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# ENVIRONMENTAL MEDICINE[1]

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Good health in man and woman, dear my lord,
Is the immediate jewel of their souls;
Who steals my purse, steals trash;
But he that filches from me my good health,
Robs me of that which not enriches him,
And makes me poor indeed.

THUS we paraphrase Othello.

Under the teachings of the great pathologist Virchow, who died in 1902, medical science has been dominated by the conception of cellular pathology and cellular organization of living bodies. Out of cells, tissues were constructed. Out of tissues, organs were constructed. All the organs, and nothing more, made up the organism. Analysis was enthroned as a god. The whole was established as the exact sum total of all its parts. All the functions of the whole were derived from its elementary components. Medical particularism held the field, as behaviorism and autonomic materialism ruled supreme.

Gradually, however, there has come a change in emphasis which we may call the outworking of philosophic method in the domain of science. The change is not complete, but as it progresses, we can hope that the inherent values of analysis and the cellular organization will be carried over and completed in the broader and more difficult conception of organic unity and functional synthesis. Thus only can we treat of man as a whole being, as an organism or an individuality, if you please, who is greater than the sum total of his parts. Speaking of society, Pareto[2] puts it in these words, "The fact that we deal with *individua* by no means implies that a number of individua taken

[1] Commencement address delivered at Pomona College, Claremont, California, June 17, 1935.

[2] Wilfredo Pareto, "The Mind and Society," Vol. I, p. 32, 1935.

together are to be considered a simple sum. They form compounds which, like chemical compounds, may have properties that are not the sum of the properties of their components." I think this trend in scientific medicine may be called the synthesis of man. Once more it exalts the service of being over the worship of doing. Its wider perspective brings into focus two principles among others, to whose consideration I invite your present attention.

The first of these principles is that alien races and cultures have important contributions out of their own thinking and their own experience, for the construction of a constantly improved understanding of man himself. Truly the proper study of mankind is man.

The second of these principles involves the solution of the indeterminate equation, man plus environment = X. I want to propose a somewhat different method for the solution of this equation. It is necessary to consider man as an organic unity in relation to his environment. This is the present formulation of the objective of medical science. Health has never been defined adequately because it is so variable a quantity. It can perhaps best be taken as the state of the complete human organism in relation to its environment. The consideration is then no longer limited to diseases which may be merely a disproportion between processes in themselves normal. All questions of normalcy thus become relative. The rightness and wrongness of symptoms and processes become matters of pragmatic definition. The field of inquiry broadens and permits research in any of its domains, but all research becomes an inherent part of an attempt at constantly better understanding of man himself. Separate analyses of small areas become part of the great synthesis of man's place in nature, his ability to control or modify nature and to adapt himself to nature. Of such materials must be constructed the eventual temple of Hygeia in which each person becomes a necessary building stone and whose sum total represents the highest attainment of humankind because it is based on, and is indivisible from, the highest possible state of health.

When we inquire as to the difference between man and his environment—when we seek the limits of the one with reference to the other—the situation becomes involved. Clear separation and demarcation is difficult, often arbitrary, but invariably necessary. Space and time enter with confusing force. For the purpose of solving our equation, we can not entirely follow Kant and make these categories purely subjective, nor can we completely accept the Cartesian axiom of an indefinable unitary and basic individuality. Our goal of synthesis requires recognition of the inter-extension of organism and environment. As Professor Livingston[3] says:

> . . . it is always true that many features of an organism are continuous with corresponding features of the environment; there is always interchange of material and energy between these two portions of a more complete system, and organism influences environment; while environment influences organism. Consequently we can not expect to proceed far toward an appreciative understanding of the ordered vital weft of internal features without giving equal attention to numerous features of the just as thoroughly ordered but different environmental weft.

Our inquiry can then no longer be limited to the particularistic study of man himself, as under the old domination. We are forced to consider man as a whole organism. To do this we are equally forced to consider his environment in all its aspects. This broad field of inquiry makes up what may be called environmental medicine. But the program must be clarified by a few clear definitions. Medicine means the prevention, cure and alleviation of disease. The doctor is merely the teacher or intellectual leader. Treatment, or therapy, comes from a word meaning servant. Whatever serves man is medical treatment. Health is based on a Saxon word meaning wholeness or soundness. Hippocrates truly said that whatever belongs in the domain of wisdom is contained in medicine. From this same idea, Cartesius drew the conclusion in broad terms that "if man can be ennobled at all, it can be accomplished by medicine alone." Following the scientific method, alleviation, cure and prevention must depend on diagnosis, which simply means thorough knowledge. Virchow's day is past, of which Abraham Jacobi said, "The perfect patient is the one who is diagnosed by Skoda and autopsied by Rokitansky." That day is past because it is being lost in the greater brilliance of this conception of environmental medicine, where man is more than an objective organism, where man and his environment are inextricably intermixed, and where the understanding of man requires understanding of the greater whole of which he is an integral part.

