But this is valuable and is not likely to be carried away to some distance from the nest. The workers of *Trigona* are small bees only 4 to 6 mm. long, so their individual excreta could hardly be in diameter a quarter to a sixth of their length. However, Rayment (1935) says there is always a busy traffic from the nest carrying out round, flat cakes of brown excrement, which is held by the mandibles and tucked in well under the head. Perhaps the material is a mass of excreta cemented together by propolis.

Water. Water for drinking is, obviously, an essential in the ecological surroundings of man. Man, however, differs from other animals in that, through his mental equipment and ingenuity, he can overcome an environment unfavourable to him in this respect and carry water with him in natural or artificial receptacles.

He may also obtain water from unexpected sources or conserve the supply he has already imbibed.

The Tasmanian native can rarely have felt the lack of water for drinking purposes in Tasmania. As his ancestors probably had inhabited the drier parts of Australia, it is of interest to consider the ways devised by the Australian aborigines for supplementing their supplies of water. Neither the Tasmanian nor the Australian possessed receptacles capable of transporting water over long distances. The Tasmanian made use of the bladders of *Fucus*, or utilized shells, bark, and skulls as receptacles for carrying water to the place of eating. The Australian uses wooden pitchis for a similar purpose, frequently sprinkling a few leaves on the top to lessen the liability to spill. Baler shells are used along the northern coasts, In the drier parts of Australia, the question of a water supply may often far outweigh the importance of food, though the two react on each other. The native can only search for food within a reasonable distance of water. Food supplies are soon exhausted in any locality, and the nomad must then make for another place where water is to be found, where the process is repeated. During the course of a year, a regular round of watering places with their supplies of food are visited, all within the tribal area. In times of drought, water may become scarce, and any possible temporary substitute may have to be employed. Spencer and Gillen (1912) describe the frog *Cheiroleptes platycephalus* and three other species, as swelling up with imbibed water after rains. Then when the rains are over, they aestivate in a chamber in the mud. Such buried frogs the natives can locate, and by compressing the urinary bladder can obtain water which is quite fresh and pure. The Needle Bush (*Hakea leucoptera*) is extensively distributed in the north of South Australia. It has long roots running superficially which can be readily exposed and pulled up. If cut across in short lengths and stood upright in a pitchi, water will drip out of the pores in drinkable amounts.

In the drier mallee areas of Southern Australia an abundant supply of excellent water can be obtained from several species of these eucalypts. Travelling north from Ooldea over a stretch of a hundred miles without any surface waters, the natives successfully cross this dry stage by relying on this source. Water in various quantities can be obtained from the superficially radiating roots of a number of eucalypts even in areas such as Encounter Bay in South Australia where the rainfall is over 20 inches. We have seen it obtained in most quantity from *Eucalyptus transcontinentalis*, perhaps only a variety of *Eucalyptus oleosa*. Radiating from the butt for 30 or 40 feet or more are rounded roots up to an inch or more in diameter. These, near the butt at least, have no rootlets and run an almost straight course outwards. They are only an inch or so below the surface of the more or less sandy soil and can be readily pulled up in lengths of many feet. They are relatively brittle and on examination consist almost entirely within the layer of bark of closely set tubes just visible to the naked eye. Broken into lengths and held vertically aloft over the mouth or on end in a receptacle, water drips freely, sometimes almost in a stream, whilst by blowing at the upper end it gushes and bubbles forth from below. Evidently by its distant ramifications and terminal rootlets, moisture in the sandy soil from even the slightest rain and perhaps from dew fallen from surrounding shrubs is retrieved and passed into the tubes in the bigger roots.

