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TROPICAL AUSTRALIA AND ITS SETTLEMENT.

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(From the Australian Institute of Tropical Medicine, Townsville.)

(Continued from page 382.)

Unfortunately the whole question of the protein requirement of man is still unsolved. Atwater's standard of 125 grammes of protein a day and Chittenden's standard of about 60 grammes are both accepted by various workers, and recent experiments of Hindhede have shown that nitrogen equilibrium can easily be maintained upon a much lower amount of protein, provided that the diet contains sufficient calorific value. He himself maintained nitrogen equilibrium on 32 grammes of protein for 150 days. The question is further complicated by the necessity of accessory food products and their relation to the different constituents of the food, about which we are as yet in almost complete ignorance.

The protein metabolism has been further studied by the examination of the various constituents of the urine, since the final products of its degradation are excreted in the urine. Eijkman found that the urine of Europeans living in the East Indies did not differ appreciably from standards in Europe. He found the average volume for twenty-four hours as 1,442 c.cm., the specific gravity 1.017, whilst the average nitrogen content was 13.04 grammes. In the physiological text-books the average for Europe is generally given as 1,200 to 1,500 c.cm., with a specific gravity of 1.015 to 1.025 and a total nitrogen content of 14 to 18 grammes. He allowed for 1.6 grammes of nitrogen lost in the sweat and concluded therefore that an acclimatized European passed as much nitrogen in his urine as he did in Europe.

Other observers, such as Wick, Ranke and Neuhauss, however, found that the urine is much more concentrated. Observations in this respect, extending over some time, have been made in Townsville by Young (1919). A number of urine samples collected during the hot months have been examined in this Institute and the average figures were obtained for the daily urine of twenty-five persons, some of whom were engaged in manual labour and others followed a sedentary occupation. The averages calculated are given in the table 4 together with European standards:—

TABLE IV.

	In Townsville.	European Standard.
Quantity	782 c.cm.	1,500 c.cm.
Specific Gravity	1.025	1.015 to 1.020
Total Nitrogen	10.4 grm.	16 grm.
Sodium Chloride	7.00 grm.	15 grm.
Phosphates	1.73 grm.	2 to 3.5 grm.
Freezing Point	—0.935° to —2.259° C.	—0.87° to —2.71° C.

These observations reveal decided differences. The volume was much lower and the specific gravity higher. The total nitrogen, too, was smaller. The most striking difference lies in the quantity of sodium chloride, which may be accounted for by the increased quantity of sweat lost, which carries with it sodium chloride. Estimations of the amount of water lost from the skin during exercise in Townsville have yielded interesting figures. After a brisk walk of about seventy minutes with an external temperature of 24.4° C. (76° F.) wet bulb, as much as 1,100 grammes in weight have been lost. As the subjects of these experiments were weighed in their clothing this figure only represents the water which had actually evaporated. Samples of sweat carefully collected contained from 0.1 to 0.3 gramme of sodium chloride per 100 c.cm., and the cutaneous excretion would account for several grammes of sodium chloride in the above experiment. The nitrogen lost in the sweat can only be small and is almost negligible, since samples of sweat only contained 0.03 to 0.04 grammes per 100 c.cm.

The urine measured during the cold weather averaged a higher volume, 1,357 c.cm., a lower specific gravity 1.019, and an increased salt content, 9.44 grm. per day.

The total nitrogen in the urine in Northern Australia was decidedly below the European standard, even considering that a small amount (1 to 2 grammes per twenty-four hours) may leave the organism by way of the skin. There is thus an indication of a decrease in the amount of protein metabolized. Whether this is due to a smaller intake of food brought about by a want of appetite during the hot weather, so commonly observed, or whether other factors came into play must be left an open question.

(f) Effect of a Tropical Climate on the Nervous System.—In many of the writings on health and disease in the tropics attention has been drawn to the frequent occurrence of a mental condition resembling neurasthenia, of the same type as that found in temperate climates. It occurs mostly amongst Europeans, women and men, after a prolonged residence in the tropics, and is referred to in the literature as tropical neurasthenia. In its mildest form it manifests itself in a lability of the mental equilibrium, fits of depression alternate with states of exuberance; unwarranted irritability over trifling matters is hardly ever absent, leading to uncontrollable outbreaks of temper. It is associated with a loss of mental activity and power of concentration, lack of confidence and failing memory, all of which cause a decreased working capacity. The realization of this state and the futile attempts to overcome it by increased spurts of energy tend to exaggerate the trouble. This condition may be stationary for a long time, influencing the career of the sufferer, or may get steadily worse and lead to a condition termed by Plehn "tropical fury" (*Tropen Koller*), which often explains the committal of deeds of violence in an outburst of uncontrollable passion.

Amongst others Fales (1907) has drawn attention

to the occurrence of neurasthenia amongst men and women after a residence of a year or more in the Philippines, which in women is often associated with disturbance of menstruation and of the vasomotor system. In his opinion it is in most instances not directly attributable to parasitic invasions, but to climate only and forms one of the chief drawbacks to acclimatization. Woodruff made the same observation in the same locality, and attributed the condition entirely to the effects of tropical light.