A complete discussion of environmental medicine would far exceed our present limits. But we can illustrate briefly the importance of environment on the health of man by reference to the field of tropical medicine.

The term "tropical medicine" is a peculiar instance of a name which can not be successfully improved or replaced, and whose exact meaning is lost in its historical connotations. By it we mean the practice of medicine in warm climates. Systematic study of dis-

[3] Burton E. Livingston, SCIENCE, 80: 569, December 21, 1935.

ease requires study of the disease cause, of its means of transfer or spread and of its human recipient. The natural history of disease is modified profoundly in all these particulars by climatic conditions. Climate is one factor in geography. In the words of the Century Dictionary, geography is the "science of the description of the earth in its external aspects, dealing with its forms and movements, physical features, climate and products, inhabitants, and natural and political divisions, and the population, industries, etc., of the various countries." When we delineate this field more exactly by the term "medical geography," we have made it include in the broadest sense man's environment in relation to health or environmental medicine.

Mankind was cradled in the tropics, and thither he now must return for food, for power, for residence. This it is which underlies the fast-growing importance of tropical medicine. But in the tropics also, history has shown at their worst the tremendous catastrophes of war, famine, epidemics and natural disasters. The burdens of these also are carried by tropical medicine. Here the extra-human biologic world reaches its greatest and most complex development, and therefore interacts most potently with man. This includes primarily animals, fish, insects, plants and various organisms capable of parasitizing man. These affect man through the agencies of food supply, animal reservoirs of disease, direct carriers of disease, nuisances and direct attack. All these health hazards are sharply focussed, highly active and much accentuated in warm climates. Improper food supply brings a host of evils, such as pellagra, sprue, beriberi, scurvy and nutritional foundations for many other conditions. Animals have an intimate and fundamental relation to human disease as carriers and as natural reservoirs of infection. This is seen, for instance, in the case of yellow fever, plague, hydrophobia and parrot fever. To illustrate animal carriers of disease, we have only to recall the rôle of mosquitoes in malaria and yellow fever; of lice and ticks, in typhus and relapsing fevers; and of rodents in rat-bite fever and plague. The animal world gives many illustrations of nuisances from the human standpoint and some of these are real health hazards, as in the case of interference with rest due to verminous insects, and secondary infections gaining access to the body through insect and other animal bites.

In warm climates the health status is influenced by environment in the maximum variety of ways. Let us look at some of these specific features of environmental medicine in the tropics, fitting all of them into the equation, man plus environment = X.

We consider first the major elements of climate itself, air pressure, humidity, temperature, insolation, magnetic and radioactive fields, winds. These are closely tied in with the movement of ocean tides and with land forms and land-sea balances. Out of these is compounded the average state of the earth's atmosphere, which we call climate. Here is one of the controlling environmental factors with reference to man's state of health. The growth, quality and variety of vegetation affects quality and quantity of food supply and the type of indigenous culture. The insect population is to a great degree dominated by climate. Man's physiology is directly affected. The evenness of equatorial climate, with its minima of physiologic contrasts and stimulation, furnishes the bases for that chiefest enemy of human progress, monotony. More immediately we see the same thing illustrated in the severe nervous disturbances which follow the "50 day wind" of Persia and the north wind of the Gran Chaco. A monotony of good things is as soporific and deadening as a monotony of adverse things. Man's very consciousness depends on contrasts. Variability is the secret of physiologic rhythm and of biologic life. California is perhaps over-stimulating in its geographic contrasts and its intense variability. As a consequence we see cults, quacks and harebrained inventions where mental discipline is deficient; and where mental discipline is adequate, we see the highest advance in the lines of social ideas, science, politics, religion and the intellect. The great apparent exception to all this is Egypt, a section of the Sahara desert with a river flowing through it. That river, by its unvarying overflow, insured reliable crops, a factor, in desert country, which counterbalanced the monotonous climate and geography.