Mr. H. A. Dadswell, of the Division of Forests Products, C.S.I.R., Melbourne, has kindly examined for me specimens of water-bearing roots from *Eucalyptus transcontinentalis* and *Hakea leucoptera* from Ooldea and from *E. fasciculosa* from

Encounter Bay. Cross sections of each were prepared for microscopic examination, and, after making measurements over the whole area of the root, the average percentage available pore area per sq. mm. of area was determined. For *E. transcontinentalis*, a small root 5·5 mm. in diameter gave an average of 32·3 per cent (Plate II), a medium-sized root of 22 mm. 31·6 per cent, and a large root of 27 mm. 33·5 per cent. A root of *H. leucoptera* 15 mm. in diameter gave an average of 34·5 per cent, and one of *E. fasciculosa* 13 mm. in diameter 27·2 per cent.

In discussing these results he writes: 'If we take the medium-sized root of *E. transcontinentalis* and assume that a length of 100 cm. was available, then the available free vessel space (neglecting the small central area) would be able to hold approximately 120 c.c. of liquid'. Thus a root a little less than an inch in diameter and a little more than a yard long could hold about 4 ozs. of liquid. Again a root 30 feet long and an inch in diameter could hold about 94 cubic inches of water. Thus about 3 of these roots could supply a gallon of water if all the fluid could be expelled. This however would not be the case on account of capillary attraction.

Magarey (1895) has given a full account of the sources of water available to the Australian native and of the indications of the likelihood of the presence of surface waters. The sources include rock-holes, soaks, natural hollows in trees, succulent plants and dew collected sometimes by a sponge-like handful of fibre. Open rock holes may be protected from evaporation or contamination by coverings. Certain birds are a sure indication of the proximity of water as are the natives themselves, though in this case the supply may not necessarily be an open one.

Adornment of the Person

Adornment of the person is an essentially human trait. It may take the shape of mutilations, dressing of the hair, clothing apart from, or in addition to, its protective qualities, the use of necklaces, rings and flowers, and the employment of pigments, including tattooing and fats. As examples of mutilations may be mentioned cheloid scars, amputating a digit and cutting the hair or shaving it off or epilating it. The knocking out of one or more teeth probably had, like circumcision and subincision, a deeper significance, though this may have been lost in some cases as in the Musgrave Ranges in South Australia.

I am not aware of any records of other mammals or birds adorning themselves under natural conditions. However, Professor Agar has kindly given me a reference to a most interesting account given by Köhler (1925). He describes how his chimpanzees were fond of hanging ropes, twigs, rags, &c., over their necks, shoulders or ears. He says 'No observer can escape the impression that . . . the objects hanging about the body serve the function of *adornment* in the widest sense. The trotting-about of the apes with objects hanging round them . . . seems to give them a naïve pleasure. Naturally we can scarcely assume that apes have a visual image of what they look like when dressed up like this, and I have never observed their frequent use of reflecting surfaces as in any way connected with their adornment; but it is very likely that primitive adornment like this takes no account of external effect—I do not give the chimpanzees credit for that—but is based entirely on the extraordinary *heightened bodily consciousness of the animal*'.

The natives of Tasmania and of Australia took pains to produce cheloid scars by making incisions which were kept open until granulation tissue had been produced from which the dense scar tissue was derived. The hair of the

Australian sometimes appears as ringlets plastered with grease and mud or may be arranged in a chignon or bun around an artificial core (Plate I, fig. 4). The Tasmanians, according to J. B. Walker (1914, p. 238), wore necklaces of shells strung on twisted kangaroo sinews dyed with red ochre; by treating the shells by burning grass over wood embers, thus producing pyroligneous acid (acetic acid), their outer coverings were removed exposing a surface that yielded prismatic colours. The Australian native uses hair-string, made from human, wallaby, wombat and other sources for various purposes and often as a band around the forehead under which the flowers of Cassias and other plants may be tucked. Girls and young women may insert the tips of slender locks of hair into the capsules or buds of Eucalypts giving quite a picturesque appearance as they dangle (Plate I, fig. 3).

