

TROPICAL ACCLIMATIZATION

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The fact that the white race has spread rapidly over all the fertile regions of the temperate zone and that emigration is now turning toward the tropics, gives special importance to the question of tropical acclimatization. Much has been written in a general way about the colonization of the tropics and the dangers of a tropical climate, but little has been done toward a scientific investigation of the phenomenon to which the name acclimatization is given. If it can be shown, however, that it is possible for the white man to become completely acclimated in the tropics, much will have been accomplished.

So late as 1850 Dr Knox of London declared that Englishmen transplanted to America and Australia must inevitably deteriorate and would die out in a few generations. The absurdity of such a statement does not need to be pointed out, but it is to be noted that this suspicion of the temperate zone has now been transferred to the hotter region, and that those who adopt this attitude rely on the very arguments which were brought forward against the acclimatization of Europeans in the more temperate regions of North America and Australia, viz., an enormous death-rate, physical deterioration, and reduced fertility. Modern science demands a thorough reëxamination of these arguments and the alleged facts supporting them. In an able paper read before the Royal Geographical Society in April, 1898,¹ Dr L. W. Sambon pointed out the absurdity of many of the opinions hitherto held in regard to acclimatization in the tropics and presented some

¹ *Geographical Journal*, 1898, vol. XII, p. 589.

strong evidence in support of his position. Much of the following is taken from or suggested by Dr Sambon's monograph.

The pessimistic opinion in regard to tropical climate arose at a time when scientific knowledge was in its infancy, and as a result of the popular discussion of the question by statesmen, geographers, meteorologists, and journalists, the old theories based on obsolete and erroneous medical opinions still prevail in the public mind. It has been repeatedly asserted that a tropical climate in itself has a peculiar effect on the human body and its functions. Ripley states it in the following words, which may be considered a very good summary of the views held on the subject by the French authorities and others: "Respiration becomes more rapid for a time, although it soon tends toward the normal; the pulse beats more quickly; the appetite is stimulated; a sur-excitation of the kidneys and sexual organs ensues; the individual as a rule becomes thinner; the liver tends to increase in size, which is, perhaps, the cause of a certain sallowness of the skin; in females, menstruation is often disturbed, the age of puberty being sooner reached."¹ In another place this author says that heat is the cause of humidity and generally accompanies it. This retards radiation through perspiration and is the cause of physiological disturbances; the blood is not properly purified and anemia ensues, if more immediate effects do not manifest themselves in intestinal disorders. But the force of all this is lost when he adds, in conclusion: "The exact nature of the physiological processes induced by the tropics is, however, so imperfectly known that we must in general rely upon concrete experience for our further conclusions."²

At one time malarial fevers were attributed to moonshine just as anemia, hepatitis, and sunstroke are still attributed to heat. In the annual report of the United States Army to the Secretary of War, heatstroke is classified, along with drowning and

¹ Ripley, *The Races of Europe*, 1899, p. 574.

² *Ibid.*, p. 578.

lightning stroke, under injuries. Dr Sambon asserts that anemia is never caused by heat, and cites the observations of Maurel, Marestang, Eijkman, and Glogner, who have proved beyond doubt that in tropical regions the influence of high temperature causes no change in the proportion of red corpuscles in the blood. The various diseases of the liver met with in the tropics are common among Europeans in temperate regions, but their accepted etiology is forgotten and they are curiously attributed to heat. Through bacteriology, then, the parasitic nature of malaria, anemia, and hepatitis have now become recognized. Sunstroke has remained the one condition that authors could bring forward to prove the noxious influence of heat. Dr Sambon thinks that this is also an infectious disease. Its premonitory symptoms indicate clearly a period of incubation. Its relapses, its morbid anatomy, its peculiar geographical distribution, its epidemic outbursts, the conditions of climate and soil under which it prevails, the relative immunity to its attacks afforded by acclimatization, all clearly point to the specific infectious nature of the disease.

