JUST IN TIME.

A physiologist among the nomad tribes of Central Australia

1929-39.

Dedicated to the men of the Pidjintara, Ilpirra, Ngalia, Anmatjira, Pintobe and Witjakopanja tribes of the Luritja family, in admiration.

" Adventure is never anywhere unless we make it. Chance releases it; some unexpected incidents of little things, the trouble is to know it in time when we see it. If we are not ready for it then it is not there. "

H.M. Tomlinson.
'On the Chesil Bank' in 'Gifts of Fortune.'

Acknowledgments:

Angus and Robertson, Sydney, N.S.W. for the quotation from 'The Red Centre' by H.H. Finlayson.

W.H. Freeman and Co. San Francisco, U.S.A. for permission to quote from 'The Nightshades', by Charles R. Heiser Jnr.

William Heinemann, London, for the quotation from 'Gifts of Fortune' by H.M. Tomlinson.

Preface.

This is a factual account, in simple language, of physiological experiments conducted on nomad aborigines whose tribes were still living in their natural state North West, West and South West of Central Australia, between the years 1929-39.

Nothing of a similar nature had ever previously been attempted, and the outstanding success of these researches was due to the unique character and co-operation of this remarkable stone-age people.

The results, which established several hitherto unexpected facts, were published in scientific journals in Australia, Europe and U.S.A., and attracted world-wide interest. This led to their incorporation in reference works on physiology.

At the request of many friends, these expeditions are here recalled and described in conversational form. The personal style of narrative has been adopted, not for the purpose of autobiography, but in order to create a perspective reality of a period, which, as I see it, is almost as unreal as the nomad occupation of those tribal regions.

To me, an octogenarian survivor, that period is literally pre-revolutionary. I have endeavoured to recreate its quality as a social background to my close personal relations with the men of the Luritja tribes. This association was of the nature of physician and patient - quite unlike that of any investigating anthropologist. It seems to me as though the repercussions of the holocaust of Western Civilization reached these tribal regions and converted them into a missile range, and dispossessed the nomads.

It does therefore, seem desirable to place on record this account of such fundamental Australian research. It is particularly the case when it is considered that interest was sufficiently aroused among scientists in other

countries for me to be invited to lecture in Austria, Switzerland, Germany, Sweden and U.S.A.

Moreover the attempt is the more justified, by the dramatic post-war confirmation of the physiological findings of the 30s, as well as of the nature of Emu Poison. The latter terminates a century old search for the chemical and botanical nature of the aboriginal chewing narcotic. This latter introduces Robert Brown, discoverer and classifier of Duboisia Myoporoides, an unexpected member of the Solanum family, an extended reference to which is included because of the great importance of the species to medicine and to human nutrition.

Rather than burden the text, I have appended selected explanatory references. The title of the book applies as much to me as to my Luritja friends.

"Woodley"

Glen Osmond,

South Australia.

4th August 1974.

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Chapter 1.

Prelude to an Odyssey.

"With your Imperialist outlook, the enclosed advertisement from the Lancet should be of interest to you." So ran the letter from a medical friend attending a Congress in Liverpool.

The University of Adelaide was offering a Medical Research Fellowship with teaching duties attached. Old age has its advantages, one can tell the truth without embarrassment! I actually turned down a Fellowship of St. John's College Cambridge, and a University Lectureship in Pathological Chemistry to follow that Imperialist star! How very odd it all seems today. Its like discovering at the Post Mortem how very wrong one's diagnosis had been.

There are as always in human affairs, mixed motives - very. There was the Cambridge climate, concerning which it was said, that people attained a great age living in indifferent health! There was the lure of action in an entirely new situation, and yes, there was also that Empire business.

On that score, Howard Florey wasted no sentiment as he endeavoured to dissuade me. "You are going out to an intellectual desert," he said.

"Perhaps that is a good reason for going. You were a Rhode Scholar, and the Founder had that idea in mind. I am under no obligations except to my companions lost in the War."

But, what of it now? Ashes in the mouth. Even my Tutor's comments belong to that world now gone. Over coffee, prior to my 'going down' he said, his finger tips together,

"So you are going out to teach the descendants of convicts?"

To which I replied, "Percentage-wise Sir, there must be many such in these Islands. But," I continued, "I have one regret, - I haven't visited Scotland."

He looked mildly astonished, and replied "Why Scotland, when there is

Greece?"

Dr. Samuel Johnson's opinions of the Scots were, like Transportation, still a live topic in certain insulated alcoves. Sam, in his great dictionary, had defined 'oats' as 'food for men in Scotland, horses in England'. The Scots' riposte juste was 'England is noted for the excellence of her horses, Scotland for the excellence of her men'.

The prejudice against Australia reached a serious stage as R.M.S. Mooltan on her maiden voyage, was two days out from Fremantle. After much high official toing and froing, I had finally been granted permission to bring with me to Australia six female and two male black and white Norwegian rats of 9 year old pedigree, to establish a standard experimental colony in my new department in Adelaide. Every day the Chief Officer and Chief Steward and I inspected and counted those rodents, housed in the chain locker in the bows. On that fateful day, fortyeight hours steaming from Fremantle, the Captain sent for me.

"Now Doctor, about those Goddam rats of yours. I want you to radio the Customs in Fremantle to get their radiogram authority to bring that cargo of yours into Australia."

"Sir," I explained, " You already have all that authority from Australia House."

"Australia House be buggered. You dont know the political trickery of that bloody country. Some jumped up descendant of a convict can easily hold up this ship in Fremantle. I'm carrying His Majesty's Mail, and I depart on schedule. Get that radio confirmation, or I'll toss the whole bloody lot of vermin over the side!"

So, following that preliminary fanfare, the rats and I came to Adelaide at the end of April 1926.

The University at that date had ten professors, and was a privately endowed institution. As Sir Charles Martin of the Lister Institute had told me, it was very like an Oxford or Cambridge College in its atmosphere, and its status in the community. Of course, it was small, but that was in its favour. Where the Refectory now stands was a vast corrugated iron shed, where the Police held dramatic daily pistol practice! The Library and other buildings now stand on the spot where Wirth's Circus, rodeos and football matches once attracted the vulgus profanum. Each year the Council, headed by the commanding figure of Sir George Murray, made its Visitation of the Departments, and talked with the Professors and even the members of staff! Believe it or not, I met a kangaroo in my foothills driveway, but alas for romance, it turned out to be a tame one.

Alas also, because the isolation soon seemed to prove that Florey, Dunhill, Von Fürth and others were only too accurate in their forecasts. Sir Thomas Dunhill, the surgeon, himself an Australian, did his very best to dissuade me from leaving Cambridge. My friend Professor von Fürth in Vienna was frankly incredulous that anyone should sacrifice a post in famous Cambridge in order to go to the remote Antipodes.

Turning to Professor Kolmer he said "Hicks says that in three years time he will revisit us from thirteen thousand miles away! Well, if we dont meet in Vienna, perhaps we shall meet in Heaven!"

A return to Cambridge and Vienna three years later restored my original faith. Doctor Murray, the bacteriologist, - one of the most persistent opponents of my Australian move had now quite reversed his view.

"You were right you know Murray," I said, "I miss ski-ing in Switzerland, and the London Scientific meetings and their stimulous."

He peered at me through half closed eyes and rasped "Ski-ing on the Continent? Eh? When do I get my vacation? In November. Where do I go in November? Lyme Regis. And why do I go to Lyme Regis? Because I know a landlady who'll take the bloody kids. And when I go for a walk in Lyme Regis in November I have to wear a bloody overcoat! " The moment of truth for the no longer unattached bachelor.

And in Vienna? Von Fürth, entering his room from the balcony where, in his white coat,he had been standing looking at the Votiv Kirche, cried,

"Herr Kollege Hicks! Es ist in Wien, es ist nicht in Himmel! " Already there was rising anti-Semitism, and the marching of Party organisations, soon to be wearing arm bands and even uniforms. The situation in European universities was already gravely unsettled.

Even Murray later became a professor in Montreal, where, when I was a visiting lecturer at McGill, I met him dressed in furs like a Russian moujik.

Chapter 2.

Naked, but Warm.

'NAKED - BUT WARM - ADAPTATION STUDIES ON STONE-AGE AUSTRALIAN ABORIGINES' Thus declaimed the posters announcing my lecture at the University of Chicago in 1949. It was an appropriate title, the temperature being 40 degrees below freezing point, and piles of dirty snow and ice everywhere.

Professor Ralph Gerard, the well-known American Physiologist, had invited me to lecture, and there I was, talking about sunny Central Australia and my scientific colleagues, the aborigines.

It was quite an experience to discover how little my audience knew about Australia, and how much less they knew about the aborigines. Gerard had visited this country on a lecture tour, but, unlike the countless G.I.s who had sojourned here, the audience consisted chiefly of post-war students and academics. This was 23 years and a World War since Prof. F. Wood Jones F.R.S. welcomed me at the University of Adelaide, and simultaneously started me on a venture that led to that lecture in Chicago.

After his welcome, Wood Jones went on to say "Here is a letter from Francis G. Benedict, Director of the Carnegie Nutrition Institute in Boston. This is your cup of tea. You answer the letter, and explain that I am a comparative anatomist, not, thank God, an experimental scientist! "

This distinguished anatomist, human and comparative, was then 47 years of age, black haired, keen eyed, with a handsome face and a perceptive, philosophical mind. His career reflected his mind. Lecturing on anatomy at St. Thomas' Hospital, University of London, he moved to a similar position in Manchester, and thence to the Far East as a wandering medical officer. Then, as anthropologist to the Egyptian government, he

made an anthropological survey of Nubia. After serving as a Medical Officer in World War I he returned as Professor of Anatomy to Manchester, leaving there to come to Adelaide, where he stayed, (so he told us, - at his farewell dinner at the Adelaide Club) "longer than anywhere else".

To our host Sir George Murray's merriment, in a reply to a toast Wood Jones said that, in all his years in Adelaide, he had been consulted only once by a member of the medical fraternity, and that was by a leading wealthy physician, who wanted him to emasculate his pet cat!

Whilst in Adelaide, he published a book on South Australian Mammals, and greatly encouraged a remarkably intrepid mammalologist and explorer, H.H. Finlayson, of the University staff. Technical staff and even Lecturers in those austere days, received little encouragement, and because Finlayson was a technician in the Chemistry Department, his lone excursions into the interior received scant interest, except from Wood Jones, who encouraged Finlayson to write his well-known book 'The Red Centre'. This little book, with the foreword by Wood Jones, will remain a classic long after many of Finlayson's contemporaries have been forgotten.

Wood Jones also obtained from the Rockefeller Foundation an offer to support a Chair of Anthropology for five years on condition that thereafter, the University would take over the responsibility. This offer was not supported by the Vice-Chancellor, Prof. Mitchell, and as a consequence, so Wood Jones told me, he resigned.

Perhaps in the prevailing climate of opinion concerning the aborigines, Mitchell could not immagine any public support for such a Chair forthcoming. I have already stated that all Professorial Chairs were at that time privately endowed.

Wood Jones' subsequent wanderings took him to Melbourne, Hawaii (as

Rockefeller Professor of Physical Anthropology), Director of Anatomy School, Peiping, and finally to the Royal College of Surgeons London.

That this remarkable and universal man stayed seven years in Adelaide, is a tribute to the academic atmosphere prevailing in the University of the day. Whilst there, he had discovered that the tiny embryo of the kangaroo, after escaping from the female vagina, was placed in the maternal pouch by the female herself, using those hand-like forepaws. Hitherto the minute creature, had been found adhering to the teat inside the pouch, and popular belief was that it had been born there.

Wood Jones described to me how he gave a public lecture with illustrations and demonstration to an invited group of pastoralists and other interested people. When he had finished, and questions had been answered, a voice was heard from a man at the back, as he was making for the door, "Born on the tit for me, anyhow."

Wood Jones has left a heritage of essays that reveal his philosophy of Design and Purpose in Nature. From the first of these 'Principles of Anatomy as seen in the Hand' right through to the last of many 'Trends of Life' runs a strong theme of anti-materialism. Had the Chair of Anthropology been established at Adelaide, Wood Jones might well have stayed on, because his interest in the aborigine was so deep, and because of his strong sense of the urgent need to study that dying race. He foresaw only too clearly the rapid disappearance of this paleolithic, nomadic people, and sensed the brevity of the time left to study them in their natural state. The fact that his pleas fell on deaf ears was more than frustrating to this sensitive scientist, especially after having convinced the Rockefeller Foundation of the necessity for prompt action.

So Adelaide lost Wood Jones and a Chair of Anthropology that might

well have brought distinction for its unique studies of early man. But a legacy remained in the form of Rockefeller Grants in aid of anthropological investigation, and Doctor T.D. Campbell, the Director of the Dental School whose study of aboriginal teeth had brought him into close relation with Wood Jones, now formed the Anthropological Committee to administer the finance.

Wood Jones' fears of aboriginal extinction may well have been heightened by the experience of Sir Baldwin Spencer who had studied their customs since 1892. Spencer had worked among the Arunta people of the Alice Springs region, with the close co-operation of Mr. F.J. Gillen the Special Magistrate appointed by the South Australian government. It is well to recall that until Federation, South Australia included the Northern Territory, and ceded that vast area to the Commonwealth on consideration that the Federal Government would continue the railway to Darwin. This promise was, in the true spirit of political casuistry, never fulfilled. South Australian enterprise surveyed and constructed the Overland Telegraph line to Darwin, the cable station for European communication, as well as the railway to Alice Springs, and Gillen's anthropological interest made it possible for Spencer to achieve so much in the way of preserving the history of the Arunta people.

In their classical, two-volume record of their many years of work, Spencer and Gillam pay tribute to another observer in the Arunta country, Pastor Strehlow, of the Hermansburg Mission. This Lutheran missionary had patiently recorded as much detail as his work at the Mission permitted, and Spencer and Gillam make many references to his observations. Only recently Pastor Strehlow's son was made the first Professor of Anthropology of the University of Adelaide.

In the preface to Volume I (1927), Spencer states, "After the publication

of Mr. Strehlow's Memoirs, I decided to get into touch once more with the Arunta and revise our earlier work. The changes that had taken place in the tribe during recent years have been of so vital a nature, that it would be absolutely impossible for anyone, starting afresh, to study it adequately. Of the local group of Udnirringita people at Alice Springs that numbered 40 when we knew them in 1896, not a solitary man woman or child remains, and this is only one of many such groups studied by us in the early days, upon whom the same fate has fallen. There are but few of the older, unspoiled Arunta men left anywhere, and soon they will be gone, and with them will pass away all knowledge of primitive customs and beliefs. The danger of trusting to information gained regarding such matters as those concerned with marriage regulations, totemic and sacred beliefs and customs from surviving and younger members of a tribe that has been for years in contact with white men, can only be realised by one who has been able to study the same tribe in its primitive and in its decadent state."

How very true is this statement as I was later to discover for myself in somewhat dramatic circumstances.

Schliemann, obsessed from early youth, with the idea that Homer's poetic account of the Trojan Wars was real history, set out in 1870 to discover Troy, and this, to the astonishment of a materialist world, proved his lifelong belief to have been based upon fact. The definitive work on 'Schliemann's Excavations' by Doctor Schuchardt was published in English translation in 1891. Troy and its troubles existed between 1500 and 1000 BC, say 3000 years ago. In 1892 Spencer and Gillan were studying living specimens of paleolithic man as he had lived in his homeland Europe for some 400,000 years, and in Australia as now established, for at least 20,000 years. So far as present knowledge goes, men were living in Europe ~~such as~~ in like manner to the

nomad aborigines until some 13000 years ago. Australia, the isolated and unknown continent, was discovered by Willem Janszoon in 1600, when he entered the Gulf of Carpentaria and sailed down the West Coast of Queensland. He found the country useless and the inhabitants utterly repellent. If we accept the figure of 5000 years as the age of Modern Man, this period is overlapped by the persistence of his paleolithic forebears in Australia by at least 10,000 years. Wood Jones did not have the knowledge of these dates because carbon dating had yet to be discovered by Willard Libby, but he knew, as Baldwin Spencer had reported in 1927, that time was running out so far as research among nomadic tribes of aborigines was concerned.

When he passed to me that letter from Benedict, with the disparaging remark that he was not an experimental scientist, he disclosed the fact that as a naturalist he was interested in the 'whole' not in its parts. He did not take Benedict's request seriously, nor could he ever imagine where it might lead. Neither did I when I read the letter.

Knowing of Wood Jones anthropological work, Benedict had written to enquire if he would co-operate in a world wide investigation of possible racial differences in basal metabolism. He offered to provide special portable field aparatus developed for the purpose of making such investigations, together with all the necessary chemicals, record books and computing tables.

To put this in graphic perspective following Warren Clarke, we can see what a remarkable, long history is that of the aborigines. The Central and Southern tribes in particular were genetically uneffected by the two suggested migrations ——— that effected the North West from Malaysia, and the North East from early Philippine sources.

The Centralian tribes have a longer and more pure pedigree than the recent European intruders who, in a manner of speaking, happen to be their own civilized (sic) descendants.

As the chart indicates, the last 10,000 years BC represent the warm period following the latest ice age. Therefore these early European nomad hunters appear to have migrated to this continent while the ice still covered much of Northern Europe, Asia and America, and they were still here as the ice receded, living as they did when Wood Jones was passing the fateful letter to me.

Chapter 3.

A Quirk of Fate.

In Cambridge, by a strange quirk of fate, I had already inadvertantly crossed one of Francis G. Benedict's lines of international communication. In 1925 a visiting professor from Hong Kong was brought to me by a Prof. Sir Gowland Hopkins, who asked me to "look after him."

H. C. Earle, who was a Cambridge medical graduate, told me of his work on the Basal Metabolism of Chinese subjects in 1921, and how it revealed a definitely lower level than that found for Europeans. This was an interesting fact, particularly as I was engaged on chemical research into the nature of the active substance produced by the Thyroid gland, and which had such a potent effect on the metabolism. We discussed the possible relation of the function of the Thyroid gland in this connection. Did the Chinese have a lower level of activity in that gland? Little did I imagine that Earl's researches would lead Benedict to follow up that clue, and in doing so, would cross my path in Adelaide in April 1926.

The Carnegie Institute of Nutrition in Boston had long been engaged in researches in the field of 'gaseous metabolism', that is, the study of the amounts of oxygen used by man under various conditions of rest and activity, and the simultaneous quantities of carbon di-oxide produced by the associated physiological processes in the body. These classical physiological researches ante-date the rise of biochemistry, the modern developments of which delve into the living cells themselves.

Benedict's name is firmly established in the annals of physiological science for two reasons. He and his associates developed special apparatus for this type of research, and he had painstakingly extended these investigations to all kinds of living creatures, from mice to elephants.

The underlying purpose of this laborious work was to discover the possible existence of fundamental differences in the energy requirements, and the chemical processes involved within the organs of the body, and the relative amounts of food nutrients so utilised.

It had recently been discovered for example, that certain diseases of the thyroid gland could greatly increase or diminish the oxygen intake of the resting human subject. Therefore, when reports of Chinese investigations by H.C. Earle seemed to indicate a lower resting oxygen requirement by Oriental subjects, Benedict and his team of co-workers carefully repeated the experiments on Chinese subjects living in the U.S.A.

Imagine his astonishment when he too found, that in spite of the fact that his Chinese subjects were consuming American food, and living under American social conditions, they had an average basal metabolism 9% below that of their European counterparts. In these days of 'confrontation', and the hurling of meaningless but emotion-laden epithets, I wonder whether Benedict, the mildest and most tolerant of gentlemen, would have been branded as a racist? And would his Institute have been daubed with obscenities?

These experiments of Benedict and his associates were conducted in 1925, and involved the measurement of the basal metabolism of a group of Chinese and Japanese women students at Mt. Holyoake College, South Hadley, Massachusetts, and at the Teachers' College of Columbia University, New York City. These results revealed a constantly lower energy requirement of about 10%, despite the fact, as I have said, that these young women had been living in the United States for one to four years, in an American College environment, and without exception, consuming only American food. It was therefore obvious that the nature of the food consumed played no part in causing the difference in metabolism.

Some years later they applied the same technique in a study of young Chinese women born in the U.S.A. For obvious reasons, the whole exercise was difficult to organise, but finally, 18 subjects ranging in age from 12 to 22 years were co-opted in the research. The scrupulous care with which these measurements were conducted was such that there could be no possible room for error. The findings confirmed the earlier results, and the fact that the basal metabolism was almost 10% lower than that of Europeans of the same age and sex. H.C. Earl's conclusions from his studies on Chinese subjects in 1921 had thus been amply confirmed.

Between 1925 and 1935, Benedict had gathered a great deal of information from various co-workers who, like myself, had been enlisted in this world-wide survey. In India, at Madras, it was found that Tamils had a metabolism 17% below North American standards. In Yucatan, the Mayas were reported as having a metabolism 8% higher. Benedict therefore felt justified in concluding that there was a racial factor in metabolism, and later studies in China on the effect of aging on metabolism, added further confirmation. With advancing age, it is the case with all races, that the metabolism slows down, but these Chinese researchers found that the fall was more rapid with Chinese than with European subjects of the same age.

The American work was conducted during the winter period of 1931-2, and the time lapse between completion of the research and the arrival of the published results in Adelaide, was almost 3 years! Although an extreme case, this serves to remind us of the effects of airmail.

This then was the background of Benedict's appeal to Professor Wood Jones, who now had firmly placed it in my hand. After all, it was by no stretch of imagination 'my cup of tea'. I had to establish a new department, and to endeavour to continue with a program of biochemical research already begun in

Cambridge. My relief can therefore be imagined, when my enquiries revealed the fact that the only considerable tribe of aborigines was that gathered at the Koonibba Lutheran Mission, in those days some 500 difficult miles distant. Nomad, unsophisticated tribes I learned, were a mere 1300 miles away in the centre of the Continent.

As I had promised Wood Jones, I wrote to Benedict and made it clear that I had neither the finance nor the transport to reach either of these groups of aborigines, and added, somewhat dubiously, that if his Institute cared to take the risk and send the field research apparatus and other essential material that he had offered, I certainly would seize any opportunity that came my way in order to assist him. Hypocritically, I felt that I had disposed of the matter. Benedict however, did send the apparatus. I was now hoist with my own moral petard.

By the year 1930 Wood Jones' efforts had secured from the Rockefeller Foundation financial support for anthropological research expeditions. Mr. M.L. Mitchell, now Sir Mark, offered to assist with transport, and I applied for and obtained a grant-in-aid to enable me to conduct metabolic research on the natives at Koonibba Mission Station. This involved a 250 mile journey by sea and 250 miles by land, a total of 1000 miles. The team consisted of Mitchell, Dr. R.F. Matters (now Sir Francis) my assistant, and Ernest Eldridge my technician. The latter, incidentally was bequeathed to me by Professor Wood Jones when he left Adelaide. Matters, Eldridge and I travelled the sea passage to Port Lincoln in Mitchell's ocean going launch. The sea was rough, and the less said about our seamanship the better. A Sou'wester blew up and throughout a pitch dark night, heavy green seas fell upon us. Never have I suffered so much myself, as well as in addition the sufferings of others.

Pastor Hoff very kindly placed the Mission schoolhouse at our disposal, the children being on vacation. The natives belonged to the Kokata tribe, and were completely detribalised; pathetic and unattractive imitations of Europeans. They were venal and evasive, and it was no simple matter to get co-operation, and the results were by no means satisfactory. Worse still, a systematic mathematical error in the recorded data was completely overlooked by me, with the result that the natives appeared to have lower oxygen requirement of some 12%. Fortunately, this error was subsequently discovered and, with embarrassment, acknowledged in a later publication.

This book is no scientific treatise, nevertheless, in order that the reader may picture our experimental difficulties, I must make some explanation of what Benedict's proposals involved. Everyone knows that we breathe in oxygen, and expire carbon di-oxide. The quantity of oxygen used is strictly related to the physical 'work' done by our bodies. This 'work' can be divided into two parts, that which is performed externally (muscular exercise for example) and that which is performed by the body and its organs in merely keeping alive and fundioning, as we, first thing in the morning, lie warm and relaxed in bed, 12 hours after the last meal (which involves work in digestion etc.) This latter condition is termed BASAL or STANDARD METABOLISM and is related mathematically not to the weight or height of the individual subject, but to the surface area of the body. This is due to the fact that we regulate our body temperature chiefly by radiating heat from the skin.

The adult European female/in these basal circumstances uses about 7% less oxygen than her male equivalent. Either she makes more efficient use of her oxygen intake, or she is less active functionally. We can leave that fact for Women's Lib to evaluate!

The measurement of oxygen consumed per sq. metre of body surface is by no means a simple procedure. There are many sources of error in the use of the apparatus, and above all, the subject under investigation must be completely relaxed, not the least apprehensive, and calmly co-operative. Just imagine these criteria in their application to measurements of this kind on aborigines. It is difficult enough to ensure their application to any white hospital patient. The nose must be clamped to prevent any passage of air, and the subject must breathe through a rubber mouthpiece that completely prevents any leakage of air. All this preliminary manipulation, and the unaccustomed mouth breathing, to say nothing of the effect of the awe inspiring mechanical apparatus and its management, are unavoidable sources of error.

To get constant results the apparatus must be continually checked and one must repeat the procedure several times, each measurement occupying 15 minutes.

The likelihood of success with aborigines seemed remote indeed, and our experience with the mission aborigines at Koonibba left me with absolutely no enthusiasm to try again. But a promise is a promise, and in addition, the taste of humble pie had to be obliterated somehow. So, when the anthropological committee of Adelaide University decided to mount an expedition to Cockatoo Creek, North West of Alice Springs, to study wild, nomad aborigines, I applied for permission for Matters, Eldridge and myself to join them, and we were generously included.

Chapter 4

Month of Decision.

August 1931 was the month of decision. It had been selected by the Anmatjera and Ilpirra tribes for a ritual meeting at a'soak' in the bed of Cockatoo Creek, in the wilderness some 200 odd miles North West of Alice Springs. The venue of this nomad meeting had been revealed to Pastor Kramer, a Swiss Lutheran missionary whose pastoral activities consisted of 6-8 week expeditions based on Alice Springs. This quiet and unassuming man made the journey with a string of camels and one Arunta interpreter called Peter. Appropriately Peter wore a beard, and had all the appearance of an apostle. As Kramer related it to me, he had long since concluded that proselytising a complex gospel among the nomad tribes was not feasible, nor indeed desirable. They had their ancient traditions and social rules which were suited to their environment and their way of life. He did however, do all that he could, to ameliorate by argument with their leaders, the unfortunate situation existing at that time, when conflict arose between pastoral lease holders and aborigines over so-called cattle stealing. I write 'so-called' advisedly, because animals collecting at a watering place on ancient tribal territory, were quite naturally looked upon by the aborigine as 'game'.

Looking back today, 1974, it is indeed difficult to appreciate the existing climate of opinion on these conflicts in 1926-31, both metropolitan and particularly in the bush. As a complete outsider, I myself could not form any well founded opinion when it was reported that an aborinee had been shot for killing cattle. Only my conversation with Pastor Kramer, and my first contact with the nomad aborigine on his own ground, gave me a basis for better understanding. Moreover, I soon found that our bushman 'guide' Fred Colson, held different views from those of many cattlemen

and inhabitants of Alice Springs.

The rendezvous at Cockatoo Creek was therefore, to a considerable extent, uncertain. Colson's aid had been sought by the University anthropological committee, and he in turn had co-operated with Kramer for some months, in the attempt to locate a tribe or tribes, in the vast areas over which they roamed in search of food. It was somewhat analagous to locating a needle in a haystack.

Having found the aborigines, there resulted a long discussion, if that is the correct term for an attempt to find where the tribes would be three months later. Not only that, but it was essential to convey to them the information that a most curious group of white men would like to meet them, and make some sort of special corroboree with them. All this had to be conveyed by a garbled mixture of the Arunta dialect, and a species of deaf and dumb alphabet. This sign language has been described in detail by Spencer and Gillen in their work on the Arunta. It had been developed in order to enable tribes speaking widely different dialects or languages to communicate matters of fundamental importance. It includes fingers, hands, arms, head and chest. For example, right arm across the chest with the hand placed on the left shoulder conveys the name of a tribal sub-group. Some hand signs involve finger or wrist movement and are not at all vigorous, looking in fact like gentle speech. The sign 'go away' which one would expect to be very emphatic, takes the following form: the right hand is held back uppermost, palm facing away from the body, the fingers are flexed downwards. The fingers are then extended and the wrist downflexed, so that the palm faces outwards. 'Go away' it says, quite firmly, but not crudely.

Try to imagine our Swiss pastor and his interpreter Peter, sitting with the elders of the tribe after making 'contact'. If my one later experience of 'making contact' had any resemblance, it must have been by finding themselves suddenly surrounded by aborigines, seemingly appearing from nowhere. Nevertheless, they were able to secure an amicable agreement to meet us, as well as to convey some idea of what we wanted them to do. The date was fixed by the number of moons, the moon being represented by placing the hand in the upward pointing attitude with the index finger half flexed. It was by no means a precise timetable, nor even a firm contract, but, remarkable to relate, it worked, and how!

Perhaps the foregoing sentence reflects my 'civilised' dubiety concerning the integrity and intelligence of these stone-age men. My experience at Koonibba on the detribalised Kokatas, had no doubt soured me. Later, after many expeditions among them, my respect for them became tinged with a considerable degree of humility. They were so intelligent, so courteous and good natured, and so willing and interested in co-operating in our experiments despite all the associated discomfort and restraint.