Péron (1809, p. 196) gives a graphic account of his meeting with a group of Tasmanian women. These 'with the exception of some few who had the skin of a kangaroo over their shoulders, were all entirely naked . . . Their black skin disgustingly greased with the fat of the sea-wolf, their short woolly hair, which was black and dirty, and which some of them had powdered with red ochre; their figure besmeared with the dust of charcoal; their shape generally lean and shrivelled . . . in a word, all the particulars of their natural constitution were in the highest degree disgusting'.

Red ochre, yellow ochre and white earthy pigments are extensively employed amongst the Australian natives, either in the shape of definite designs or sometimes applied indiscriminately. Charcoal also may be used, as it was by the Tasmanians. In the central parts of Australia there is to be found a stalked puff-ball, *Podaxon pistillaris*, the stalk of which is surmounted by a fusiform fruiting body. The exoperidium can readily be removed from this like a glove from the finger, leaving behind a dark purplish-fuscous mass of spores. Holding the base of the stalk in his hand the native may apply this purplish mass liberally to the cheeks and nose much as face powder is employed by Europeans; in both cases a 'flesh-coloured' tint is applied.

The down of birds lends itself to decorative purposes, especially that of the eagle. It is extensively used for ceremonial purposes being stuck on to the body by means of the sticky serum that exudes from the clotting of human blood. To obtain this blood, the men readily open the veins of the arm by means of a short longitudinal incision with a shap pointed piece of stone, often prepared on the spot. Recently at Ooldea some of the younger men were wearing long feathers, such as those of the bustard or native turkey, tucked into the hair arranged as a chignon. These plumes waving about had quite a picturesque effect. Other instances of adornment consist of placing sticks through a perforation in the septum of the nose (Plate I, fig. 4), and often flowers may be inserted in this way.

Adhesive Substances

Adhesive substances are of very obvious importance to primitive peoples. Their non-use may mean either that their practical applications have not been realized or that the requisite materials are not available. The sticky serum from clotted blood is mentioned elsewhere as being used for applying eagle down to the surface of the body or to materials used for ceremonial purposes. The adhesive substances, however, which chiefly concern us are those employed in making or hafting weapons and tools. In the central parts of Australia various gummy and resinous substances are in general employment for fixing stone flakes at, for instance, one end of a spear-thrower to form a small adze, or for the

purpose of helping to fix an axe head on a cleft stick, or to support wallaby tendons in attaching the spear point to the end of a long light shaft, and for other similar purposes. One of the best and most abundant sources of this kind of substance is a species of porcupine grass (*Triodia*), the plant referred to by explorers usually as 'spinifex'. Most of the Triodias have a resinous material between and around the bases of the leaves. This is, in some species, so sticky that occasionally birds may lose feathers from coming in contact with it. It also gives rise to a fierce flame when the porcupine grass is burnt. Considerable quantities can be collected by the natives and made into flat cakes of a dark colour. These can be readily melted and soon set firmly again.

On the Diamantina we were surprised to find that mindry gum was obtained from the roots of *Leschenaultia divaricata*, one of the Goodeniaceae. Gum from *Myoporum platycarpum* (False Sandalwood) and from grass-trees (*Xanthorrhoea*) are also employed in more southern parts, but these materials seem more brittle and less useful. There seems no evidence of the employment of such adhesive substances by the Tasmanian natives. This is probably due to the absence of suitable material. Though grass-tree gum is used on the mainland, it does not seem very successful, and its use there may have been merely an attempt at copying the more successful gum substances of the interior. I cannot recall any other vegetable product in Tasmania that would be likely to lend itself for this purpose.

The Native's Control of His Environment

A little consideration will show that the natives of Tasmania and Australia exercised but little influence over their environment, whilst more advanced races controlled their surroundings by clearing forest lands and planting crops, by growing fruit-trees and vegetables and domesticating useful animals. In great part our natives, through no fault of their own, did none of these. Though the control of their food supply by cultivation was negligible and the breeding of useful animals non-existent, they were nevertheless under the firm conviction that by increase ceremonies and tabus they were actually in control of these supplies and able to affect their abundance.