Dr Sambon, however, draws a distinction that most writers do not make. Instead of classing heat exhaustion and thermic fever together under the head of sunstroke, he separates them. Heat exhaustion he calls syncope, and thermic fever is, therefore, the specific infectious disease to which he has reference. To this he gives the name *siriasis*, the oldest name for it, used by the ancients because they thought it occurred in the hottest months when Sirius, the dog star, rises and sets with the sun. The prevalence of *siriasis*, like that of enteric fever, cholera infantum, and other infectious diseases, is closely connected with summer, but it is important to remark that this connection with the hottest season does not necessarily imply a connection with the highest temperature. Indeed, it has often been observed that the hottest days and hottest years are not those in which the disease especially occurs, and again, it is not always found in the warmest regions. Many of our workmen, such as metal-casters, glass-blowers,

furnacemen, and stokers, are exposed for hours together to far greater heat than ever emanated from a tropical sun, yet they never suffer from siriasis. Men who work in Turkish baths are subjected to a high temperature and a moist atmosphere, two conditions which have been regarded as peculiarly conducive to siriasis in the tropics, but these men suffer mainly from rheumatism and tuberculosis. In the United Consols mines at Gwennap, in Cornwall, the temperature is 125° F. Siriasis has never occurred among its miners; their special disease is tuberculosis.

Siriasis must be distinguished carefully from syncope, alcoholic coma, cerebral hemorrhage, epilepsy, and especially from cerebrospinal fever and pernicious malaria. Syncope is common among old stokers,—“stoker's collapse”,—who are very liable to cardiac affections on account of their laborious occupation and of their free indulgence in strong drink. It is very frequent among soldiers, who likewise suffer exceedingly from circulatory disorders. Soldiers fall unconscious from syncope on parades. Col. Charles R. Greenleaf, chief surgeon, Division of the Philippines, in a report dated May 31, 1901, says: “It is an interesting fact that heatstroke generally so much feared in the tropics is practically unknown here; men often drop out on the march overcome by heat, but fatal stroke and lasting heat exhaustion is very rare.”¹ Dr Patrick Manson, of the London School of Tropical Medicine, says that heat and moisture are not in themselves the direct cause of any tropical disease.² Ninety-nine per cent of these diseases are zymotic and are caused by germs requiring a tropical habitat. Disease germs are as much members of the fauna and flora of a country as are the other living things found in it, and they are amenable to the same laws and conditions determining geographical distribution. Chief among these conditions are heat, moisture, and the nature of the soil.

Much remains to be done in this field of investigation, but the

¹ *Report of the Surgeon-General of the Army*, 1901, p. 132.

² *British Medical Journal*, 1898, vol. I, p. 1168.

opinion that the microbe is the real enemy which is to be met in the tropics, is strongly supported by some of the highest authorities in tropical pathology.¹ If this be true, then it is as possible to combat the microbe in the tropics as in the temperate zones, by sanitation and hygienic precautions.

The same difficulties which oppose the colonization of tropical lands at the present time were met by the ancient Greeks when they colonized Sicily and southern Italy. Malaria was rife in all the places which offered the best commercial prospects. In England malaria has almost entirely disappeared, but in Italy it is still deadly to the laborers of the Roman Campagna and the rice-fields of Lombardy. The French thought at one time that they would never be able to thrive in Algeria, because the climate was considered deadly to Europeans. Now invalids are sent to that country, many of the localities having obtained the reputation of excellent sanatoria. The West Indies, which used to be considered the "white man's grave," now rank among the best health resorts. The death-rate of European troops in the tropics, which used to be 129 per 1000, is now as low as 12 per 1000 in India. In Trinidad and Barbadoes sickness and mortality among the European soldiers are actually less than at home. Only a century ago smallpox was as great a scourge in the temperate zone as tropic fevers are today in the tropics, yet science has reduced that evil to relative insignificance. Hygiene and sanitation have thus accomplished much, both in the temperate zones and in the tropics, and certainly much more may be expected from wider experience and further knowledge.