In 1913 the Society of Tropical Medicine devoted a meeting to the discussion of this subject, at which the President, Sir Havelock Charles, delivered an introductory address on "Neurasthenia and its bearing on the decay of northern peoples in India." He discussed the occurrence of "Punjab head" in Bengal, which is characterized by shortness of temper, forgetfulness, sleeplessness and disinclination to work, etc., which corresponds to tropical neurasthenia. Similar "heads" occur throughout India and other parts of the tropics, and affect Europeans after having lived in the tropics for a considerable period without furlough. In a number of cases, according to Havelock Charles, tropical disease may be held primarily responsible for the condition, but in many instances he considers climate alone as the root of the evil. Since, "the constitution of the northern races is developed in temperate latitudes" he believes "that its powers are injuriously affected by the climatic conditions of the hot zone, and this must be attributed to damage done mainly to the nervous system by a hot and humid climate." Unfortunately his address and a great deal of the discussion which followed, were marred by statements which were merely expressions of personal opinions, collected during a shorter or longer residence in the tropics, and often coloured by prejudice; actual data in support of these opinions were sadly lacking.

Basil Price (1913), who for many years examined the causes of invaliding home of members of the Church Missionary Society, found that neurasthenic conditions were the cause of 25% of invalidity in most countries.

A perusal of the general literature on the tropics confirms the fact that a complaint similar to neurasthenia is very prevalent amongst Europeans who have emigrated to the tropics, but it is difficult to gauge how far climatic influences alone may be held responsible, or what part is played by the altered conditions and habits of tropical life. The novelty of the strange environment often leads to an increased output of energy and it is only after a time that the newcomer realizes his energy capacity under the new conditions and begins to husband his strength, but often too late to avoid paying the penalty.

It is, however, beyond doubt that the monotony and discomfort of life and climate, the lack of pleasure and excitement, the big distances from the centres of civilization and, in women especially, the confinement to the house during the hot hours of the day, all help towards producing a mental condition resembling neurasthenia.

(g) Clothing in the Tropics.—The degree of bodily comfort in the tropics, in the same way as in a cold climate, is governed by a number of factors, many of which may be modified artificially. In a cold climate bodily comfort is attained by conservation of heat, in a hot climate by the allowance of a maximum amount of cooling and the clothing is a very important factor in this respect.

The literature contains numerous accounts of experiments and suggestions on the most suitable kind of clothing for a tropical climate. The aboriginal inhabitants possess a dark pigmented skin and, theoretically, therefore, a dark coloured garment, allowing of ample ventilation, would appear to be the ideal, since it would imitate nature. Practice, however, does not bear out this assumption. It has been shown that a dark skin absorbs heat rays to a greater extent than does the white skin; its temperature, therefore, rises more quickly and the sweating mechanism is brought into action earlier and the cooling due to evaporation is more effective. A dark dress material absorbs heat in the same way as a dark skin, promotes perspiration, but at the same time acts as an obstacle to the free evaporation of sweat from the skin. There is between the skin and the clothing a space filled with stagnant air, which in fact contains more moisture than the surrounding air, on account of insufficient ventilation. In consequence, the dress material becomes more and more impregnated with moisture and the meshes of the fabric clogged with water and the degree of saturation of the air space between skin and clothing exaggerated. Young has recorded observations in North Queensland upon the temperature between skin and shirt—"skin-shirt temperature"—which confirm and amplify Hill's (1914) previous experiments in the same direction, which were carried out in England. Wet and dry bulb thermometers were used, the bulbs of which were encased in wire cages to prevent contact. The temperatures thus observed were invariably several degrees higher than the outer temperatures. Hill's observations, made during an English winter, showed figures as high as those recorded in North Queensland, but his subjects wore heavy clothing, suitable to winter conditions in Europe, whereas Young's subjects only wore a thin shirt. This is a clear proof that the quantity of clothing and the nature of the material is of paramount importance in determining the condition of the air surrounding the skin. The former does not require any further explanation; the latter, however, the nature of the material, may be further discussed here. It should possess two properties, firstly, that of absorbing moisture and allowing of a maximum surface for speedy evaporation—the difference between woollen, cotton and silk material is well known—and, secondly, it should prevent, as far as possible, penetration of heat waves.

Attempts to obain this objective have been made by several workers, who experimented on the suitability of material of various colours for tropical use. This question has been discussed by Sambon (1907), who based suggestions upon experiments carried out by Baly upon the penetration of rays from an electric arc through a piece of dark pigmented skin derived from an Indian. Baly photographed the spectrum after passage of the rays through the skin and noticed that rays of shorter wave length than 3,600 $\mu\mu$. (ultra-violet) were entirely absorbed, proving thus that the skin pigment excludes the ultra-violet rays. From these observations Sambon suggested that, for tropi-

cal use, material coloured black, red or orange should be used, colours which eliminate the rays of short wave length. As all these colours absorb heat rays, he suggested at first a combination of white outer garments and coloured underwear, the former to reflect heat rays, the latter to exclude actinic rays. Later he suggested the manufacture of a special material, combining both advantages, and this has been put on the market as "Solaro." This fabric is composed of white and suitably coloured threads, woven in such a way as to present a warp (upper surface) of white and a weft (under surface) of orange, red or black, and it has been proved by spectroscopical examination to be as impervious to actinic rays as the black skin.

Schmidt (1909) suggested the wearing of loose garments made of either thick light-coloured or thin dark-coloured material and recommended the use of material similar to that suggested by Sambon.

