

# THE INFLUENCE OF CLIMATE ON HUMAN ORGANISM AS EVIDENCED BY THE DEATH RATE FROM CERTAIN DISEASES, AND BY CONCEPTION RATE.\*

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Little effort has ever been made to ascertain in any detail the biological influences which climate may exert upon the human race. Certain differences between people of different countries have been recognized and classed as racial or environmental in origin, but no serious effort has ever been made to see how much is due to the climatic factor alone. Huntington (1) has presented perhaps the most interesting observations and theories along these lines, showing climate to be very important in the development or regression of peoples. It still remains, however, to establish the more exact manner in which man is thus influenced.

During a two years' sojourn in north China, the writer became much interested in the possible physiological effects of the intense and constant moist heat of their tropical monsoon summer period, which extends practically to the Arctic circle. The people of China, from Canton in the south to Mukden in the north, have been found to consume oxygen at a rate about 10% less than that of people of Europe and northern United States, their blood pressure is about 10% lower, and various other measurements show a level of physical activity distinctly below our accepted western standards. Westerners staying two years or more in China often suffer a distinct fall in blood pressure, while Chinese coming to Europe or America show a rise in pressure and energy expenditure.

In addition to these physiological differences which seem to result from prolonged residence in the Orient, it was observed that the incidence of certain metabolic diseases, such as diabetes mellitus, pernicious anemia and exophthalmic goiter, was very low among the natives, and of mild form when present. Arteriosclerosis with hypertension was also very infrequent, which

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would fit in well with the general low level of blood pressure. In other words the very diseases which are increasing at such an alarming rate in America, are very mild or non-existent in the Orient. This raised the question as to what factors could possibly be responsible for such differences.

As a starting point for a study of this question, I collected statistics on the death rates for various diseases in all possible countries, and in the different states of this country. Recognizing that mortality statistics can be no more reliable than is the ability of the physician signing the death report, still I feel that they offer at present the best information obtainable over any considerable portion of the world. The information obtained has indicated a very definite geographic, or climatic, influence at work on the mortality from these diseases.

#### *Diabetes Mellitus.*

Diabetes Mellitus, for instance has a mean death rate of 9.9 per 100,000 population in 11 southern states for 1920, 1925, and 1926, while the northern states range upward to the high point of 22.1 for New England. The cities show similar differences, ten southern cities having a rate of 14.1 diabetic deaths per 100,000 population, 20 cities through the central section from San Francisco to Baltimore with a rate of 20.4, and 26 cities farther north having a rate of 23.0. The negroes show this increasing diabetes death rate toward the north even more strikingly than does the white race. Thus the colored rate is about 4.0 in gulf states, rises to 8.2 in Virginia, 11.2 in Kentucky, 17.0 in New York, and 17.6 in Pennsylvania. In the last state named the colored rate is higher than for the white race, as is also true in Kentucky. This same difference is seen in the countries of Europe, the low rates being found south of the 50th parallel, and the high rates north. Finally, a survey of the diabetes death rate over the earth shows it to be generally low in the tropics, subtropics and Orient, and high in the cooler countries both north and south of the Equator. Australia, New Zealand and South Africa for instance have high rates such as are seen in northern Europe, northern United States and Canada.

#### *Pernicious Anemia.*

With pernicious anemia much the same distribution is found although the difference is even more striking. In the

southern states the rate is 2.1 deaths per 100,000 population while the rate in the north is 6.8, rising as high as 10.4 in Iowa. The rate throughout the tropics and orient is very low, while in the cooler countries both north and south the rate is high and was rapidly increasing up to the advent of liver therapy in 1926. Since then it has been decreasing in the countries with the high rates.

#### *Exophthalmic Goiter.*

With exophthalmic goiter the story is slightly different. Although there is the same difference between northern and southern states, with a mean rate of 4.0 in the north and 1.5 in the south, there is also found a low rate in all states bordering on the Atlantic ocean, even including Maine. On the Pacific ocean the rate is high. This same oceanic effect is found in the provinces of Canada. Further search will be made for the explanation of these findings. Over the rest of the world we find a low death rate from exophthalmic goiter in the tropics, sub-tropics and Orient, and a high rate in the cooler countries. Jamaica provides an exception worthy of note. Although located in the tropics, it has headed the list of countries with high goiter death rates for the last few years. Previous to about 1924 it had practically no deaths from exophthalmic goiter.