A fact which gave rise to the pessimistic notion about tropical colonization was the fearful mortality among the first white visitors to tropical shores. This, however, may be explained by their insanitary ships, their insanitary habits, and their ignorance of tropical conditions of health. The fertility of the land and the conveniences of trade have generally determined the

¹ *British Medical Journal*, 1898, vol. 2, p. 912.

location of settlements on the deadly alluvial soils at the mouths of rivers. Towns thus built in the very worst places in consideration of their apparent value, but totally regardless of their qualities with reference to health, are largely responsible for the reputation of unwholesomeness which is associated with tropical countries. Bordier says that in a general way the mortality of a race increases in the measure that it displaces itself toward the equator.¹ Such a statement is too sweeping, and it leaves out of consideration many elements which may be eliminated. Climates do not depend entirely on geographic position, for they are affected largely by a variety of conditions, such as the distribution of land and water, the nature of the soil and the vegetation, elevation or depression, and the character of the land at or adjacent to the place under consideration. Facts do not bear out the assertion, for the Spaniards and the Portuguese, according to Bordier himself, have a lower mortality rate in Cuba than in Spain.

Alfred Russell Wallace, who lived and worked for twelve years within ten degrees of the equator, in the Amazon valley and the Malay archipelago, says² that the great trading centers of tropical America from Havana and Vera Cruz to Rio de Janeiro owe their extreme unhealthfulness to two main causes: first, the absence of all effective sanitary arrangements among the native population, and second, the fact that they were for several centuries emporiums of the slave trade. The slave ships reached their destination full of indescribable filth, which year after year was poured into the shallow water of the harbors and soon formed a permanent constituent of the soil between high and low water marks. In the East there were no such slave ships and there is no yellow fever. Mr Wallace goes on to say that his own experience has shown him that swamps and marshes near the equator are perfectly healthful so long as they are left nearly

¹ Bordier, *La Colonisation*, 1884, p. 91.

² *Independent*, March, 1899.

in a state of nature, that is, covered with dense forests and other vegetation. It is when extensive marshy areas are cleared for cultivation and for one-half of the year are dried up by the tropical sun that they become deadly. He lived for months together in or close to tropical swamps in the valley of the Amazon, in Borneo, and in the Moluccas, without a day's illness, but when living in open cultivated marshy districts almost invariably had malarial fever. Malarial fever, therefore, he attributes to ignorant dealing with the soil and not in any sense to climate. Bordier is of the opinion that the danger of hot climates resides mainly in marshes. He says that health on board ship in the tropics is generally good and that disease usually makes its appearance when a ship approaches the coasts and the winds come from the shore. Sir Harry Johnston, in the discussion following the reading of Dr Sambon's paper before the Royal Geographical Society, said that it had often been remarked to him by Europeans in Central Africa and that he had said over and over again to himself: "What a delicious climate, but what a cruelly unhealthy place!" In Dr Livingstone's book on the Zambesi expedition he remarks and quotes the statements of several naval officers to the effect that the climate "is like that of Italy." Thus medical experts and travelers agree that it is not the climate in itself that makes the tropics dangerous to the white man.

In this connection it is worthy of note that among the officers of the various life-insurance companies there is a growing opinion in favor of removing from policy-holders all restrictions as to residence or travel, and extending insurance to residents of the tropics on the same terms as apply in temperate regions. Of the sixty-four leading American life-insurance companies, on May 1, 1901, thirty-seven placed more or less restriction on tropical exposure — four permanently forbidding it without a special permit; twenty-four, for two years after the issuance of the policy; eight exempting it for one year; and one forbidding it without a special permit for the period from July 1 to November 1. The

remaining twenty-seven companies placed no restrictions whatever on their policy-holders as to residence or travel.¹