Our train arrived at Alice Springs at 9 a.m., and by the time we had transhipped our gear to Fred Colson's 'caravan' and prepared to move, it was already past 11 a.m. The caravan consisted of a two ton vintage Chevrolet truck, and two sedan cars of the same make, both of ancient ancestry. They had 'washed up' in Alice Springs like flotsam from the South. The tray of the truck had been winched into position by a fencing wire windlass. It looked as though it might part company with the chassis at any moment, and gladly. The springs were already almost flat before they felt the load, and they seemed to be wincing at the prospect. The radiator wept silently. Its drip, drip, drip of tears added nothing

of comfort to my sense of unreality and uncertainty. Colson, a typical Australian backwoodsman, overheard me comment to Eldridge, and tried to reassure me by remarking that, after all we carried a sixteen gallon drum of water, and we could always find a 'soak'. The whole transport looked like something out of one of Charlie Chaplin's film comedies, - 'Klondike' for instance.

After all, I and my two companions, Dr. Matters and Ernest Eldridge were 'supernumary to establishment', and it was not for us to express opinions as we watched with mounting concern, the springs of all the vehicles flatten, and then bow downswards with their loads. Altogether there were 15 of the party. Five crowded into each of the sedans, and four on top of the gear on the truck, and one in the driving cab.

The anthropologists were all enthusiastic amateurs with the exception of Mr. Hale the Director, and Mr. Tindale of the Staff of the South Australian Museum. There was also Dr. T.D. Campbell, Director of the Dental School, whose interest was in the teeth and masticatory apparatus of the aborigines. Prof. Cleland, - later Sir John, and Prof. Harvey Johnson, both of whom were microbiologists, were interested in blood grouping. Prof. Wilkinson, the anatomist, and Dr. Hugo Grey were to make physical measurements of the aborigines, and Drs. Pullein and Kenneth Fry, with Mr. Hale were to make 'intelligence tests'. Tindale was the archeologist of the expedition.

Last but by no means least, was the enigma of the party, a friend of Dr. Campbell, by name 'Pat' Stocker. He was a prominent, much travelled, laconic and somewhat weather-beaten businessman from Sydney, who paid all his own expenses in order to indulge his hobby - cinematography. At that date there were no amateur movie cameras, and his was a large Hollywood machine.

Again, in retrospect, when I recall the great size of his machine, I find it difficult to get my images of then and now into juxtaposition. I'm sure that the reader will not. Adelaide after 6 p.m. was so deserted that if one fired both barrells of a 12 bore gun in the city's main shopping street, the only response would have been the echo. Everything has so vastly and so rapidly changed since then as to baffle translitteration.

The train to Alice Springs from Port Augusta for example, was still the same that was built when the government of the Colony of South Australia constructed the railway, en route, it should be remembered, to Darwin, which was then included in the Colony. 'Emmet' has immortalised such trains in Punch, when that Journal was still worth reading. The ancient locomotive was slowed up by the merest rise in the otherwise flat landscape, and stopped panting, at frequent intervals to take in water from the bores along the track, and, according to Matters, to recover its breath.

At such few halts as were marked by a stockyard and siding, there were, to our vast amusement warning signs waving their arms and crying 'look out for trains! ' Who, in all that vast, bare wilderness would even trouble to cross the track at that particular spot? A Pavlovian reflex conditioned camel. After all, a train could be detected half an hour before it panted into the siding.

'The Alice' itself, basking sleepily in the sun, with its backwoods hotel and boardinghouse, Wallis Fogarty's store, the police station and Inland Mission hospital and little else, revealed no outward signs of life. And now there stood before us Colson's 'caravan', with not one curious onlooker. But Stocker, fitted into all this as a hand into a wellfitting glove. Imperturbable, wryly humorous, and with a strange, lipless manner of speech, he was destined to produce invaluable motion pictures of the remaining nomads, before they

disappeared. Eventually we became fast friends, and the University of Adelaide and the South Australian Museum, owe a considerable debt to Dr. T.D. Campbell (later Professor) for his foresight in enlisting the interest of his friend 'Pat' Stocker.

The splendid photographs in Spencer and Gillen's book are a tribute to those authors. Spencer states in his preface to the 1927 Edition, that they managed on their 1926 expedition to take some cinematograph records of native dances as well as some phonograph records of the accompanying songs. Their cine-camera must have been similar to that of Stocker.

Then there was the extremely rough route, which was nothing more than a rocky track over the McDonnell Range and the not much better rutted and dusty track along the telegraph line to Aileron, where the vague bush trail to Tanami turned off to the North West. Our speed varied from 15 to 20 m.p.h. Had we tried to travel faster we certainly would have lost the tray of the truck, which, even with careful driving, we had to winch back into place from time to time, and as for the overloaded springs, I even rose instinctively with every solid bump on the axle-housing as though to lighten the load.

The Tanami track was no more than the wheel and hoof marks of vehicles and horses that might have traversed that empty land half a century ago. So little rain falls, and so little wind blows, that tracks remain almost indefinitely in the red sandy soil between the sparsely distributed, bleached tufts of grass, or clumps of saltbush and porcupine grass (spinifex).

As we hobbled along, Colson remarked to me "I see that Robb must have turned off there", nodding in the direction of the passing mulga trees along the track. His trained bushman's eyes were reading the fine print of the news of 'happenings in the Centre'. "How did you know it was Robb?" I asked.

"I know his horse" was Colson's simple rejoinder, as though that

explained everything.

I was riding with him in the cab of the truck, and learned from this quiet man everything that contributed to our subsequent success. Colson dismissed from my mind any thought that our experience with the Mission station Kokatas bore any relation to what we might expect at Cockatoo Creek. His life as an overland drover, across Australia, had taught him to respect and admire the nomad aborigines. He had never, whilst travelling alone, been treated other than with friendliness. Even though he saw no natives for days, he was aware that they knew that he was in their territory.

He advised me to restrict all my experiments to the adult males, and to make it quite clear to them that we wanted absolutely no truck with women and children. "If you strengthen their feelings of importance by making your experiments 'big medicine' for men only, you cant go wrong," he said. He also advised strongly against taking body temperatures per rectum. "They maybe naked, but they are very particular - their rules of behaviour are very strict" was Colson's opinion, - and events demonstrated the wisdom of his views. For example, although my work led to close personal association with the aborigines, I never saw anyone defecate, whilst urination apparently posed no more problem of decorum than it does to a Frenchman.

As all travellers in Central Australia know - and how simple such travel is today (provided one keeps to the road) the smaller mountain ranges rising so abruptly from the plain, seem higher than they really are. In fact, more often than not, they rise no more than 300-500 feet above the plain. On the other hand, the plain itself is between 1000-1500 feet above sea level, making the total height of the smallest peaks 1300 feet above sea level. It is their jagged outline, and the absence of foothills

that deceives the eye, and the indigo blue of their mass at 5 miles adds to the deception.

The Hann Range was our first 'mountain' chain. It lay along our left flank with the Reynolds to the right, and we camped for the night at Napperby Creek. This was a dry, sandy watercourse with magnificent redgums growing in the wide streambed. To get across, Colson had already cut a track down the steep banks on both sides. We all dismounted and pushed the spavined vehicles as they struggled across. Breaking the established rule, we camped in the creek bed to escape the ants. Even after man has disappeared from Australia, the ants will be there. Our reasoning, though weak, was that the creek watershed was quite close, and we should be aware of a rainstorm on the hills. Many lives have been lost by this practice, because a cloud burst a hundred miles away can send a wall of water roaring down upon the unsuspecting traveller.

The most likely explanation of the total disappearance of Dr. Leichardt and his men and his waggons, is that they were overwhelmed when crossing a wide creek bed by a raging torrent, like a tidal bore, starting from a hundred or more miles away. The fact that many searches have discovered no trace, suggests that all were buried under an avalanche of gravel borne by the torrent. All these dry river beds show ample evidence of torrential floods. Debris is piled up against the base of the great trees standing in the watercourses. The monotonous grey-green of the acacia and mulga, is gratefully relieved by the appearance of the fresh green foliage of these great trees as one approaches a watercourse. As I write these lines, I am aware that tourist buses even travel to Ayre's Rock, where accommodation and all facilities give the lie to my backward glance. Yet, during those years of which I write, a foolhardy youth lost his life trying to reach Ayre's Rock by motor cycle

from Oodnadatta. He even refused to carry the extra water that Mr. Wilkinson, storekeeper, begged him to take. His body was found by Bob Buck, a wellknown local bushman. The youth had wandered in circles around his motorbike, having become demented by the heat and dehydration. Even today there are these foolhardy people, like the father of the family - all of whom were lost when they wandered off the Birdsville Track.

We had stopped to stretch our legs at Mt. Freeling, a group of red granite hills, and being separated from the others only temporarily, with the heat reflecting from the rocks in physically felt waves, and the complete absence of sound, I felt a twinge of fear. Death is quite close in this deceptively innocent country, unless one is fully prepared and has good bush sense. Every outcrop of rock looks like every other. Yet, Giles in particular, and Goss and Stuart and Sturt and others managed some incredible traverses, even with horses, in this country. In our case, we had Peter and his camels as our reserve transport, I was glad to note.

Professor Cleland occupied his travelling time with keeping a botanical record of plants noted along the route,-a sort of strip map plant census. This indefatigable naturalist also recorded the approximate numbers and types of fauna. But what interested me most, was a remark made by Fred Colson when he sighted two emus on the last lap of the second day after crossing the River Lander. He said "Yes, the abos will be there. Where there is game there will be natives."

Astonished, I asked why not make the reverse deduction."Surely",I continued,"the game would mean absence of hunters?" Then followed my first lesson in human ecology, although, at the time, I did not realise it.

Colson went on, "They move WITH the game as much as possible. They do not make the animals 'gunshy' if they can avoid it. The animals are easier

to catch in these wide open spaces, if they act cautiously and creep up on them. The full import of this information from one of the last true bushmen dawned upon me after several more expeditions. The aboriginal tribes were small, perhaps 30-40 in my experience. The larger fauna were dispersed over the vast area of the tribal territory, say 1000 sq. miles, excepting the areas where the meagre average rainfall had fallen and improved the local plant growth and had filled sheltered rock holes in the ranges. Ecology? I had never heard or seen the word at that date, although it had been invented by a Danish plant scientist as early as 1895.

According to a modern authority on plant communities, it is only quite recently that Ecology has become a scientific study in its own right.

Our truck foundered when we were crossing the wide sandy bed of the Lander, in spite of everyone pushing. It was necessary to excavate the rear wheels and to lay matting of branches and mulga across their tracks. With everyone pushing and pulling, the wheels eventually gripped, and we managed the crossing without unloading, and once again winched the tray of the truck back into place. Someone remarked, "What will happen when the fencing wire breaks?" The question merely hung in the hot air unanswered.

The squat, thatched hut of Coniston 'home station' was unoccupied when we passed, and we had not seen a trace of any cattle. This was the limit of occupation, and we had crossed two leasehold cattle stations without seeing human or animal life. These had been drought years. To look at a map of the Northern Territory and see the letters H.S. (Home Station) is to read hieroglyphs for what had or might have been, or might still again become pastoral runs of hundreds of square miles of territory. This is gamblers' country. Those who have succeeded manage to sell out in a good season,

and to leave the successor to face the inevitable failure of what the meteorologists call 'precipitation'. The average rainfall of 11 inches conveys a false impression of reliability. Over the vast area of the Centre of Australia, some regions get little or no rainfall, whilst others become flooded. As I write, the rainfall has been so extensive as to convert a large part of Central Australia into a lake, complete with fish!

During most of the period of our expeditions between 1930-39, drought conditions prevailed over much of the region in which we worked. At Cockatoo Creek, water was found by scooping out of the sand of the river bed a hole seven feet deep. This was the 'soak'. Both water and frogs were found.

After Coniston, the track headed for Mt. Treachery, appropriately named, because it was on this stretch that an unfortunate prospector had been done to death at his campfire, as an act of vicarious vengeance, only some weeks previously. Elsewhere an aborigine had lost his life at the hands of a pastoralist who had lost some cattle. We passed through some dense mulga and came out into the more open country with Mt. Campbell ahead, and the great red-gums of Cockatoo Creek on our left. About 10 miles from Mt. Campbell we met our 'reception committee' on the river bank.

Chapter 5

First Encounter.

The Arnmatjira men confronted us in dress uniform, greased and blackened with charcoal, their bodies shone like polished ebony. Around their foreheads were wound whitened bands of 'string' made from human hair and animal fur, and through their noses each had a piece of straw. They were fully armed with spears and woomera, and except for a 'string' tassle tied in the pubic hair, they were naked.

They looked at us without expression. This settles it, I thought, we wont have a chance to work on these fellows. Matters muttered to me "I have a notion that they dont like us, perhaps we stink!"

Pastor Kramer spoke to them and so did Peter his Arunta man, and the anthropological party set to work to prepare the camp, whilst Matters, Eldridge and I set up our apparatus for the great rehearsal-demonstration. The women and children were some 1000 yards distant.

The men squatted in a crescent and with inscrutable expression watched us prepare our apparatus without uttering a word. It had been explained to them by Peter and by Kramer that we were medicine men, and that the ritual we would perform would, if they chose to co-operate, greatly improve their wind. It was also explained that in order to get the best results, we would come to their camp long before sunrise in the early morning to conduct this special performance, and that only fully inducted men would be admitted to this privileged ceremony. That restricted our measurements to not only circumcised, but sub-incised fully mature adults. I was following Colson's advice carefully. They listened imperturbably, and they watched our dumb show with close attention, but in stony silence. "Nice co-operative and friendly chaps" said Matters, "They'd kill us if they really knew what we want them to put up with"

added Eldridge, as he lay down on the ground for Matters and me to demonstrate what we hoped to do to them.

It had to happen! As we were charging the apparatus with oxygen from the high pressure cylinder, the tube leading to the rubber balloon, slipped from the nozzle with a sharp'crack' like a pistol shot,followed by a loud, piercing hiss, but our audience remained unmoved! Eldridge just had time to say "Did you have to make that bloody noise?" before his nose was clipped and the mouthpiece fitted into his mouth. As he breathed, the rubber cap of the metabolimeter rose and fell with each respiration. Kramer, providing an Arunta commentary again impressed on the natives how this would improve their wind. His Lutheran conscience being, as he explained, eased by the fact that they were breathing life-giving oxygen.

The same performance was repeated on each one of us to give them ample time to form their opinions. The aborigines simply remained silent and expressionless. At the conclusion of our charade, Kramer asked them if they had anything to say, and receiving no reply, told them that we would be at their camp very, very, very early the next morning. They rose with one accord, and without comment, and left us in a state of shattered, incredulous uncertainty. Fred Colson however, reassured us, or tried to, and Pastor Kramer supported him.

"There's only one thing you can do," said Colson "Try it out."

"But what if they get 'ostile?" asked Eldgridge, dropping h's with more than customary clarity, and answering my own thoughts.

"They wont be hostile, or they'd have made it obvious when you showed them what you want to do," said Colson. "It's my bet that they'll be alright."

I felt a little, just a little reassured, but Matters and Eldridge

remained sceptical.

"It will be a horse of another colour in the morning," said Matters, "We can be sure of that. How would you like to play poker with that bunch?"

Next morning about 4.30 a.m., we were rudely awakened by Eldridge, and found that the water in our bucket was frozen to a depth of ½ inch, and the temperature was 26° Farenheit. Chattering with cold, and with our hands sticking to the cold metal of gas cylinder and metal apparatus, we plodded, muttering forebodings, through the mulga to our unpredictable, paleolithic objective. We had taken the precaution to follow the track to their camp the day before, otherwise we would certainly have got lost.

In the dim light of our kerosene storm lanterns, we could just discern the natives lying side by side in shallow hollows scooped in the sandy soil. At their heads was arranged a wind-break of brushwood and grass, about 2 feet in height. It was so placed as to break the movement of air immediately above their bodies, and lay at right angles to the prevailing drift. On this, what might be called the 'head of the bed', believe it or not, they had placed their decorative pubic tassels. They had removed that decoration (about 2 inches long and 3 inches in circumference) before retiring for the night! On the windbreak also lay their spears, woomeras and boomerangs. This was the unmated male dormitory of about 9 men. At their feet, and between each bed were the remains of small fires, the ashes in some cases still warm. The natives lay supine and showed little sign that they acknowledged our presence, but of course they must have been watching through eyelid slits like sleeping cats. A tame dingo snarled, and was immediately quieted. But for that break in the silence none moved, and all remained with their eyes apparently closed!

Matters and I whispered to each other as though the aborigines were

still asleep. No doubt they continued to watch us whilst strictly observing the instructions and demonstration that we thought they had ignored. We began our fantastic performance on the occupant of number 1 bed! I tapped him on the shoulder and briefly he opened his eyes and looked at me. First the insertion of the mouth-piece. "My God," whispered Matters as he tried to fit the rubber flange between the lips and gums. "How d'you get this big mouth to fit closely over the mouthpieeee?"

Our number one subject raised his left hand, and with the index finger, removed a large, dark-coloured wad of something from within his cheek, and parked it behind his ear! We knew nothing at that moment of their habit of chewing native tobacco, nor did we expect to find anything in the mouth except teeth. But the problem of fitting the mouth-piece remained. The lips were soft and pliable, and the mouth large, and during these first trials we had to be on the alert for leaks! Our subjects seemed to realise this, and even helped by tightening the lips. And then the nose-clip! The nostrils were not only wide, but soft, - much softer and more mobile than those of the long narrow nose of the European. One had to gather the whole nose as it were, into a bunch, and hope that the nose-clip designed for Europeans, would effectively block the airway, compelling all the respired oxygen to pass through the mouthpiece.

Number One lay like a log, his breathing absolutely regular. Unbelieving we whispered, "Do you think we could repeat the measurement?"

This we did. In all, we made three measurements each of 15 minutes. Respiration and pulse rates remained as regular as clockwork. Did someone mention Yoga? With rising confidence we tried number two, having patted number one on the shoulder to indicate that he no longer need lie like a corpse after nose-clip and mouth-piece were removed! Number two behaved

in precisely the same manner, and so also did number three, and by that time it was daylight, and we'd had enough.

What with the cold, the absence of muscular movement in our restricted positions, and the nervous strain, we were glad to stop. Each of these aborigines had suffered his indignities at our hands without one single departure from the strict requirements of our precise measurements of their oxygen intake! Our one concern at this stage was the question of leaks past mouthpiece and nose-clip. Our calculations would soon reveal this possibility.

Our subjects grinned at us as we patted the others and indicated that they would be the next 'patients'. This was the first sign of friendliness. A sign we were to learn that we three, in some mysterious fashion had been admitted to membership of their rather select club. All three of us had noticed some interesting facts which we discussed. When number one sat up, after we had finished with him, he shivered, quite violently! He then pushed the end of a smouldering piece of firewood at his feet into the middle of the ashes, after waving it about in the air until it began to glow. Obviously he hadn't FELT cold before sitting up. Was it because, when sitting, he exposed his torso to the movement of ground air? So far as we could judge there was no wind, not a zephyr. Or, had he suddenly switched his vegetative (involuntary) nervous system from 'sleep' to 'wake' ? We were later to learn more about this phenomenon. Sometimes we saw them get up when we had finished, and squat some three feet away from the foot of the bed and urinate, and then lie down again. The squatting posture was the result of penile sub-incision. The tame dingo and the half dozen dogs who had 'gone bush' from cattle stations, remained silent. Their remote control

by their masters was complete, and with minimal fuss.

We trudged back to camp incredulous, if not spellbound by our experience. Colson had been proved right. On our way we decided to increase the size of the mouthpiece and the rubber pads on the nose-clamps, whether the calculations proved the absence of leaks or otherwise. We also agreed that the low temperature posed a threat to the valves and pump mechanism, but the one great question, namely, how the aborigines would react to our experimental procedure, had been answered without equivocation. These fellows were magnificent, and the Koonibba experience by comparison, was nightmare evidence of decadence of a noble race under the influence of Western civilization.

It is neither easy nor pleasant to breathe through the mouth only, and because the oxygen was dry and cold, even more unpleasant. Quite frankly we expected them to protest, and wondered just what they would tell their interested companions and potential victims of these strange, white medicine men. All three of us agreed that no white subjects could, or would have behaved as such perfect experimental animals. It was our first lesson on the qualities of intelligence, self control, and natural gentlemanly behaviour of the truly nomad(Myall) Centralian aborigine. He had decided to co-operate, and behaved precisely as we had demonstrated. What an intelligence test!

In all, we conducted 33 measurements on 20 aborigines. This included repeated trials, conducted in order to ensure even a greater degree of accuracy. The detailed results were published in a Scientific Journal and have no place in this popular account. Nevertheless, in order to convey some sense of what we were trying to do, it is necessary to describe and explain some of the procedures essential to the completion of the

investigation. The measurement of the volumes of oxygen used by each native had to be conducted with great accuracy. This meant continual checking of the apparatus. Leaks were always possible at some part of the oxygen circuit. Accurate temperature and barometer readings were necessary throughout the experiment, and finally, each period of measurement had to be precisely timed by a stopwatch.

It will be apparent that these measurements of oxygen uptake were conducted in the early morning before daylight, and whilst the natives were just awakened. Moreover, it has been emphasised that they lay quite relaxed and unmoving. So far so good, these major criteria had been satisfied. The equivalent situation for Europeans would be warm in bed before rising in the morning, and before taking any food. Under these conditions the oxygen intake is used to provide energy for the movements for the chest and abdomen in breathing, the pumping of the blood in circulating it throughout the body, and some movements of the gastro-intestinal tract.

In addition to these obvious mechanical demands for oxygen to fuel these energy processes, there is still a steady oxygen requirement by all the bio-chemical processes essential to the life and function of the cells of the body tissues themselves. As already explained, this life process is called 'basal' metabolism, and in the resting state, 12 hours after a meal (which demands energy for digestion) it is a constant value for given individuals.

In order to compare individual values of oxygen usage in this basal state however, an additional physical constant must be applied, for example, body weight. But this is not good enough. Some individuals

have light bones, others have much inert fat and so on. There is however, one feature that provides an accurate basis for comparison of the resting energy requirements of different subjects, and that is the surface area of the body. It is still necessary to make special allowances for the very fat and the extremely thin and tall individuals.

How does one measure the surface area of the human body? Direct measurements can be made by encasing the body in complete tight fitting cotton combinations, and painting these over with wax, and then cutting the wax mould away and measuring the area of each piece. The head is treated in similar fashion as in making a cast in plaster of Paris. From these results, physiologists have developed a mathematical formula which enable one to compute a remarkably accurate estimate of surface area from the height and weight of the individual. This formula was applied to the weights and heights of our aborigines. But our investigations were open to serious criticism on at least two counts. Could naked subjects lying on the ground with surrounding air temperatures around 26° F (- 2.8° C) and with the almost dead ashes of small fires close to them, reasonably be compared with the European subject warm in bed, in a warm room?

Furthermore, how could we be sure that the Height/Weight formula derived from researches on Europeans could be accurately applied in the case of these stone-age people? We couldn't be sure! We therefore resorted to a simple and effective Japanese method of measuring surface area. We made a crayon mark down the spine and the middle of the chest and abdomen, and carefully applied strips of gummed packaging tape completely to cover one half of the body. We measured the pieces so applied from front to back, around the arms and legs and feet, keeping

the edges of the tape as close as possible without overlap. This sounds simple and easy, in fact it was neither, - it was Hell! In that arid desert atmosphere the gum dried before we could complete the application of one strip. The foul stuff stuck to our fingers and dried there. We even managed to stick ourselves onto the aborigines. Those pestiferous bush flies of Central Australia seemed to know instantly when one's hands are occupied, and in they dived and clustered around eyes and mouths! The unfortunate native, irritated beyond endurance by the semi-carapace of gummed tape, and with only one free arm, suffered the agonies of St. Stephen pierced by arrows! His friends (sic) sat around and hooted with merriment, especially when at last set free, the victim dashed for the waterhole and clawed the mess from his body. The aborigines certainly have a strong sense of fun, and this performance was painfully ridiculous.

Yet, such was the morale of these good fellows, that we were able successfully to carry out this torture on six of them. The area of the head and neck we measured from plaster castes made on these subjects by Mr. Hale for the South Australian Museum. Our results were within 5% of those calculated by the Height/Weight formula. It was therefore not unreasonable to assume that the surface area of these Central Australian aborigines was at least approximately the same as that of Europeans. The Metabolic Rate, i.e. the oxygen requirement per sq. meter of the body surface per hour, when finally calculated, turned out to be within the limits of experimental error of the method used, the same as that of Europeans. Although we did not yet know the results of Clelands blood group studies, these two conclusions of ours were destined to conform with his, and with

the more recent anthropological conclusions that the aborigines are in fact, archaic Europeans.

But the second gnawing doubt refused to go away. These aborigines were in no warm bed. They were naked on the ground with air temperatures well below freezing point.

There were three possibilities. Could it be that lying in their hollow beds with a wind break and with smouldering embers of fires close to their flanks and feet, their local 'climate' was similar to that of a warm bed?

Perhaps they did have a lower metabolism than Europeans, and did bring their oxygen usage up to European levels as they stoked their internal fires in order to keep warm?

There was ample experimental evidence produced by Sir Charles Martin and others that the metabolism increased with falling temperature BEFORE gooseflesh and shivering became manifest. Gooseflesh is a pathetic attempt on the part of the sparse and ineffectual body hairs to pull themselves upright in order to thicken the furcoat! A reminder of our apelike ancestors. The rise of metabolism is a response to the cooling of the skin, and is quite literally due to increased heat production, and therefore greater oxygen usage. Shivering, the next stage, is involuntary muscular contraction, or muscular exercise if you like, which, by liberating energy as heat, calls for yet more oxygen intake.

The only other possibility was the existence of some unexpected physiological mechanism which enabled the aborigine to conserve his body heat, which otherwise would have escaped by radiation and convection from the skin surface. In other words, could the aborigines regulate their radiators?

Of these three possibilities I chose the first for study on our next expedition, because it happened to be the crux of Benedict's investigations. Already our favourable experience with the Anamatjira tribe was spurring me on. I was 'hooked' by these remarkable, intelligent and friendly people, and felt confident that we could continue to work with them. Speaking of intelligence, and recalling my doubts after the Koonibba experience, it was interesting to see our anthropological friends testing the intelligence of the natives. These were being cajoled into tracing with the finger, their tortuous way through a maze drawn by chalk on paper, or to copy patterns with matches stuck in holes, and equally illuminating tests.

One day, after having often noticed the puzzled expressions on the faces of the natives, I could not refrain from the comment "I think that the aborigines are testing your intelligence, and they're not very impressed!"

If one asked a native to trace in the sand the tracks of an iguana, a wombat, an emu, or any other creature, he would smooth the sandy surface like cleaning a slate, and with lightning swiftness and dexterity, produce a most sophisticated replica of the spoor of the smallest animal. It was spellbinding to watch. How does one test intelligence, even of one's own race? Aptitudes and interest are surely involved in 'attention', and without attention how can the examinee perform at his best?

Because we were involved so personally and continuously with our group of male aborigines, they were always suggesting to us a sort of return corroboree, and as a result we witnessed many different ceremonies. But what confounded us was to watch them provide their own blood for use as an adhesive to adorn themselves with eagle-down feathers for a corroboree.

All this has been recorded long ago by Spencer and Gillen and others. I mention it only because we were medically interested. A tourniquet was applied to the left upper arm, and when the saphenous vein was thoroughly engorged, it was neatly nicked with a thin sliver of quartz held in the right hand, and about half a pint of blood was collected in a pitchi.* (Footnote: Pitchi is an Arunta name for a hollow, boat-shaped wooden vessel used for carrying water, grass seed, and even an infant. It is about 2 feet long, 6 inches deep and 9 inches wide, and beautifully fashioned by means of a quartz chisel, and usually coloured brownish red with hematite. The Luritja word is 'wirra'.)

With the index finger a geometric pattern appropriate to the particular ceremony was traced with delicate touch in blood on the bodies of the chief performers, and the white downfeathers gently applied in small tufts to the sticky tracing. We noticed that the blood did not dry as rapidly as our gummed paper!

In only one instance have I seen blood used as a decoration by itself. Members of this same tribe quite roughly stabbed the exposed urethra of the sub-incised and engorged penis in order to splash the backs and shoulders of the principal actors with blood, which ran in streaks down to their buttocks. A half inch diameter twig of mulga was crudely torn by the teeth to form a jagged point which was stabbed into the flesh in somewhat unnerving manner. As Dr. Pulleine commented as we watched these preliminaries to a 'wild dog' corroboree,

"First they ruin a perfectly good organ, and then they insult it!"

These self inflicted wounds seemed miraculously free from infection. This raised another question. Perhaps this example may indicate the

nature of the problem. The soles of the feet of these aborigines are shod with a half inch thick skin like a worn motorcar tyre. Quite often they tread on a large splinter of dead brushwood as thick as a little finger which penetrates deep into the flesh. I have watched a native dig a deep hole into the sole of his foot to remove such a splinter. He used a piece of mulga, once again roughly pointed by tearing it with his teeth, and simply gouged a hole until he reached the remnant of the broken splinter. It was an unnerving process to watch. When finished, he scooped up a handful of sand and poured it into the gory wound, and walked off without a limp. Their bodies are always covered with dust, excepting only when greased and charcoaled as part of ceremonial dress. Does this fact, and the deliberate use of sandy soil to dress a wound, suggest that anti-biotic fungal material is present in the sunbaked soil? In 1931 anti-biotics had not been heard of, and we were therefore not a little confused by the obvious absence of infection in the above mentioned instances. The dust obviously cleanses their skin, and although they have, as we do, a distinctive odour, it is not repulsive as was that of the natives at Koonibba Mission Station.