Control of Temperature

The most interesting aspect of his control of his environment is, however, seen in the ways he overcame the effects of low temperatures and secured for himself a sufficiency of warmth in cold weather. We therefore have to consider his control of the temperature to serve his ends or even to make continued existence possible.

Climate is naturally one of the most important ecological agents affecting man, as also other animals and plants. When in the course of evolution, various vertebrates emerged from the waters in which their ancestors had developed, they overcame the difficulty in change of environment by devices which really meant that they carried their essential original surroundings with them. With the coming of warm-blooded creatures, mammals and birds, a suitable temperature was maintained throughout with consequent better control over the environment. Feathers or a hairy covering conserved heat during cold periods. Man's natural covering of hair is so poor, however, that it can serve him but little as a protection against cold. The utilisation of the skins of animals for purposes of warmth was a discovery of much moment to him. Nevertheless as a nomad such an added burden of weight might at times be a handicap. The making of breakwinds and shelters doubtless preceded the making of garments. Finally came the discovery of fire

as a means of warmth and later for cooking. Shelters, clothing and fire enabled primitive man to extend his range to colder regions—by means of these devices the environment was controlled so as not to be injurious to him. How did the Tasmanian and Australian natives fare in this regard? No clothing of any kind is worn by the natives—men, women and children—in Central Australia. In the more southern parts and in Tasmania, the skins of animals were sometimes used, but the amount of warmth thus obtained cannot have been great, and in the case of the Tasmanian women it is considered that the skins were chiefly used to support the infants. Fire has been the chief means for mitigating the effects of cold. The native of Australia invariably carries a firestick with him, which in cold weather gives a little warmth, waved in front of his body and with which he may frequently set fire to tussocks of porcupine grass and bushes and warm himself at the blaze. At night he sleeps behind a breakwind with a little fire on each side of him and often another at his feet. Sir Stanton Hicks and W. J. O'Connor (1938) have carried out a number of investigations on the heat regulation of the Australian natives under cold conditions. They find that, as a result of the use of these small fires, to which the native is able to lie very close, areas of high skin temperatures are to be found on the body of the sleeping native. They believe that in this way a considerable amount of radiant heat is absorbed, which counter-balances to some extent the loss from those parts intensely cold. Moreover the aboriginal has an extremely active control over the blood circulation in his skin so that heat loss from a cold part is minimized by a diminution of circulation through that part. In contrast with the clothed European, whose metabolism is increased when he is cold, so that more fuel is used to warm him, the native does not show any such increase. Where food supplies may be precarious, this conservation is an interesting finding, there being no needless waste of food income merely for the purposes of warmth. Thus the chief means adopted for maintaining the body warmth during cold weather and especially at night consist of breakwinds, small fires yielding considerable radiant energy, and such a local control over the blood circulating in the skin that those parts exposed to the cold lose as little heat as possible through a diminished circulation through them.

The Effects of His External Environment on Man

Teeth

Absence of Caries. The infrequency of caries of the teeth in Tasmanian (Wunderly, 1939, p. 331) and Australian (Campbell, 1939) natives is well known and at once obvious on examining any collection of skulls. Campbell has fully dealt with the Australian aspect. Decalcification of the enamel apparently can only be achieved by the action of acid. A sticky, fermentable carbohydrate glued on to the teeth may there undergo an acid fermentation and the concentration of acid may be sufficiently great to lead to decalcification; in this way decay originates. Living under natural Australian and Tasmanian conditions glutinous food-stuffs are negligible in amount, and even where grains are ground the resulting flour is so coarse that the food does not tend to become adherent around the teeth. The fibrous, stringy and tough nature of much of the food also exercises a detergent effect, reducing again the risk of caries.