In a report to the Secretary of War, under date of February 4, 1899, in response to the United States Senate's resolution of January 30, 1899, calling for a statement as to the sickness and mortality among the soldiers in the Philippines, Surgeon-General Sternberg made the following statement: "I have to submit that climatic diseases do not appear so far to have been attended with unusual mortality. Malarial diseases have caused no deaths. The total death rate, taken from reports submitted by medical officers for the months July to October, inclusive, equals an annual death rate of 9.36 per 1000 men. This is only slightly in excess of that which prevails in the garrisons of the United States in time of peace. The average annual rate of our army for the decade 1886-1895 was 7.12. Typhoid fever in the Philippines caused deaths equal to an annual rate of 5.16 per 1000 men, or more than half the total death rate. If the deaths from this fever—which is not a climatic disease—be excluded from consideration, the remaining mortality from all causes in the Philippines would be less than the corresponding mortality in the United States." In his report for the year 1900, based on data reviewing the United States Army's experience in the Philippines as late as August 16, 1900, he also says: "The opinion is prevalent among our medical officers that in time of peace and doing only garrison duty the sick rate of the army in the Philippine Islands would be no higher than it ordinarily is in the southern United States." From the close of the calendar year 1900 to the latest reports the health of the troops in the Philippines had been steadily improving. Smallpox, so prevalent and deadly in the early occupancy of the islands, has been almost entirely suppressed. Dysentery, constituting 13.44 percent of all cases of sickness, is the dangerous disease. The health of the troops serving in Cuba was excellent during the year. The medi-

¹ Phelps, *Tropical Hazards*, 1901, pp. 113-114.

cal record of the troops in Porto Rico for the year 1900 is an excellent one, comparing favorably with that of the troops serving at the home stations.¹

Heatstroke receives but slight attention in the Surgeon-General's reports as a cause of disability in the tropics. In his report for 1900, speaking with reference to the prevalence of heatstroke in the entire army, he says that it occasioned 544 admissions in 1898, equal to 3.68 cases per 1000 men, with nine deaths and twelve discharges for disability; and in 1899, 204 admissions, equal to 1.93 cases per 1000 men, with two discharges but no death.² The experience of the United States army in the tropics would seem to support Dr Sambon's position.

Most tropical diseases, like diseases elsewhere, are caused by germs or parasites. These parasites, to maintain their existence, must pass, at some time or other of their life histories, from one human body to another, and must contrive to live during this passage for a longer or shorter period in outer nature. During this temporary extra-corporeal existence, the conditions—temperature, soil, and other intervening factors—must be suitable. Hence arise the peculiarities of geographic distribution of the various germ diseases.³ Dr Manson holds that there is a weak and unprotected point in the life history of every parasite, and since most diseases are caused by parasites, it is possible, did we but know this unprotected point, to stay disease. So firmly has he come to believe this that his opinion on the subject of colonization of the tropics has completely changed. In the discussion following the reading of Dr Sambon's paper, he stated that, contrary to his former opinion, he now thoroughly believes in the possibility of tropical colonization by the white race and that its postponement is merely a matter depending, first, on the growth of knowledge, and second, on the general assimilation and rational application of this knowledge.

¹ *Report of the Surgeon-General of the Army*, 1901, pp. 128-129.

² *Ibid.*, 1900, p. 285.

³ *British Medical Journal*, January 9, 1897, p. 94.

Many writers admit the possibility of acclimatization in the tropics, but assert that the white man in the process of acclimatization will degenerate into an inferior race. On this point we have conflicting testimony. Sir William Moore, for some years medical officer and secretary of one of the hill asylums for European children founded by Sir Henry Lawrence, in India, states that he found the physique of the children, especially that of the females, much inferior in after life to that of children reared in England. To offset this we have the statement of Dr Sambon, who says that thirty years ago Sir Joseph Fayer conclusively proved, from the experience of Lawrence Orphanage, that under proper management children could thrive in India as well as in England, not only in the hill stations but in the very plains of Bengal. The reason for the general opinion is the fact that children are often reared in unhealthy districts and are foolishly managed. For fear of diseases wrongly attributed to solar heat, they are constantly shut up in stuffy and darkened houses, bringing about conditions favorable to the development of the very diseases they seek to avoid. Under similar conditions children thrive no better in England.