When that native walked off without a limp did he feel pain but suppressed it? On later expeditions I have witnessed a circumcision and also the knocking out of an incisor tooth as part of an initiation ceremony. In both cases the pulse rate remained just as steady as during our metabolic experiments! This control over the vital vegetative nervous system may help to explain the fatal resignation of an aborigine who believes that he is the victim of bone-pointing by a witch doctor. The same type of control has been demonstrated in India by Yogi.

It is appropriate here to refer to our inscrutable companion Stocker,

the cinematographer. His weatherbeaten wrinkled face and quiet husky drawl were external features of a deep psychological sensitivity. He used this to great advantage whilst cultivating the friendship of the rather truculent and suspicious medicine-man of the tribe, who I felt took a dislike to our activities. I watched with mingled amusement and amazement the opening gambit of Stocker's approach. Without uttering a word, he went up to the medicine-man and slowly opened his closed fist, showing something to his 'colleague' for I realised at once that they were both of the same ilk. The witch-doctor peered at the disclosed secret, and Stocker at once closed his fist again. From then on he complied with all Stocker's wishes. I asked Stocker what it was that he had so secretly disclosed. Believe it or not - three white quartz pebbles, which he then showed me. "It is the way that it's done that matters " said he, grinning. No wonder that he was a successful bunsinessman! To use his own words, he sold himself, not the pebbles. He succeeded, as a consequence, in taking cinematograph film of the aboriginal method of copulation, the witch-doctor being the willing demonstrator. I have never learned how he succeeded in getting this co-operation.

The female sits astride the thighs of the squatting male, and it can be appreciated that, combined with sub-incision, the chances of impregnation would be greatly reduced. Whatever the theory of the origin of sub-incision, control of numbers is essential to tribal survival in this inhospitable region. It seemed however, that copulation and conception were not associated among these natives. Conception was believed to be caused when the female first noticed foetal movement in a region sacred to the tribal ancestor, who was then deemed responsible. The tribal ancestor could be a snake, an emu, a wild-dog or whatever. (See Spencer and Gillen).

Chapter 6.

Second Encounter.

In 1932 the anthropological committee decided on an expedition to Mt. Liebig, some 200 miles West of Alice Springs, at the western end of the Macdonnell Range. This was the edge of the undulating, low scrub and spinifex sand-ridges that stretch like an open ocean towards Western Australia. The border is 150 miles distant. Travel was by means of the same Colson transport, but the track was much rougher, particularly after passing Mt. Ziel. The trail had been prepared by Colson after the Ngalia tribe had been contacted, and their gathering, together with the Pintobes at Mt. Liebig had been forecast for August.

Colson had once again prepared the crossings of the major river beds by cutting a ramp to the high banks on either side, in particular of the Dashwood and Darwent Rivers. He also established caches of petrol, and there was no other trail excepting that marked by Colson. After passing Haast's Bluff there were many smaller water courses to slow our progress, and, as it transpired, to wreck some of our delicate apparatus. On the return journey it even broke one of those containing springs on the truck.

Unlike the Cockatoo Creek route, this one followed the Northern flank of the MacDonnell Range, and we were regaled with magnificent views of this rugged remnant of what were once very high mountains, in fact, the spine of the Continent. In the Cretaceous period, some 100 million years ago, the sea had invaded from the Gulf of Carpentaria as far south as Lake Eyre. The deep blue of the distant peaks starkly contrasted with the bright red of quartzite ridges in the foreground. This sharp contrast had attracted the Adelaide artist Rex Batterbee, and he spent some time painting in the McDonnells around Alice Springs. It was whilst watching him paint that the

detribalised Arunta, Albert Namajira displayed sufficient interest to encourage Batterbee to teach him how to use watercolours. After World War 11 Namajira became famous for his art, and, as a tragic consequence, was encouraged to produce countless 'potboilers' that suffered in quality but found a good market.

During the 'phony war ' in early 1949, I was involved in a reconnaissance for an all-weather military highway from Alice Springs to Darwin, and had called on the store-keeper in 'The Alice'. The town was unchanged. The dusty, silent main street baked in the noon-day sun. The storekeeper pointed to a heavily built aborigine in shirt and trousers walking on the opposite side of the street, saying,

"That's the 'boong' that Batterbee taught to paint. He was in here trying to sell me a couple of his pictures. Would you like to have a gander?"

I hadn't heard of Batterbee and his aboriginal pupil, nor had I heard the word 'gander' - meaning 'to look'. I recalled my experiences among the nomad tribes, and said

"Yes, I would". I can see the storekeeper now, standing silhouetted in the doorway / against the blinding outside sunlight. He shouted

"Albert!" The big aborigine lumbered across the street, thinking I suppose, that the storekeeper had changed his mind. "Albert," he continued as the native entered the store, "show the Lieutenant them pictures."

From his trouser belt Albert extracted an off-white narrow tube which, it transpired, was a roll of two sheets of Whatman paper, which he unrolled on the counter, holding the edges with his big hands. I was struck by the art and by the scene of the uppermost picture. I recognised the scene at once.

"I know that mountain Albert, that's Mt. Sonder."

Albert grinned hugely, "You know 'im boss?"

"Certainly I do. Am I right?"

" Sure. O.K. You like to buy 'im?"

"How much?"

"Thirty bob," replied Albert, and the painting changed hands. The Whatman snapping back like a steel spring to form a tight roll about an inch in diameter, so desiccated was the paper.

The picture was about 18 inches by 12, and I pushed it into the farthest recess of the canvas pillow pocket of my sleeping bag, and forgot all about it until the war's end. Home again, I hung that war-stained travel bag on the clothes line to air, and out fell Albert's roll of Whatman! There was only a slight defect due to water that marred that mountain scene. The indigo blue range with that strange cliff-like tor of Mt. Sonder. The grey-green of the spinifex in the middle distance, and the stark red quartzite outcrops in the foreground. One of his original masterpieces! It had come through much unanticipated experience since that day in Wallis Fogarty's store in the Alice.

When this expedition was being planned, and although I was no anthropologist, that courteous gentleman, Prof. J.B. Cleland invited me to join the managing committee. Knowing my own character only too well I politely demurred. He was insistent that I would be most valuable on the committee.

"The fact is J.B., I take a strict line where the spending of other people's money is concerned. You might find me too hard."

But the dear man put me on the committee. We met at his house.

"Before we proceed with choosing personnel, might we be told the function of each one proposed for the expedition?" I asked.

"But of course," answered J.B., "Everyone has his task to perform."

"In that case what did Professor x do at Cockatoo Creek?"

"He took photographs".

"Yes," I agreed, "but he exposed all of his half-plate negatives to light, and lost them all . Did he perform any other useful function to justify the expense of including him? " There was no answer to my query. So I continued

"I move that Prof. x be not included in the expedition."

"But," objected my peace-loving colleague, "he'll find out that we excluded him".

"Oh no," I replied, "He will learn within 12 hours that I was responsible."

Dr. T.D. Campbell, the leader of the expedition, and I were deputed to approach 'The Advertiser' management for additional financial aid in return for sole reporting rights. We were on a tight budget. Mr. Lloyd Dumas (later Sir Lloyd) agreed, and gave us £200, a considerable sum in those days, and Mr. Max Lamshed, the journalist, was deputed to accompany us. No sooner had we settled ourselves in our ancient carriage on the train at Port Augusta, than we discovered that 'The News' had sent a reporter to follow us. In spite of my protest that we could not allow him to join our party, it was decided to wait and see what transpired at Alice Springs.

On our arrival I again spoke to him as on the train, and he replied that he was a free agent and could go where he chose. "Not with this expedition" I explained. "It has cost, and is costing a great deal of Rockefeller money to carry out, and the Advertiser has given generous additional support on the strength of a promise of sole reporting rights!"

That, I thought, was the end of him. The complacent attitude of my colleagues astonished me. I felt that it was moral turpitude. After this contretemps we proceeded on our journey.

Apart from the rough travelling due to the crossing of countless creekbeds the journey West was full of interest. The country had the appearance of a vast park carpeted with tow-coloured grass bleached by the sun. As this carpet unrolled, the tufts of grass became separated by one or two yards of red, sandy soil.

There were strange isolated communities of plants. Here,a grove of sheoak with black trunks and dark heads of stringy foliage, standing alone among tufts of spinifex. There,a stand of cork trees, and near the ranges smaller clumps of mallee or acacia. The occasional ghost-gum with its white-washed trunk and light green foliage stood out against the rocky outcrops like Beauty in the presence of the Beast.

On the third day we arrived at Mt. Liebig, which was a truly impressive peak, and at the foot of which we set up our camp. Across a wide, deeply cut river bed the Ngalias had already established their 'camp', and once again the aborigines had kept their rendezvous. The Pintobes it transpired, had not yet arrived. The rough river bed was strewn with trunks of trees and other debris including large boulders, ample evidence of the fury of the torrent produced when a heavy rainstorm pours its waters off those bare rocky ranges.

Whilst the main party were setting up their camp, we three, Eldridge our technician, Moore, a science student working his way through his university course as a laboratory cadet, and I, arranged our gear for the demonstration. The Ngalia men were mustered by Peter. Unlike the aborigines at Cockatoo Creek they were not ceremoniously dressed, and looked less well-fed and somewhat shaggy. Nevertheless they sat around and listened to what Pastor Kramer and Peter had to say by way of introducing us. Again, unlike the Anmatjiras they talked a little with each other, and I got the distinct impression that

in some manner they had acquired more information than had been imparted by Kramer and Peter when they had been first contacted. On further expeditions this fact became clearly established. We seemed to have become as familiar as wandering minstrels were to the villages of medieval Europe.

As Spencer and Gillen relate in their account of the wanderings of the Achilpa men of the Arunta tribe, there is contact along the frontiers of the great tribal regions. In the case of the Aruntas, the map covers some 60,000 sq. miles!

The territorial integrity of European groups such as Slovaks, Croats, Ruthenians etc., is reflected here. We forget also that China is thus divided. It is the Chinese Culture frozen in the ideographic script that seems to obscure racial territorialism from superficial observation.

We were asking more of these Ngalia than of the Anmatjira. We wanted 14 men on whom to carry out more complete investigations for a longer period, namely, from early morning till midday, in pairs, continuously! They watched us go through the routine of our procedures, and apart from that little discussion among them, they remained impassive.

Following this encounter, we adjourned the meeting until very, very, very early, - it was emphasised by Peter, next morning. We pitched our camp and set up our laboratory tents, complete with apparatus.

We had just settled for the evening meal, when a car arrived with a driver and that tenacious journalist, who now wanted a meal! After the meal we held a meeting of all members, and I proposed that the intruders be firmly told that unless they could support themselves independently, they would have to return to Alice Springs. After this contratemps, we three continued with the task of preparing our equipment for the next day's work.

Our investigations proceded with the same unruffled calm as at Cockatoo Creek, even though we kept our victims in their 'beds' from 5 a.m. till 1 p.m. We wished to make as complete a study as was possible, of their metabolism, as the atmospheric temperature rose from below freezing point to 90° Farenheit in the shade.

The rough journey had smashed some of our delicate apparatus, and we were unable to make any measurements of air movement and the cooling power of the atmosphere, or of radiation from the small bedside fires. We were however, successful in our efforts to measure the ratio of the oxygen consumed by the aborigine, to the amount of carbon-dioxide that he expired, under special physiological conditions which I will now endeavour to describe.

Within 30 minutes of consuming a meal, especially one consisting of meat, the uptake of oxygen is quite rapidly increased, and heat is produced. This is the reason why we feel warm after a meal, - it is not due to the heat of the food itself. This reaction is known as the 'specific dynamic response', and is due to energy set free during the processes of metabolism of the products of digestion. This is also part of the reason why the basal metabolic measurements must be made in the post-absorptive state, 12 hours after the last meal, when stomach and gut movements are at a minimum.

As I have already explained, we were searching for some explanation of the apparently 'normal' European basal metabolism of naked aborigines, under conditions far from comparable with those of Europeans in a warm bed. Would they, for example, respond differently after a meat meal? Would they perhaps, waste less energy in these circumstances than a European? Would they reveal some marked difference in the nutrients which the

cells utilised in the process - that is, in the relative proportions of protein, fat and carbohydrate of the foodstuffs eaten?

These proposed experiments were to say the least, ambitious. Would the natives submit to five hours of continuous investigations? Accurate gas analysis is an extremely tedious procedure in a laboratory; how would the apparatus stand up to such rapid and extensive changes of temperature? How would the grease in the glass taps behave? And above all, how would the unfortunate scientist behave under these conditions, - pestered by flies, by leaks developing in the apparatus, and by constant re-checking throughout each stage of each measurement?

As already related, one important piece of apparatus was smashed beyond repair. That accident doubled the workload on the one remaining, increasing the risk of error. It also confined this work to only one operator, because only one man can manipulate such gear and learn how to handle its peculiar, individual vagaries, the more so under these trying conditions.

I cannot pay too great a tribute to Mr. Moore, who conducted all these laborious analyses in triplicate. With a fly net over his head he sat in his tent all day long doing nothing else, and then spent the evening with me until the late hours, re-checking all the taps for leaks and the spirometer for accuracy, replacing chemicals and entering the results in the record book.

The arid atmosphere and great temperature changes played havoc with every tap, valve and joint. It is little wonder that Moore, working his way through University, finally became head of a Division of Imperial Chemical Industries before his untimely death. The taxation supported

student of today, in my opinion, is really under-privileged, because he is deprived of stimulous, thought and action, as well as of the experience of working his own way. Eldridge, my technician, was unshakable in his attention to every detail, and wonderfully patient and sympathetic with his aboriginal subjects. He collected all the great Douglas bags of expired air, and assisted in extracting the samples for analysis, as well as in measuring the volume of the bags of air. Taking into consideration all the difficulties involved in these procedures, with apparatus that would be a laughing stock today, it is a matter for comment that we obtained the good results that we did. Messrs Moore and Eldridge, and the aborigines in particular made this possible. Eldridge, a 6 foot 3 inches Man of Kent, an ex-soldier, had hands like hams, and yet he was as gentle and efficient with delicate glass apparatus as he was with his aboriginal subjects, and they reciprocated with friendship. He was also a man of character, for, at the breakfast table one morning, he made a justified, critical comment on the fact that by the time we three arrived, the others had almost finished the meal, and they had left us scarcely any of our butter ration. The Professor responsible for the rations bridled and said

"You wouldn't speak to your own professor like that!"

"'Course I would" replied Eldridge, who hadn't an aspirate in his vocabulary, "if I thought 'e was wrong, and out 'ere more likely, where men count only as men!"

I could not refrain from commenting, "Eldridge is quite right, and in fact I depend upon him to do just that, - he is my alter ego! "

The most remarkable feature of these investigations at Mt. Liebig was once again the performance of the aborigines. The instructions which Pastor Kramer and Peter had to convey were much more complicated than those which had been imparted to the Anmatjiras at Cockatoo Creek. We wanted 14 men in all, on whom we would conduct our ritual from before dawn until midday. Only two would be required at a time, and one of them would get a big piece of kangaroo meat. The other would not get his ration of meat until midday, but he would get twice as much for waiting. Both would lie in their sleeping place and not move about.

We demonstrated the basal metabolism apparatus in action, and also the added business of breathing into a Douglas bag, hoping that the carrying away of a bagful of their breath would not raise some suspicions of witchcraft. We were naturally dubious of the co-operation we would get, particularly because the experiments lasted so long. In the event however, the aborigines behaved magnificently, and proved that they would do precisely what we wanted of them. It was not only imperative that they move as little as possible, but equally essential that they in no way altered their rate and depth of breathing when we took the bag sample. Our results could have been utterly ruined by any departure from normal breathing. Of course this latter could not be explained to them, and we could only rely on their Yoga-like behaviour. With medical students who understand precisely the importance of

these limiting factors, they more often than not, over-breathe as soon as the test begins. This is due to the nervous effect of breathing against the resistence of the valves. Only after some patiently repeated tests do students overcome the interruption of their normal breathing. So far as we could determine, these natives completely ignored the fact that they were breathing into a flexible pipe leading to a large Douglas bag. Our apparatus was much more fallible than they were! All in all, in spite of the frustrations and difficulties with the apparatus, it was worth it. We discovered no explanation of their basal metabolism in terms of some peculiarity in the use of food, nutrients or of oxygen.

The meatmeal consisted of raw kangaroo shot by Colson. Following its consumption there was a delay of one hour before the specific dynamic response set in, and when it did, it was considerably greater than the average value hitherto recorded for Europeans. This seemed to suggest that it was due to the fact that normally the aborigines ate only when food was available, and not as we do, who eat meals at regular hours. This also explains the fact that they are capable of gorging themselves with amazing quantities of meat at one sitting. This recalls the fact that Farley Mowat, who lived among the Eskimos of the North West of Canada, referred to the fact that when meat was available and they were hungry, these Eskimos could consume as much as 10-15 lbs of meat at a sitting.

In the present experiments, the aborigines who were acting as fasting controls, showed a steady fall in their metabolism and an increased demand on their body stores of fat. This seemed to indicate a borderline state of nutrition which confirmed our opinion of their appearance when we first met them.

Unlike the Arrmatjiras at Cockatoo Creek, who looked well fed and in

good condition, these Ngalias appeared to have lost weight due to the continued drought years in their territory. Mowat also refers to the Eskimo craving for fat. They become quite ill if they do not get enough. One would have had to live for weeks with the aborigines to discover precisely how their nutrition was balanced, but they certainly extracted every piece of fat they could from marrow bones and the omentum, and obviously the witchetty grub was a supreme fatty delicacy.

As already stated, it was not feasible to measure with any degree of accuracy the characteristics of their local bedsid 'climate'. There is a post-war sequel to this to which I shall refer later. It seemed however, that our only hope lay in somehow using the aboriginal himself, as the instrument to measure the effect of his local 'climate'.

It now seemed much more likely that the aborigine was in some way controlling his heat loss, rather than burning more fuel in his 'internal fires' in order to keep warm. The question was, how could we investigate this possibility? The scene will eventually switch to distant Switzerland before we can find our answer.

Before making that voyage however,-five weeks by sea as a ship's surgeon in those days, there are some side observations that deserve mention. Because the Pintobi tribe had not arrived, Mr. Strehlow, the only anthropologist in the party who could speak Arunta, and who was a natural bushman, volunteered to go with Peter as far as the Ilbilba rockhole in the Ehrenberg Range, half way to the Westralian border, in order to locate them. They set off on this desert journey on camels, and expected to return within four days.

Deciding to take Sunday afternoon off, we elected to climb Mt. Liebig. We left shortly after noon, and carried with us an ample supply of water.

The party consisted of Pastor Kramer, three aboriginal boys, Moore, Eldridge and myself. On the way up the razorback of Liebig, the boys, with excitement, drew our attention to smoke signals in the North Western waste, and promptly, by means of their firesticks, ignited some great tufts of spinifex. It was in fact our first sight of the Pintobe tribe approaching from another direction to that taken by Strehlow. We began to fear that the whole mountainside would burn, but fortunately, there being no breeze, the fire died down.

On our way we each had a drink of water, but the boys spurned the offer. On reaching the top, and having another drink, we offered the remainder - about 2 quarts, to the boys, who drank it practically in one gulp. It seemed as though they had some form of water discipline. They could do without constant slaking of thirst, which is wellknown to be detrimental by both explorers and athletes, but when water was available and no effort was demanded, they could drink large quantities.

From the top of Mt. Liebig we could see the Ehrenberg Range, like an island in the midst of a vast sea of gently undulating dunes, covered with low scrub. Looking Eastward, the view was that of some tortured, mountainous, uninhabited terrain. Appropriately we sang some Swiss mountain songs led by Pastor Kramer, and after the boys had so spectacularly drunk the remainder of the water, we returned.

Next day, two extremely fine looking, fully dressed and armed young men arrived as an advance party of the Pintobes. They were well nourished, well-built young men of about 26 years of age, painted red-brown with hematite, and wearing whitened string headbands. They walked into the camp without any sign of emotion, even when Stocker set up his Hollywood contraption to roll off some film, and I danced around with my

Leica camera. They were unimpressed so far as one could tell, by the tents and impedimenta of the camp. They joined the Ngalias and must have conveyed some message as the sequel illustrates.

The most astonishing event as far as we physiologists were concerned, was to discover them lying in new beds alongside our Ngalaia men, and ready and waiting for us to measure their metabolic rate!

Surely this is one of the most fascinating records of those now departed nomads! Who told them to do this, and how was the information imparted? Did they also have earlier knowledge passed on to them from Cockatoo Creek?

That same day the Pintobe tribe came in sight, and our aborigine friends informed Kramer, and he and I went to meet them. In single file, the women half a mile behind the men, they marched steadily through the spinifex, the men coloured red, and all armed, a young circumcised boy bringing up the rear. He was no longer permitted to join the ladies.

The women carried babies and quite big children - about 3-4 years of age, as well as pitchis of water. The small infants they carried in their pitchi and the larger children on their backs.

When the men arrived, all Hell was suddenly let loose. The Ngalias met them brandishing spears, and the Pintobes retaliated. And then they broke into a circular menacing dance, stamping on the ground as they whirled in a circle of dust, pointing their spears at each other, and uttering a loud"Ugh, ugh, ugh,"as each foot was brought down in unison. It was a somewhat frightening sight. Then, quite as suddenly as it had started, the mock joust ceased, and still in a circle, they sat down and made signs to each other across the 'tribal boundary' as it were. Manifestly they also understood sufficient of each other's dialect.

Was this what the ethologists had discovered during the past 30 years

to be a universal manifestation of territorialism among living creatures? Robert Ardrey has done a considerable service by bringing all that scientific literature together for the general public, in his book 'The Territorial Imperative'. How right was Wood-Jones! Our efforts to comprehend these remnants of our living forebears were too little, too late.

So the Pintobes, like Blücher at Waterloo, had kept their word. But what about Strehlow and Peter, who had gone to meet them? The fourth day came, the fifth, the sixth, and the seventh arrived, and by this time our anxiety had reached the point of action. Fires were lit as beacons on the higher ranges, and it was decided to send back half the team to Alice Springs for assistance, as well as to conserve provisions for the rear party. Although Colson still considered that Strehlow would turn up, he agreed with the proposal.

On the morning of the seventh day a great commotion among the aborigines heralded the arrival of Strehlow and Peter. It was quite evident, as they crowded around their camels, that they were well aware of our anxiety.

Strehlow seemed slightly surprised that we should have been so disturbed! Our relief can be imagined.

On the return journey, we had to unload the truck to fix a broken spring. As we were negotiating the particularly rough track through the MacDonnells to Alice Springs, we, on the truck, saw something that might not have been so funny three days earlier. Rolling downhill towards us were the gear wheels that had fallen out of the preceding sedan car. It had expired on the last lap!

Chapter 7.

Third Encounter.

The original question posed by Benedict was:-Does the Australian aborigine, like the Chinese, reveal a racial difference from Europeans in his metabolic oxygen requirements? So far, our investigations had revealed no evidence to support that possibility. The climatic and social conditions under which we conducted our investigations however, had compelled us to seek the reason why their oxygen /energy requirement was unaffected by the cold, night climate.

In this search we had found by crude means that their skin temperature had, in fact, fallen some 5° below the level tolerable by a European, and yet, their oxygen demand remained the same, as if they were in bed at a temperature 5° or more above the room temperature! What could be the explanation? We were left with only one possibility. These natives must be able to CONSERVE their heat energy! If so, they responded to the cooling power of the night temperature, by controlling the loss by radiation of heat from their skins. How to prove this was quite another matter.

Such is the nature of the universal, questing, human spirit, that evokes what is called scientific research, that every experience, however unrelated to any other at the time, remains impressed in the store of memory. It so happened, that I had seen in Prof. Sahli's clinic in Berne, a device that he had constructed to assist in the more accurate diagnosis of cardio-vascular disease. He called it a sphygmo-bolometer (sphygmo= pulse, bolo = stroke, metron = measure)a pulse/volume measuring device. When appropriately strapped to the wrist, it transmitted a graphic record of the volume of blood passing through the radial artery at each pulsation. This record could be calibrated in such a manner as to provide a basis

We constructed a replica of this device in the physiology laboratory of Adelaide University, and Dr. O'Connor devoted much painstaking investigation of its accuracy, and its ability to give reasonably significant information concerning the blood flow through the skin. His laboratory studies involved a critical assessment of the results of other workers in the field of vaso-motor control of small arteries in the limbs, (vaso motor = vessel control). This is too recondite a subject for further reference here. Suffice it to say, that upon Dr. O'Connor's experimental skill, and physiological analysis, depended the possibility of further useful field work with our friends the aborigines. His results justified the magnitude of the effort.

The Sahli pulse/volume bolometer, used in the manner that O'Connor devised, could give an approximately quantitative measurement of the state of constriction of the blood vessels supplying the skin of the arm. He had also found during his investigations, that the magnitude of the blood supply to the skin of the arm, was closely related to that of the skin of the whole body, and therefore could be used as an index of the state of constriction of all skin blood vessels. This was an entirely new use of the instrument, and one not envisaged by Sahli himself.

But there was a practical difficulty to be overcome. The device was quite unsuitable for transport and for use in the field. I had meanwhile visited the well-known scientific instrument maker Jacquet, of Basle, and knew that he was developing a portable pulse/volume bolometer. It was a beautifully conceived device, and I persuaded him to let us have one of the first that his workshop constructed. Armed with this instrument, and with Sir Charles Martin's specially made skin thermometer, we prepared for

another expedition.

The anthropological committee now planned to meet a tribe of aborigines of the Luritja group at the Ernabella waterhole in the Musgrave Ranges. Two dingo scalp hunters had camped there for some time, and were living a relatively rewarding, if primitive existence, by trading tea, sugar and flour , with the aborigines, who collected the dingo scalps, and, so it was rumoured, reared dingos to meet the demand!

The dingo, according to some authorities, is the only true dog that is unrelated to the wolf. It is believed that the original migration of aborigines from Ice-Age Europe, brought the dingo with it, over what was then almost a land bridge from Malaysia, caused by the retreat of the ocean, due to so much water being locked up in the ice of the Big Freeze. Be that as it may, this reddish - furred animal made depredations among sheep on the pastoral runs, and there was a government price on its head - or scalp.

These 'doggers' therefore, were well situated to make arrangements for a native rendez-vous with the expedition. Seen in the modern context of nutrition science, this traditional pay-ration could do nothing but undermine the basis of the health and stamina of the natives. The same attitude in principle, was the cause of malnutrition among troops during the 1939-46 war.

Ernabella waterhole is approximately 250 miles from Oodnadatta, on the railway to Alice Springs. Our route lay North West along the course of the Neales Creek, a dry water course of what becomes a broad river 400 miles in length during flood seasons. The first part of the journey led to Todmorden pastoral homestead, some 60 miles from Oodnadatta. There the route turned due West to the Moorilyana rockhole, and again North West to Glen Ferdinand and Ernabella in the Musgrave Ranges.

Today there is a road into Ernabella, where the Presbyterian Mission Station now stands, but, at that date, after leaving Moorilyana, it was necessary to cut away the mallee scrub in many places, in order to get our vehicles through. Hitherto packhorses had been the only means of transport into Ernabella. Our vehicles were much superior to those used on the previous expeditions, but great care was necessary to avoid any cut branch that might penetrate the radiator, or any stump that might tear a tyre or puncture the sump of the engine. Progress over the last 70 miles was therefore slow. We were destined to see rapid changes in this part of the route, during subsequent expeditions.

The first halt was at Todmorden. The great stockyard, and buildings of a once prosperous pastoral run, stood silent and deserted. As far as the eye could reach there was nothing but bare, red earth, with here and there skeletons of dead mulga trees. Only the occasional whining creak from the almost motionless windmill, or the dismal cawing of crows, broke the silence. On a low hill stood a large white, one storeyed homestead. We ascended to find ourselves in the courtyard of a spacious mansion, built on three sides of a rectangle, enclosing what had once been an extensive patio laid out in ornamental gardens and walks, with acetylene gas lampstandards for nocturnal illumination. Wide verandahs bordered the patio, and on their flooring our footsteps sounded uncannily loud. One felt as though one were intruding on privacy. It must have been a lovely setting 'once upon a time'. The billiard room looked as though it had only recently been in use. The pictures were still on the walls. All was deserted. Thinking of the abandoned schooner Marie Celeste, I almost expected to find a recently partaken meal on the dining table. The crows mocked raucously, for it was, in fact, a House Built on Sand! That hillock was a sandhill!

During the 1914-18 war, so I was told, this station had enjoyed good seasons, and its owners had prospered from the sale of beef cattle and army remounts. Then followed inexorably, the series of ever leaner years of ever increasing drought. The cattle came in to drink at the homestead bore, and then consumed all the bark and leaves they could reach from the scrub within a radius of two miles from the water trough. It was a desert in the making. The great homestead with its gay parties-"they dressed for dinner"I was told, became isolated within its own self-made desert.

Todmorden! Did those settlers come from that district of Yorkshire whose name will always be associated with the Industrial Revolution and child labour in the cotton mills? Rochdale, and the revolt against the burden of church taxes. Rochdale and the Pioneers, the first-ever co-operative supply store. Todmorden, only five miles from Rochdale, was already a cotton spinning and weaving town in the 40s of last century.