The practical test of coloured underwear, however, has not proved it to be advantageous. Phalen (1910) conducted experiments on a large scale on soldiers in the Philippines. He supplied five hundred soldiers with orange-red underwear and compared their well-being in the course of a year with another group wearing white underwear. He compared body weight, the number of red cells and hæmoglobin, blood pressure, pulse and respiration rate, body temperature and incidence of sickness in both groups. He found that the men wearing orange-red underwear showed changes due to heat, such as loss in body weight and hæmoglobin and decreased blood pressure, more marked than the control group. Phalen concluded from his experiments that the coloured garments were more receptive to heat rays than were the white, since wearers complained persistently of greater heat, greater weight and increased perspiration and expressed the opinion that khaki clothing alone affords the same protection from chemical rays as the special underwear.

The question of clothing in the tropics has been dealt with from a more common sense point of view by Gibbs (1917). "Clothing which in the sun will cast a shade upon the body without hindering the air circulation and heat radiation will be the most desirable, and if a colour is used which will give a minimum of heat absorption, the efficiency is increased. This ideal condition is fulfilled by the umbrella and it is evident that a large white umbrella lined with a material of a colour agreeable to the eyes, for example, a shade of green, will be most efficient." He states that, since custom prescribes that the man shall cover his body, this mode of "clothing" is in fact impracticable and substitutes for the umbrella a large brimmed helmet, casting a shadow over the back, shoulders and chest, and a loosely fitting white suit of material as thin as possible.

Judging by our own experience, the wearing of light-coloured suits of porous material assures the maximum amount of comfort possible, but it is obviously impossible for a labourer to wear white clothing at his work. In North Queensland he wears, as a rule, khaki-coloured trousers and a thick, dark-coloured flannel shirt, which prevents the sun's rays from penetrating to the skin and absorbs perspiration and thus allows a maximum degree of evaporation of the sweat.

On the whole, an extended inquiry amongst the residents in tropical Queensland has revealed such a diversity of opinions as to what type of clothing is the most comfortable that it appears presumptuous to lay down definite rules. Many prefer cotton for underwear, others pin their faith on wool, but all agree on the one point that outer as well as under garments should be as porous and as light in weight as possible.

(4) Summary of Physiological Changes of the White Man in the Tropics.

A review of the known facts concerning the physiological changes of the white man, transplanted to the tropics, is from a scientific point of view disappointing. Throughout the literature published since the begininng of the last century many scrappy attempts have been made to obtain evidence in this respect; figures have been collected and experiments on metabolism and other physiological functions have been performed. In spite of the energy expended, the results are not conclusive; firstly, on account of the smallness of the number of observations recorded by the different individual observers, too small to eliminate individual variation and error; secondly, on account of the uncertainty of the generally-accepted standards which may be considered normal for a temperate climate. The question of body temperature is a case in point. Several observers formed their conclusions by accepting 37° C. (98.6° F.) as a normal body temperature and considering even a small rise above this as an indication of an increase in body temperature in the tropics. If a series of observations had been taken on a few subjects at intervals during the day and night, and the average calculated, discordant results would have been the outcome, even in Europe.

The same criticism applies to experiments regarding other physiological functions, as, for example, the total metabolism as measured by the gaseous exchange. As already pointed out, a great deal of work has been attempted in Europe and recently on a much larger scale than hitherto in the large nutrition laboratories in the United States. In spite of these concentrated and intensive efforts, as Benedict has pointed out, no definite unit for the comparison of the metabolism of normal individuals has been discovered and there does not exist at present a definite knowledge of the factors influencing individual variations.

Such changes as have been noted, have been of a qualitative, but not of a quantitative, nature. Thus, with regard to maintenance of body temperature under tropical conditions, no evidence could be found in support of the view that heat, generated by internal combustion, is reduced in order to regulate the body temperature; even under the altered conditions the body still relies on physical means for this purpose. As convection and radiation of the body are greatly decreased with the high temperature, cooling must be brought about to a much larger extent by sweating and evaporation than in a temperate climate.

Again, the increased loss of fluid from the body by the skin is accompanied by a decrease in the quantity of the urine voided. As the sweat contains sodium chloride, an increased amount of this salt must be lost through the skin, which in its turn again leads to a decreased amount of salt excreted in the urine.

Blood examinations performed on a large scale have not proved the occurrence of a tropical anæmia as such, since the figures for hæmoglobin and for the formed elements do not show a definite decrease. There is a certain alteration in the percentage of the various types of white blood corpuscles and in the number of cell fragments in the polymorphonuclear neutrophile leucocytes, showing that the percentage of "young leucocytes" in the circulation, that is, leucocytes containing a smaller number of nuclei or nuclear fragments, is larger than in a temperate climate. This is expressed in hæmatological language as a "shift of the Arneth index to the left." The significance of this change is, however, not clear, but at any rate does not seem to indicate a decreased power for resisting disease, as supposed by the Philippine observers.

The consensus of opinion gleaned from experiences in various parts of the tropics seems to indicate that living in the tropics affects the nervous system and that neurasthenia seems to be more prevalent than in a temperate climate. It is, however, impossible to obtain definite figures and data, and most statements are only based on personal experience. In the light of this it would be interesting to ascertain whether a detailed examination of the functions of the nervous system would reveal any definite alterations, which, on account of their frequent incidence, would have to be considered an outcome of life in a tropical climate.

It appears, therefore, possible that a closer study of the functions of central and peripheral nervous system might reveal definite alterations. It would be advisable to obtain figures for the promptitude and quality of the response given by the nervous system to various stimuli. Reaction times and responses to different stimuli are quantities readily capable of exact measurements by means of generally used apparatus.