Dr G. M. Giles, in medical charge of the Lawrence Military Asylum, Sanawar, Punjab, says: "I am inclined to doubt if there be any marked differences between children reared in India and in England; at any rate, if they get a fair share of the hills. The fact is, that the notions that have sprung up on this point are without exception the result of desultory, general observation, entirely unchecked by the numerical method. Take the oft-quoted statement that you cannot find a single fourth-generation European raised in India and the deduction thence that Europeans deteriorate in India. Where are you to find such a case among people of our habits? The darkest Eurasian will always speak of England as 'home', and if he can only get the money will go there himself and send his children there to be educated. Now, a family too poor to send their children home is hardly

likely to keep up a family history going back many generations, and if they know all about their grandfathers it is as much as can be expected. Few middle-class people, even in England, can go beyond their great-grandfathers. Hence the statement, though probably true, will not bear the deduction; as whatever the influence of climate may be, the fact depends on the social customs of Anglo-Indians, which are such that it is scarcely conceivable that one should find a family that could give an authentic history for four generations and yet had been so poor as to be unable to have its children brought up at home for a more or less considerable portion of their rearing—to say nothing of the fact that it would be practically impossible for such a family to find other similar families quite free from Asiatic blood with which to intermarry through so many generations. . . . The fact is, from the nature of the case it cannot occur, and so cannot be tested.¹

The assertion that a tropical climate *per se* induces deterioration can hardly be maintained. In Europe itself today there is appalling deterioration due to tuberculosis, rickets, and syphilis, and there is no reason to suppose that any deterioration that takes place among Europeans in the tropics should be due purely to solar influences. Deterioration in the tropics, as in Europe, is that condition of organic failure which is characteristic of long-continued (chronic) diseases, such as tuberculosis and leprosy. The two great causes of deterioration in the tropics among Europeans are malaria and tuberculosis. Dr Knox asserted that Europeans settling in America would inevitably deteriorate, but results do not confirm his statement. Other cases of a similar nature might be mentioned.

Coupled with this notion about deterioration there has been prevalent for many years a belief that sterility of the white race ensues after three generations in the tropics. After giving some

¹ *Report of the Seventh International Congress of Hygiene and Demography, 1891, vol. x, p. 184.*

evidence both pro and con, and pointing out the difficulties of eliminating the effects of crossing with the natives, or else of marrying with newly arrived immigrants, Ripley concludes that sterility from climate as a single cause can neither be affirmed nor denied, from utter lack of evidence. Fritsch, the German ethnographer, says that although sterility may result, there is no direct evidence to prove it. Prof. B. J. Stokvis (Amsterdam) makes this statement: "In the only places of which I can personally speak—the Dutch West India Colonies—pedigrees are to be had of true European families, persisting for almost three centuries, without introducing a drop of native blood."¹ Spanish women in Guayaquil, on the authority of Dr Spruce, cited by Wallace, in a region where the temperature is seldom below 83° F., and in complete absence of intermarriage with the natives, are the finest along the coast, and the white population is exceedingly prolific. Clements R. Markham, in a paper read at the Seventh International Congress of Hygiene and Demography, gathered all available information, much of which he had collected himself, and proved that families of pure European blood had been settled for upward of two centuries in places within the tropics and that in each case living representatives were quite the equal of their progenitors in moral and physical development. According to Wallace,² the editor of the *Ceylon Observer* adduces case after case of officers, planters, doctors, etc., who have lived from twenty-five to fifty-eight years in Ceylon and have retained almost continuous good health. He also refers to Dutch families descended from settlers who came out from one hundred and fifty to two hundred years ago and who have maintained average good health even in the heat of the plains. In the Moluccas there are even more striking examples, many of the Dutch families having been continuously on the islands for three hundred years and they have

¹ *Report of the Seventh International Congress of Hygiene and Demography, 1891*, vol. x, p. 185.