Attrition, or grinding down of the teeth, is a striking feature in Australian and Tasmanian skulls. Sometimes by middle life the teeth are so ground down as to be on the level with the gums, the pulp chamber having been obliterated by the formation of secondary dentine as the attrition proceeded. This grinding

away of the teeth is attributable to the incorporation of much sand and grit in food-stuffs consumed in the open and to the separation of small stone particles in grinding grain in the hand mills. In addition much masticatory effort is required in dealing with foods which are often tough and fibrous. F. St. J. Steadman (1937), in a recent examination of 52 Tasmanian skulls in collections in England, states that a very striking feature was the marked and almost universal attrition. Dr. W. Crowther has kindly supplied me with notes on the degree of attrition in Tasmanian skulls in his own possession and in the Tasmanian Museum. He finds that this condition is frequent, though the degree, perhaps, is not so great as in some Australian skulls.

Intoxicating Beverages and Narcotics

These might be considered under the caption of food, but they seem more appropriate when considering the effects of his external environment on man. The Tasmanian natives obtained a fermented drink from the saccharine sap which exudes at certain seasons from the Ribbony or Cider gum. Holes were ground into the trunk, and the juice that flowed from the apertures was collected in a hole at the foot of the tree and allowed to ferment.

On the mainland of Australia, two Solanaceous genera of plants, *Nicotiana* and *Duboisia*, include species with narcotic properties, used by the natives. Neither genus occurs in Tasmania, and in fact there are there only two species altogether of this family, namely *Solanum aviculare* and *Solanum nigrum*. The Tasmanian aborigines had therefore no chance of using narcotics, though this Society has an interesting association with the famous pituri or pitcherry of Australia. Morris (1898) gives the earliest reference to the employment of the word pitcherry as being in the Proceedings of this Society for April, 1863, p. 1, when W. Johnston presented nardoo 'seed' and pitcherry. The wording is '"Pitchery", a narcotic plant brought by King, the explorer, from the interior of Australia, where it is used by the natives to produce intoxication . . . In appearance it resembled the stem and leaves of a small plant partly rubbed into a coarse powder . . . On one occasion, Mr. King swallowed a small pinch of the powder, and described its effects as being almost identical with those produced by a large quantity of spirits.'

Morris was, however, not correct in his statement that the first printed use of the word 'pitcherry' was in these Proceedings as Wills in his diary, dated May 7, 1861, referred to 'bedgery or pedgery' (other spellings for pitcherry) and this diary was published in 1861 and again in 1862 and 1863. Pituri (this seems to be the most appropriate spelling) consists of the twigs and dried leaves of *Duboisia Hopwoodii* gathered somewhere in the neighbourhood of the upper parts of the Mulligan River near the South-west corner of Queensland. It was traded extensively to the natives along the Diamantina and thence even down to the Flinders Ranges and eastwards along the Cooper (Johnston and Cleland, 1933-34). Coming from afar by barter to these southern tribes, it had a glamour about it which helped doubtless to mask its origin. Bushes of *Duboisia* grow at Bellamy's Well, about 70 miles west of Lake Torrens, and yet this nearer source for the leaves and twigs was not realised by the natives of the district or those of the Flinders Ranges. Moreover the plant grows abundantly in the sandhill country of Central Australia, where it is used for stupefying emus by placing small quantities in the rockholes where they come to drink. In these parts it is not used at all by man or at most only occasionally when another narcotic supply, the leaves of several species of true tobacco (*Nicotiana* spp.), are running short or