As I stood looking over the drought stricken scene, I imagined migrants from Yorkshire coming here into 'the bush', and experiencing a series of deceptively alluring good seasons, and setting up a "fine gentleman's residence", as a poke in the eye for the sweat and tears of the 'dark satanic mills' of Todmorden. I may be romancing but, the moral remains. As I write 40 years later, that same Industrial Revolution has already run its extravagant course. There, at Todmorden Yorkshire, a few became rich on the grinding toil of the many, mostly women and children. Here, in a new Todmorden, some became rich on the destruction of the environment, about whose finely balanced structure, the climate and natural history, they knew nothing. Nor could they have known. Provided that they got out in time, they could keep their gains, if not, they came out as they went in, cut down to size by the climatic cycles of this ancient, arid Southern

continent.

This account is no history of pastoral leases, it is merely the musing of a scientist, then a newcomer to Australia, who found himself in the Red Heart by the strangest concatenation of circumstances. I was seeing and feeling the environment of the aborigine, an early stone-age man, who, together with the environment, had survived we now know, at least 22,000 years, in spite of the climate's terrible vagaries.

After travelling some 100 miles further, we camped at the Indulkanna Creek, having passed Lambina Homestead, a modest, white-painted weatherboard house some 25 feet above the bed of the Alberga. It too was deserted. The same scene of 'eaten out' desolation met the eye. Empty stockyards, no sign of man or beast, and always the crows, one in particular, up in the single gum tree standing by the white gate in the picket fence. It gave its raucous, mocking cry and flew away. Like Edgar Allan Poe's raven, it might well have been crying 'Never more!' That lone tree was destined to save the lives of a little family from the raging waters of the flood!

Granite Downs, marked on the map 'Home Station' was merely a ruined pile of stones. It had long since been deserted. I began to feel that the Red Centre had shrugged from its shoulders its would-be exploiters. After leaving Moorilyana rockhole, cutting our way through the mulga scrub, we finally entered a savannah type of country, and the indigo blue of the distant Musgraves beckoned us on. Glen Ferdinand looked quite attractive in the deceptive manner that valleys in these dry, sunbaked red ranges contrive. The effect on the eyes of the green spinifex, the occasional bright green of gum trees, acacias and smaller shrubs, as well as the tow coloured tufts of dry grass, at a distance, is diminished as one approaches. This is because they are all so sparsely distributed, and distance merges the individual features into a composite whole. The country has in this respect, a mirage-

like quality. Dr. H. Basedow, who visited it in the winter of 1903 writes as follows:

"When the mists of evening rose, and the light in the Glen grew dim, the blue-black thickets of mulga on the plain could no longer be distinguished from the pines on the hills, and I could scarce persuade myself to believe that the landscape before me was part of arid Central Australia, and not Thuringia or Tyrol."

The "mists of evening" increased the mirage effect.

Near the waterhole at Ernabella, quite a large and attractive pool in the rockbed of the Officer Creek, stood the 'doggers' tents, and we were welcomed by two weatherbeaten ex-soldiers who had escaped from civilisation. The Witjakopanja tribe, a Luritja branch, had arrived and were camped half a mile away. We set to work and made our camp. My group consisted of Dr. John O'Connor, my senior Lecturer, my technician Eldridge and myself.

On this first expedition to Ernabella we hoped to find some co-relation between carefully mapped temperature spots on the skin of the whole body, and the volume of blood passing with each pulsation at the wrists.

Sir Charles Martin, Director of the Lister Institute London, who had studied skin temperature in relation to feelings of comfort or cold, as well as oxygen usage, loaned us a set of his especially constructed, sensitive, flat-bulb skin thermometers. Dr. O'Connor made the pulse volume measurements, whilst Eldridge and I simultaneously mapped the skin temperature.

Unfortunately, the thermometers proved to be too slow in operation, and not accurate enough. This was disappointing, and proved one thing, namely, that one should not accept a technique however successfully applied in a laboratory situation, and expect it to work under less favourable and

more demanding circumstances.

Our results nevertheless did give us the evidence that we were on the right track. The blood flow at the wrist followed closely the changes of atmospheric temperature. What we needed was greater accuracy as well as much greater rapidity of measurement of the temperature of the skin.

Attempts to estimate in some useful manner the 'local climate' of the sleeping aborigines proved futile. We measured radiant heat from the almost quenched fires, and the rate of cooling of the atmosphere at the head, torso and feet of the natives, but the mass of data yielded only confusion. We became convinced that, if we could accurately and swiftly measure the skin temperature of the aborigine, we should solve the problem.

The rate of cooling, or cooling power of the atmosphere measured by means of a kata-thermometer is expressed in terms of both air temperature and air movement. It has a particular application in the determination of the 'comfort range' in air-conditioned rooms.

There is a wealth of technical literature on this subject. Australians who have suffered the stifling heat of American air-conditioned room atmospheres, will take 'comfort' from these aboriginal studies! The Honeywell thermostats in hotels and public buildings in U.S.A. are set for a temperature range of 72° - 78° Farenheit, or 22.2° - 28° Centigrade. No wonder they work in their shirt sleeves, and wear the lightest of clothing. Surely this is the uttermost limit of the absurd. It has long been a puzzle to me that such air-conditioned temperatures are officially accepted in the U.S.A. When recently, owing to the 'energy crisis' the nation was advised to lower the thermostat by 4° i.e. to 72° F. or 22.2° C., it was considered that real austerity had overwhelmed them! Those who remember their 'Alice through the Looking Glass' may find, in this context, that the technological age is just

as distorted as Alice's world. Patriotically obeying the appeal from Washington, and the even louder appeal from the Consolidated Edison Electric Supply, the citizens of Westchester, discovered that that company was charging them an increased tariff to offset the smaller demand. In other words they were paying for what they weren't getting! As a consequence they staged a sitdown strike.

There is always an element of luck in scientific research. Consider for a moment the vast amount of excellent work done without a positive result, or with results that culminate too late for publication. Someone else has got there first, like Amundsen racing Capt. Scott to the South Pole. This high drama is a good example. Scott, approaching from the West encountered the worst of terrain and of blizzard, Amundsen from the East, enjoyed sunshine and smooth terrain. He planted his flag for the unfortunate Scott to discover! The ill-fated Capt. Scott lost his life in a blizzard on the return journey.

Here at Ernabella, we had two amazing pieces of luck. Quite exceptionally the skies clouded over, and, during the second week it began to rain - in August! It so happened that Dr. O'Connor was making blood pressure measurements on a native at the moment when a stray cloud, in an otherwise blue sky, temporarily cast a shadow over the recumbent aborigine. His blood pressure rose steeply by 30% ! This isolated fact, like a piece of a jigsaw puzzle, fell into place with those previously reported experiments with the sphygmobolomter in the laboratory. Obviously the rise in blood pressure had been caused by extensive constriction of the blood vessels of the skin.

The second piece of luck was fateful. Intrigued by stories of 'poison bush', one mouthful of which, so we were assured by the camel-drivers, would kill a camel, I had gone with an aborigine guide some 12 miles

South of the Musgraves to collect some of this remarkable bush for investigation. Although I did not realise it at the time, I was soon to be engaged in another research that in Edinburgh, had crossed the path of Drs. Livingstone and Kirk of 'Darkest Africa' fame of the 19th century.

We found a small grove of these tall bushes growing among the spinifex. Their narrow lanceolate leaves were a light green, and the bushes were about 9 feet high. We tethered the camels before collecting our sackful of branches and twigs. My guide tied the sack before him on his camel, and, feeling like Sir Richard Burton of Arabian Nights fame, I travelled back to camp, slightly bemused by the stench of so much camel-belch, which hung in the hot, still air, following each regurgitation of fermenting fodder, to be remasticated. I began to watch in anticipation each regurgitation ascending the long throat, like a travelling Adam's apple, and braced myself for the ordeal. The sack was dumped outside our tent. Unexpectedly, and unseasonably, the sky clouded over and light rain began to fall, and the sack and its contents became wet. Then the leaves began to ferment, and the thing that drew attention to this was a cloud of steam arising from the sack! My precious 'poison bush' which Professor Johnston recognised as Duboisia Hopwoodii was going up in smoke!

We lit a fire and spread the stuff, now partly discoloured, around the fire to dry, and whilst turning it over, some aborigines gathered around shivering, as their skins got wet. They gesticulated at the stuff we were drying and chattered in some excitement. I asked what they were so excited about. My guide replied, in that curious third person speech

"Him blackfellow use with Mingil. Mingil no find."

Mingil is the Luritja name for native tobacco, which they prefer to chew. Pituri is the Arunta name for the corresponding leaves of Duboisia Hopwoodii which Spencer and Gillen state was chewed by the Arunta tribes. It is the same plant used by the Cooper Creek natives as reported by King, the sole survivor of the Burke and Wills expedition.

It was at this fireside, in drizzling rain, that I learned that the natives actually chewed the 'emu poison' as they called it, together with native tobacco. If the stories of poison bush were true, this was astonishing to me, who was ignorant at the time of the long history of Duboisia. The aborigines used this same leaf as a poison to catch emus, a proceeding which I later saw for myself.

The rain, which began as an uncertain drizzle, set in in earnest. The aborigines, after looking at the sky and debating among themselves, shivering with cold due to the evaporation on their wet skins, quite suddenly dispersed. Swiftly they constructed crude, conical shelters by piling branches against each other, and very soon all were crouched in the shelter of these 'wurlies'.

The doggers began to express concern about our return movement to Oodnadatta. My two senior academic colleagues however, with all the valour of ignorance, considered that there was absolutely no need for anxiety! As someone has written, "Man's vanity and the scholar's self-confidence will never know their limits." They even refused the offer of a carcass of mutton as a food standby in case we begame marooned. They also refused to take the advice of these hardened bushmen, not to proceed if we got bogged before reaching Moorilyana. According to Stan

Ferguson, the older of the two doggers, if the rain was so bad at Moorilyana, it was probably raining all the way to Oodnadatta. As he explained to me in somewhat colourful terms,

"No-one will expect you at Oodnadatta, they wouldn't think that anyone would be such bloody fools as to try to get through. And we here at Ernabella wouldn't know whether you had got through. You might bloody well be out there for a fortnight or more, and no-one would know!"
I could only agree, but being no anthropologist, and super-numerary to 'establishment' I could do no more that attempt to persuade my colleagues to listen to the advice of such social outcastes as the doggers!

A mildly sensorious attitude had already been revealed one evening at dinner in the doggers'tent. Stan Ferguson asked if we would like to hear some music, and set up a Decca portable gramaphone which played a well-known record by Ronald Frankau entitled "I do like a murder when I'm out". The reverse side of the record however, became slightly more, shall we say, in modern terms, 'trendy'. The chorus ran "She wore red flannel where she should wear crepe-de-chine, — nothing ever happened to her." My staid colleagues rose and left the 'table' of our hosts! The rest of us dissolved in ribbald mirth! I could almost hear the famous words "We are not amused".

The inevitable of course happened. We reached Moorilyana after a difficult traverse of that bush track, in increasingly heavy rain, at dusk, and sank up to our axles in mud! Like Cassandra, I reminded my colleagues of the warning not to proceed.

"Those fellows know this country, and we dont. Their point was that if it is raining at Moorilyana, it is probably raining all the way to Oodnadatta, and in rain the track becomes dangerous."

But no, they decided that if we could get the truck out of the mud, they would try to push on to the railhead. We set to work, off-loaded some gear, and practically lifted the truck out onto firmer ground. Alec MacLeod, our driver and owner of the truck, kept his opinions to himself. He had been born in that country, but his advice was not sought. He drove carefully into the darkness, the rain slanting in glittering streams towards our headlights. The experienced Alec fortunately knew the track, even though it now appeared to be non-existent. Every so often there would be a sickening skidding of wheels, followed by a lurch as we drove through a soft spot onto harder ground. These episodes increased in frequency, causing an exchange of sour humour among the wet and cold team perched out on the load.

At last, appropriately at midnight, we sank, this time for good! Our irrepressibly optimistic and courteous senior, could be heard saying,

"Come gentlemen, let us all get the truck out onto firm ground! "

We sank over our boot-tops, and no amount of muscular effort prevailed, whilst the revolving wheels plastered us with mud and only dug deeper into the mire. Every time we lifted our feet with a sucking sound, out of the morass the other foot sank deeper.

*

"What about kadaitcha shoes now?" muttered Cecil Hackett.

*

[Kadaitcha shoes are fashioned from eagle feathers, and when worn, leave no toe and heel impression on the ground. They are worn by an aborigine who wishes to leave no trace of his murderous mission of vengeance.]

We off-loaded to no better purpose than to deposit kitbags in water. It was evident that we would have to spend the night where we were, wet and utterly exhausted. Morosely, I carried my sleeping bag and waded about until

I found hard ground only just covered by water, unrolled my bag, crawled in and slept, hoping that the water would not rise further.

Mercifully the rain ceased and I woke to hear the gentle tones of my imperturbable colleague calling "Come on gentlemen, get a fire going for breakfast."

There, some fifty yards distant was the truck, and behind it the sedan car. The former was sunk to the floorboards at the rear, and as far as the eye could reach in every direction - water! Protruding from this inland sea a lone bush some hundred yards away was the objective of the professor, who splashed his way under the impulse of dire physiological need. That 'old man saltbush' proved to be merely a token gesture of ppopriety.

We lifted the unloaded truck bodily out of the mud, and then pushed it forward without using the motor, until we felt the ground harden. In answer to my question as to what lay ahead, the laconic Alec replied

"One thing's in our favour, - the rain has stopped." We were in the middle of the Central Australian plain, wellknown for its quagmire qualities. Camels had sunk to their death in these conditions in one of the deeper claypans, invisible of course, when covered by water. As though to disprove all bush law in favour of academic education, but with many breathtaking near misses, we finally reached the firmer track, and Oodnadatta.

When our mud bespattered truck and party pulled up outside the pub, we were met by no enthusiastic welcoming party. Two police constables and a few stranded 'locals' greeted us with such a scalding chorus of obscene personal contempt, that it made Ronald Frankau's record seem like a Salvation Army hymn. The gist of it was that no-one had been permitted to leave Oodnadatta for the past three days, and who did we think we were to pose such a search problem for law abiding blokes?

Chapter 8

Fourth Encounter.

After mulling over the results of our last expedition, we decided that we would have to make a final attempt to prove our theory that the aborigines were controlling heat loss through the skin. Martin's thermometers had let us down rather badly, they were too slow. We had to measure the skin temperature of the whole body of the aborigine, simultaneously with the measurement of blood flow through the wrist. Speed was essential. We decided on an electrical method.

If the junction of two unlike metals is heated, an electric current is produced. The junction is called a thermo-couple. Could we construct a thermo-couple so minute and so sensitive that it would almost instantly tell us the temperature of the skin, where it rested ever so lightly?

We fabricated such a device. The thermo-couple was no larger than a pin-head. What is more, it worked. It required only six seconds to tell us the temperature. By rapidly measuring the skin temperature at the points marked on the body chart, we could keep pace with the blood flow measurements. This account makes it seem simple, but believe me, the preparatory work was far from that, because it was absolutely essential that the tiny thermo-couple pressed on the skin with equal pressure everywhere it was applied. Dr. O'Connor and I arranged with Mr. Wilkinson, the storekeeper at Oodnadatta, to transport us to Ernabella and back on the 'tea and sugar truck' with Alec McLeod. The Rev. Mr. Love at the recently established Presbyterian Mission at Ernabella would look after us. Civilisation was now taking over.

The journey over the old track raised memories of that wet night on the Central Australian Plain. Alec admitted that he might have refused to on that occasion

proceed after our arrival at Moorilyana, but said that he "didn't care to throw his weight about." He considered that had the rain continued, as well it might have done, we would have been in " a difficult situation". Difficult,I thought, was a typical Central Australian understatement.

The only change along the track was the appearance of a pale blue wisp of smoke issuing from the chimney at Lambina. We stopped at the lone gum tree outside the gate in the picket fence, and went down the path to the house, to be greeted by a Mrs. Page and her mother. Page had taken up the lease of Lambina, gambling on the ending of the drought years. He was away at the time, on the vast area of which he was now 'monarch of all he surveyed.'

They gave us a cup of tea, we admired the infant, and took our leave. There was still water in the long rocky bed of the Alberga Creek, but the drought had not yet really broken.

When we arrived at Ernabella, we found to our disappointment that there were no aborigines. The Rev. Mr. Love suggested that they must be in the vicinity, and that we could take two of his camels and a native boy, who acted as his shepherd for his goats and sheep, and that we should journey South some 25 miles to Erliwunya-wunya, where he was certain we would meet the tribe.

Somewhat despondently we set out on what could be a long journey, and, as we swayed along in single file, we discussed this first, unfavourable outcome of our plans.

The track lay along the South Western bend of Glen Ferdinand, and was bordered by fairly dense mulga scrub, and after travelling some 5 miles, quite suddenly, without warning, even from the camels, we found ourselves completely surrounded by aborigines. They greeted us like old friends.

One well bearded man placed his hands on my shoulders and shook me, ejaculating "Waddi Chilpi, Waddi Chilpi," and pointed to the North. So far as we could get the boy to translate this, it meant, "Old man of the tribe". It appeared that he himself had travelled from Mt. Liebig 200 miles to the North, in order to take part in another special ritual of ours. He had been one of my subjects at Mt. Liebig!

There were about 20 men, and we wanted only 12, and after much difficulty managed to convey our meaning by signs, because our 'boy' was not nearly so good as Peter was. We remounted our camels, and escorted by the 12 chosen, including my old friend, returned to Ernabella. The other aborigines merely faded into the mulga without any palaver whatsoever, and returned to Erliwanya-wunya, the sacred meeting place, where the tribe had gathered.

Our twelve volunteers were a cheerful group of young men whose ages ranged, we estimated, from 20-30 years. My friend from the North was perhaps 35. They made a camp on the bank of the creek, not far from the waterhole. On the opposite bank of the creekbed, about 100 yards away, stood a small 'wurli' that sheltered an old aboriginal woman, bent with arthritis. How she fed herself, apart from yams, grass seed and berries, I am not able to say. We worked from 5 a.m. until 12 noon, and sometimes even later.

It was no easy task for Dr. O'Connor. The Jaquet pulse-volume bolometer was a small, delicate instrument housed in a sheltering box, and its manipulation was most exacting. e.g. the record was traced by the moving point on a strip of paper coated with soot from a burning piece of camphor. The strip was 1 inch wide, and 9 inches long, and was fed between rollers rotated by clockwork. Each reading had to be calibrated by delicate marks in the soot, traced and then at the finish,

the soot had to be 'fixed' by dipping the strip into varnish. I can hear the horse-laugh of modern technologists!

We had to work closely in unison. Each time I fastened a wrist piece and adjusted it until the pulse beat came through, Dr. O'Connor had to calibrate the record, and then we would start to run our parallel measurements together. As the photograph reveals, O'Connor had to crouch in the most awkward position in order to conduct these measurements.

At the same time, atmospheric conditions had to be recorded. - These were temperature, cooling power, and radiation from the sun during the day. The mass of data thus collected required a laborious analysis on our return to Adelaide, but the results were most rewarding. They confirmed our suspicion that the natives conserve their heat energy, by controlling the loss of heat through the skin. This explained why they seemed to react like European subjects in bed in a warm room. We concluded that the radiant heat from the small bedside fires sufficed to enable them to get to sleep. After that, as the fires died down, their own controls were adequate. As might be expected, the occasional hot ember would roll down into their hollowed 'bed', with results that can be imagined. They all showed small scars from such burns.

I should again emphasise the fact that we purposely restricted our studies to the males. How the women and children and older men slept, we had no idea. It may seem that this is as incredible as it is unfortunate, but our whole day was occupied as on earlier expeditions. In any case, Colson's warning was enough to me - better to be sure than sorry.

Such glimpses as I had of women and children were incidental. The younger children playing at boomerang and spear throwing, the older ones digging for yams or honey ants, or gathering grass seed with the women.

In other words, so far as this narrative goes, it refers to behaviour and action of the adult male aborigine.

Did our findings suggest that the aborigine posessed a unique physiological mechanism, to control the loss of heat? It seemed unlikely, but not impossible. The deeper network of blood vessels of the skin were obviously being constricted as the temperature fell. This lowered the temperature of the skin, and consequently, the loss of heat from the body. They slept on their backs, lying stretched out full length. The normal reaction to cooling, as everyone knows, is to draw the legs up so as to expose as little surface to the cold air as possible. This manoeuvre the aborigines could not manage in their narrow trough beds. So far as I could see, their sleeping position was maintained by their Yoga-like body control.

Mr. and Mrs. Love prepared our meals, and we slept in our bags under the verandah of their brick bungalow. Time was marching on, and it would not be long before even the remaining nomad aborigines would become clothed Australian citizens. O tempora, o mores!

Working one day with the young men, we saw the arthritic old woman making for her lonely wurli. The men called out to her - "Mamu, Mamu," which, so far as I could discover meant "Old devil", or its pejorative equivalent. The suddenly, up sprang one of the men, who seized a firestick, and whirling it into flame, bounded across the rough watercourse like a gazelle, to light her fire for her.

At Mt. Liebig we had seen another aspect of human kindness. With the Ngalias was a blind man of perhaps 55 years of age, whom they fed. He was reddish haired, going grey, but a fine figure of a man. His hearing, like that of a bat, enabled him to avoid collision with the trees, and he never set foot in any hot ashes.

Chapter 9

Double Check.

August 1937, and we were back again at Ernabella. This time we wanted to test white subjects and aborigines simultaneously for their reaction to cooling of the skin. We felt that this would put an end to any scientific argument. Moreover, we wanted to be sure that the aborigines were using a mechanism which was peculiar to them.

We had persuaded two colleagues, the recently appointed professor of anatomy, Dr. F. Goldby, a Cambridge man, and my research assistant Donald Sinclair M.Sc., a NewZealander, to join the expedition as guineapigs. Once again Mr. Wilkinson at Oodnadatta and the Rev. Mr. J.B. Love at Ernabella offered every assistance.

These were portentous days. Field Marshall Goering had made the first approach on the part of Germany to Mussolini in Rome, and in the Spanish Civil War, 'Non intervention' had completely failed to control the conflict.

About a mile away, North of the waterhole, the same tribe as before had come in for ritual meeting, and we went over to visit them. O'Connor and I were received like old friends. They were in the process of dividing the carcase of a large kangaroo among themselves, having first burned the fur from the animal by holding it over a fire. Nothing - but nothing, as the French say - of the beast was not eaten. Even the long bones were broken and the marrow sucked from them, and smaller pieces of bone were chewed and swallowed. The performance sounded very much like dogs crunching bones. When they had finished, the men insisted on performing a night corrobboree for our benefit. To this I shall make reference later.

It was arranged that white and black subjects, in pairs, would lie in a tent to shelter them from the wind, on the eastern side of a mountain spur. The plan was to study the skin temperatures and radial pulse-volume during the passage from sunshine to shadow, as the sun sank behind the spur. The aborigines were manifestly intrigued, and showed amused anticipation. Just what would be the next performance we medicine men could produce? We repeated the measurements several times on the white and black guineapigs, and the new charade gave the onlookers clustered around the tent entrance, material for a new chapter in their tribal annals.

As the shadow of the mountain engulfed the tent, the temperature fell rapidly, owing to the fact that there is no moisture blanket in that desert atmosphere. At once the skin temperature of both whites and aborigines began to fall. The mouth temperature of the natives also fell, but that of the white subjects did not. This was significant, but the most significant results to emerge were, that although both subjects felt cold at about the same time, the volume of blood passing the wrist, rapidly diminished in the case of the natives, but only slowly changed in the case of the whites. Manifestly, from the moment the temperature started to fall, the aborigine was shutting down the flow of blood to his skin, and was thus conserving his body heat. He did not shiver, nor did he show gooseflesh. On went the white subjects however, wastefully radiating heat until, after feeling miserably cold and showing gooseflesh, they started to shiver at a skin temperature of 30° Centigrade. Only then did the pulse-volume at the wrist fall rapidly. How the onlookers laughed and chattered as their unfortunate white colleagues shook with the cold!

With regard to the mouth temperatures just mentioned, it has been

forgotten that Dr. Leonard Hill long ago, together with his co-worker Dr. Muecke, an Adelaide medical graduate, demonstrated a very important physiological fact. They found that if a stream of cold air were directed against the skin of the back of the neck, the blood vessels of the mucous membrane of the nose and pharynx became engorged. This reflex nervous response causes sneezing, and often presages a 'cold'.

Does this observation on the aborigine suggest that the wearing of clothes plays an important part in this response? We considered that here indeed was a fruitful new line of investigation, but events in Europe as already stated, were moving to a climax, and destined to intervene.

But why the shivering? As I have already stated elsewhere, it is involuntary, repeated contraction of all the body muscles, in order, as in muscular exercise, to produce heat and a feeling of warmth. In other words, the whites could not control their heat loss, and were compelled to 'stoke' their internal fires. Of course this would increase their intake of oxygen and raise their metabolism.

These expeditions amongst the aborigines had begun originally as part of a world-wide search for racial differences in basal metabolism, and they had ended with a rather nice demonstration of how the Australian aborigine of the Red Centre was able to conserve his heat. But was that in itself a racial, that is to say, genetic facility?

I had been invited to give a broadcast talk about these investigations, and on the day following the broadcast, received a telephone call from Mr. Williams, proprietor of an old established firm that supplies equipment and clothing for stockmen and outback settlers. He had, it seems, been born and reared in the outback, and as a youth had been

interested in the manner in which the natives tolerated the cold at night. He had taught himself to sleep naked under similar conditions. This single observation substantiated the view of Dr. O'Connor and myself, that the phenomenon was a product of biological adaptation on the part of the aborigine. Many years later, following the war this opinion was confirmed in a somewhat dramatic manner.

Prior to our embarking on our final expedition to the Musgraves, there had been a mild controversy in the local press as to whether Mt. St. Mary in the Flinders Ranges was higher than Mt. Woodroffe in the Musgraves. I discussed this with the Surveyor General and offered to make some triangulation measurements in an attempt to dertermine the facts. He kindly co-operated by providing a map with barometric height measurements made as long ago as 1903 by Dr. H. Basedow. Because such measurements are subject to meteorological influences, even if instrumentally correct, they are approximate only, unless there is a contemporaneously accurate meteorological check. At the early date of those existing measurements the latter was unlikely. All that we could do therefore, was to accept the barometric height of the plain at the foot of Mt. Woodroffe as the level from which to measure with our theodolite.

Sir. Douglas Mawson very generously lent us his Antarctic lightweight instrument. It was made of aluminium alloy, and when we tested it, we found to our dismay, that if the hot Australian sun shone on one side, the metal expanded and the readings were distorted. Mr. Sinclair and I had to evolve a special double checking procedure even on the plain itself. However, when the great day arrived, we moved South of Mt. Woodroffe and found that the heated air rising from the sunbaked surface of the sandy plain, caused the top of the peak to dance so madly in the telescope, that

we could get no readings at all. With the surveyor's tape we measured a half mile baseline on the ground, and from that measured the height of a three hundred foot rocky outcrop, from which we were able to get a steadier image of the peak of Woodroffe in the telescope. After a fantastic amount of 'mucking about', we succeeded in calculating the height which seemed to make Mt. Woodroffe some 600 feet higher than St. Mary's peak.

As we were coping with heat and flies, the latter always cleverly getting between the eyepiece of the theodolite and one's own eye, a moving cloud of dust came into view in the region of the exit of Glen Ferdinand. We would not have noticed it, had we not been perched on this rocky eminence. Sinclair turned the telescope onto it, and believe it or not, the cause of the dust cloud was a contraption on four motor wheels, drawn by two camels. The passengers were native women -'gins' in ragged 'Mother Hubbards', and the driver was a white man. The equippage came to a stop at the ruins of a red adobe hut that we had earlier inspected near the Ranges. Later, when we had completed our task, we called on the occupant. The camels had been hobbled. The tyres of the wheels were stuffed with grass. The owner of the 'pastoral run' dubbed 'Upson Downs', one Paddy Connally, a middle aged, weather beaten denizen of the desert. His speech, as he invited us to have 'a cuppa' seemed redolent of better days. We sat in the dark interior, drinking hot, black tea out of serrated edged jamtins, held by the bent back lids. I was facing a hole in the wall through which I could see, in the blinding sunlight, the peak of Woodroffe dancing a tarantella.

The silence was broken by Paddy's voice, "Would ye like to hear some

music?"

"Dont tell us that you're going to play the flute?" said I.

"I've got me a gramaphone" he replied. And then there materialised out of the gloom, in a corner, one of those ancient fretwork cabinets propped up by a block of mud brick where a leg was missing. He fished out a record, held it to the light coming from the hole in the wall, blew an enormous cloud of red dust from its surface, and said, as he cranked the ancient machine, "It's me favourite toon."

The warped disc scratched its wavy way until the 'toon' came forth in wavy, gravelly tones, and every so often, as its cadence fell, Paddy would give the handle a new turn.

The 'toon'? Land of Hope and Glory! Overcome with emotion, I gazed fixedly at the dancing peak, beyond the camel buggy in whose shade sat the four gins of the harem. What path had Paddy travelled to this blistering plain and dust and flies? That melody! Those words! Those fateful years!

For the purpose of collecting some further samples of poison-bush, we travelled South as far as the Officer Creek. We were astonished to see a primitive red adobe hut, from which a pale blue smoke-haze gave signs of life. The hut was not far from the creek bed and we found its occupant to be a white woman with an infant child. The husband, she explained, was away on the 'station'. From her speech the woman appeared to be well educated and we were somewhat non-plussed by the incongruity of the way of life and extreme isolation.