² *Independent*, March, 1899.

still the fair complexions and robustness of form characteristic of their kinsfolk in Holland. The government physician at Amboyna, a German, thinks the race is quite as prolific as in Europe, families of ten or a dozen children being not uncommon. There are many examples of continued and even increased fertility. On the authority of Dr Sambon, I may say that the Spaniards in their own country have a birth-rate of 37 per 1,000, in Cuba 41, in Algeria 46, while the French have a birth-rate at home of 26 and of 41 in Algeria. In an address before the New England Free Trade League, in November, 1901, Gen. James H. Wilson spoke in the following terms: "Speaking from my own observation and somewhat extended study of the question, I have not the slightest doubt that the white man can and does maintain his social efficiency unimpaired, at least in all insular tropical countries, and especially in the Greater and Lesser Antilles. He is just as prolific and industrious, class for class, in those islands as he is in the country from which he comes, and there is absolutely no reason why he should not be. In the first place, the climate and temperature of Cuba and Porto Rico are at all times better and more equable than in any of our states in the Mississippi valley south of the Ohio and Missouri rivers. It is warmer and more balmy in winter, and cooler and more agreeable in summer in those islands than it is in Tennessee, Arkansas, Louisiana, Texas, Mississippi, Alabama, Florida, Georgia, or South Carolina, and no one can properly claim, since the war of the rebellion and the economic reconstruction which followed the abolition of slavery, that the white man has physically degenerated in any of the southern states."¹

The belief that the white man cannot work in the tropics has arisen largely from the assertions of advocates of colored labor. It is true, however, that the turning up of a virgin soil is frequently dangerous in the tropics. Hong Kong was especially unhealthful during the first years of occupancy, and Wallace, as

¹ *New York Times*, Nov. 10, 1901.

quoted above, refers to the unhealthfulness of cultivated marshy areas. With this in mind, however, Wallace declares it is not the fact that white men cannot permanently live and work in the tropics. Work of some sort, there as here, is a condition of healthy life. At Para, in 1848, Mr Wallace says he saw a striking case of how a white man can work in the tropics. A young Scotchman had turned milkman for a village, and notwithstanding his hard work, with the temperature from 80 to 90 degrees or upward every day, he was the picture of health and appeared to enjoy his life.

It is a well known fact that in Ceylon and India the men who enjoy the best health are the enthusiastic sportsmen. They seize every opportunity of getting away from civilization and often submit to much privation and fatigue with benefit, rather than injury, to their health. The tea planters of Assam furnish a remarkable illustration of the safety with which Europeans may expose themselves in the hottest sun. Tea planters are a large class and their duties require them to be out in the hottest season and at the hottest time of the day. Sailors do their regular work when stationed in the tropics and do not suffer injury either from the climate or the labor, if not exposed to infectious diseases while on shore. The climate of Queensland is completely tropical, yet white men work in every part of it. In a report made by an officer in the Signal Corps of the United States Army, Division of the Philippines, the statement is made that the men who have the hardest work and most exercise seem to be well, the variety of their work accounting in a measure for their health.¹ The fact seems to be that white men can live and work almost anywhere in the tropics if they are obliged to do so, and unless they are obliged, they will not work, as a rule, even in temperate regions. Wherever there are inferior races they are subjugated by the white man and forced to work for him.