An extensive investigation into the mental activities in general would perhaps yield figures of definite value. The testing of a great number of individuals in the tropics on similar lines to those applied in choosing aviators would be very interesting. The applying of the Binet-Simon test for mentality to a great number of school children, again, would furnish figures of definite value for deciding the presence or absence of racial degeneration. In the mentality tests the methods are rough and only a very large number of tests, sufficiently large to eliminate personal error on the part of the observer and to minimize the influence of a few feeble-minded children, would yield figures of value. In short, all the efforts to detect physiological changes due to living in a tropical climate have not yielded definite results. It would, however, be premature to conclude that such changes do not exist and it is possible that the advent of refined methods and more sensitive apparatus may in the future demonstrate definite alterations.

White Settlement in Tropical Australia.

(1) General Conditions and Statistics.

When comparing tropical Australia with other countries situated in the torrid zone, it becomes apparent that northern Australia occupies a somewhat unique position from more than one point of view. On the whole, the general conditions of a tropical country are modified to a much greater extent by climate *per se,* meaning seasonal incidence and degree of rainfall, than a country within the temperate zone. With the exception of a wet belt on the Queensland coast, mentioned previously, the rainfall is limited to a few months in the year and during the remainder of the year at the most an occasional light shower disturbs the monotony of sunshine and during about seven months of the year the weather conditions correspond to the "dry tropics." Vegetation, which is luxuriant during the wet season, dies down and the green of the countryside gives place to a uniform brown. The shrivelled up undergrowth is often consumed by bush fires, which are said to be sometimes started by an accidental focussing of the sun's rays and which sweep for miles over the country, leaving only the trees standing, bare of their bark.

Many phases of insect life, which are dependent on vegetation and moisture, die down during the dry months, only to become all-pervading again as soon as the rains start. These changes are more marked inland than on the coast, since many of the inland districts have a very small rainfall and the hot winds arising from the barren desert of central Australia cause the inland plains of northern Australia to approximate to a typical "'desert type" of climate, with cold nights and scorching hot days.

The great bugbear of northern Australia is the common occurrence of droughts, lasting for months and even years, when the whole country is baked by a pitiless, blazing sun and becomes denuded of all vegetation, the ground for hundreds of miles showing hardly a blade of grass.

Another respect in which northern Australia differs from other tropical regions is the sparcity of the aboriginal population. The natural conditions of northern Australia seem to militate against a large aboriginal population and the natives have never evolved beyond the nomad state and have for an unknown reason never made any attempt towards settlement. The uncertain food conditions, aggravated by droughts, have helped to keep down their numbers. After the arrival of Europeans, the inability of the aboriginals to change their nomadic habits has led to a decrease in their number and has prevented them from living alongside the white man. In consequence, in any part where a large white population exists, the black man has become extinct.

The white population is still very scanty and is mostly concentrated in a few towns which are long distances apart.

The climatic conditions, especially the small and erratic seasonal rainfall, in conjunction with the scarcity of population, have created the unique position which northern Australia holds to-day. The long dry season influences the insect life and those tropical diseases which are transmitted by certain insects, such as the mosquito, are apt to show a corresponding seasonal incidence and are to a certain extent kept in check. Other diseases, such as infectious and contagious ailments, are in a similar way kept down by the sterilizing action of the sunlight, which may kill the virus before it can spread over large and scantily populated areas.

The contention that the prevalence of certain diseases is favoured by larger and more evenly dis-

tributed rainfall is borne out by the fact that in districts situated within the wet belt a greater incidence of certain diseases is observed. Various fevers, such as endemic glandular fever, other scrub fevers of unknown ætiology, which are most probably insect-borne, occur throughout the wet belt, but are absent from other drier districts. In the same way hookworm disease is far more prevalent in those places where the rainfall is higher and is, as far as our present experience goes, practically absent from other districts showing similar local conditions but a smaller and strictly seasonal rainfall.

The effects of climate and surroundings upon any race finds a clear expression in the vital statistics, such as birth and death rates, infantile mortality rates and expectation of life.

The statistical data for North Queensland and northern Australia have not been published separately for comparison with similar statistics for the rest of Australia; moreover, it is impossible to obtain definite data as to the number of inhabitants in Australia, since the last census took place in 1911, and the population of northern Australia is of a migratory character; any figures obtained are therefore only of approximate value. The Commonwealth Statistician, Mr. G. H. Knibbs, C.M.G., was able to supply information which throws light upon this question and has kindly given permission to include his statements in the present publication.

The area and population of the tropical portion of the Commonwealth are shown in the following table:—

AREA AND POPULATION OF THE TROPICAL PORTION OF AUSTRALIA.

Tropical Portion of—	Area in Square Miles.	Population (Exclusive of Full-blooded Aboriginals) at Census of— 1881.	1891.	1901.	1911.
Northern Territory	426,320 ..	3,451	4,393	4,096	3,310
Queensland	359,000 ..	56,041	108,986	145,982	157,112
Western Australia	364,000 ..	661	3,711	4,664	4,998
Total	1,149,320 ..	60,153	117,595	154,742	165,420

These figures relate to all that portion of the Commonwealth which lies to the north of the Tropic of Capricorn. For the tropical portions of Queensland and Western Australia population figures are available at the date of a census only. For the Northern Territory they are compiled quarterly and the returns for December 31, 1917, give a total of 4,908—an increase of 1,598 since the census of 1911.