The Officer is the largest river in this part of Central Australia. It is formed by the confluence of several streams draining the southern slopes of the Musgrave Ranges, but the largest of them is the Ferdinand

which, at Ernabella, had ploughed a bed almost a hundred yards wide. In the spinifex plain where this hut stood, the river bed was even wider, and torn into ridges of boulders and gravel, - ample testimony to the force of the current which last had rushed on its hundred mile journey south, to lose itself in the sand.

These dry river courses are always marked by avenues of magnificent gum trees, the trunks of those standing in the streambed are always piled with debris left by floods. H.H. Finlayson, that lone and intrepid naturalist, in his book 'The Red Centre', gives a vivid account of his experience of a rainstorm in these regions.

" ..... for storms result such as we never see nor hear in the South. I was caught in a series of them when travelling alone with two camels.... and the effect upon the camels was not the least disturbing part of the experience. On each occasion the pall formed overhead, and the stillness fell as I have described. Plodding on through the gloom, one came to listen with a certain dread for the signal - most uneasy of sounds - which never failed to usher in the debacle - the distant moaning of an approaching wind when all about one is still. When the storm broke, the uproar was as though the hills were being torn to pieces; and the rain, if one may call it that, fell in sheets, blotting out detail in the scrub a hundred feet away. On the last occasion of this series of storms (14 Feb.1934) the rain began at 6 p.m. and continued till 11 p.m., and within 30 minutes of the first drop the whole countryside near the Range, sandy as it was, was covered with a sheet of water 4 inches deep, flowing swiftly towards the lower country. Feeling the sand liquifying under their feet, the camels (always distrustful of a false footing) became terrified. They cried and whimpered like children and floundered wildly

about so that I was hard pushed to get them to a gravelly knoll in time to prevent them throwing their loads into the mud, which for two days after the storm effectually prevented any travelling."

That summer, as it again happened recently (1946-7), continued heavy rain deluged this part of Central Australia. The railway track was swept away by the Neales Creek at Algebukina, and for many weeks, supplies could be sent to isolated settlers only by means of light aeroplanes then available. This dramatic phenomenon is an aspect of the climatic extremes, which the Australian Continent is prone. Years of drought can be followed by cataclysmic flood. The aborigines know all about this aspect of their environment. They have lived with it for thousands of years. The brief life of 'Economic Man' carries no such traditional experience. He is literlly an uprooted man. His overstocked pastoral areas were either over grazed and his animals starved, or they were drowned in floods such as that which gave rise to the Noah Myth of Mesopotamia.

At Lambina, the Alberga rose above the rooftop of that white weatherboard house, where once we had been entertained at tea by Mrs. Page. Page roped his small family into the topmost branches of that lone gumtree at the gate, which we had so often passed during the deserted years of drought. During that terrifying night, they clung to their one safe refuge, while moaning cattle were swept past them on the flood. The waters rose as high as their feet and they feared that even the tree might be swept away.

At last, when help could reach the unfortunate family, they were safe, but young Mrs. Page's ordeal had proved too much, and she suffered

a breakdown which required hospital treatment.

It was some time before the flood plain in the region of the Officer could be negotiated. When at last the search party succeeded in reaching it, the red adobe hut was a pile of mud entombing a family of three.

It was said, I cannot vouch for the truth of the tale, that the woman was a university graduate who had believed the story that her suitor was the owner of a pastoral lease. He was in fact, hunting dingo scalps, or so ran the story 'in the bush'.

But what a country! Glen Ferdinand between its picturesque ranges, with its fine stands of eucalypts in the creek beds and in the small glens opening into the main valley, and the deceptive park-like appearance of isolated grass tufts and shrubs, merged by the phenomenon of perspective, might be a pleasant spot. It is, and has always been in the Red Centre, a pleasant place for those aborigines who form part of it. For Economic Man it is a warning, writ large, in cryptic blank verse.

Knowing that our last experiments would be completed within 10 days, we had arranged for Alec McLeod to devote the third week to a detour South, to the Everard Ranges on our return journey. The appointed day came, and Alec failed to arrive. Nor did he arrive on the succeeding three days! We became apprehensive, as much for his safety, as for our own movements. The train in those days ran only twice weekly. On the fourth day I was awakened by the barking of dogs and cries of natives. And then I heard the sound of a motor, but it didn't seem like that of a truck. Climbing out of my sleeping bag, I saw, carefully negotiating

the creekbed a washed-out blue, ancient buckboard, out of which climbed Jack Killeen, a prospector acquaintance of a previous expedition.

It seemed that Alec's truck had sustained a broken stub-axle on that rough track, and that he had walked ten miles to Lambina homestead in the heat, and had borrowed Page's Ford to return to Oodnadatta. There he had telegraphed the Ford agent in Adelaide to send a replacement axle by the light plane that was coming to Oodnadatta on the following day. The axle came, but it was the wrong type! Alec and Wilkinson, the manager of Wallis Fogarty's store, were discussing the knotty problem of how to extricate the University team from Ernabella, when, in a cloud of dust and flies, Jack Killeen the prospector pulled up outside.

He joined in the conversation by asking "Who are the blokes out there any'ow?"

Alec explained his troubles, and that I was there with some three others. Jack asked who the others were, and Alec told him that they were new to him.

"O.K." said Jack, "I'll go out and fetch them, but I wouldn't go for those other bastards!"

He had neither forgotten nor forgiven my morally disapproving colleagues for cold-shouldering him because he lived with native gins.

"If you'll do that Jack, I'll grub-stake you," said Wilkinson. And so it transpired that the ancient 6 cylinder Chev buckboard, driven with consummate care and skill, brought us back in time to catch our train South.

Wilkinson was adamant in refusing to charge us any extra for petrol and stores for Killeen, and Jack was equally so for his almost

600 miles journey.

"I promised to get you there and back for your money, and that's my responsibility," said Wilkinson.

Our first meeting with Jack Killeen had been about 9 p.m. on a pitch black night, just before we stopped to camp. The light of his campfire had caused some speculation that perhaps it was the light of a star. Our headlights revealed him camped near his native women, lying on the ground, wrapped in a grey blanket. He reached out a hand for his 'quart-pot' of cold tea, and setting it on the fire asked "Ave a cuppa?" We did, and then camped close by.

In the morning Eldridge and I took our breakfast across and sat with Jack as we ate it. He was prospecting for mica, he explained. My morally disapproving, academic colleagues, remained aloof.

That was 1937, and those were the reactions of real Australians in the bush at that date. Petrol in the Centre then cost double the Adelaide price. And Killeen knew that his motor had a CRACKED OUTER CYLINDER CASING, and his differential sounded like a buzz-saw. It was all part of an Australia that has passed, and which in fact is incomprehensible to the modern, affluent generation of today, more's the pity.

Almost total mechanisation of our society has resulted in equivalent dehumanisation of values. Consider for example the following sequel.

The 'Phony War' of 1939-40 was on, and I arrived at Barrow Creek covered with red 'bull dust' in an army utility. The sentry, an 'Old and Bold' 1914-18 vintage of my own age, held up his storm lantern and scrutinised me.

"Are you Lieut. Hicks?"- pause - "Sir?" "There was a bloke in 'ere two days ago lookin' for you."

Astonished, I asked who he was. "Jack Killeen - 'e said. Some

prospector bloke. 'E's fossickin' about 40 miles from 'ere. Said 'E'd 'eard you was in the vicinity."

Jack Killeen! In that whispering gallery of sunburned wasteland as big as all belief, Jack had HEARD of my presence in the area! He had used his precious petrol and risked his old vehicle to travel 80 miles just for old times' sake. I could have wept, and was grateful for the mask of caked, red dust.

That night corroboree to which we were invited by the aborigines, as a sort of celebration of the return of Dr. O'Connor and myself, to their tribal gathering, was a weird experience, as well as a revealing one. The night was moonless. The natives, each carrying a glowing fire-stick, which he whirled every now and again to renew its smouldering end, led us through dense mulga scrub, and over a most rocky terrain to the traditional spot where they conducted their performance.

From time to time, they would ignite a tuft of grass, and use it as a torch to light the way for their visitors. What with those briefly flaring flambeaux and the dramatic effect of the whirling firesticks, our passage was as spectacular as it was memorable. The native who personally conducted me, always held back the mulga branches until I'd passed, and, while clambering down a rocky ridge, I felt my foot seized and firmly positioned on the ledge below!

The dance, for such it was, was executed by men carrying torches of burning grass, while the others also illuminated the scene. All four of us returned from that experience of hospitality, courtesy and obvious friendliness, emotionally shaken.

As it transpired, this was for us, their Swan Song. We would never

meet again. Nor could we, because, following civilization's bloody debauch and the demise of whole nations, their nomad life would also have come to an end.

Chapter 10.

They thought we were wrong.

In 1939 war broke out, and in the A.I.F. I completely forgot about all those years of work among the aborigines. Events piled themselves swiftly upon events, and I found myself in Washington on a special secret mission. What however surprised me was, that my scientific reputation had preceded me. It was, believe it or not, that climatic adaptation work among the aborigines- it had nothing whatever to do with the subject of my mission, which was concerned with dwindling food supplies.

My good aboriginal colleagues had provided information which was being utilised in connection with research and development of military clothing for arctic and subarctic survival purposes. So far from my mind were those distant days in Central Australia, that it took some time for me to realise why I was being included in military conferences on acclimatisation. I certainly did not expect any further developments.

Some four years after the war, I was visited at the University by a pleasant, fair haired Norwegian, who explained that he was the advance party of a 12 man International research expedition to the Centre of Australia, to study climatic adaptation of the aborigines. The team, led by a Swedish scientist, Prof. Peter Scholander, consisted of Canadian, U.S.A., and Scandinavian colleagues, who would, he explained, arrive within a few days. Would I assist them by providing space for the assembly of their rather complicated apparatus, before proceding to the interior?

"That goes without saying," was my reply. "But why go to Central Australia?"

"Well," said the young man, "You see, there were some scientific papers published years ago on the climatic adaptation of the aborigines, and we consider that with more up to date and accurate apparatus, we can

show that the conclusions were incorrect, because their apparatus was inadequate."

Obviously he hadn't realised who I was. Tapping myself on the chest, I replied,

"I wrote those papers."

"Oh No!" was the startled exclamation, "I thought you were dead long ago."

"On the contrary," I continued, looking at his red face, "I'm not dead, at least no-one seems to have noticed a bad odour about me," and my laughter eased his discomforture.

He asked if I could assist them in making contact with the aborigines, and I said that I could indeed, because the one man who really knew all about the natives and their whereabouts, was now on the University staff. So I telephoned my erstwhile companion Dr. Strehlow.

I hadn't seen Strehlow for 15 years. After preliminary greetings, and a briefing on this coming expedition, I explained that I would like to send to him this young man for a description of conditions, and how to get into touch with the nomad tribes of the Centre. There was a long pause. Strehlow, as I remembered him, was always reserved and weighed his words with care. I was however, unprepared for his reply when it came.

"Professor, I dont think that you realise that those tribes with which you worked are no longer there. They have all been mustered in the Settlement by the Department of Territories, and are being educated for assimilation into the Australian community."

I felt like Rip Van Winkle,and said so. "Do you mean that they wear clothes?"

"Oh yes, and go to school. There are no naked aborigines living as you

saw them."

I relayed this astonishing information to my visitor. All that I could do was to send him over to Strehlow in order to get 'the picture' as the pragmatic military phrase goes.

In due course the International scientific expedition arrived, and they brought with them everything that could be imagined in one's wildest dreams of scientific affluence. The bio-physicist from the U.S. Air Force Unit at the University of Pensylvania, unfolded a kit of man's most sophisticated scientific instrumentation, designed to measure with the greatest accuracy, the local climate in which the naked aborigines slept. He was a serious minded and meticulous physicist, determined to leave no room for error. I watched him, not without envy, setting up his precious toys, and remarked,

"Well, if with all that gear you can't discover where ours went wrong, nobody else will!"

He looked up without a smile and said "You could be right at that."

My wife and I entertained the leaders at dinner, and projected films of those early, one might almost say, prehistoric investigations among the naked nomads, whom they were never going to meet. The idea was to get the natives at the settlement to undress for these experiments! I even had to secure the intervention of the Minister for Territories, Mr. Paul Hasluck to obtain permission to visit and work at the settlement!

Pete Scholander, a delightful character, part marauding Viking, and part distinguished scientist, hoped against hope that he might achieve co-operation with these now detribalised aborigines. His reason for doubting the accuracy of our observations, were extremely valid. They had conducted metabolic measurements on natives in the Kalahari desert of

South Africa, under similar, but not identical conditions, and had found a considerable increase in oxygen utilisation. Having used more sophisticated apparatus than was available to me in the 1930s, they concluded that within our 10% range of experimental error, we could not have detected a possible increase of metabolism. Like their Norwegian precursor, they too were astonished to find me alive and active, such is the nature of man's trivial sojourn on this planet. They were however, somewhat impressed by the fact that we had found the native himself to be the most satisfactory test-apparatus for measuring his local 'bedroom' climate. Still, with all this new and sensitive instrumentation, and that Kalahari experience, they might just come across something, - they would see, and off they went.

They were accompanied by a member of my research staff, Dr. H. Le Messurier, who had accompanied some post-war anthropological visits to the native settlement, and could provide local assistance.

The cavalcade returned baffled! They would have to produce a local climate by artificial means. The instrumentation hadn't performed as expected under the conditions, and the natives were not like those I had described. So, within a year they returned, at Heaven only knows at what financial cost, and this time they took with them a refrigerated van to provide a 'controlled climate' ! The results stubbornly remained as we had found them, using our earlier, more primitive technique.

Once again a scientific explanation is necessary. This is not just another example of how real scientists can manage with bits of string and tin cans! True, the physicist relied too heavily on his more complete and precise instrumentation, to discover the quite reasonable

likely source of error in our results. The real explanation however, was detected by Dr. Scholander. The atmospheric temperature in the Kalahari Desert fell to a much lower level than it did in Central Australia. Our aborigines therefore were able to controltheir heat loss, just sufficiently, to obviate the need for increasing their internal heat production to cover the loss. That was the reason why we found a 'normal' basal metabolism.

The radiant heat from the small fires close to their flanks and feet, and the low brushwood windbreak, enabled them to fall asleep by tipping the heat balance in their favour. No imaginable instrumentation could measure and integrate all these variable factors, that went to constitute their 'local bedroom climate'. Only the natives' own physiology could do that. We were just lucky enough to find a method that measured this, but we were also in luck, because the air temperature did not fall too low for their control to function so perfectly!

Of course, Scholander might have come to that conclusion without such a costly expedition, - if only our method had been more accurate than plus or minus 5%. It was that niggling question mark, that, as always, compels scientists to refine their techniques and look for proof instead of accepting a theoretical explanation. But weren't we lucky?

Chapter 11.

Walkabout.

There were some interesting side-issues to these climatic adaptation studies. Before the war, whilst working at the First Medical Clinic in Vienna, I was invited by Hofrat Durig, Professor of Physiology in the University of Vienna, to address the Vienna Biological Society on our aboriginal work. Dürig himself had a world wide reputation in the field of Alpine physiology, and was intrigued by my published papers. His great lecture hall, complete with gallery, was packed with professors, lecturers and students. It was the turbulent period of political unrest, and anti-semitic, anti-communist, anti-fascist activities among the students.

All the exits to the lecture hall were guarded by armed police. But what intimidated me most was the knowledge that my spoken German had been largely picked up at the patients' bedside, in boarding house, in cafes and third class railway carriages. It was far from being a cultured, academic lecture that I would deliver.

My protests on this score were politely brushed aside by Dürig. "You speak German very well, never mind the grammatical mistakes."

But that did not allay my fears. His assistant, Dozent Schemisky, handled the projection of the Leica films of our expeditions.

The Austrians are by nature a tolerant and humerous people, and, but for the manifest amusement at my use of colloqialisms, the audience of some 500, gave me a good hearing. There were however, two occasions when they dissolved in uproarious mirth. I had commented on the appearance of a singularly repellent looking aborigine, and added that he was without doubt an ancestral Ayrian, because my colleagues had found that his blood group was 50/50 A and O. The many Jews in the audience of course thoroughly enjoyed that quip and I was glad that the police were both numerous

and armed!

The second occasion arose when the long film jammed, as it was being fed through to a section dealing with another aspect of our investigations. Scheminsky was obviously getting flustered. I said "Dont let it worry you Herr Kollege, let us pause and look at this picture for a moment." The scene happened to be a corroboree in which 8 natives, fully decorated, with fancy head-dress and complete geometric patterns drawn on their torsos in blood and eagle down, squatted on the ground in a line, close behind each other. I explained how the preparatory phase of decoration had lasted two hours, during which the ritual chanting had taken place. Then I pulled the pin out of the grenade, and added

"Sie sehen aus wie eine Oxford Rudermannschaft, nicht wahr?"
"They look like an Oxford rowing eight, dont they?"

There was instant uproar, because, apart from the incongruity of the comparison, Cambridge, as reported in large black type in 'Der Blaue Montag' that very morning, had beaten Oxford on the river for the eleventh time in succession.

At the end of the lecture amid applause, Professors and staff came up and shook hands, making adulatory noises, and someone said "It is very evident Herr Professor, that you are a Cambridge man."

If any evidence were necessary to prove how dear the England of those years was to the hearts of the Viennese, that experience was sufficient for me.

But the next morning, at 6.45 a.m., at the First Medical Clinic, my "Guten Morgen Herr Professor," was met with a gruff response. Eppinger was at any time an intimidating character, and now he loomed larger than lifesize. In front of the 12 post-graduate doctors, from Russia, Poland, Turkey, Rumania, Hungary and Yugoslavia, he growled at the only unfortunate English-speaking member of this clinic. "You lectured yesterday in Dürig's theatre at 11 a.m.,

(I thought I was being reprimanded for being absent,) You know that I cant get away at that hour. You will repeat the lecture in MY theatre, yes? And I will guarrantee a much bigger audience! "

It was an order. - Yes, Sir.

True to his promise, he gathered one evening, so I was told, some 1200 medicos. I had never been faced with such an audience, both in numbers and in critical mood. They were there almost under duress by the great man. In white coat, he sat in the front row, together with his also white coated staff. I was under emotional strain, and tired, and my German was in consequence, even worse than usual. After 45 minutes I announced that I felt that I had said enough, and apologised for my bad German.

"No," snapped Eppinger from his seat. "Will you explain more fully how you calibrated the volume bolometer?"

Sweating and quite exhausted by the strain, I finished amid standing applause, Eppinger leaving like a drum major. He came over, shook hands and muttered, "Was gut," and majestically swept out.

Dr. Scherf, his Second Assistant, opened a large, gilt edged, leather-bound volume before me saying, "The Chief's compliments, will you please sign the book. - It is a great honour," he added sotto voce. It was indeed. No less a signature than that of Romberg preceded that of mine. My aboriginal friends were so far away, yet so vividly present in my mind. I wished they could see and understand.

Next morning, in the Währingerstrasse, I met Dr. Hitzenberger, the Chief Medical Assistant. He explained that he was unable to be present at my lecture, because he had been on duty. "You were a great success," he added.

"Oh, What makes you say that?"

"Scherf told me. Do you realise that the Chief seldom sits through such a lecture? His technique is well-known. He nudges the Junior seated on his left. The Junior stands, bows to the lecturer and leaves. Presently the Head Sister on duty appears at the door, carrying on a pole a large white notice which reads, 'The presence of the Herr Direktor is urgently requested.' Eppinger rises, bows to the lecturer, bows to the audience and disappears. He sat through your lecture, and even made you speak longer. Mein liebe Hicks, gratuliere."

The Anthropological Society also invited me to speak, but I had to keep a date as Surgeon with the S.S. Jervis Bay, and was unable to address them. But I did manage a brief broadcast over URANIA station.

I have often wondered how my German, mutilated as it was, affected the listeners.

A long way from Australia by sea and train. Today, a matter of hours, but it seems to me, it is now more a matter of fact than of romance. Perhaps Romance is associated with penury - I had just a little more money than the impoverished Viennese.

After the post-war visit of Dr. Scholander and his team, I was invited to make a lecture tour of certain United States Universities and Medical Schools, beginning at Yale. The widow of Dr. Gagge, whose work incidentally we had confirmed, was in the audience, as also was Dr. Bruce Dill, who had accompanied Prof. Barcroft of Cambridge in his historic work on respiration in the high Andes. At La Jolla California, Pete Scholander himself chaired the meeting, at the Scripps Institute, University of California, and paid more than generous tribute. Who could have imagined that the letter from Francis Benedict,

placed in my hands by Prof. F. Wood Jones on my arrival in Adelaide in 1926 would have started such reverberations?

Other invitations to lecture came from Zurich, Basle and Heidleberg, all of which were in part a tribute to the astonishing co-operation of my aborigine collaborators whose remarkable demeanour was the subject of much discussion.

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These journeys among the early stone-age men of Central Australia were an education in themselves. It is therefore worth repeating that the impression made upon me was one of conservation of energy by the natives, and conservation of their own numbers and their habitat. Their culture was to me, merely an aspect of the limitations of their environment, not an index of their genetic backwardness.

There are no native plants that provide even second rate fibres, like linen etc., and no edible plant product worthy of development as a foodstuff. There was no cultivable seed-bearing grass like wheat, barley, rice or rye. There was therefore not even the botanical basis for an agriculture, and agriculture is the basis of all higher cultures. The aborigines could fashion sharp tools and weapons, but there was no settled existence to encourage them to polish and beautify these artifacts. The 12 foot spear could be fashioned only by removing all the kinks out of the natural wood by warming and bending over the fire. There were no straight branches of plants that would provide a straight spear, and no flexible strong stem from which to construct a bow. The aboriginal invented both the boomerang and the woomera, the latter being a spear thrower that extends the throwing arm by almost 3 feet.

I am speaking as a casual observer, not as an anthropological expert. Thousands of years of experience of living in Australia, seem to me to have selected those qualities valuable for survival, in what can only be described as an environment distinctly hostile to man. Comparing their behaviour with that of the members of our expedition, these salient facts emerged. They could live their nomadic life without clothing. They could make fire by means quite beyond our capability. They used small fires and sat close to them, like the Japanese around the habachi. They spun thread from hair and fur, and twisted it into string. Obviously they could have woven had fibres been available and the need had existed. They ate their food raw, but knew how to cook it, and at times did so. They ground grass seed between stones, winnowed it, and made rough cakes which they partly baked in hot ashes. They lived WITH their game animals, and did not massacre them. They gathered roots and berries, and kept their water use to a minimum. They never travelled during the heat of day, but rested in the shade. They carried water in boat-shaped pitchis under their arm, and prevented it from splashing by scattering leaves on the surface.

On the other hand we whites lit bonfires and sat at a distance. We used clothes in a manner that made wasteful demands on the environment. We cooked or processed most of the protective food-factors out of our food. Our use of water was excessive, and our hunting methods drove the game away. Our use of beasts of burden and of machines, made even greater demands on the environment, and our numbers increased without restraint.

Gradually it seemed to me that I was dealing with ancestral human beings who, for the sake of survival, formed a stable part of the environment, and a subtle reorientation of my outlook on life was taking

place. The lesson presented by those two prophetic books, 'Famine in England' 1935, and 'Look to the Land' 1940, by Viscount Lymington and Lord Northbourne respectively, fell on receptive ears, attuned by experiences with my paleolithic friends. These books written by farmers were, together with a number of other books published just prior to and immediately after the war, the forerunners of the present ecological movement, if that is the correct term for all that goes on, both officially and otherwise, under that heading today. It is safe to say, that the vital message of those early writers has been, and still is, obscured in part intentionally, by emphasising only one aspect of the subject, namely pollution. It is so much easier and vastly less costly to issue an air pollution alert than to face the stark facts of destruction of the Biosphere, especially that portion which is in the soil, by technico-economic depredation.

The Australian aborigine in the Red Heart may have been saved from this development, by the absence of draught animals, but at least he conformed to the situation and survived as part of his Biosphere, not at the expense of it. His small numbers per sq. mile are a manifest warning to us.

When, in 1943, the famous mathematical physicist, Erwin Schroedinger, self-exiled from his Austrian homeland, published his three lectures at Trinity College, Dublin, entitled 'What is Life?' he drew attention to an aspect of our life on earth which strikes at the root of our social and economic ills. This momentous little book came into my hands in 1948, and the way of life of the aborigines seemed to me to comply with his views. Here briefly is the basis of his conclusions.

All life on this earth derives the energy for its maintenance from the sun's rays. These consist of ultra minute packets of energy called protons. The chlorophyll containing structures of green leaves and algae, themselves a miraculous arrangement of molecules, trap these protons and use the energy thus supplied to maintain their complex life processes. Other living creatures feed on these plants and algae,(the latter in water), and others again feed on the plant and algae feeders. We ourselves, for example.

But, you may say, we all know that. It's nothing new. Schrödinger was not satisfied with the simple explanation that we all have learned. Nutrition we know, or thought we knew, is necessary to supply protein to replace 'wear and tear', and fat and carbo-hydrate to provide energy. But why the 'wear and tear'? This physicist pointed to a central fact of the nature of our Universe, which is, inexorably, continuous change from a more orderly arrangement of atoms and molecules - of which our material world is constructed, including ourselves, to a state of greater disorder. This change is irreversible. It is in fact an aspect of the flow of energy from a higher level to a lower. When there is no further difference in levels, the flow ceases. Man can only accellerate this flow, he cannot reverse it. If he burns coal, the energy is dissipated, whether it is used to boil water or merely heat a room, In either case the result is the same, the energy so used increases the amount of energy that is no longer usable. This change will, in eons of time, take place even if the coal remains in the ground. By burning it, we merely hasten the process. The increase in molecular disorder, which is the same thing as the increase in unavailable energy is called 'increase of Entropy'.

On this earth therefore, energy can, like water, only run downhill; and again like water, it can be raised uphill only by energy from outside the earth. The source of that energy is the sun, which evaporates seawater which falls again as rain on the hilltops. The energy for restoring molecular order, likewise comes from the sun. Its photons enable the earth's green carpet to rebuild complex, ordered molecules which animals consume, in order to replace their losses due to increasing disorder.

Nutrition seen from this point of view, consists fundamentally of imbibing molecular order, and Life is the only process that can defeat the Law of Entropy, or Law of Increase of Molecular Disorder. This was the basic fact that interested Schroedinger.

Life therefore, is a Process maintained by solar energy operating in the chloroplasts in the humble green leaf, or in water, the humble green algae. All other life on earth is dependent upon the chloroplasts, and there are strict limits to the size and effectiveness of the green carpet.

Obviously the life process itself is to be considered in continuity, not in individual living things. Sooner or later, for an as yet unexplained reason, disorder overtakes the individual grass or clover plant, shrub, tree, gnat, elephant or man, but mystery of mysteries, sexual reproduction renews the life process.

The quantity of life on the earth depends on the maintenance of the earth's green carpet, which is limited in size and effectiveness by 'overgrazing', and Man's unchecked increase is even now 'overgrazing' that carpet.

This excursion into the science of thermo-dynamics (an intimidating

name) would seem utterly remote from our subject of the climatic adaptation of the aborigines, but, in fact, it is the other way around. This stone-age people conserve energy as much as possible, and in doing so, conserve their habitat. They did not 'overgraze' it, to further extend the metaphor. We civilised people squander energy and lay waste our habitat. Only now is it becoming a matter of public knowledge, though it has been observed for fifty years or more, that the African habitat as a whole, is being destroyed, and that famine on a vast scale is impending. The prelude is already there now, in 1974.

The African tribes of the Sahel region are pastoralists and agriculturalists. Their situation differs from that of the U.S.A. for example, only because that country enjoys a more bountiful habitat. Australia is much more comparable with Africa in this respect. But where the U.S.A. and Australia are similar, is in their squandering of energy, the more rapidly to squander the habitat! The energy that has been dissipated in manufacturing a farm tractor, and in fuelling its propulsion, represents a great and irreparable loss, and this is the point that modern economists overlook in all their calculations.

Marx, the apostle of a new socio-economic order, overlooked it. All economists, among them a recent Nobel Laureate, assume that the economic process is a circular one. Nature acts otherwise - it is a one-way street!

The unavoidable conclusion from the Entropy Law is, that economic 'activity' as we understand it, involves waste both of energy and materials, but, in the course of the activity, produces human satisfaction, joy of life, or what you will. The activity by itself always leads to a

deficit of both energy and natural resources. Even the recently considered 'steady state' economy leads to a deficit in the long term. But it at least explodes the myth of ever increasing G.N.P., which infers that the economic process actually produces something de novo.

Only the Life process closes the energy circle, and this process depends on the daily intake of energy from the sun. When all the earthly sources of energy are finally dissipated, only the solar source will remain, and that includes energy trapped by plants. The latter is in fact our very life itself. Schroedinger observed that living things strive to maintain their entropy at a constant level, and when they fail to do this they die. The earth's green carpet of plants and algae (single celled plants) depends upon the maintenance of a highly complex balance between creatures above ground as well as underground. Modern ecology is the study of these relations, and let it be said loud and clear, that at this date, there is no sign in high places, that its fateful implications for mankind are being noted.

It is indeed a matter for serious thought, that the first European settlers arrived in Adelaide in 1836. The first steamship, the Great Western, made of wood, was built in 1838. Already the machine-age was changing the face of Britain, and by 1851 the Great Exhibition displayed before the astonished world, the ingenuity and the promise of plenty through engineering. How could those Britons with a Christian deity made in the image of a successful English gentleman, look upon the aborigine other than a degenerate human form?