#### *Addison's Disease.*

Deaths from Addison's disease number only 0.1 per 100,000 population in our southern states as contrasted with 0.5 in the rest of the country. The other countries of the earth show the same climatic differences as were seen for the other diseases. Jamaica, however, again comes high in the list, quite out of its class as a tropical country.

#### *Angina Pectoris.*

The death rates for angina pectoris were taken as a rough index of the blood vessel changes and blood pressure. It was noted in China that arteriosclerosis and hypertension occur with much less frequency than in America, and that the mean blood pressure of the people is distinctly lower there. The blood pressure of foreigners going to China falls slightly after a residence of more than two years there, but rises after returning home. It was, therefore, thought that it would be of

interest to study the death rate from angina pectoris under different climatic conditions.

In our southern states its death rate is 9.8 per 100,000 population as contrasted with a northern rate of 18.6. In various countries over the earth the rate is generally low in the warmer latitudes and high in the cooler regions. Again Jamaica is high in the list of countries with high rates. It will be of great interest to ascertain what change has taken place in this island in the last 6 or 8 years that might be responsible for its high death rate from exophthalmic goiter, Addison's disease and angina pectoris. Japan and North China on the other hand, although placed well north, have truly tropical rates for all these metabolic diseases. This may perhaps be due to the tropical summers which they must endure.

#### *Human Fertility.*

In attempting to determine the effect of climate on the sex glands, recourse was had to the birth statistics in various regions. The numbers of births in each month for any locality were obtained, the months equalized to a 31 day basis, and the time of conception calculated by counting back 9 months and 10 days. The variations in the conception rate thus obtained were studied in relation to the mean monthly temperature, rainfall and relative humidity.

In the northern countries and states, where the winter temperatures are low and the mean July and August temperature does not rise above 70° F., the conception rate is low in late winter rises through April, May and June, to a summer peak, and falls gradually through the fall months. This applies, for instance, in such countries as Canada and the Netherlands, and in the state of Maine. As we go further south and the mean temperature rises above 70° F., a slight summer depression in conceptions occurs which becomes more marked the higher the mean summer temperature goes. In such cities as Charleston, South Carolina, and Tampa, where the mean temperature rises to 82° F. and 83° F. for the summer, there occurs corresponding depressions of 27% and 31% in the conception rate for the heat period.

In Japan the conception rate is exceedingly high for the three spring months from March 15th to June 15th, but then suffers a 50% reduction through the succeeding three months of summer heat and constantly high humidity. Dr. T. J.

Le Blanc obtained data on the use of houses of prostitution in Japan throughout the year, and found no reduction in this evidence of male sexual activity during the summer months. Since in Japan the male sexual activity would dominate the picture so far as frequency of intercourse is concerned, we may infer that the marked reduction in summer conceptions represents a reduction in fertility of the population. Less than 10% of the spring increase in conceptions in Japan could possibly be attributed to the spring increase in marriage rate. In Switzerland, for instance, there is a second marriage peak in the fall which is accompanied by no increase in the conception rate. Therefore fluctuations in the monthly marriage rate are not an important responsible factor in the conception rate changes. It would seem fairly certain, then, that we are dealing with real changes in human fertility.

It is of interest to note that, not only do mean temperatures above 70° F. depress fertility, but those below 40° F. act likewise, and around 65° F. is always found the highest conception rate for the year. Huntington, studying human efficiency in various fields of endeavor, arrived at 64° F. as the optimum temperature for maximum efficiency.

#### *Conclusions.*

In conclusion, then, it seems evident that climate does exert a distinct effect on the activity of the endocrine glands, and through them it markedly influences the death rate from the metabolic diseases. The most stimulating climates and those leading to highest human efficiency, are also those where the over-stimulative or exhaustive diseases are most prevalent and most rapidly increasing. These facts should be recognized and proper steps taken to control the high rate of metabolic breakdown in the cooler climates. The northerner living a high-pressure life should go to Florida, not in February when the climate there is most stimulating, but in mid-summer when it is most depressing to the metabolism. It would seem probable that certain portions of the human race are trying to live beyond their metabolic possibilities.

NOTE:—A more detailed consideration of the various phases of these statistics will appear in issues of the Archives of Internal Medicine.

#### REFERENCE.

- (1) Huntington, Ellsworth, "World Power and Evolution," Yale University Press, New Haven, 1920, page 230.