At the census of 1911 the total population of Queensland (exclusive of full-blooded aboriginals) was 605,813, so that at that date the tropical population of Queensland represented rather more than 25% of the total. It also represented about 95% of the total tropical population of Australia. It might consequently be presumed that any unhealthiness of tropical Australia would have left its impress on the vital statistics of Queensland. That this is not the case is clearly shown from the following comparison of the Queensland death rates per 1,000 of population with those for the Commonwealth as a whole:—

COMPARISON OF QUEENSLAND AND COMMONWEALTH DEATH RATES, 1906 TO 1917.

	1906.	1907.	1908.	1909.	1910.	1911.	1912.	1913.	1914.	1915.	1916.	1917.
Queensland	9.50	10.31	10.26	9.70	9.71	10.65	10.96	10.39	9.97	11.00	11.09	9.64
Commonwealth	10.92	10.99	11.07	10.33	10.43	10.66	11.23	10.78	10.50	10.66	11.04	9.80

It will be seen that in ten out of the twelve years under review Queensland recorded a lighter death rate than the Commonwealth as a whole and that in one of the other two years (*viz.*, 1916) the difference was inappreciable. The remaining year (1915) was that in which Queensland suffered from the most severe drought even known there, while the greater part of the remaining Sates experienced normal conditions, having suffered from drought in the preceding year.

Another test of salubrity often applied is that derived from a comparison of the deaths of infants under one year of age with the total births. The rate so deduced (*i.e.* the number of deaths of infants under one year of age per 1,000 births) is what is generally known as the "infantile mortality." A comparison of the Queensland results with those of the Commonwealth as a whole for the past twelve years is furnished in the following table:—

COMPARISON OF QUEENSLAND AND COMMONWEALTH INFANTILE MORTALITY, 1906 TO 1917.

	1906.	1907.	1908.	1909.	1910.	1911.	1912.	1913.	1914.	1915.	1916.	1917.
Queensland	74.68	77.65	70.67	71.50	62.90	65.36	71.73	63.35	63.93	64.33	70.27	53.87
Commonwealth	83.26	81.06	77.78	71.56	74.81	68.49	71.74	72.21.	71.47	67.52	70.33	55.91

In every one of the twelve years under review the infantile mortality of Queensland was more favourable than that of the Commonwealth as a whole. Further, in both the foregoing tables the comparison has been between Queensland on the one hand and the Commonwealth, inclusive of Queensland, on the other. A comparison between Queensland and the Commonwealth exclusive of Queensland would have given results even more favourable to Queensland than those deduced above.

In the absence of complete data in respect to the population and mortality of the tropical parts of Australia it is impracticable to carry the test further, but the figures given above indicate that the vital statistics of the Commonwealth furnish no evidence of lack of salubrity in those parts. On the contrary, the State having 25% of its population within the tropics and containing some 95% of the tropical population of the Commonwealth, has a record for general and infant mortality much more favourable than that for the Commonwealth as a whole. It may be noted that practically the whole of the State of Queensland lies in the north of the twenty-ninth parallel of south latitude.

Striking as the foregoing Queensland figures are in comparison with those for the whole of Australia, an even more telling result is obtained by comparing them with those of some of the leading European and other countries. (See page 400.)

Country.	Year.	Death Rate.	Rate of Infantile Mortality.
Queensland	1913	10.4	63
Commonwealth	1913	10.8	72
Netherlands	1913	12.3	91
Denmark	1913	12.5	94
Ontario (Canada)	1913	12.7	117
Norway	1913	13.2	65
Sweden	1913	13.6	70
England and Wales	1913	13.8	108
U.S.A. (registration area)	1913	14.1	*
Switzerland	1913	14.3	96
Belgium	1913	14.8	120
Germany	1913	15.0	151
Scotland	1913	15.5	110
Ireland	1913	17.1	97
France	1913	17.7	98
Italy	1913	18.7	137
Japan	1913	19.5	150
Austria	1913	20.5	180
Jamaica	1913	21.7	171
Spain	1913	22.1	*
Hungary	1913	23.3	186
Rumania	1913	25.9	202
Ceylon	1913	28.4	189
Chile	1913	30.1	255

* Not available.

In addition to the foregoing, it may be pointed out that the mortality experience of Queensland has been continuously improving, both absolutely and also in relation to the experience of the Commonwealth as a whole. This is clearly brought out in the next table, showing the expectation of life at age 0 in each of the last three decades.

EXPECTATION OF LIFE AT AGE 0.

Decade.	Males. Queensland. Years.	Males. C'wealth. Years.	Females. Queensland. Years.	Females. C'wealth. Years.
1881-1890	41.330	47.199	49.754	50.844
1891-1900	49.512	51.076	55.800	54.756
1901-1910	54.203	55.200	59.294	58.837

In Mr. Knibbs's opinion local statistics relating to individual towns would not give results sufficiently reliable to warrant definite conclusions, owing to the migratory character of much of the population, and, in connexion with birth, owing to the tendency to move into the towns for purposes of confinement.

(2) Housing.

The question of the construction of suitable dwellings in the tropics has been the object of a great deal of study and controversy. A suitable tropical residence should be so constructed that the interior is protected as much as possible from the direct rays of the sun, in order to prevent excessive heating of the walls of the room and at the same time sufficient ventilation should be provided, in order to secure the quickest possible cooling of the structure. Unfortunately, in the construction of the average dwelling house in North Queensland these principles have not been sufficiently considered. The greater proportion of the dwellings of the settlers on the land are entirely unsuitable and a great number in the larger towns are far from ideal. A statement of a leading firm of architects with twenty years' experience in the north is of interest, namely, that they have never designed one cottage as they know a cottage should be designed, on account of the prejudice against the introduction of novel ideas.