And yet, already in 1824, Sadi Carnot, an engineer officer in Napoleon's army, had discovered the law of Entropy even though he didn't call it by that name. He set out to calculate the energy economy of

this new fangled steam engine invented by George Stephenson, and proved that it always yielded a deficit in output! His study of the economy of steam-engines founded the science of thermo-dynamics, and as Georgescu-Rogen, himself an economist, albeit an aberrant specimen, points out, thermo-dynamics remains, despite its abstract ramifications, essentially the physics of economic values.

Those economists whose theories and advice still guide the world's leaders, remain insulated from the economic facts of energy, which were first revealed in 1824, by an economist engineer.

At this moment of 'energy crisis' in the industrialised world, one might well pause and consider the economics of the Central Australian aborigine. Someone is certain to conclude that I am about to advocate a return to berry and grub hunting! What I have attempted however, is to show how energy researches on the Centralian aborigine leads to a rethink about man's place in Nature.

The raw facts of human existence became more obvious to me the more often we worked among those stone-age men. They were compelled to conform to ecological rules, or, accept ultimate annihilation. The absence from their culture of technological evidence of higher intelligence, gave rise to understandable misinterpretation of their way of life by Europeans, flush with 'victory over the forces of nature'. It is too late directly to learn from them now. We have destroyed them. Only the observations of Spencer and Gillen remain as a rich store of anthropological evidence, beautifully illustrated and treated with empathy.

Their two volumes on 'The Arunta, a study of Stone-age people', which I did not read until after the war, contains many perceptive observations on the moral and social structure of the tribes, that in my

opinion parallel our own in the sphere of energy resources. They may well prove unpalatable to the ivory tower sociologist, but they have the pragmatic authority of 20,000 years of trial and error in human co-existence - a greater and more realistic store of social knowledge than can be imparted during any university course of training.

I am profoundly grateful for my experience among the last nomad aborigines of the Centre, and proud to have been accepted by that stone-age ancestor as worthy of induction into their tribe- an honour most respectfully declined!

Part 11. Chapter 12.

Emu poison - or what?

Synopsis: At Cockatoo Creek, in the Northern Territory, we found, on inserting the mouth-piece of our metabolimeter that our Anmatjira subject had secreted a cud of chewing material inside his cheek. Our anthropological colleagues explained that it was 'native tobacco' called by the natives 'pituri', and we accepted that authoritative explanation.

Some years later, whilst working among the luritja tribes of the Musgrave Ranges, we learned of a bush that contained a powerful poison. The natives called it 'emu-poison' and used it for the purpose of catching those big birds. The bushmen and camel drivers called it 'camel bush or camel poison' because a mouthful was alleged to be fatal to a camel.

Having collected some of this bush for further study, we discovered quite by accident, that the aborigines sometimes mixed this 'poison' with native tobacco, which they chewed under the name of 'mingil'.

This confusing information encouraged me to locate and identify the tobacco species that they used as mingil, and to collect specimens for further identification.

Pituri: Tobacoo: Mingil: Emu poison: Camel poison - what did all these odd facts mean?

Lifting the veil on this mysterious aspect of our expeditions of the 1930s discloses some fascinating aspects of Australian exploration and scientific history.

That the poison was potent I witnessed myself, when my aborigine colleagues demonstrated to me how they used the leaves to poison emus. True, the ground up leaves, when scattered in a rockhole containing about 10 gallons of water, stupefied the birds without killing them. But the poison wasn't given much opportunity, because the natives rushed in and struck them down. As it was, the poison acted rapidly enough, and was due I thought, to the swallowing of much of the pulverised leaves, that did not sink below the surface. The emus are greedy drinkers. However, I was convinced and already had taken the precaution to secure a sufficiently large amount with which to experiment.

At the time, I was completely ignorant of its botany, its history, or whether the poisonous properties had been thoroughly investigated. I merely happened to be there in Central Australia, and the plant was available. Furthermore I did not wish to overlook anything of interest in a region at that time so difficult of access, and so far from civilisation. I was bringing the material back 'just in case'. I believe the word serendipity might apply to my action.

Then occurred that strange situation as I was drying the wet specimens before a fire, and the incidental information, that the natives mixed it with their 'mingil', the native tobacco that they had shown me growing in some profusion. Emu poison mixed with tobacco? Later developments might never have come to pass except for that unseasonable rain in August.

On reaching Adelaide, I searched all the scientific references to Duboisia Hopwoodii, as my specimens of poison-bush had been identified.

There was indeed quite a considerable literature on the subject. Careful study of all these reports seemed to leave one with a confused idea of the nature of the poison, and this takes us back into the period of Australian exploration of the 19th century.

Oddly enough, though vastly different in appearance, both the Duboisia and the tobacco plants belong to the same botanical genus, the Solanum group, or Solanaceae. They are different species of the group, just like different families of McWhirter.

According to Nancy Burbidge of the Division of Plant Industry (Council of Scientific and Industrial Research Organisation), there are no less than 40 species and sub-species of Australian Nicotiana (tobacco) plants. There are however only three species of Duboisia; Duboisia Myoporoides, Duboisia Hopwoodii, and Duboisia Leichardtii. But what the Duboisias lack in species difference, they make up for, according to Colin Barnard of the same C.S.I.R.O. Division, in the varying nature of their content and admixture of alkaloidal poisons.

But, Burbidge and Barnard bring us up to the year 1959 and 1953 respectively, and I am reaching back to my expeditions of the 1930s and even further, to the voyage of Mathew Flinders of 1802, and the Burke and Wills expedition of 1861.

I am greatly indebted to Mr. Simon, taxonomist at the Waite Agricultural Institute, University of Adelaide, for his assistance in filling the gaps in my knowledge of these plants, since I published the results of my own researches, prior to enlisting in the A.I.F. in 1939. The gap is considerable in time and space, and in mind, and the discoveries made during the intervening period are interesting not only in themselves, but because they illustrate the accelerating rate of research compared

with that of those very early days of 1861 to 1892.

It is difficult, if not impossible, to recreate the intellectual and social climate of the 19th century in Australia, yet, one must endeavour to recall salient aspects of it, in order to breathe life into the dry bones of scientific investigation, out of which grew our pre-war researches on the poison of Duboisia Hopwoodii.

The 1801-2 expedition of Mathew Flinders carried with it two men destined to become famous. There was a midshipman named Franklin, who became Rear Admiral Sir John Franklin, Lt. Governor of Tasmania, ant-arctic and arctic explorer of renoun, and Robert Brown, botanist to the expedition, who became celebrated and internationally honoured for his contributions to the science of Botany.

This Scottish botanist was spnnsored by Sir Joseph Banks, naturalist with Capt. Cook, as botanist for the Flinders surveying expedition to Australia. Interest in Botany was inspired by the search for medicines, and is as old as historical man himself, but in the 16th and 17th centuries, as the result of world wide navigation, Herbal and later Botanical Gardens became a feature of the Western world.

In order to classify these collections of plants, Linné of Sweden made the first attempt, and proposed for this purpose to use the sexual organs of the plants, (stamens and pistils). Linné fully realised the limitations of his method, and his classification was subsequently modified by others, but is still the foundation of all plant catalogues. But who were the others?

The De Candolle family, father, son and grandson, and our Scotts botanist Robert Brown, no less, who established the Linnean classification of plants on a much firmer basis. Brown, who identified the difference

between gymnosperms (naked seed plants) and angiosperms (covered seed plants), also established several new families of plants, and earned world wide recognition as a botanist.

For me however, his discovery in 1827 of what is today known as Brownian Movement, is his most significant single observation. Whilst examining under the microscope a drop of water containing a fine suspension of Gamboge pigment, he observed and reported in 1827 the astonishing phenomenon of rapid, irregular movements of the particles of yellow pigment. The existence of atoms and molecules of modern chemistry had only recently been postulated by Dalton in 1810, but no-one had any objective evidence of their existence. It was indeed a 'theory' to explain chemical action. Not until 1879 did Ramsay, later Sir William, show that the movements were, in all probability, due to bombardment of the pigment particles by water molecules moving about under the influence of their own heat energy. Gouy in 1888, more precisely developed this idea independently, and sharpened the evidence of proof, but, it really was not until 1911 that Perrin finally completed his experiments and calculations, to prove that Brown had in fact, stumbled upon the first demonstration of the reality of molecules! That was 84 years later.

The irregular movement of the Gamboge particles as they are bumped about by the water molecules, discloses the fundamental heat movement of all molecules, and is that movement from a higher to a lower energy level to which I have already referred in Part 1. The molecules with greater heat-energy move towards regions of lower heat-energy. The movement ultimately becomes quite random i.e. without direction, and that is the state of maximum molecular disorder, or maximum entropy.

But, Robert Brown, who brought back to England 2000 specimens,

including many that were new, among which was Duboisia Myoporoides, which he named after a contemporary botanist. The discovery of this plant is the beginning of the Duboisia Saga.

Duboisia Myoporoides flourishes in New South Wales coastal regions North and South of Sydney, where subsequent exploration up to 1828 had established its wide distribution.

Burke and Wills' ill-fated expedition was the first to come upon another Duboisia, in the region of the Darling and Coopers Creek. Wills recorded in his diary of May 7th, 1861 "In the evening various members of the tribe came down with clumps of Nardoo and handfuls of fish, until we were positively unable to eat any more. They also gave us some stuff they called 'Bedgery' or 'Pedgery'; it has a highly intoxicating effect when chewed, even in small quantities. It appears to be the dried leaves and stem of some shrub." (Nardoo is the seed-case of a local shrub).

Owing to the mismanagement of the expedition by the leader of the rear party, who had been too hastily enlisted as his deputy, at Menindie, by the impetuous James O'Hara Burke, the main supplies and personnel never rendez-voused at Coopers Creek as planned, and Dr. Beckler the medical officer and botanist with the rear party of the expedition, had ample time to botanise, and he collected among other specimens, those of a native shrub which he brought back to Baron Von Mueller, one of the sponsors of the expedition.

The sole survivor of the advance party of four, that reached the Gulf of Carpentaria, the goal of the expedition, was King, who lived with an aboriginal tribe on native food for months, until found by Mr. Howitt's search party. King told Dr. Murray who accompanied Howitt, that he had chewed this native 'pituri' to allay the pangs of hunger, and that he

thought the natives used it for the same purpose. One must endeavour to recapture the sense of drama associated with this period, and with the first glimpse of a narcotic substance used by the aborigines.

Von Mueller, a most distinguished natural scientist, named the plant after a Mr. Hopwood of Echuca, a co-sponsor of the expedition, Anthocercis Hopwoodii. But later, in 1872, when Giles who made an astonishing traverse with horses as far as Mt. Liebig, and brought back some fruit of the same plant, Von Mueller was enabled to reclassify it as a Duboisia, one of the Solanum group, together with Brown's Duboisia Myoporoides.

Dr. Ludwig Leichardt, whose last expedition was lost without trace ever having been found, brought back from his famous Northern trans-Australia expedition of 1844, a specimen of another Duboisia which, Von Mueller, having meanwhile received Giles' specimen, named Duboisia Leichardtii in his honour.

It is at this point that confusion begins, because in 1877 Von Mueller received from W.C. Hodgkinson a specimen of native pituri from North West Queensland, and identified it as Duboisia Hopwoodii.

We now have (i) Duboisia Myoporoides (Brown)

(ii)Anthocercis Hopwoodii, changing into

Duboisia Hopwoodii (Von Mueller)

(iii) Duboisia Leichardtii (Von Mueller).

About the poison, or about the true nature of the alleged narcotic properties of pituri, or of Duboisia Myoporoides, we know nothing.

Here we meet a most remarkable man, Dr. Joseph Bancroft of Brisbane, to whom, in 1873 a Mr. Gilmour brought a specimen of native pituri from Eyres Creek in South West Queensland.

Joseph Bancroft, the only son of a farmer, was born in 1836 at Stretford

in Lancashire. He was, as then customary, apprenticed to a physician in Cheshire, and then completed his medical education at the Royal School of Medicine and Surgery, Manchester. He qualified M.R.C.S. and L.S.A. and passed the examination for M.D. at St. Andrews in 1859. This is a formidable course of study at any time, and for a man married as a student, even more remarkable.

He practised in Nottingham, but his son Thomas suffered from bronchitis following an attack of whooping cough, and Joseph himself it seems, suffered from albuminuria. So the family sailed for Australia in 1864, to find a better climate! In my opinion any climate is better than that of the midlands, but even so, the voyage to Australia was no tourist's picnic for anyone in search of health.

But let us examine in more detail the intellectual background of Joseph Bancroft that was so useful for his Australian future. He came of farming stock, and grew up on a farm. He was interested in botany, and had been President of the Nottingham Naturalist Society for three years. He assisted in sending the first live shipment of trout eggs to Australia, and even on the voyage out, preserved 53 albatrosses! The crime of the Ancient Mariner seems trivial by comparison. He dissected flying fish, and collected plants at St. Vincent and St. Helena - in fact, he never desisted from scientific studies all his life.

When the Bancrofts arrived in Brisbane, after a voyage lasting some five months, that settlement consisted of 12,000 people inhabiting an area not entirely cleared of bush, and mostly living in temporary cabins of split logs and bark roofing. The cause of infectious disease was unknown, although contact disease such as smallpox, leprosy, and syphilis was recognised. Because of this ignorance, the England they had left

behind, still suffered from severe typhoid and cholera epidemics. Antiseptic surgery was in the future, and so also was anesthesia, except by overpowering doses of rum.

Water for the settlement was still being carried in casks from a dam at the bottom of Roma Street, and Bancroft now completely recovered from his kidney complaint, after a temporary sojourn in the town, retreated to 12 acres of bush on the creek at Enoggera, where he established the home named Kelvin Grove, after public gardens of that name that he had admired in Glascow.

It is here that we must imagine this avid medical naturalist, making the first studies of the physiological action of extracts made from the leaves of Duboisia Myoporoides, and Duboisia Hopwoodii. All his scientific work was done, be it remembered, in his spare time from a busy medical practice! He discovered in 1874, in the blood of a patient, the adult form of the micro-filaria parasite now named after him, and he recognised the first case of leprosy in an aborigine in Queensland. His contributions to medicine are so numerous as to preclude their cataloguing here. For example, he studied the bitter extract of the bark of Alstonia Constricta and found that its action was unlike that of Quinine, since it had no effect on malaria, though he used it as a tonic, with some beneficial results.

In 1953 this extract was found to contain reserpine, a substance long known in India as a tranquilliser, and used extensively today as such, and also for reducing high blood pressure. It was no accident therefore, that the Duboisias became additional objects of his manifold researches. Bancroft was definitely one of the early pharmacologists, and was prompted

by the spirit of the times, which sought in botanical investigation in foreign lands, new sources of food plants and of medicinal remedies.

During the recent war, 1939-45, when I was trying to develop a lightweight jungle patrol ration, I learned from C.S.I.R.O. sources, that the redoubtable Bancroft had long ago produced a dessicated beef called 'dried pemmican', that had been successfully used as a reserve ration by explorers and by sea captains.

In 1872 Bancroft began his tests on frogs, dogs and cats, and continued with the/se studies when an explorer named Hodgkinson, who also collected for Von Mueller, supplied him with more pituri from the North West of Queensland in 1877. It was this material that Von Mueller identified as Duboisia Hopwoodii. In a letter to Bancroft, Hodgkinson wrote of the Mulligan River tribe of West Queensland, to this effect:

"the natives tell of mysterious legends of a place called pecheringa, the natives of which area carry on extensive commerce in a narcotic they call pecherie".

This seems to explain the application of the word pituri to the leaves of Duboisia Hopwoodii.

In order once again to emphasise the very difficult and confusing background of the botanical and aboriginal information of that period, I quote verbatim from the footnote to Barnard's C.S.I.R.O. Report of 1952.

" The earliest reference to the physiological activity of Duboisia Myoporoides, was made in 1867 by the Rev. W. Woolls, a clergyman in the Richmond Parish near Sydney, who was a keen amateur botanist and also collected for Baron Von Mueller. He recorded the observation that Duboisia Myoporoides was used by the aborigines on account of its toxicant properties, and he said "they make holes in the trunks, and pour

some fluid into them, which, when drunk on the following morning, produces stupour" and also that "the branches of this tree are thrown into pools for the purpose of intoxicating the eels and bringing them to the surface". Woolls says that he had this information from a Miss Atkinson who in turn, had it from the blacks! It is very doubtful that this report was correct, and that the natives ever did use Myoporoides for these purposes."

The words of the Rev. Woolls speak for themselves, but so also does the final observation of Mr. Barnard. One would have thought that this alleged use of Myoporoides was worth investigation, even though on the face of it, the effects seemed to be improbable.

Barnard himself in the same paper, reports some highly interesting work of Hills, Trautner and Rodwell, in which they grafted tomato cuttings onto Duboisia Myoporoides, and concluded that either the alkaloids or their precursors were formed in the roots. If so, the Atkinson/Woolls story may not be so improbable, because the rising sap containing the potent substances, would contaminate water placed in the hole in the trunk.

Bancroft reported that after injecting a watery extract of Duboisia Myoporoides leaf, "the pupil of the eye was always widely expanded, that the animals walked as if blind, and if let alone fell asleep." He then tried the effect of eye drops made from the extract, in both animals and man, with the same result. His observations were confirmed by ophthalmologists in Sydney, Brisbane and Ipswich hospitals, to whom he sent specimen extracts for testing. The preparation of safe solutions for this purpose was in itself no mean feat.

In 1877 the government chemist in Brisbane prepared the purified

active principle of Bancroft's extracts, but was unable to crystallise the yellow, oily material. To a chemist this must have been frustrating because, only by obtaining crystals can one be certain that one has a pure substance.

In 1944 the Government Chemist in Brisbane was exonerated, because it was found by Willis and Ralph, that Duboisia Myoporoides leaves, collected in late Spring and Summer, provided a syrupy extract from which it was difficult to obtain the alkaloids in crystalline form.

At this stage therefore, Bancroft was able only to register a 'near miss'.

Chapter 13.

Bancroft goes to Europe.

In the year 1878, the indefatigable Bancroft, carried with him to England sample specimens of Pituri and of Myoporoides, which he personally distributed among the leading European scientists of the day. It was from these gentlemen that further conflicting reports emanated between 1878 and 1879.

Doctors Gerrard, Paul, Tweedie, Ringer, Murrell and Wells, as well as Petit of Paris, all concurred in the opinion, that Duboisia Myoporoides contained an alkaloid that acted like Atropine, but was NOT Atropine.

In 1880 Gerrard succeeded where the Queensland Government Chemist had failed; he obtained crystals of a substance which he named Duboisine.

Ladenberg in Paris, extracted a substance which he identified as Hyoscyamine, and five years later, Bender obtained new specimens from different sources and extracted Hyoscyamine from one, and Scopolamine (Hyoscine) from the other. Keep in mind this confusion in the investigations of Duboisia Myoporoides, when we come to discuss the investigations of Duboisia Hopwoodii.

Australia in the remote Antipodes, was already noted for strange animals as well as the aborigines, there were those kangaroos, wombats, platypusses and even Bunyips.*

Footnote* Bunyip: An aborigine mythical swamp animal, invisible to white men.

Bear in mind also, that Joseph Bancroft was the catalyst of all this activity, and that it was his bright questing spirit that introduced the Duboisias to European science, through his own pioneering researches and by making that long voyage from Brisbane.

He had conducted the initial fundamental experiments on extracts from both species of Duboisia, although for the moment, we are concentrating our

attention on Duboisia Myoporoides. Bancroft could not proceed further in Brisbane with his investigations without the aid of more sophisticated chemistry.

In 1926 the Medical Association of Queensland established the Annual Joseph Memorial Lecture in his memory, and it so happens that I myself have had the honour of being one of those lecturers. It is belatedly being realised that young scientists have been too narrowly trained, and in Britain today there is a strong movement in favour of inculcating the history of scientific development. Australia has many pioneers in scientific endeavour, whose names and work should be more widely appreciated. Joseph Bancroft is one of the foremost.

After Ladenberg announced his conclusions, disputation became the major aspect of the Duboisia Myoporoides question. From 1865 to 1897 many prominent international scientists working with fresh samples of the plant, could not agree as to the nature of the alkaloids it contained. In 1893 E. Merck reported the presence of Pseudo-hyoscyamine. In 1897 the same scientist who had done much to advance our knowledge of the alkaloids, concluded, that Duboisine, which was the name given to the active substance at the time, was a mixture of Scopolamine, Hyoscyamine, and Pseudo-hyoscyamine.

It is interesting to relate that E. Merck was an apothecary in Darmstadt, and his shop, which is preserved to this day, is a period scientific museum.

In order to bring the matter up to recent date, it was in 1940, that Professors Mitchell and Barger of Edinburgh, the latter a well-known chemist in the field of naturally occurring drugs and poisons, found no Hyoscyamine at all in a variety of samples collected at different seasons, and from different regions of Australia! They found moreover, that the quantity of alkaloid present, was highly variable from specimen to specimen, and even

described four new alkaloids which they isolated and named Tigloidine, Valeroidine, Porsidine and Iso-porsidine! Where, one might well ask, do we go from here?

Finally, Finnemore and Barnard of the Council for Scientific and Industrial Research, in 1945, after assaying Duboisia Myoporoides from 60 different locations, and identifying the alkaloids from 22 samples, came to the conclusion that leaves from Northern N.S.W. and Southern Queensland, contained Hyoscine (Scopolamine) as the major alkaloid, and those from the South of Sydney contained Hyoscyamine as the main alkaloidal constituent.

If the reader has persisted so far, he must be struck by the confusion of tongues! Manifestly, a main cause of the trouble was the variation in the chemistry of the plant due to season, geographical region, soil, climate and knowing the Australian scene, the weather pattern.

When I recall how rapidly my Duboisia Hopwoodii fermented when moist, I find myself wondering whether enzyme action in the leaves of these plants after harvesting, had altered the alkaloids in some manner.

According to Barnard, Duboisia Leichardtii is being increasingly used as an industrial source of Atropine and Hyoscine, because the bulk harvest, yields the alkaloids in the ratio industrially required. The same scientist states, as his opinion, that D. Leichardtii may well become "the principle world source of Hyosine, and possibly of Atropine in the future".

Barnard also states, that Felton, Grimwade and Co. of Melbourne produced 7000 ounces of Hyoscine as an emergency supply during the war. This, it is claimed, is the largest quantity produced on a world scale, up to that date.

In 1877 Bancroft was able to demonstrate that extracts made from D.

Hopwoodii, when injected into animals, produced quite different effects upon the pupil of the eye from those made from D. Myoporoides. This pioneer pharmacologist thus established a fact that seems to have been either overlooked, or given too little credence by subsequent investigators. The other reactions of the injected animals, were sufficiently similar to lead to confusion, e.g. the production of preliminary excitement, followed by ultimate convulsions.

Von Mueller, who was perhaps the most authoritative scientist in Australia at that time, issued in 1879, the following statement: "Piturine (the extract from D. Hopwoodii) is in some respects allied to Nicotine, but more closely akin to Duboisine of D. Myoporoides, the latter being of a lighter colour, of bitter not acrid taste, of fainter odour, less irritating to the eyes and respiratory passages." He then goes on to describe some chemical tests which are unsuitable for this general and historical narrative. I may comment however, as I did in my original report in 1935, that there were possible reasons why his chemical tests showed ambiguous results.

It is quite evident that Von Mueller was not prepared to be dogmatic about his conclusions, but it is also clearly demonstrated that he believed that the poison was not Nicotine.

Baron Von Mueller, K.C.M.G., F.R.S., was a most distinguished and influential Botanist and Natural scientist, on whom Britain and many European countries had bestowed high honour. He first migrated to South Australia in 1848, and his scientific explorations there, long since forgotten by the citizens of that State, are among the most extensive and fruitful. The remainder of his life was spent in Victoria, where, for 17 years, he was Director and Designer of the Botanical Gardens, and was most active in distributing Eucalyptus globulus in America, Africa, India and Europe. His pron-

ouncement on the subject of the poison of D. Hopwoodii therefore, had world-wide acceptance.

Apropos the distribution of Eucalyptus globulus by Von Mueller, my colleague, Prof. J.B. Cleland, when welcoming a visiting Californian scientist, was somewhat non-plussed when his visitor remarked "I see that you have our eucalypts here! " - That comment would have shaken Von Mueller.

During extensive travel in Italy, whilst studying Land Reform, my wife and I were surprised to find two varieties of eucalypts, one of them globulus, which, we were informed, were used in the manufacture of fine writing paper. We were equally surprised to find in the high Eastern Ghats at Koonoor in India, a vast cultivation of eucalypts as a source of their medicinal oil, eucalyptus.

Sydney Ringer, the physiologist at Cambridge, was one to whom Bancroft presented a specimen of Pituri. It was simply 'pituri', the material from a Duboisia, chewed as a narcotic by those strange distant aborigines of a remote antipodean continent. A.W. Gerard, a chemist, prepared for him an extract from this material, and reported his work in the Journal of Pharmacy in 1878. Ringer, together with Murrell, subjected this extract to rigorous physiological tests, which they also reported in the Journal of Physiology of that year. Having regard to the confused state of knowledge of this subject at that distant date, I quote the following verbatim extract from their paper.

" As we had already shown that D. Myoporoides acts in most respects like Atropia, the fact of Pituri being a solanaceous plant, and moreover, a Duboisia, led us to expect that 'pituri' would manifest the properties of Atropia, and our experiments confirm this conclusion. We find that 'pituri'

causes drowsiness, dilates the pupil (the emphasis is mine), dries the mouth, produces general weakness with convulsive twitchings, and antagonises the action of muscarine on the heart. It possesses two properties however, distinct from Atropia; it produces sickness and increases salivary secretion in large doses, before it dries the mouth. " In a second paper published a year later, these investigators stated that, "'Piturine' is more closely related to Nicotine than to the solanaceous alkaloids." By that last statement they must have meant the Nightshade, Henbane and Mandrake group, because Nicotine is a product of a different species of solanaceous plants. Apparently Ringer did not realise that Piturine came from a member of that same botanical family.

Ringer's name will long be remembered when those of other contemporaries even more famous will have been forgotten. He devised the life-saving solution of the chlorides of Sodium, Potassium and Calcium that has changed the face of surgery and medicine, and has made possible the cultivation of living cells and tissues outside of the body. Ringer's Solution in its modified form, is a life-saving venous infusion used in every modern hospital and clinic.

Other famous men who received samples of Pituri from Bancroft, also got into the act, and it is not surprising that among these was the Professor of medicine in Edinburgh. Ringer's Solution had made it possible to keep a frog's heart beating when removed from the frog. As a direct result, and for the first time, it became possible to study precisely, the effect of drugs upon the heart. Professor Sir Thomas Fraser, at that time was using Ringer's technique in his classic researches on Strophanthin, which led him to introduce that glucocide in the treatment of heart disease. This takes us into 'darkest Africa' with the famous explorer Dr. Livingstone.

Dr. John Kirk was a product of the same Edinburgh Medical School, at that time the most pretigious centre of medical education in the British Isles. He was a keen natural scientist and an invaluable companion for Livingstone during their first expedition into unknown Africa. On that occasion they became the first white men to set eyes on Lake Nyassa. On this journey, Kirk had plucked some of the feathery seeds of an African plant, later known as Strophanthus Kombé, and had put them in the pocket of his jacket. His fingers became contaminated with the powder from these seeds, and he noted in his diary that following the bitter taste, he became aware that his heart action was strongly affected. This observation of heart reaction, and his deduction that it was connected with the contamination of his fingers by these seeds, is a typical example of scientific thinking.

This period of African adventure coincides with that of Australian exploration, and Ringer's experiments with D. Hopwoodii naturally attracted the attention of Fraser, who conducted his own experiments, and published a paper on the subject in 1879. He concluded that although in many ways similar to Nicotine, the pituri alkaloid was not in fact Nicotine, largely owing to its different action upon the eye!

Again we find the same doubt as originally expressed by Bancroft in 1877, but for an entirely different reason. Bancroft was comparing the effects of extracts from two different varieties of Duboisia.

In 1879 A. Petit received from Bancroft some 50 grams of pituri, and from a careful chemical analysis of its extract in water, he found "conclusive proof" that the toxic alkaloid was Nicotine! I must admit that his results were most convincing.

Chapter 14.

Utter confusion.

From this point onwards the plot not only 'thickened', it became veritably lumpy. Professor Liversidge of Sydney, a very competent chemist, investigated some pituri from Cooper's Creek in 1880. I will omit the chemical details, which for those who may be interested are published in Vol. 13, 1935 p.175 of the Australian Journal of Experimental Biology and Medical Science. Liversidge's results revealed a very slight difference between those calculated for Nicotine, and those which he found for 'Piturine'. But what seemed to settle the matter once and for all, was the finding of Langley and Dickinson in 1890 at Cambridge. Langley, who later became Prof. of Physiology at that university, was rapidly becoming a world authority on the physiological action of Nicotine, in fact he had used this alkaloid as an experimental tool, to reveal the nature and ramifications of the so-called 'involuntary' nervous system.

Who was better qualified therefore to investigate the nature of this elusive stuff? Langley, without hesitation or equivocation, pronounced it to be Nicotine!

Finally, and chemically, in 1910 the seal was set on this conclusion of Langley by none other than one of his own Cambridge students, Dr. A.C. Rothera, still known for his urinary test for Diabetes. He was the first lecturer in bio-chemistry at Melbourne University, and as such, published his paper on Pituri in the very first volume of the Biochemical Journal.