Some writers have advocated crossing with the natives as

¹ *Report of the Surgeon-General of the Army, 1901, p. 130.*

a means of acclimatization. In the strict sense of the word it is not acclimatization at all and it is certainly not essential to acclimatization. While intermarriage is said to be the secret of Spanish permanence in Mexico, the Portuguese who intermarried with the native women in India have been almost entirely absorbed. The most successful examples of acclimatization have occurred where there has been a complete absence of intercrossing, as among the Jews in the Reunion isles and the Boers in South Africa. Dr Sambon asserts that in unhealthy colonies halfbreeds maintain their health no better than pure whites. He says that a cross between races is often apt to be a weakling, sharing the pathological predispositions of each of its parent stocks, while enjoying but imperfectly their several immunities. As yet nothing positive is known as to the mechanism of immunity and the possibility of its transmission by heredity. A great deal has been written about racial immunity, and that of colored races from malaria was once considered indisputable. More recent observations, however, have proved that differences are usually small and mostly unfavorable to the natives. It is commonly observed in the provinces of the Philippine islands that the natives have "calentura" as severely as American soldiers and with considerable mortality.¹ Much of the immunity of natives is only apparent, because we must not forget that those we meet are the survivors. The immunity of the native is not a natural (racial) but an acquired immunity, and the colonizer can acquire it just as well.

It must be remembered that in considering the subject of acclimatization a number of confusing factors should be eliminated. As Ripley says,² the neglect to eliminate these factors vitiates much of the testimony of observers in the field. In the first place, a change of residence in itself always tends to upset the regular habits of the soldier or the colonist. A temperate youth

¹ *Report of the Surgeon-General of the Army*, 1901, p. 134.

² *The Races of Europe*, 1899, p. 561.

in England becomes a heavy drinker in the barracks of India. The deadliness of hepatitis among English soldiers in India is probably due more to the consumption of alcoholic drinks than to the influence of the climate.¹ Hand in hand with alcoholism is usually to be found sexual immorality. An engineer in Algeria testifies that a Sunday will put more men in the hospital than three days in the hot sun. In dealing with the crossing of races and the effects of climate upon fecundity, the elimination of this factor is especially important. The influence of national habits in the choice of food is a third element to be taken into consideration. In this regard the Teutonic nations are specially handicapped in competition with Mediterranean peoples. The English and the Germans insist on their usual allowance of meat, where the Spaniards or Italians are content with cereals or lighter food. The Chinese are especially favored in accommodating themselves to a new tropical climate by reason of their simple diet of rice. The effect of the daily life and profession on the physiological processes is another correction to be applied. An indolent life always and everywhere tends to superinduce a multitude of disorders. An important hygienic precaution to be observed in the tropics is gentle and regular exercise, being careful to avoid over-exertion. Statistics for the Jewish race, confining all its activities to shops in the towns, must be corrected for this circumstance, therefore, before they are compared with statistics for the Germans who, as colonists, take up the ever-deadly cultivation of the soil. Ripley thinks the Boers who thrive as herders would undoubtedly suffer were they to stir up the soil as husbandmen. Wherever slavery exists it always produces a high death-rate and this vitiates the comparison between statistics of the whites and the negro.

Bordier emphasizes the importance of time in the phenomenon of acclimatization.² When wheat was taken for the first time from Europe to Sierra Leone, the first year it produced only the

¹ Davidson, *Geographical Pathology*, 1892, vol. 1, p. 455.

² Bordier, *La Colonisation*, 1884, p. 37 ff.

plant and a few grains; the second year from the small number of grains sown very few germinated, but those that did produced stalks more fertile than those of the first year. From year to year the number of good grains increased, but many years were necessary to bring about the production of wheat identical with that which was brought from Europe. When geese were first taken to Bogotá they laid but few eggs, and the greater part of these were not fertile—even those that were fertile produced weaklings. The year following, the number of eggs, the proportion of fertile eggs, and the number of young ones that were successfully raised, increased. From year to year conditions improved, and at the end of twenty years the goose could reproduce on the plateau of Santa Fé de Bogotá almost as well as in Europe. If it were a question of the acclimatization of man, then years must be changed to generations. Twenty generations at twenty-five years each would make a total of five hundred years, and those who, at the end of fifty years, might despair of acclimatization would, undoubtedly, draw a too hasty judgment. No doubt the requisite number of generations in the case of man, owing to his greater powers of adaptation, would be considerably less than the corresponding years in the other case; but this, again, would be somewhat counteracted by the fact that man has a smaller number of offspring.