not available. This latter source is of unusual interest. With the possible exception of New Guinea, America and Australia are the only parts of the world where species of *Nicotiana* are indigenous. In both regions, the native inhabitants have discovered their narcotic effects and prize them highly in consequence. Fifteen species have already been described from Australia (Wheeler, 1935). Of these we have personally observed the use of four (*Nicotiana excelsior, N. Gossei, N. ingulba,* and *N. Benthamiana*), whilst other species, often similar in general appearance, are discarded. Their employment for chewing extends at least from the Musgrave Ranges (south of 26° Lat.) in the N.W. of South Australia to the whole extent of the MacDonnell Ranges and as far north as the Granites in the extreme west of the Northern Territory near the parallel of 20·6° Lat. The leaves, fresh or dried, are chewed into a bolus which is parked when not in use behind the ear where it is readily available for personal use or that of a friend. From time to time it is rubbed in the fine wood ashes obtained by burning small twigs of several species of Acacia, especially *A. ligulata,* the alkaline ash accentuating the liberation of the alkaloid nicotine. Chewing is the only method the natives employ in using it though European tobacco may be smoked in a pipe or cigarette or chewed. The pre-European American Indians apparently smoked their tobacco in pipes or as cigars, inhaled it as snuff and chewed it as well. There can be no doubt that the use of indigenous species of *Nicotiana* by the Australian natives antedated any European influence.

Changes Wrought in the Environment Through the Agency of Man

Destructive Wood-Infesting Grubs Eaten by Natives

Civilized man has made remarkable and, in some cases, lamentable, changes in his environment. What changes in their environment can we attribute to the natives of Tasmania and Australia?

For the purposes of this discussion we can consider them together, and our analysis will show that these food-gatherers exercised extraordinarily little permanent effect on their surroundings. There was no tilling of the soil and consequently no clearing of the original vegetation of the land. With the exception of the dingo kept by the Australian native, there were no domesticated animals at all, and so no flocks and herds to play their part in altering the country-side. The nomadic character of the Australian aborigine did not lend itself to the serious depletion of the vegetable and animal foods on which these people depended, so that a balanced position was attained. We have no reason to think that any species of animal or plant disappeared as a result of its use as food by the natives.

They did, however, exercise some control by extracting the large white witchetty or bardi grubs of certain beetles and moths found in the stems and roots of a number of native trees and shrubs. Since the introduction of the rabbit the Australian native has been playing quite an important role in its control.

Effects of Fire

Both the Tasmanian and the Australian natives were able to make fire and habitually used it. The Australian and Tasmanian vegetation is remarkably resistant to exposure to fire. Many shrubs and trees sprout again, and the effect of these fires is to produce a very considerable seed-bed. Is there any evidence that this recovery from fire is a result of the evolution of fire-

resistant types of plants? Information supplied to me by the Conservator of Forests in South Australia, Mr. G. J. Rodger, shows that forest fires from lightning may occur not infrequently. Before the coming of man, however, such fires, occurring only after long intervals, probably exercised little influence on the vegetation. When man came, however, accompanied in his wanderings by fire, which he either carried with him or made by the 'sawing method' or the 'twirling method' as occasion demanded, accidental fires were probably frequent, though a recent writer in 'Nature' doubts whether this was the case. It is quite possible that the frequent occurrence of fires has led to the disappearance of some species of plants, perhaps numerically few, which were unusually susceptible to it. We have, of course, no means of ascertaining how many kinds of plants have disappeared in this way. Any alteration in the appearance of the vegetation from this cause is as nothing compared with the effects of clearing the land and grazing produced by Europeans. In Tasmania, however, James B. Walker (1914) describes open plains formerly known as favourite resorts of the blacks which subsequently became overgrown with forest during the discontinuance of their annual burnings. Dr. D. A. Herbert (1938) suggests that certain grassy areas interspersed with rain forest in the Bunya Mountains in Queensland were the result of fires produced by the blacks. Taking them altogether it will be seen that the changes wrought in the environment through the agency of primitive man in Australia and Tasmania are almost negligible

The Effects of the Environment Man Brought With Him to Australia

Parasites and Disease

In considering the ecology of man, one must not overlook that intimate environment that he himself carries with him, an environment in which parasitic and saprophytic organisms may flourish and the former be responsible for disease. The parasitic organisms themselves may possess a relatively simple life-history associated almost entirely with man, as in the case of head-lice and such viruses as those of poliomyelitis and epidemic influenza; or the life cycle may be a complicated one, involving intermediate hosts, which in their turn may be dependent on specialized conditions as in malaria and yellow fever, sleeping sickness and hydatid disease. It is unnecessary to dwell on the toll on human life that some of these diseases may take. What part have such organisms played in the lives of the Australian and Tasmanian natives in the pre-European era?