The majority of the scattered habitations of the smaller settlers in north-western Queensland are built of galvanized iron on a wooden framework, without verandahs or any insulation, and the temperature of the interior during the hot hours of the day surpasses by far the outer air temperature.

The small dwellings in the towns are raised on piles and contain as a rule four rooms; they possess a narrow verandah in front and sometimes also on the side. The rooms are as a rule low and the roof is composed of galvanized iron sheets and often does not possess an inner lining. The kitchen is nearly always detached and generally consists of a small cubicle built of galvanized iron only. Most of the larger wooden houses have a verandah all round and higher rooms, with ample ventilation.

A good type of tropical house may be seen in Darwin, where many of the houses are constructed after a design similar to houses in the Far East. The verandahs are wide and are closed in by bamboo shutters, which are kept shut during the heat of the day and thus prevent the heating up of the rooms and at the same time allow of sufficient ventilation; the shutters are opened as soon as the sun gets low.

It is quite evident that a galvanized iron "humpy," without verandah, is the most unsuitable structure to reside in in a hot climate. During the day the heat is nearly unbearable and the only advantage is the speedy cooling of the walls after sundown. The larger houses, built of timber, with open verandahs, are, on the whole, suitable for the climatic conditions, if attention has been paid to several points.

The house should be raised off the ground and built on piles, in order that the air should have free access to every part of the house. It should be so placed, if practicable, that it lies in the direction of the prevailing breeze and windows and doors should as far as possible be opposite, in order to allow of the maximum of ventilation. The verandah should be sufficiently broad to protect the walls from the direct rays of the sun at any time, but the minimum width depends upon the latitude in the geographical sense. According to Schilling (1909), the houses in regions near to the equator require a verandah on the four sides, as the path of the sun is more vertical. In regions below the Tropic of Capricorn a verandah on the south side is not absolutely necessary, as the path of the sun is inclined from the north and the south side of the house is not struck by the direct rays at any time. The rooms should be spacious and with as many windows and doors as practical, for the sake of ventilation and lighting. It is only too well known that mosquitoes and other insects choose dark corners and avoid light. A roof of galvanized iron is suitable, provided that the necessary ventilation is allowed for. The roof should be slightly raised from the wall. The top gable should be provided with a ventilator and, if possible, there should be louvres on either side below the gable, to provide additional ventilation. If the roof be closed in, there is a layer of hot, stagnant air between the roof and the ceiling of the rooms, which is heated by the sun to a higher temperature than the outside air and this keeps the temperature of the rooms high after sunset.

We are indebted to Messrs. Lynch and Hunt, architects, of Townsville, whose activities extend throughout North Queensland, for the framing of the following recommendations for building small dwellings suit-

able for North Queensland and costing approximately from £200 to £600.

Apart from any further items that may be found advisable, as many of the following recommendations as the site will permit should be embodied in every cottage:—

1. Buildings should face due east and have verandahs to front and back of not less than nine feet in width.

2. In addition to other necessary openings, there should also be doors and windows so arranged in every room to allow the wind to enter on the weather side and escape on the lee side. Doors should also be arranged as to avoid the necessity of retracing one's steps to get to any section of the house.

3. Buildings should not be more than one room in depth.

4. The size of a room built under the most favourable circumstances should be regulated by the number of prospective occupants. Eight hundred cubic per head would be a fair minimum.

5. Side verandahs and excess widths to other verandahs should not be constructed at the expense of the size of the rooms. Large rooms and limited verandah space are infinitely better than small rooms and wide verandahs.

6. Blocks should be approximately 2 feet 6 inches above the ground. They should be either brick or concrete.

7. All buildings should be constructed to resist cyclones.

8. Fully exposed walls should be double sheeted and ventilated.

9. Roofs should be fitted with ventilators.

10. Ceilings should stand two feet below the top of top plates. In this connexion studding should not be less than twelve feet in length for the smallest cottage and proportionately longer for larger cottages.