Thank Heaven for this act of loyalty to this then embryo journal of an embryo science, because my search of the literature failed to reveal any reference to Rothera's work.

Quite naturally, the chemical abstract journals had overlooked the

Biochemical Journal Vol. 1 as a source of information on the chemistry of a poisonous alkaloid. Had I read that excellent paper, I should never have continued with my own investigations.

Rothera, it appears, had been asked to investigate a mixed sample of dried, lanceolate leaves and twigs, alleged to be a cure for neuralgia when smoked. Finding that the effect corresponded with that of Nicotine, and being led by that to the subject of 'Pituri', he took the logical precaution of having the material botanically identified by his colleague, the Professor of Botany. Ewart identified the fragments as the leaves and twigs of D. Hopwoodii.

Armed with this botanical information, Rothera then proceeded to distil the acqueous mash, mixed with lime in a current of steam, and then went on to conduct a perfect chemical analysis of the resulting product. His findings confirmed in impeccably precise detail, that the extract was indeed Nicotine!

It was, as I have said, fortunate for me that I had not seen this paper until after I had completed my own investigations, and was already quite certain that the poison of D. Hopwoodii was NOT Nicotine.

Prior to World War 1 which altered so many careers, I had specialised in organic and physical chemistry, and although converted by war into a physician, I remained true to my first love. Therefore I learned the new micro-chemistry in a summer school in Gratz, Austria, and brought to Australia, Pregl's complete outfit for micro-chemical organic analysis. This, together with an ultra-violet absorption spectro-photometer, placed in my hands a very precise technique for tackling the problem of emu poison.

Assisted by H. Le Messurier, a post graduate student, I used Pregl's technique to determine the composition and structure of the poison molecule.

We found that the molecule differed from that of Nicotine by only a small grouping of carbon and hydrogen atoms, and that in solution, it rotated a beam of polarised light to the right. Nicotine rotates this beam to the left. When its toxic action was carefully assayed, it proved to be almost 4 times as poisonous as Nicotine which was the most toxic alkaloid then known.

It often happens that poisonous alkaloids exist in two forms, one which rotates polarised light to the right, and the other to the left. The most poisonous alkaloids are however, those which rotate polarised light to the left, so that our new alkaloid was unique in that respect. More important however, was the positive proof that the aborigines and the bushmen were not romancing when they spoke of the D. Hopwoodii in that region, with a certain awe.

Let us consider for a moment the part played by the statistics of 'sciene' in this latter stage of a century old mystery.

i. Quite unseasonably rain fell in the Musgraves in August, and my poison bush got wet.

ii. The aborigines gathered around and passed information that sometimes they mixed 'inkulpa' - (poison bush) with chewing tobacco.

Knowing that admixture with tobacco, was therefore possible with 'pituri' specimens, which had been the object of so much confusion and research, I concluded that this might be in fact the cause of all the trouble. I myself was working with 'poison bush' which I personally had collected.

The post World War 11 investigations reported by Barnard, reveal the fact that I was even more fortunate than I knew. The D. Hopwoodii growing in the Musgraves produced ONLY Nor-Nicotine. Duboisia specimens collected

elsewhere in Australia produce either Nicotine only, or Nicotine together with some varying amount of Nor-Nicotine.

Furthermore, Burbidge's report, which is very extensive, provides ample evidence of the existence of 40 varieties of native tobacco plants growing right across the Australian continent. It is unlikely that only the Luritjas used tobacco; Nicotiana Gossei, one of their chosen varieties, is shown by Burbidge to be growing in the Western basin of Cooper's Creek. Surely it too must have been used for chewing!

In other words, admixture of Duboisia with native tobacco was always, in my opinion, highly probable.

It seems to me that I had several advantages over my predecessors; I knew how the aborigines used both D. Hopwoodii and native tobacco, and I collected my own specimens both of Duboisia and Nicotiana, also I had seen the emu poison in action. The earlier investigators were, in addition confused by the similarity in some respects, of the physiological action of extractz of D. Myoporoides.

My predecessors in reserach were very likely to find Nicotine, which is easier to extract from specimens of pituri than is Nor-nicotine. Moreover, the leaves and stems of Duboisia are hard, and fragments are still botanically recognisable in a mixture with tobacco, whilst the soft, dry Nicotiana leaves simply disintegrate into a powder in any desiccated sample of 'Pituri' likely to reach civilisation from the arid interior. This could well be an explanation of Rothera's results, for even though Prof. Ewart had identified the resistant bits and pieces of Duboisia, he proably never had suspected that the rest of the powder might be derived from another plant.

However correct this deduction may be, the fact is, that the

chemical problem was difficult enough to solve, without these gross sources of error, and with the small amounts of chewing stuff available, the difficulties were compounded.

The term 'Pituri' was applied to Duboisia leaves chewed by the Arunta tribe around Alice Springs, and also by the Eastern Australian tribes. Following the use of the word by others, I used it in my publications. The Luritja (outside) tribes to the West however, called chewing tobacco 'Mingil', and it is of interest to record that Spencer and Gillen make no mention of tobacco, but refer only to Duboisia Hopwoodii as 'Pituri.'

How intriguing this is when one considers how long these tribes have been in contact along the borders of their territories. The Arunta, it seems, from more recent studies of the distribution of D. Hopwoodii, had more in common with the tribes to the East. See map of Duboisia distribution.

Nevertheless, Burbidge's maps of distribution of varieties of Nicotiana would seem to suggest, that some at least, must have been used for chewing, and this opens up a vast field of access, especially in the East and South West. If N. Gossei for example, were used by the Luritja as a traditional source, N. Gossei in the Western Cooper Creek basin must also have been used. It would appear that we lack precise information concerning the chewing habits of these Eastern tribes.

It was certainly fortunate that we had the micro-analytical apparatus available in Adelaide. It was the first equipment of its kind in Australia.

Armed with this exciting evidence of the existence of an entirely new alkaloid, I decided to pay a visit to Dr. T.A. Henry, the Director of the Welcome Foundation in London, and world authority on alkaloids.

A magnificently caparisoned commissionaire confronted me in the spacious marble entrance hall, and, like a general addressing a lance-corporal, he asked my business.

"I wish to see Dr. Henry," said I.

"I'm afraid that's quite impossible. - Why do you wish to see him?"

"One moment," I said, "I'll send him my card," and wrote on the back of it - 'Possible discovery of dextro-nor-nicotine.'

He beckoned a small blue-uniformed lad, and ordered him to take the card to Dr. Henry. - "Yes, Sir." said the brilliantly be-buttoned page.

I sat, as ordered, and waited.

At last the door of the lift opened, and out came Dr. Henry himself, and taking me by the arm, he led me to the lift. Tableau!

He examined our data very carefully, and said "Splendid, you've tied it up alright. What about reading a paper at the Chemical Society next Thursday?"

"I'm on my way to Vienna," I explained.

"Pity," continued Henry, "But of course you'll publish in the Journal? Call on Professor Spaeth, give him my regards, he is the world authority on Nicotine and its related compounds. He will be most interested."

Spaeth certainly was. He said "I knew that there must be a Nor-nicotine somewhere, and I've hunted for it through all the Nicotine I can get from the State tobacco monopoly, but, a dextro variety, - that is something I did not expect."

I had brought some of the pure Nor-nicotine with me, and together with Spaeth, conducted some confirmatory synthetic chemistry experiments, which were published by the German Chemical Society.

At the Pharmacological Institute where I was working, I enlisted the co-operation of two delightful Austrians, and together we completed a very thorough study of the physiological action of the Duboisia poison, and published the results in an international journal. After surviving Hitler's war as medical officers, those two good friends of mine became respectively Professors of Pharmacology and of Medicine in the University of Vienna.

An interesting historical connection was thus established. Th. von Brücke, one of my collaborators, was grandson of the famous von Brücke, the first Professor of Physiology of the University of Vienna. The old laboratory in which we worked was founded by Prof. Geheimrat Horst Meyer, at that time an octogenarian visitor to his old department, and a pupil of Schmiedeberg, the founder of the science of Pharmacology. These men bridge the period of Bancroft and the Duboisias, and place Bancroft, of Kelvin Grove, Enoggera, Queensland, in his proper company.

What a tapestry is life. The warp decides the basic theme, the weft the variation on the theme. Acting with free will we have the power to determine those variations. After all, I need never have attempted in the first place, to assist Francis G. Benedict of Boston, and could quite conscientiously have pleaded that I had no spare time to devote to his quest for racial differences in metabolism.

Chapter 15.

Nicotine and its uses.

The Central Australian Luritja aborigine carried in his cheek, or behind his ear, a cud of a dark greenish mass about the size of one's thumb. It was, as I have explained, native tobacco, sometimes eked out with a little Duboisia Hopwoodii. When the aborigine considered it necessary, he rolled it in some ashes before replacing it or passing it to a companion.

He has learned that the effect of the alkaloids - whether Nicotine or Nor-nicotine is enhanced by this process, and this in itself is a most intriguing physiological and chemical fact. The wood ash contains the mild alkalis Potassium and Sodium Carbonate, -(the latter is washing soda), which release the alkaloids from their combination with the acids of the plant. They are then only absorbed in the mouth or swallowed in sufficient quantity to produce the desired narcotic effect.

The discovery of narcotic plant alkaloids and their controlled use by chewing, is almost universal. The discovery of the effect of alkali to strengthen the action is also universal. The Inca aristocrats of Peru used beautifully designed gold lime-holders as part of the culture of Coca leaf chewing. When the addition of ash no longer produces the desired effect, the Mingil is then thrown away. What is the effect? "It makes them feel good." is the only answer I could get from Stan Ferguson, the dingo scalp hunter.

When they poison a waterhole with Duboisia leaves, the amount of poison set free must be relatively small. The emu, which is a voracious drinker on the other hand, must be very susceptible. Having watched this procedure, I was not even certain that the bird didn't swallow much of the crushed leaves which float on the surface. Certainly it stupefied the bird which could then

easily be dispatched by the waiting natives. The fact that the ruse works is a tribute to the toxic potency of the duboisia of the Musgrave Ranges. It is a tribute also to the strange determination of man to enjoy, even at the risk of death, some pleasant side-effect of intoxication.

What does pharmacological authority say about the effect of Nicotine? "Habitual users of tobacco experience a certain pleasure, which appears to resolve itself into a reposeful, calming and stabilising effect on their nervous equilibrium, provided that the quantity of tobacco is not excessive, otherwise it may increase nervous excitability." From a standard textbook of pharmacology. According to Charles Darwin, monkeys smoke tobacco with pleasure.

Search the scientific literature as one may, there is no more accurate explanation of this almost universal habit. Yet, the same literature, contains volumes of detailed, accurate descriptions of the action of Nicotine on the vital, physiological functions such as respiration, heart action, blood vessels, the eyes, digestion, liver function, the muscles, the nervous system, appetite, nutrition, yes, and even sexual potency.

The elusive psychological effects of Nicotine is such that even the latest investigations by experimental psychologists have yielded little information of the Narcotic action. About Marihuana, L.S.D., Truth drugs, etc., the psychologists are vocal enough, and we are well informed by them on the action of alcohol. But on the narcotic action of Nicotine, and of course that includes Duboisia, there is mystery.

There is something gratifying it seems to me, when Science fails to uncover such a universal enigma.

There are some 86 species and sub-species of Nicotiana in the world, of which 45 are native to North and South America. They are absent from Northern South America and Southern Central America, a fact which gives rise to no end of speculation as to how the plant became distributed.

There are no less than 40 species peculiar to Australia, some of these I have already mentioned as being used by the natives of the Musgrave and Petermann Ranges. The map showing the distribution of Australian varieties of Nicotiana also demonstrates the fact that the number of chromosomes in the cells of the plants, tends to increase from the South and to the North East East to the West of Australia.

This seems to indicate an increasing degree of hybridisation by cross fertilisation over a long period of time. According to Burbidge from whose paper this map was prepared, this phenomenon fits in with the theory that Nicotiana Suaveolens variety might have entered Australia via the South East corner when this continent was closer to the great Antarctic continent, which in turn bridged the gap to South America.

Be that as it may, it is certainly in keeping with the findings of modern submarine geology. These have adduced a mass of factual evidence that Australia has moved, and is still moving North and slightly West. The theory that there was a land connection between Africa and America, which opened to leave the Atlantic Ocean, is also finding similar support.

The continents ride as it were, on socalled Tectonic Plates that move slowly on the surface of the more fluid interior of the globe.

The great arid centre of the Australian continent provides as yet unexplained ecological phenomena to which some reference has already been

made, namely circumscribed stands or groves of one type of tree or shrub growing quite alone in the spinifex studded, red, sandy plain; sheoak, corkwood or rarely duboisia. The distinguishing botanical feature of the tobacco species that differentiates from the deadly nightshade group is the long tubular flowers, their grouping at the top of the plant, and the small dry capsular fruit. The seeds are extremely small.

It is a strange fact, that although the wild species have been used as narcotics in both Australia and Eastern North America, there is no evidence that wild species were so used in South America, - their country of origin. On the other hand, the two hybrid species, nicotiana tabacum and n. rustica, (which, so geneticists believe, were derived from them,) had spread by means unknown from Argentina to Central and North America, where the former has been the triumphant plant. Nicotiana rustica is a shrub about 4 feet high, with fleshy leaves attached to the stem by stalks. It was this variety that was introduced into France by Jean Nicot, the French Ambassador to Portugal in 1560. Naturally enough, this was fashionable for its medicinal properties among the aristocracy of Portugal, and when introduced into France it was called 'Ambassador's weed'. Ultimately it was named Nicotiana, after Nicot, even though N. Tabacum, the superior variety, had already been introduced into France by Jean Andre Thevet 3 years earlier.

Such is fame! An Ambassador at the Portugese court, finding that N. Rustica was a fashionable panacea for all the ills among the aristocracy, overshadows completely a mere botanist, who made no such foolish claims for the plant!

N. Rustica was rapidly displaced by N. Tabacum, which was less rank in flavour, and had a lower nicotine content. Rustica is still cultivated

by peasants in Europe, Asia and Mexico, and was at one time used as a source of nicotine extract for insecticide purposes. Today however, the extract is a bi-product of the enormous tobacco industry.

Nicotiana Tabacum on the other hand ranges in height from 2 feet to 9 feet. The leaves are disproportionately larger and have no stalk. These characteristics doubtless result from preferential selection in plant breeding.

*

Since the discovery of the chromosomal basis of genetics, a quite romantic new kind of exploration and anthropological discovery has developed. The place of origin of man's most valuable plant foods has thus been located. Maize, wheat, oats, rye and the potato, to mention the chief examples, have been traced to their cradles.

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Footnote: Chromosomes are the discrete structures in the nucleus of the living cell, that interact during fertilisation. They carry the genetic code peculiar to the given species. See References.

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Using genetic analysis, the two parents of N. Tabacum were found to be wild varieties growing in Argentina, namely N. Sylvestris and N. Octophoro. These plants by natural crossing gave rise to the hybrid which ultimately became the selected variety that was cultivated by the natives of Argentina.

The parentage of N. Rustica is however rather more obscure, an observation that could be applied to the distant origin of each and every one of us, however embarrassing this may be. Rustica seems to have originated in Peru, where suspicion centres on a variety called 'Undulata' , and another called 'Paniculata'. The search for truth is dark and difficult, for there is no evidence as yet that Rustica was ever used by the Peruvian natives in ancient times, and today it exists in Peru somewhat sparsely as a weed. I would add myself, that the Coca leaf culture might well have

suppressed any tendency to develop tobacco chewing.

The steady burrowing of archeologists however, has revealed so much astonishing information within the last decade, that for all I am aware, someone has already revealed that secret. Meanwhile there is no end of speculation as to how the seeds of N. Tabacum reached the East coast of Mexico and North America. I will not confuse my readers by recounting these theories, which make an acrostic crossword puzzle look comparatively simple.

Suffice it to say that the seeds are minute, and could have been dispersed by a variety of simple means. Consider for a moment, the arrival in Australia of weeds from Europe, Asia and America. Consider also the fact that the use of tobacco as a narcotic has evolved independently in different parts of the Americas and in Australia. Man it appears, has tried everything!

The Central Australian aborigine chewed his Mingil or his Pituri, he never smoked it. Doubtless, in trial and error experimentation with plants in his environment, chewing was the way to find out the taste and the effect, if any, for man was omnivorous it seems, from the time that he rose from all fours.

Columbus and his crews found that the natives 'drank smoke'. They attributed magic powers to the plant and used it more as a ritual procedure or as a cure for human ills, or to protect against evil spirits. They also used it as a means of communicating with the Gods.

The Red Indians of North America sat around and smoked the 'pipe of peace' after a tribal campaign. The tobacco that they smoked was the very strong Rustica variety which often knocked them quite unconscious. It was indeed 'powerful medicine'.

Long before Columbus arrived, all the present methods of use of Nicotiana

were in vogue. They used pipes, cigars, cigarettes, the outer covering of which was paper-thin maize husk. They used chewing tobacco, snuff, and the admixture of tobacco with aromatic herbs. Nevertheless, the origin of the word tobacco is unknown, though there were other native names which it replaced. The natives of Brazil called it Petum; the Mexicans, Picietl; the Peruvians, Saire; and, as we have seen, it was introduced into Europe as a medicine.

At the time of Australia's colonisation, the medicinal value of tobacco was recorded in the 'London Dispensatory' for 1815 as follows:

"Medicinal properities and uses. Tobacco is narcotic, sedative, cathartic, errhine, whether it be taken into the stomach, or externally applied.

The three first mentioned properties are sufficiently obvious, even from the effects which smoking or chewing produce on persons unaccustomed to its use. These are, very acute sickness, headache, extreme debility, cold sweats, and sometimes even convulsions."

The official preparations listed were the infusion, and tobacco wine. The former was for use as an enema! A footnote in the Dispensatory is very interesting.

" The custom of smoking was introduced into England by Sir Walter Raleigh, and at one time was extremely prevalent, but is now confined to the lower class of the people. In some parts of Europe however, it is regarded as the greatest solace and pleasure of the luxurious."

Henry Mayhew, in his snobbish 'Guide to Travellers on the Rhine,' speaks with corresponding contempt of the smoking habits of the Germans.

King James I. wrote the following in his famous 'Counterblaste to Tobacco.'

"A custome loathsome to the eye, hateful to the nose, harmful to

the brain, dangerous to the lungs, and in the black, stinking fume thereof, nearest resembling the horrible Stygian smoke of the Pit that is bottomless."

Another, in verse declaims:

Tobacco, that outlandish weed,
It spends the brain and spoils the seed,
It dulls the sprite,
It spoils the sight,
It robs a woman of her right."

Present day opposition to cigarette smoking is however, entirely different in its origin, and less based upon the effect of Nicotine than upon a method of using tobacco, namely cigarette smoking with inhalation. This method, which dates from the 1870s but did not really become widespread until after World War 1, introduces hazards to health that have little to do with Nicotine, except possibly, in the case of Buerger's Disease of blood vessels, to which I will refer later.

The real causes of trouble are the carcinogenic tars that the habit of inhalation introduces into the lungs, and another is the absorption into the blood of the toxic gas, carbon-monoxide.

I have long taught, that the firm chemical combination of carbon-monoxide with the haemoglobin (the red oxygen carrying pigment) of the blood, may ultimately be proved to be the real culprit in diseases of the blood vessels. It could act by impeding oxygenation of the tissues of the blood vessels. To this effect must be added the tendency of Nicotine to constrict the small blood vessels, and in this way, to interfere with the oxygen supply to the vessel walls.

Let us return to the history of tobacco as it steadily acquired a place in the lives of Europeans. We have seen that the superior variety of N. Tabacum grew in Spanish America. Noone knows how the seeds of this plant were secured by John Rolfe of Virginia in 1611. Remember in this connection the Anglo-Spanish blood feud that still persisted on the high seas. Between 1615 and 1630, from Rolfe's original source, the export of tobacco from the colony of Virginia rose from 2,300 lbs to 1½million lbs. Despite punitive duty on tobacco imported into England, the trade flourished, and with it, the Cornish smugglers, as the song recalls,

" Four and twenty horsemen trotting through the dark,
Brandy for the parson, baccy for the clerk,
Laces for the lady, letters for the spy,
Watch the wall my darling, while the gentlemen go by."

The coast watchers' tracks along the cliffs above the secret coves of Devon and Cornwall are still there to recall those romantic times.

By the end of the 17th century the annual export of tobacco from Virginia had reached the astounding figure of 76 million lbs. Tobacco became legal tender in Virginia, because of the lack of specie, and attempts to compel the use of paper money failed, especially after the famous 'Parson's Cause' in 1763, in which Patrick Henry won the case against the Crown.

The Rev. Maury sued for payment of salary in 16,000 lbs of tobacco instead of the less valuable paper money! Henry's speech before the Court, which was extremely radical, denied the right of the King to enforce the currency payment. Thus did the defence of tobacco become an early shot fired in the rebellion which Patrick Henry's later speeches did so much to invoke.

Maryland also became a tobacco growing colony, and the results of exhaustion of the soil by its hungry exploitation, can readily be seen today. The effects of soil erosion soon manifested themselves in silted waterways rendered no longer navigable by shipping.

Smoking rapidly became popular, even though the tobacco of the period was rank by comparison with that of today. In London there were even 'professors' who taught the art of 'whiffing' in parlours set up for the purpose. The use of 'the weed' although inveighed against by Royalty, the Clergy and the Pope, and by the Chinese Emperor in the form of lip splitting and torture, had come from the New World to conquer the Old. Tobacco was chewed, and, in the finely powdered form, taken as snuff. The same powder was also brushed on the gums, and even drunk a decoction. But the twentieth century was to see the triumph of the cigarette.

The immense fortune of the Duke family was founded on the cigarette made from light tobacco grown on the Durham Estate, and soon was made from blends mixed with other ingredients to create special flavours, even raisins for example!

Nevertheless, some 22 million lbs/ per annum of snuff are sold at the present time, and I was privileged to watch a unique initiation into its use. During the recent war, whilst on a special military mission to the U.K., I was spending a night in my old Cambridge College of Trinity, and after dining at High Table, the Fellows adjourned to their Common Room to 'pass the Port and Madiera' .

Two very young Canadian airmen were the honoured guests, and they were being treated like Royalty by the white-maned galaxy of distinguished Dons. The Master, Sir George Trvellyan, passed the silver College snuffbox

to the lads, after demonstrating with aristocratic flourish, the method of sniffing ' a pinch' of the fragrant powder. What was the aircrew notion of a 'pinch,' I am unable to relate, but the effect was volcanic!

Did anyone laugh? No, indeed, merely a quiet smile was all that the polite hosts of that famous College permitted themselves.

"Jeeze, but that stuff's dynamite," confided one of the victims to me after we left the table. I could only confess that I had demurred when the handsome snuffbox came to me, because I funked it.

"But the Old Man sneezed so quietly," continued the Flight Sergeant.

"Ah," replied I, "he is probably used to it, and besides, he is also a famous Historian, which makes quite a difference."

"I guess so," replied the F/Sgt. , ignoring the non sequitur.

The chewing of tobacco and Duboisia, which was the only method of use evolved by the aborigines, had also been one of the several methods used by the American Indians. Chewing was also adopted by the American colonists and by British sailors, when smoking aboard ship was forbidden for fear of fire. The American habit however became general, and was associated with frequent expectoration, - a disgusting habit at any time, but greatly increased by the stimulating action of the nicotine upon the secretion of saliva.

The contemptuous attitude of the English towards the rebel Americans in the 19th century, was greatly enhanced by this habit of affluent American visitors. English cartoonists of the period portrayed the typical Uncle Sam, or the United States Senator with a fat cigar which he also chewed. The chewing gum habit which is also a product of Central America, is thought by some to have its origin in tobacco chewing.

My first experience of this phenomenon was in Newport News, Virginia,

on a hot, humid Summer's day in 1924, during a confrontation with four Customs officials at the Customs House. All four chewed and/or smoked cigars, which they deftly rolled from one side of the mouth to the other. They spoke without removing the cigars, and expectorated with both force and accuracy into tall brass cuspidors, placed strategically about the room. The sight completely fascinated me. The quantity of saliva, and the precision of aim, more often than not with cigar still in the opposite corner of the mouth!

My Georgian friends assure me that the practice can be seen in any County Courthouse in the Southern States today. In fact, a tobacco spitting contest is still held in the U.S.A. The championship record standing at 24 feet 10½ inches. The measurement of that last ½ inch intrigues me. Lest anyone considers that tobacco chewing is heading for extinction, consider the most recent production figures for chewing tobacco. They amount to almost 70 million lbs annually.

As for cigar smoking, imagine my surprise, to see, after an affluent society dinner, at the apartment of my Viennese Professor of Medicine, who also was in private practice, the elegant ladies join the male guests in smoking fat cigars! Ambulare discimus! - Travel teaches.

Perhaps, after this summary of the history of nicotine and its more toxic Australian cousin Nor-nicotine, one might conclude that the social use of nicotine is not so harmful after all. In my opinion, it is all a matter of the quantity and the concentration of the alkaloids in the blood and tissues that matters. Not all the aborigines carried a cud of chewing tobacco, and they passed it from one to the other when wanted. Likewise they rolled it in the ashes to increase its effect when necessary.

The inhalation of cigarette smoke is quite

another matter.

The area of lung surface exposed to the inhaled smoke is about the size of a tennis court. Imagine the layer of blood spread over that area changing every half second, that is an impressive absorbing mechanism is it not? The depth of the inhalation and the rate of puffing, and the number of cigarettes smoked daily, must surely be the major factors affecting resultant nicotine intoxication.

The pipe, the cigar and the chewing plug cannot compete with the cigarette, because only the surface of the mouth is available for absorption of nicotine, apart from that which maybe swallowed.

On the other hand, the same lung surface area is available for absorbing the carbon-monoxide in the cigarette smoke, and this, as I have already mentioned, combines firmly with the red haemoglobin of the blood. Its effect is to reduce the oxygen carrying capacity of the blood and to interfere with the rate of oxygen supply to the cells of the body as a whole. This is like placing a governor on a motor engine, it lowers the peak performance. Once again it is all a matter of how often one smokes a cigarette, and how deeply one inhales. *

* Footnote: Carbon-monoxide is produced by the incomplete combustion of the tobacco. It is also produced by an idling motorcar engine, and is sometimes used to commit suicide.

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The tars in the smoke irritate the surface cells of the airway and lungs, and tend to cause cancer, but more frequently they cause chronic bronchitis. Coughing one's way to cardiac failure is not my idea of a pleasant retirement.

Chapter 16.

The Family with the bad name.

Before we take final leave of tobacco, it is surely an odd fact that the origin of the name is obscure. It had been assumed that it derived from the name of a Mexican province, Tobasco. On the other hand, the double ended tube which fitted the nostrils, and through which the smoke of burning Nicotiana leaves was inhaled, was called tabaco, and it is suggested that the Spaniards transferred the name from the tube to the fragrant weed. But Tobasco is noted for a very potent member of the Solanum family, the chili pepper, which, mixed with chocolate, was a special favourite with the Aztecs.

Chocotatl as it was called, was specially prepared for the Emperor Montezuma, by beating the chocolate liquor flavoured with vanilla and chili, to a stiff froth of the consistency of honey. He consumed an enormous quantity of chocolatl according to Cortes. This extremely hot, spiced drink has given us the word chocolate.

Seeds of this particular chili 'pepper' plant were given to a Louisianan banker named McIlhenny by an American soldier returning from the Mexican War of 1846-8, and they were planted on Avery Island, Louisiana, near the Gulf of Mexico. McIlhenny, exiled and impoverished by the Civil War, returned to find that his pepper plants were flourishing, and to make a living he resorted to the preparation of a hot chilli sauce, which, under the name of Tobasco, now has a world-wide distribution.

It is prepared today as it was then, by a purely manual and natural aging process, without the application of heat at any stage. As a result of the process, the highly concentrated, aromatic constitutuents are preserved, if not enhanced in quality, and the flavour is unique.

The millionaire McIlhenny and Avery families are still the sole proprietors of the process, which they personally supervise from field to bottle. More than 5 million of those small bottles of Tabasco are produced annually from a relatively small acreage on Avery Island.

Cortez, whose reports of chocolatl created much less interest than his reports on precious metals, could not have imagined that the red pepper of Tabasco would ultimately reap a much richer harvest of millions of ducats! The hot peppers were to the Aztecs, what salt is to the Europeans, and Mexican dishes to this day bring tears to the eyes.

The Duboisia saga began with Robert Brown, of the Matthew Flinders survey expedition of 1801-2. He discovered , identified, and named the first specimen, and subsequently, as we have seen, contributed much to the science of plant classification. It is appropriate therefore, to examine more closely, the Solanum genus of plants to which Brown assigned Duboisia Myoporoides.

The name Solanum is probably derived from the Latin word 'Solanem', which means tranquillising, but man's recognition of the family relationship of these plants, and their use in medicine, is much older than the Roman Empire. In 1923 R.C. Thompson, previously an Assyriologist, at the British Museum, published his transcription of ancient Mesopotanium lists of herbs used in medicine. Conspicuous amongst those present are the members of the Solanum group, e.g. Deadly Nightshade, Mandrake and Henbane.

The foremost of these was Nightshade, or, to give it its more recent name, Atropa Belladonna. The name Atropa is derived from Atropos

the 'Unchangeable', the third of the Three Fates of Greek mythology, who cut the thread of Life at Death. Her two companions were Clotho the Spinner, who spun the thread of Life, and Lachesis the Dispenser of Lots, who determined the course of Life. Atropos wielded the scissors!