Early vocabularies, both Australian (Brough Smyth, 1878) and Tasmanian (Ling Roth, 1890), give native words for the louse, presumably the head louse of man. These early references indicate that these creatures accompanied both races when they reached Australia. We can say definitely that the Australian native was not the host for any helminth (worm) parasites before contact with Europeans. Both the Australian and Tasmanian natives readily acquired European infective diseases when exposed to them, and many died in consequence. The scattered nature of the population and the infrequent intercourse between tribes led, however, to the almost complete absence of epidemic and infectious diseases amongst the original inhabitants; whatever they may have brought with them, with one or two possible exceptions, died out in consequence of these difficulties.

It is doubtful whether they suffered from infectious colds, and they certainly did not suffer from tuberculosis, measles and other similar diseases before the coming of the white man.

Nevertheless they did suffer from two important diseases. In 1789, a little more than a year after the First Fleet reached Port Jackson, natives were found dying in considerable numbers in rock shelters and other situations round the Harbour from an eruptive disease which was considered to be smallpox. Brough Smyth (1878), in a statement to which, perhaps, little credence can be attached, says that it is conjectured that prior to the colonization of Tasmania a large number of persons had been carried off by smallpox. Smallpox amongst the Australian natives swept across Australia in three waves of which there are records (Cleland, 1928). Apparently it had been introduced on each occasion along the northern coastline, probably by Malay trepang fishers.

The other disease is yaws, which Dr. C. Hackett (1938) has shown to be widely spread in Central and Northern Australia and probably occurred throughout it. It is possible, though not probable, that certain references to skin conditions in the Tasmanians may have been to yaws. The infection of yaws is spread by accidental contact, direct or indirect, from open sores in which the spirochaetes may be abundant. The native is unclothed, so that all sores are exposed freely to the air, and anyone who has paid a visit to the warmer parts of Australia in summertime knows how abundant flies are and how they cluster round the eyes and mouth and especially round any sore with a moist surface. Quite obviously flies are a ready means of transmitting the infection from one case to another, and flies consequently have played quite an important role in the ecology of the Australian native, and possibly also in the Tasmanian.

Captain Dampier (1697, p. 282), writing of the natives of the North-west of Australia, described them as being the 'miserablest people in the world. The Hodmadods of Monomatapa, though a nasty people, yet for wealth are gentlemen to these.' In describing their appearance he goes on to say that 'their eyelids are always half-closed, to keep the flies out of their eyes, they being so troublesome here that no fanning will keep them from coming to one's face; and without the assistance of both hands to keep them off, they will creep into one's nostrils, and mouth too, if the lips are not shut very close. So that from their infancy, being thus annoyed with these insects, they do never open their eyes as other people, and therefore they cannot see far, unless they hold up their heads, as if they were looking at somewhat over them.'

This graphic description by Dampier is as true to-day in Central Australia as it was in his day. The fly concerned is a native fly, *Musca vetustissima*. We all know how persistent it is when we go for a walk through the bush in summertime, the flies being so troublesome that no fanning will keep them from coming to one's face. They take every opportunity of abstracting moisture and nutriment from the tears in the corners of the eyes and the saliva round the mouth, and the blood from any recent scratch. One can readily see, therefore, that the infection of 'erkintja' the native name for yaws can be spread by these persistent creatures from an infected sore in one child to a scratch on another.