11. Fan-lights should be hung immediately under ceilings.

12. Ledges and corners should be avoided as far as possible.

13. Roofs should be hipped and continuous, having eaves approximately two feet in width, to walls and verandahs.

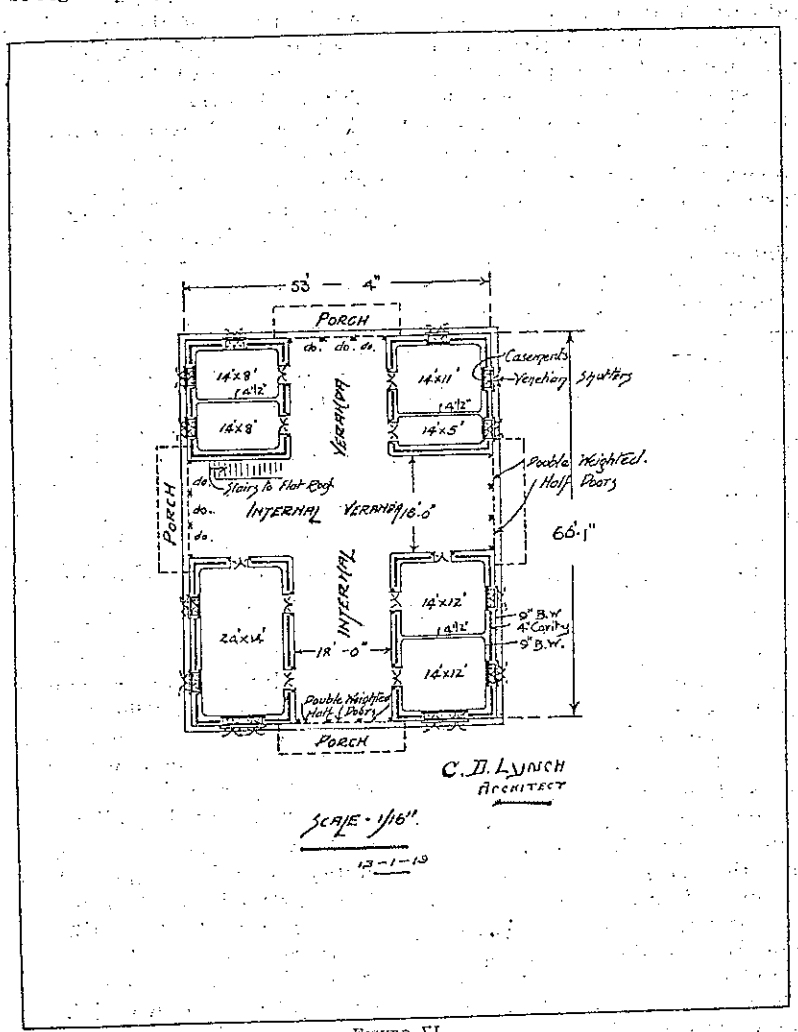

FIGURE VI.
(Reduced one half from original drawing.)

Mr. C. D. Lynch has kindly put at our disposal a novel suggestion for building suitable houses, which would entail an expenditure of at least a thousand pounds and which scheme is the outcome of twenty years' practical experience of house designing in North Queensland. The building, the idea of which is shown in the accompanying sketch (Fig. VI.), is constructed of re-inforced concrete or brick and possesses double outer walls, with an intervening and suitably ventilated air space of about three inches, thus ensuring coolness and dispensing with the necessity of verandahs. The floor space is subdivided by wide corridors (3.5 to 4.5 metres, or about 12 to 15 feet) arranged in the form of a cross, on to which the rooms, placed at the corners of the house, open. The corridor may serve as a general living room, since it enjoys the maximum amount of ventilation, whatever the direction of the wind may be. A flat roof, surrounded by a balustrade, would, according to Mr. Lynch, add further to the roominess and comfort of the building.

Suggestions are found in the literature for cooling houses by artificial means. Attempts have been made to circulate artificially cooled air through buildings, but in practice this method has not proved satisfactory, on account of the high initial expense of the necessary machinery and the technical skill required for its maintenance. Less costly, but at the same time less effective means, are fans run by electrical or water power; but as the majority of the northern towns of Queensland are without electrical power and as the water rate is excessive and the supply often uncertain, fans in private houses have not come into general use.

The systematic laying out of towns in tropical Australia has unfortunately been sorely neglected and most settlements have been allowed to grow up in a haphazard way. In the main streets of the larger towns ground has become too valuable to permit of an adequate space between buildings to allow free circulation of air. The main streets have often been laid out regardless of the prevailing winds. Flinders Street, the main street in Townsville, runs in the direc-

tion from north to south, the prevailing breezes blowing from south-east, and, as a result, the street has the well-deserved reputation of being the hottest corner in North Queensland. If, in the original laying out of the town, this point had been considered and a number of cross streets in the direction of the prevailing winds allowed for, a great deal of discomfort might have been spared.

General Résumé.

A consideration of the position in northern Australia at present shows evidence that the progress in North Queensland and to a still greater extent in the Northern Territory, has not been commensurate with the advance of time and with the undeveloped resources of the country. Certain townships, without doubt, have gone ahead, have increased in population and prosperity, but at the same time other towns have ceased to prosper, have decreased in population and their inhabitants have migrated to the prospering townships. It is, however, difficult to get definite figures which would illustrate this point, as the census is only taken every ten years, but the relatively small increase of the population of the north when compared with the south of Queensland during the decade between two census (1901-1911) is significant. The total increase in population for Queensland during this time amounted to 108,657 souls; of these, only 7,577 represent the increase in the north. Considering that in 1911 25% of the total population of Queensland was living in the northern division, the increase in district was relatively much smaller than in the centre or in the south. Even if figures for the last seven years could be obtained, their value for gauging the progress of the country would be doubtful, on account of conditions brought about by the war, which led to a nearly complete cessation of immigration.

The population of the Northern Territory has slightly increased lately. Even so, at the end of 1917 the total population is 4,908 and represents approximately one inhabitant to about 80 squares miles.

It is therefore obvious that northern Australia is not as favoured for settlement as the southern parts of the Commonwealth and in this connexion it was pointed out by Sir Thomas Anderson Stuart on the occasion of a meeting of the Royal Colonial Institute in 1912 that the southern and more salubrious parts of Australia were not by any means overpopulated yet and that immigrants naturally preferred to settle there than to go further afield; thus, in the course of time, they would find it an easier matter to obtain a setlement in the northern parts than in the south. It was simply a case of filling up and the rapidity would depend on the rate of immigration. A similar conclusion was arrived at by Atlee Hunt (1915) regarding the Northern Territory. "Should any new and rich mining field be discovered, the question of populating the Territory will settle itself; but in the absence of any such happening, it is submitted that the only course open is to wait until, in the natural course of things, the trend of population moves gradually northward."