The more modern name, Belladonna, refers to the enlarged, dark pupil to produce which, allegedly, women chewed the leaf in order to enhance their charm! But the herb had other, more sinister names; Solanum Mortiferum (death dealing), Solanum Furiale (maddening), and Solanum Somniferum (sleep bringing). All these three characteristic effects depend upon the dose, and Bancroft described each of them perfectly, as occurring during his tests with extracts of Brown's Duboisia Myoporoides.

But Robert Brown did not classify his new Duboisia on the strength of its physiological effect, or the nature of the alkaloids, if any, which it contained. His classification was purely botanical. Is it not a remarkable fact of Nature that so many of the plants classified as Solanaceae, should in the main, contain similar poisonous alkaloids? The tobacco plant, and the other Duboisia, also produce poisonous alkaloids, but of an entirely different nature - or perhaps I should say, with a different molecular structure, but not entirely unrelated.

But as I have said, the intriguing fact is the close co-incidence of the botanical class and alkaloid content. This is the crux of the contribution to botany of Robert Brown and his Continental contemporaries. The classification of plants was, at that period, being more scientifically defined.

Most of the Solanum family are herbaceous plants, others like Duboisia are shrubs, whilst a few, like the tree tomato and egg plant, are trees. The flowers are the main feature of the family, and the photographs of

Duboisia flowers give some idea of this, when other species are described. Note that the petals are partly united to form a tube which opens out to form a circular wheel-like flower. The flower commonly produces a fleshy fruit or berry, but, as in the case of Duboisia, sometimes a dry seed capsule, such as that brought by Giles to von Mueller.

It certainly looks as though the members of the Solanum family developed from some ancestral type in the remote geological past - but what a fantastic variety of descendents! These include the common garden petunia, the tomato, the potato, the egg plant, and the so-called peppers, as well as the nightshade group, to which Myoporoides belongs. Even the potato, when unripe or exposed to light when growing, becomes poisonous to both man and cattle.

The only Solanum species available to the aborigines were the narcotic varieties. Other countries, and particularly South America produced in addition to tobacco, useful flavouring peppers or capsicums, tomatoes and potatoes. India produced another edible Solanum, the eggplant.

Owing to the poisonous nature of so many of the Solanum family, and the tenacity of tribal memory, the eggplant was first grown in England and America, only as an ornamental tree, and the fruit was called mad-apple. This is a good example of transference of qualities from one plant to another, because of a strong resemblance between the flowers. It is, as I see it, the same sort of rough identification that our pre-historic ancestors learned to make after bitter experience. I have already mentioned the long established world-wide search for medicinal herbs, as well as for food plants, and the establishment of

Herbal Gardens. It was therefore a natural development that lists of plants and their description should appear after the spread of the art of printing. Caxton printed his first book in England in 1477.

Among several such herbal lists, the one produced in 1579 by a London barber-surgeon named Gerard is the most famous. His Herbal is best remembered by all botanists more perhaps for the picturesque descriptions and the literary charm of his observations, than for the botanical information it contains.

Gerard himself was a horticulturalist of note. His reference to the egg plant, or as it was then known, Mala Insana or mad-apple, conveys the accepted notion of its poisonous nature. Moreover, the 'fact' was established in the printed word, which, as in our own newspapers, has the same influence today. With reference to the mad-apple John Gerard writes:

"But I rather wish Englishmen to content themselves with the meat and sauces of our owne country, than with fruit and sauce eaten with such peril, for doubtless these Apples have a mischievous qualitie, the use whereof is utterly to be forsaken.... it is therefore better to esteem this plant and have it in the garden for your pleasure and the rareness thereof, than for any virtue or good qualities yet knowne."

Despite the statements of travellers who had seen the fruit of this tree widely used as food in India, Italy, Asia Minor and Africa, the prejudice persisted. One writer reported that "They engender Melancholy, the Leprosie, Cancers, the Piles, Imposumes, the Headahce and a stinking breath, breed obstructions in the Liver and Spleene, and change the complection into a foule blacke and yellow colour, unless they be boiled in Vinegar." Imposume = abscess.

But how did it get the name egg plant one might well ask? For the fruit neither looks like an egg, nor does it taste like one. The fact is, that the purple fruit known to us today was not the sort that was introduced into Britain in the 17th century. Gerard states that they are "of a bigness of a swan's egge, and sometimes much greater, of a white colour, sometimes yellow, and often brown."

Travelling in India or Asia Minor, one finds the egg plant, or as the French call it, the aubergine, served as a vegetable in the cooked, sliced form. It is the Europeans who, preparing it as a specialty, conceived the notion of scooping out the pulp, mixing it with butter and flavouring, and after returning the result to the shell, baking it in the oven. Often a cook book advises preliminary soaking in salt water - this is a hangover from the days of the belief in its poisonous character.

The tomato, another and more decorative member of the Solanum family, which also comes from South America, long suffered from the same widespread belief that it was poisonous. This is the more extraordinary since it had long been cultivated as a food in Italy as early as the 16th century, under the name of pomodoro, the golden apple, because it was yellow.

Although the plant originated in Peru or Equador as the wild cherry tomato, and had spread to Europe and then back to America, the mode of its travel is not precisely known. If the Italians were already growing it in 1534, and Peru and Equador were not conquered until 1533, it seems more proable that the conquistadors who found the tomatl widely domesticated in Mexico at the time of the Conquest in 1519, brought it back from there.

It was in Mexico that the tomato was first selected as a domeSticated

plant, but how it reached Mexico is as unknown as the reason why it was never cultivated in its original home, Peru and Equador. It has been suggested that birds have been the most likely mode of spread, because it would be most unlikely that human beings would transfer the wild plant. Just for fun, I propose the turtle as the likely travelling seed-salesman.

There are wild tomatoes growing on that strange rocky group of islands known as the Galapagos. They are 500 miles from the coast of Equador, and among the creatures that live there, are the giant lizards and tortoises that so interested Charles Darwin. It seems that attempts to germinate the seeds of this wild tomato were extremely difficult. Soaking in acid or alkaline solutions and planting them in soil brought from the Galapagos Islands were unsucessful. Birds were fed on the tomatoes, and seeds from their droppings were tested, having in mind possible bird transport, but also without result. Finally, Galapagos tortoises were fed on the fruit, and, sure enough, the seeds that passed through the digestive systems of these ancient reptiles, germinated perfectly.

Remembering the extraordinary researches of the breeding habits of the large green turtle, that browses on the so-called turtle-grass in the warm, shallow marine shelf, from Florida to North Brazil, it occurred to me that maybe, who knows as yet, the Galapagos turtle might have brought the tomato from Equador to the Galapagos and back to Mexico.

Green turtles, tagged and traced by Professor Carr of Florida University, swim out to Ascension Island, a 5000 foot perpendicular rock that protrudes in the middle of the Atlantic Ocean, to mate in the

surf of that lonely island, and lay their eggs in the sand of its inaccessible beaches. They travel 1400 miles for a honeymoon on that secluded spot, and return again to the turtle grass of the Caribbean Sea. Ascension Island has no food for turtles.

I do not intend to pursue the problem of how the turtles manage the navigation, but I do suggest that if Caribbean green turtles can migrate over such vast ocean distances, that the Galapagos turtle, which is a seagoing tortoise, and his or her propensity for stimulating germination could be responsible for sowing a few wild tomato seeds on the Pacific coast of Mexico.

Lest some reader, knowing how readily the domesticated tomato seed germinates, feels doubtful, I may add, that of all the tests on germination of wild Galapagos tomato seeds conducted by the University of California, the only successful one discovered by chance (apart from tortoise digestion) was treatment with ordinary household bleach!

In Mexico however, the domestication of tomatl as it was called, had produced a diversity of varieties, including the cherry tomato, which is, in its wild form, indigenous to Peru and Equador. In the Nahautl language of Mexico the cherry tomato and its many hybrid offspring were known as Tomatl. Is it not curious that even today, the use of the tomato in Equador is rather more restricted to the Spanish colonists, whilst in Mexico, the Indians themselves use it even more extensively than the Spanish? This reflects the fact now gaining acceptance, that it was from Mexico and not from Peru that the tomato migrated to Europe.

When we trace the plant to Europe however, the trail gets lost in Spain where is should be so very obvious. It has been suggested that at that date it was not accepted by the Spaniards, but that the Moors,

who had long occupied Southern Spain, and many of whom after its conquest by the Christians had remained there, transported it to Morocco. Certainly it flourished in Morocco long before reaching Italy.

It is obvious that we are dealing with human food prejudice, and its reinforcement by Herbal writings that emphasised its poisonous nature. Once given a bad name, the members of the Solanum family could not shake it off. The ancient Herbalists had for so long dealt with the famous medicinal and of course poisonous members of the family, and had been the accepted authorities for more than 3000 years.

It could scarcely have been otherwise, when the flowers of the dreaded Mandrake, and those of other Solanum plants, including the tomato were so very similar.

The tomato, after its long European sojourn, at last in 1710, reached North America, but did not become widely known until 1779. Even then with strong suspicions of its character. In fact, the public eating of a tomato (or love apple) in 1820 made a certain Robert Gibbon famous - if that is the word. Even in 1900 a similar act of daring achieved notoriety because it was the performance of the leading negro educator of the day, George Washington Carver.

I myself remember quite well overhearing with a child's long ears the conversation of visitors at afternoon tea. They were discussing the tomato which my father cultivated, - and the ladies all seemed to agree that there was something odd about the tomato, for which 'one must have acquired taste'. That phrase stuck in my memory when much more important things should have had priority.

The Mandrake however, even in my boyhood had cast its spell over the tomato. There were friends of the family who considered that

Chapter 17.

The Most Important Member of the Family.

The most important member of the Solanum family is undoubtedly the potato, and the most valuable and fascinating book on the subject is, without doubt, 'The History and Social Influence of the Potato' by Redcliffe Salaman. The one-time Director of the Potato Virus Research Station in Cambridge, writes that "one year's world crop today, is vastly more valuable than all the gold that the Spanish brought out of the Americas."

Once again it was from the mountainous region of Equador and Peru that the cultivated variety came, but how it reached Europe, and when, is not known with any certainty. The Spaniards first saw the Peruvian Indians cultivating the plant in 1531, and were greatly puzzled by the fact that the small green fruit - like a minute tomato - was poisonous, according to the Indians, whilst the root was their staple foodstuff. They watched with amazement the heaping up of the soil around the stem of the plant, to produce those odd-looking 'roots'. These 'roots' are in fact, stems, and the 'eyes' are the points from which leaves normally would spring, and they are clustered near the top of the tuber. The real root extends from its lower end. The tuber is in fact a swelling of the stem of the plant. Consider the discovery by the ancient Peruvian Indians of the fact that unless the tubers were covered with earth, they became poisonous! As Salaman tells it, the potato plant seems to have been discovered growing in the high Andes by Indian migrants coming from the Eastern side of the giant range. The genetic history fixes the period some 2000 years before the Spanish conquest.

The migrants were a maize eating people, and maize would not grow at the higher levels of the mountains. The discovery of this strange

root ensured their survival at heights over 10,000 feet, and Salaman suggests that in this way, the potato enabled maize to reach the Pacific coast.

Potatoes were used by the Peruvians as we use them today, and also in a dehydrated form as a reserve foodstuff. The latter, which is still prepared by the Andean Indians as they did in ancient times, is called chuñó. To prepare it, the potatoes are left in the open to freeze. This ruptures their cellular structure, and releases water from the cells. They are then tramped by bare feet to form a mush, and the process is repeated several times in order to squeeze all the water from the tubers, which still retain their flattened outline. They are then dried in the sun and arid air of the altiplano to form dehydrated whole potato, a valuable, life-sustaining reserve foodstuff. A special white, floury variety of chuñó is also prepared and used as a thickening for stews. This variety is not a fully nutritious food because it is chiefly starch, like our own dehydrated potato mash! The Andean Indians know better than we do about the food value of whole potato.

It is a most instructive backward glance into the inventive genius of early man, who, under stress of necessity, has selectively bred, in this case, varieties of wild potato plants, to produce the hybrids we know in the modern world. All this, be it remembered, took place at altitudes above 10,000 feet and in a hostile climate. The unripe potato, that is before the plant itself withers, or one not covered by the soil, is poisonous. The poison is identical with that of the deadly nightshade, and is known as Solanine, which is a compound of Atropine and a complex kind of sugar. Solanine has long been used in medicine. Dioscorides, (AD50),

a Greek physician, writes that "the herb (deadly nightshade) hath a cooling faculty, and can be used for various skin diseases, headache, burning stomach and ear pain, and stops the womanish flux (when applied as a wool pessary)". Until the 20th century it was used as a sedative and anti-spasmodic in bronchitis and asthma, as well as in billiary and renal colic. Today it has been replaced by the pure alkaloids themselves, but the effect is the same.

The name given by the Peruvians to the potato plant was 'papa'. The Spaniards wrongly applied to it the native name for the sweet potato, 'batata' which is not a potato, but a member of the 'morning glory' family. The Italians confused the tuber with the truffle - an edible underground fungus, and called it 'tartuffoli', and the German word 'kartoffel' reflects the same sort of confusion. The French, always to be different, called it 'pomme de terre' or earth-apple, and the Serbs, not to be outdone, converted the occasional German word 'grundbirnen' - ground pear, into 'krumpir'. There is no end to philological fun of this sort.

In Spain, the hospital in Seville was already being supplied with potatoes in 1573. It was not until 1586 that Francis Drake brought the tuber from North America, a country then unknown to the Spaniards. Raleigh had named it Virginia after Elizabeth the virgin Queen. Some of Raleigh's men presented a plant to the London Botanical Garden in 1596, but already Sir John Falstaff, in The Merry Wives of Windsor was declaiming "Let the sky rain potatoes", and surely this love-sick would-be adulterer would not make reference to a tuber that was not already commonly known, or the intended humorous declammation would have fallen flat among the 'groundlings', - those rough islanders standing on the ground in the Pit, at the Globe Theatre on the South bank of the Thames in 1599.

Nevertheless, because of its poisonous berry, there was the Deadly Nightshade curse on the potato, and many would not eat it, because it was alleged to cause leprosy and scrofula! Owing to the fact that it was not mentioned in the Bible was sufficient cause for a Presbyterian Divine to denounce it as 'no food for man'.

The authority of Scripture, however, is not necessary to prove the nutritive value of the potato. It contains 78% water, 18% carbohydrate, mainly starch, 2% protein, 0.1% fat and some sugar. Chuno therefore was a valuable protein reserve, and a diet of potatoes supplemented with milk and butter is a complete food, the two latter supplying the only vitamins seriously lacking in the potato - namely Vitamins A and D.

In World War 1 the potato was Germany's secret weapon against the blockade. In World War II it performed the same service for the Dutch. In the 18th Century however, it had a sinister effect in Britain. It enabled the Industrial Revolution to succeed by depressing wages. As time passes, and cogent facts are revealed, it may be seen as doubtful whether Adam Smith or Ricardo would have developed their economic theories had not mechanised industry proved so successful; Success being measured by the price of the manufactured product and the profit of the industrialist.

Because the potato was found to be a sustaining and inexpensive foodstuff, the avarice of industrialists, justified by the materialist economic theories of Smith and Ricardo, compelled the workers to adopt a purely subsistence diet of potato. This meant the almost complete disappearance of meat, grain and milk products from the table of both rural and industrial workers. William Cobbett's ire was fanned by what he saw on the tables of the workers as he travelled up and down England.

In Ireland, it enabled the absentee landlords to squeeze the last drop of rent from the peasant, because he could still subsist on his potato patch, which also maintained his pig. When Blight wiped out this sole means of subsistence, the great Irish Famine stalked the land in 1845, with political results, the repercussions of which are with us today.

Tribal memories die hard, not only with the Irish, but with the Walloons in Belgium, the Slovaks in Czechoslovakia, the Croats in Yugoslavia, the Basques in Spain and France, the Druzes in Iraq, and so on and so on ad infinitum.

Had the real cost of traditionally well fed British labour (the envy of Continental observers in the 18th century), been used in the accountancy of early industrialism, its product would not have been economically so rewarding, and the pace and ruthlessness of industrial development might well have been slowed, and its character and effects so modified as perhaps to have given rise to a better social climate.

Certainly it had the effect of destroying rural England, Scotland and Ireland, compelling emigration and the exploitation of the Colonies. The verb ' to exploit' was taught in my New Zealand village school as an important aspect of the supply of colonial raw material for the mother country!

In this period of social disruption, the immigrants came to Australia. Some were transported for the express purpose of providing labour to open up the country, for the same reason as they had been previously transported to Virginia, then closed to the British authorities by the War of Independence.

But it is with the effect on the aborigines that I am concerned. Migrants from a land caught in the thraldom of the exploitation of labour, in accordance with the new industrial economics in which the potato played

a fundamental role, could scarcely be expected to act other than they did towards the strange, indigenous population, which seemed so backward as to be of little use as a source of slave labour. Civilization in its most destructive form, its mechanised form, had arrived in Australia, together with its materialist philosophy, notwithstanding the averred piety of the majority of the settlers.

The wheel has now turned full circle. The nomad Central Australian aborigine is no more. He is being integrated, like thyme and sage in sausage meat. I make my bow to my stone-age gentlemen friends, who taught me so much about Man's place in the Biosphere, and whose pedigree reaches back long before civilization - that idealised possibility of the human spirit that seems to have degenerated to a veneer under the pervading influence of greed, envy, and their product malice.

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Biosphere: The total layer of living creatures, plant and animal, that covers the earth like the rind of an orange. It is thick in the tropics and thin in deserts and oceans. All life within any zone of the Biosphere maintains an equilibrium amongst the various entities. Sometimes climatic conditions favour one element, and if it multiplies excessively e.g. locusts, the situation of equilibrium is restored by the diminution of food supply and the increase in the number of predators.

Brown, Robert. 1773-1858. Born Montrose, Scotland. Educated local grammar school, then Marischal College, Aberdeen, and finally University of Edinburgh, where his interest in Botany attracted attention. Served as an Ensign and Surgeon with the Forfarshire Infantry in Northern Ireland 1795. Met Sir Joseph Banks 1798. After return from Australia became Librarian of Linnean Society. In 1810 published Vol. 1 in Latin 'Prodromus Florae Nobae Hollandiae et Insulae Van Diemen' in

which he used the more sophisticated Linnean classification, which immediately earned International reputation. The immense prestige of classical scholarship in Scotland however, led to the publication of a criticism of Brown's Latin grammar in the Edinburgh Review, and Brown, as a result, suppressed further publication. Banks made him his personal librarian in 1810, when Napoleon was retreating from Moscow. He became Banks' legatee, and when Banks' great Botanical collection was moved to the British Museum Brown became head of that Botanical Department. He was President of the Linnean Society 1849-53, and Copley Medalist of the Royal Society. Associate of the Institute of France, and Pour le Merité, Prussia. Died in Banks' house in Soho Square.

Brücke, Von Ernst. 1845, First Professor Physiology, Vienna. Discovered that the heart regulated its own intrinsic rate of beat, and that the nerves merely accelerated or retarded this. A fantastic controversy arose in Vienna between Von Brücke and the famous anatomist Hyrtl over this matter. Brücke also added much to our knowledge of the eye.

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Carr, Archie. Professor. 'Navigation of the Green-turtle.' This is almost like reading a fairy story. Scientific American, May 1965.

Clarke, Graham. Professor of Archeology, Cambridge. Author, 'Hunters and Gatherers of the Stone-Age.' This is a most readable and informative book.

Cobbett, William. 1763-1835. Farmhand, lawyer's clerk, soldier, and as a Sgt. Maj. disclosed peculation by officers of regimental funds, was framed by perjurors and had to flee to America where he became a noted pamphleteer. Always on

the side of the oppressed and persecuted. A prominent fighter for Parliamentary reform. Returned as M.P. in first Reform Parliament in England. Wrote many books of which the most famous is 'Rural Rides' now a Penguin Book. This gives a vigorous account of the ill effects of industrialisation.

Cortez, Fernando. Conqueror of Mexico. W.H. Prescott's history of the 'Conquest of Mexico' based on original reports and documents is a most fascinating account of this remarkable exploit by a small body of men.

Drake, Sir Francis. According to Salaman, who quotes Malpeaux, 1899, 'Culture de la pomme de terre', 1586 in which he states that Drake introduced the potato into England. Salaman states this may well be correct. Raleigh made a further introduction of the potato in 1623. It had already been cultivated in Spain earlier than 1573. The confusion however is considerable, owing to inaccuracies in compiling 'Herbals'. These botanical lists were legion because of the extra-ordinary interest in herbs, plant remedies, and exotic food plants in the 16th century. Raleigh however, gets the full force of William Cobbett's scorn for the introduction of the 'lazy root' into England.

Dunhill, T. (Sir). Graduated in medicine, Melbourne. Became a distinguished London surgeon specialising in Thyroid Disease. Chairman of 'ttee of Medical Research Council of which author was a member.

Enzyme: A living catalyst. A catalyst is an agent whose chemical nature enables a chemical reaction to take place, or accelerates its rate without being used up in the process. In the living cell catalysts are called enzymes, and are proteins which control the whole of the vital processes. There is an Arabian tale of a Sheik who left his 17 camels to be divided among three sons. The oldest was to receive one

half, the second one third and the youngest one ninth. The arithmetic confused everyone, except an old friend of the family, who said "As Allah so wills, I have many camels, and of these I will give one to you to solve this troublesome problem. You now have 18 camels. Ali gets 9, Jafar gets 6 and Yamani 2. I can now take back my camel for the division is as Allah and your father willed." That camel was the catalyst.

Finlayson, H.H. Author of 'The Red Centre', an unrivalled, accurate account, beautifully illustrated by a most courageous, dedicated naturalist and explorer.

Florey, Howard (Lord Florey), distinguished South Australian medical graduate, who developed the application of Penicillin discovered by Fleming, for medical use. Rhodes Scholar and Nobel Laureate.

Furth, Otto Von (Prof). Biochemistry, University of Vienna. The first to isolate Adrenalin, the blood-pressure controlling hormone of the Adrenal gland.

Gamboge: A yellow, natural gum resin that exudes from the bark of a shrub growing in Cambodia. The reddish yellow dried ,material is a water-colour pigment. The gum resin diffuses in water in such minute particles that they are capable of being moved by the collisions of molecules. The microscopic size of the particles was essential to betray the movements recorded by Brown.

Georgescu - Rogen, Nicholas, Prof. of Economics, Vanderbilt University. One of a group of economists who consider that the fallacies of modern economic theory stem from ignoring the energy cost of utilising natural resources. By accepting this energy as well as the material resources as a 'free gift', they are in effect falsifying the book-keeping on which their theories and advice are based. This modern group of economists

advocates a Steady State, rather than a Growing State of Economy. Adam Smith, 1776, published his 'Inquiry into the Nature of the Wealth of Nations', which became to Capitalism what Marx's book 'Das Capital' became to Communists, namely a dogmatic Bible. Smith made the error of taking energy and resources as a free gift, and believed that self-interest would prevent abuse of free competition. Like Marx, he thought too well of human nature.

Gerard, Ralph. Prominent American neuro-physiologist and educator. Professor of Physiology Uni. of Illinois, Chicago.

Gillen F.J. Special magistrate and Protector of aborigines under the South Australian government and, after Federation, Sub-protector of aborigines for the Northern Territory, under Baldwin Spencer at Alice Springs.

Heiser, Charles B. Prof. of Botany, Indiana University. Author of 'The Nightshades'. Extensively used as a reference source for the present book.

Libby, W.F. Author 'Age Determination by radio-carbon content' 1949. Radio - active isotope of carbon is formed by the action of cosmic rays on nitrogen in the upper atmosphere. It is absorbed as carbon-dioxide by plants and animals. Radio-carbon changes into nitrogen at a constant rate. Therefore its ratio to ordinary carbon in archeological specimens can measure ages.

Metabolism: Literally, the turnover of the food nutrients after digestion. Food in the stomach and intestine is really outside the body. Digestion converts it into nutrients which are then absorbed into the blood. On these expeditions the <u>total</u> metabolism, and the metabolism of protein, fat and carbohydrate nutrients were studied as far as conditions permitted.

Meyer, Hans Horst. Studied under the founders of modern physiology and

pharmacology, i.e. Ludwig and Schmiedeberg respectively. He thus represented in those inter-war years, a last living link with the beginnings of scientific medicine. Brücke and Meyer are introduced into this narrative to give a sense of historical perspective.

Micro-filaria: This minute creature, like a worm, is about 25 times as long, and of the same thickness as a red blood corpuscle. It can be found in the blood of the affected individual only at night, increasing in numbers until midnight, to about 300 in a drop of blood. The numbers then decrease, and finally disappear during the day. They block the lymphatics and cause fantastic swellings of the limbs. Hence the name of the disease, elephantiasis. Bancroft's assiduous use of the microscope was amply illustrated by this really great discovery, which, if made today, would bring international publicity and fame.

Mueller, Baron Von. 1825-96. Born Rostock. Orphaned in early life. Educated in Schleswig where he studied the regional flora. 1840 migrated to South Australia. 1848-52 travelled and explored in S.A. discovering many new plants. The government of Victoria in 1852 appointed him Government Botanist, and he discovered many Alpine plants hitherto unknown. Joined expedition of Augustus Gregory to explore North Aust. Victoria River region. One of 4 to reach Termination Lake in 1852. Accompanied Gregory's expedition overland to Moreton Bay 1852-3. Director Botanical Gardens Melbourne. Honoured by France, Denmark, Portugal. K.C.M.G. 1879. Created Baron by King of Wurtemburg, and F.R.S.,London. Published 11 volumes 'Fragmenta Phytographica' and, with Bentham 'Flora Australiensis'. Sponsored the Burke and Wills and other exped'ns.

Murray C.D. Lecturer in Bacteriology, Cambridge. Later Prof. Bact. McGill University, Montreal. A strong opponent of my leaving Cambridge.

O'Connor, John. Adelaide Science and Medical graduate. First full time Lecturer in Physiology, Uni. of Adelaide. First Beit Memorial Med. Research Fellow. Post-grad. research Cambridge, England. Reader in Physiol. Uni. of Leeds. Authority on renal function.

Odum, E.P. Professor Uni. of Florida. Author 'Ecology'. A pioneer in the study of regeneration of plants after the removal of forests. Devised time-scale as follows: 1-10 years for grass cover to reach climax. 10-25 yrs for small scrub cover to develop. 28-100 years for a pine forest to take over, and after 100 years the succession is hardwoods. During these stages of regeneration there is a continuous change in the bird, and insect populations, and species change from sparrow and lark to thrush and cuckoo, caused by the nature of insects and nesting cover.

Plate techtonics: Origin of continents. Prior to the first world war a small group of geologists conceived the separation of a large land mass to form continents. Of these Alfred Wegner between 1915-29 published a fully developed theory that, as always, created opposition. Recent submarine boring in the mid-Atlantic and elsewhere have revealed the presence of much more recent rock in the sea floor along a line in the middle of the Ocean. This rock has exuded from the molten under layer and has spread sideways, pushing the older rock plates on either side apart. In mid-Atlantic the rate of movement is 1½ inches per year. These plates push under the continents. 180 million years ago it is estimated, a land mass called Gondwana land, included East Antartica, Australia, Africa, India and Madagasca. This was broken and separated by these rifts as described above.

Reserpine: The name given to the active principle of Serpina, the Indian plant so long used in medicine in that country.

Ricardo, David. Author 'Principles of Political Economy'. A successful stockbroker, more hard headed than Adam Smith. He considered that increasing population would force wages to subsistence level. The potato enabled that level to be lowered still more, in terms of wages. Giesbrecht has written a most readable and interesting book that discusses these matters, entitled 'The evolution of Economic Society', W.H. Freeman & Co.

Salaman, Redcliffe. Author 'The History and Social Influence of the Potato'. Distinguished scientist and historian. This is a large and detailed account by a man who probably was the greatest authority on the subject. There is no aspect of potato culture that is ommitted. He gives a terrible account of the expulsion of the Scottish crofters by newly ennobled landlords, converting their estates to sheep runs. The crofters were driven to live on the West coast on fish and potatoes, prior to migrating to Canada. The potato story reveals man's inhumanity to man. Even today, the bureaucracy of the E.E.C. is compelling the growers to restrict cultivation to 3 only varieties under pain of oppressive fine. The ultimate effect of this sort of genetic over-specialisation could be disastrous in the case of virus disease. Overspecialisation in the case of maize in the U.S.A. recently led to a loss of 33% of the crop from fungus disease.

Strehlow, Pastor C. Lutheran Missioner at Hermansberg in the McDonnell Ranges. Extensively referred to by Spencer and Gillen, who quote from his published work (2 vols) 'The Arunta and Luritja Tribes of Central Australia'. His son, Prof. T.G.H. Strehlow, himself a distinguished

anthropologist, was first Prof. of Anthropology, Uni. of Adelaide. He has made great contributions to an understanding of the dialects and the tribal mythology of the Centralian aborigines.

Stramonium: or thorn apple. One of the poisonous family of Solanum. Marc Antony's campaign in Parthia AD36, reports the following: "The troops had to resort to roots and plants which they did not know. As a result they also ate of one plant that killed men after driving them mad. Whoever ate of it forgot all that they had hitherto done, and recognised nothing." From 'Science and Secrets of early Medicine' by Thorbald. Extensive investigation of edible plants in the North of Australia was made by the Army during the war, with the object of saving the lives of lost airmen or army patrols.

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