This species of fly is indigenous to Australia, and strange to say has not yet acquired the habit of entering into our houses, although they may enter more or less open tents. The flies that occur indoors are introduced species, more particularly *Musca domestica*. As a result of these differences in habits, the bush fly plays little part in the spread of typhoid fever in Australian communities, whereas the domestic fly is undoubtedly frequently responsible.

Summary and Conclusion

In this brief survey some aspects only of the ecology of primitive man in Tasmania and Australia have been considered. No reference has been made to his implements, handicrafts and art, or to the sources and nature of the materials used for these purposes; none to the Australian native's interpretation of natural objects as representing the doings of ancestral beings; none to the skill in tracking and hunting game or to the habits as they affect the hunter of the animals so hunted; none to many other sides of the complicated relationships that exist between man and his natural surroundings. I have merely taken some aspects that have appealed to me particularly as a naturalist and many of which I think would have appealed to Clive Lord also. I have tried to show that the country to which these peoples came was neither literally nor metaphorically flowing with milk and honey. Nevertheless they overcame with remarkable success the difficulties that presented themselves and obtained food and water often from unusual sources and in unexpected ways. I have shown that through the absence of suitable plants to cultivate and animals to domesticate they could not control their environment by growing food-stuffs or keeping flocks and herds and so remained or became food-gatherers only. Though often destitute of coverings and so going naked by day and night, their skilful use of little fires and physiological changes that sophisticated man has lost have enabled them to control the deleterious factor of cold. One important effect of the environment has been the grinding down of the teeth through the frequent incorporation of sand and grit in the diet and the fibrous nature of much of the food; the use of native tobacco and pituri as narcotics has also been mentioned. Fire has been the only means by which they have altered thir environment and that probably only to a trifling extent. Epidemic diseases for reasons stated were almost non-existent.

In conclusion, may I say that the Australian native is a very likeable being, as doubtless was the Tasmanian. The latter has passed away as a pure race and the former, I regret to say, seems to be passing away too. Civilization seems to have been fatal to each; with detribalization, the interest in life ceases. Removed from their own country with its ancestral associations they languish and die. Grave wrongs have been done to many. But even kindness and fostering care and patient endeavour have proved unable to stem the tide of decay. Through all the ages have descended the bloods of these two ancient races of man, of man who is the acme of evolution. In the clash of worldly interests, I see little hope for the continued existence of the pure-blood Australian native beyond a few scores of years. But of both races there are descendants of mixed blood. The aboriginal element in them, I am convinced, is by no means an undesirable one. The same may be said of the European side, when it came from sturdy pioneering stock. The task before us now, in Tasmania and in Australia, is not to keep these folk segregated, but to fit them for taking their place in our social organization. There can be no other solution. Gradually absorption will occur, and thus the blood of the ancient Tasmanian and Australian races will, I trust, live on in the veins of some at least of our successors in this Island and in this Commonwealth, and not to their disadvantage

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PLATE I

FIG. 1.—Looking for a bees' nest. Men and boys searching the ground for small dark particles 1 mm. diameter, carried away from the nest by the bees. If found, they indicate that a bees' nest is near. Macdonald Downs, Central Australia. (Photo by Professor T. Harvey Johnston.)

FIG. 2.—Woman dehusking grain by movements of the feet in a hole in the ground. She is partly supporting herself against a mulga stem. Macdonald Downs, Central Australia. (Photo by Professor Wilkinson.)

FIG. 3.—Adornment of the Person. Young woman with the tips of strands of hair forced into the orifices of 'gum nuts' (Eucalyptus capsules). Warburton Ranges, W. Australia. (Photo by O. Stocker.)

FIG. 4.—Adornment of the Person. Young man with hair arranged in a chignon and cheloid body scars. Another with a bone placed through a hole in the nasal septum. Mt. Liebig, Central Australia. (Photo by Professor T. Harvey Johnston.)