It is well known that economic conditions play an important part in the settlement of any country, and especially of the tropics. There is no doubt that life in the tropics is burdened with a great deal of discomfort, due to heat and other general conditions brought about by climate. For this reason the settlement of the tropics carries with it more difficulties than settlement in a temperate climate. This is borne out in practice by the experience that, throughout the world, the white population in tropical parts is largely of a migratory character. Tropical Australia does not form any exception to this rule. Even during a comparatively short residence one notices that the population is continuously changing and that there exists a general desire amongst the inhabitants that their stay in the north shall be as short as possible, and the whole aspect of the majority of northern towns bear testimony to this. A lack of public interest is noticed everywhere and has led to putting up with makeshifts. Houses are only rarely built for comfort, as their owners hope to occupy them only for a few years. Town improvements are often only of an ephemeral character and short-sighted policies are the rule in most instances. This again is due to the unsettled mental condition of a migratory population, which is unable to concentrate on anything but the most pressing immediate needs.

Many conditions co-operate in bringing about this state of affairs. North Queensland is the most recently settled part of Australia; it is an enormous stretch of country, with comparatively few lines of communication with the centres, and consequently it has received a great lack of consideration from the centres of government. A feeling of isolation is a natural outcome and exaggerates migratory tendencies and the desire to get back to "civilization."

The hot summer naturally militates against permanent settlement, especially since the housing, lack of water, etc., do not mitigate the severe discomforts. If a person residing in northern Europe were obliged to live during a severe winter in a draughty wooden house, without artificial means of heating, a strong desire to move to a more congenial climate would be created. In the same way one could not expect a white population to thrive in the tropics unless all possible means be adopted to alleviate climatic conditions.

Many newcomers arrive in the North with a prejudice against northern Australian heat, which has been instilled into them by their southern friends and adds greatly to this discomfort. Dressed in their southern clothing they walk about perspiring, but never think that a cold day in the south, spent in a light cotton suit, would be equally, if not more, uncomfortable for the opposite reason.

In addition to climatic influences, the mode of employment in general tends to attract a migratory population. North Queensland is dependent almost entirely on raw products for supporting its inhabitants and permanent institutions, such as factories, giving employment throughout the year, are lacking.

The settler in the north has thus to face conditions which, when compared with those of a temperature climate, render life in one way more uncomfortable, although in another way less strenuous on account of the lack of competition. During the hot season work is carried out under trying conditions; the least exertion causes profuse perspiration, the degree of dis-

comfort depending mostly on the nature of the work and on the surroundings, but is well pronounced, even in people who follow a sedentary occupation. In addition, during the very hot months of the year, the continuous pouring out of perspiration during the day is not relieved by a respite during the hot night, when, although at rest with doors and windows wide open, one perspires freely and wakens up in the morning unrefreshed and more tired than one felt on going to bed.

It requires but little thought to realize that this discomfort plays a still more important part in the life of the women. Their work—domestic duties—is carried out during the hottest part of the day, indoors in the hottest part of the house and in most instances in that part which has been most neglected in construction. It is very difficult to obtain domestic help, on account of the small number of domestic servants available, whose wages are in consequence very high, demanding an expenditure which is in most instances prohibitive for a medium income. The wife of the settler on the land is in a still worse plight, as she has not only to do her own housework, but in many instances has to cook for the employees. There is, in fact, no eight-hour working day for these women.

As man is largely affected by his surroundings and the quality and quantity of his work influenced by outer conditions, it can be readily understood that a tropical climate with a hot atmosphere laden with moisture, where the discomfort following any bodily exertion is great, is not conducive to a maximum output of energy, especially if the lack of competition makes the condition of life easy. There is no doubt that climate *per se* tends to affect greatly the quality and quantity of physical and mental work. A cold climate conduces to physical activity, a warm climate to lassitude and the economic conditions are then the determining factor for the output of energy.

In North Queensland, with its enormous natural resources, its remarkable recuperating power after a series of bad seasons and its small population, the conditions of life are such that poverty is unknown and an easy living earned at a minimum cost of exertion and the rate of wages is very high.

Another factor which plays a very important part in the determination of the quality of work is the abuse of alcohol, which is rampant amongst all classes of the community. A number of factors contribute to this abuse, such as the thirst caused by the heat, the temptation to quench this thirst, owing to the great number of licensed public houses, the temporary stimulating effect of the slow poison and last, but not least, the well known open-hearted hospitality of the north, which finds its expression in "shouting."

The foregoing observations prove that in North Queensland both climate and economic conditions, namely, the lack of competition and high wages, have created a tendency in the same direction, towards a deterioration of labour, and it is impossible at present to apportion correctly the influence of either factor. It is quite probable that, in the future, when the population of northern Australia has increased and competition has become keener, the quality of labour may improve, unless in the meanwhile a definite decay of the race, due to climate, has set in. Up to the present, however, no such decay is apparent, but it must be kept in mind that in a newly-settled country, with a floating population, which, to a great extent, is maintained by immigration, racial degeneration would not make itself felt until after a somewhat prolonged period.

The "Great Experiment of White Australia" in most previous discussions has been considered entirely from one point of view, namely, the health point. It has been assumed that the possibility of a population of European descent to live, propagate and thrive in a tropical climate, alone would decide the question. In northern Australia, however, the economic conditions are of equal importance and present a problem as far-reaching in its influence as health for the permanent settlement of tropical Australia.

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