It is difficult to draw any definite and well-defined conclusion as to acclimatization in the tropics. Ripley attempts to summarize opinions and to balance authorities, but with little success, for he confuses the terms acclimatization and colonization. The former may be possible, while the latter, for economic and other reasons may be, if not impossible, at least wholly inexpedient. "On the whole," as Mr Wallace says,¹ "we seem justified in concluding that under favorable conditions and with proper adaptation of means to end in view, man may become acclimatized with at least as much certainty and rapidity (counting generations rather than years) as any of the lower animals."

¹ *Encyclopædia Britannica*, 9th ed. vol. 1, p. 90.

Many authorities agree that Teutonic peoples, as compared with other races, are exceedingly inelastic in power of adaptation to tropical climates, but it is to be doubted if this difference is due to ethnic peculiarities so much as to differences in national habits. Wallace makes the statement that the English, who cannot give up animal food and spirituous liquors, are less able to sustain the heat of the tropics than the more sober Spaniards and Portuguese. This, however, does not make it necessary to answer the question in the negative, and assert that the white man cannot be acclimatized in the tropics. It shows only that in certain cases Europeans have failed to meet the conditions either through ignorance or through imprudence, and that acclimatization is in most cases necessary, not that it cannot take place.

Dr Sambon recognizes the difficulties attending acclimatization, but he thinks that it is in the power of modern science to remove an important section of these difficulties. He recognizes, as does every one else, that the two important obstacles to tropical acclimatization are heat and disease, but he differs from almost every one else in accentuating the fact that these two, as regards their direct action on man, are independent of each other. His predecessors looked rather upon the tropical heat as the cause of tropical disease, but Dr Sambon draws a clear and definite distinction between these two different factors. Disease causes deterioration and tends to exterminate; it must be met by a hygiene directed against the disease germs, and is not to any great extent to be counteracted by adaptation. Heat undoubtedly has a direct influence on our well-being, especially if combined with moisture, but there are two efficient means of protection against meteorological agencies. One is that wonderful process of organic adaptation which can change into hair the wool of European sheep imported to the West Indies; the other is advancing civilization, which tends to make man more and more independent of his environment. Even with our present imperfect knowledge, a colony planted upon the isthmus of Darien

would not be annihilated by the climate, as was the Scotch colony placed there in 1698. The science of reducing the temperature of rooms and buildings is still in its infancy; yet a government arsenal already exists in Marseilles—that hottest of European cities—where the temperature is so reduced by artificial means that artisans can work there with comfort during the hottest months.¹ The reduction in the cost of artificial ice makes possible a more general use of ice in warm climates, and much has been predicted of the effectiveness of the utilization of liquid air for cooling purposes. Many of the simplest mechanical inventions of recent years have contributed enormously to lighten the labor of the agriculturist and the artisan. The demand made upon the laborer today is for the intelligent direction of his implements rather than the use of mere physical strength.

The sanitation of the past, although it has accomplished a great reduction in mortality, has hardly been more than a blind application of measures which had proved useful against diseases in temperate climates. To act efficiently in the prevention of diseases, definite knowledge must be had of the parasites which cause them; their areas of distribution must be known, their various breeding grounds, the conditions favorable to their development, and the means by which they are conveyed to man. A great deal has been recently accomplished in tropical pathology by such men as Pasteur, Koch, Laveran, Hansen, Manson, Kitasato, Bruce, Sanarelli; but a great deal more remains to be done. The establishment of a School of Tropical Medicine in London in 1899 marked an important step in the right direction.

It is true that artificial adaptation to new climatic conditions is not real acclimatization, but it aids materially in bringing about that result. Time is necessary in order that the organic changes may take place through which true acclimatization is attained. Life and health must be preserved until this organic process is complete. The task for the future is to study means and

¹ Beale, in *The Forum*, July, 1899.

conditions which may lead to a complete victory over the tropical microbes, the real enemies to be conquered. Already more than ten million white men and their descendants are settled within the tropics, laying the foundations of new and perhaps greater civilizations. It seems hardly reasonable to dispute any longer the possibility of tropical acclimatization.