Low latitudes are usually associated with the rain forests, humid air, cloudiness, heat and exuberant biologic growth of the equatorial zone. But outside of this area, both north and south, the earth is belted with deserts. Abrupt changes in character of population and culture appear. Disease takes on new forms. The human economy is adapted to dryness, dust and glare. Food habits bring different health problems. Nomadic life, milk foods and animal culture become possible and necessary. Due to change in climate, the cultus of the desert has overflowed in at least two great historical movements which have had untold influence down to the present. The first of these was the westward march of Islam under the Caliphs, extending finally into Spain. The second was the movement of the hordes out of central Asia into Europe, China and India. As a result China incorporated Mongolian traits in government, social life, economics and racial temper. Russia for over 200 years was ruled by Tartars with a lasting intermixture of Asiatic oriental blood. In India, while the Moslem impact received a great impetus with Mahmoud of Ghazni in the year

1000, it became completely dominant under the 300-year rule of the Moguls or Mongols. The tremendous social changes there are illustrated by the development of the zemindar landlord system, which caused the basic agrarian problem of India and has only recently given promise of solution by return to a modified Hindu village communism. Another nearly insoluble social problem is seen in the bitter animosity between the 80,000,000 Moslems of north India and the 220,000,000 of the Hindu religion. These two historical problems lie at the root of India's complex difficulties to-day. Both are factors of environmental medicine and of primary concern for the health status of that great country.

The economic type of culture is in general a product of hereditary social and geographic factors. The rain-forest dwellers of the Congo and Niger basins and the southern fringe of eastern Asia have a fairly fixed location, considerable isolation and rudimentary agriculture. Insects and diseases interfere with animal husbandry. The negroid and Malay inheritances prevent intellectual advance. All the environmental conditions retard cultural improvement. Equatorial Africa has been largely denuded of domestic animals by infections carried by the tsetse fly, which has also depopulated entire districts by sleeping sickness. Yet this destruction of live stock saved central Africa in the seventh century from occupation by the Moslems, since even the desert-trained Arabs could not take their horses south of the Sahara. The tsetse fly turned Islam north into Spain. And the tsetse fly is a product of geography.

Ocean currents are another geographic agency of untold importance in human affairs. The story of the Japan current, flowing from the breeding ground of hurricanes in the Malay Islands and making China, Japan and our own West Coast habitable, is matched by the saga of the Gulf Stream, starting from its own nest of hurricanes in the Caribbean and giving sustenance to the cultures of the north Atlantic and Mediterranean. Islands and coastlines shared in this influence and contributed their full geographic share to the glories of Greece and Rome. Again the growth of great cities has been a function of geography and pays due tribute to the importance of environment in moulding man's habits and health. The trend to cities characterizes the modern epoch. The geographic history of London, Calcutta, Tokyo, Shanghai, Manila and New York throw added light on the powerful influence of environment on medicine.

A different kind of health influence is seen when we turn to the eating and drinking habits of the races. Empirical habits may be good or bad. Undoubtedly China owes no small part of her longevity to chopsticks and boiling hot tea. By contrast we see the Arab, not even observing the Koranic permission to wash in sand when water can not be had, eating from a common dish directly with his well-weathered fingers. The half-rotten meat of the mid-African zone introduces digestive hazards well matched by the parasites swallowed in half-rotten dried fish by the Chinese and raw, even live fish, by the Japanese.

The wheat-eaters of north China are in strong contrast to the rice-eaters south of the Yang-Tze River. Freshly fixed nitrogen of volcanic origin is washed by torrential rains into the lower valleys of Java to make possible one of the densest populations known, supported by the rich rice paddies and the vitamins of tropical fruits. The liking of rice-eaters for over-milled rice results in beriberi when other dietary balances are lacking. Sprue declined rapidly in Ceylon when the foreign population began to depend less on imported canned goods. Medical science made possible food preservation, which has become a complex and highly capitalized industry, so that tinned goods and concentrates may still be balanced and safe. Nature has kindly provided a rich assortment of spices to stimulate digestive organs suffering from the monotony of tropical dietaries, and their over-use easily leads to disorders of the liver and intestinal tract, already inclined to passive congestion and inflammation. These are but a few of many illustrations of the influence on health of geographic eating and drinking habits.

It is probable that every race has invented or adapted some type of poison that suits it best and pleases it most. We have our alcohol, tobacco, coffee and other favorite drugs. The Andean peoples have their coca leaf. Asia has its opium. Mexico has provided marihuana. The Pacific Islands and Malaya have demonstrated the brotherhood of man by refinements of alcoholic manufacture. The southern half of Asia, the great eastern islands and a third of Africa are delighted addicts of the betel nut. This last is one of the most highly developed, wide-spread and ingenious of man's attempted improvements on nature. In ancient Turkestan, hemp was a fiber plant valued for its many uses. Transported across the great mountains into the hot, low plains of north India, it took on or was found to have peculiar narcotic properties. Its crude stems and leaves make the favorite social drink of the country. Its more purified portions are smoked, drunk and chewed with betel nut, as ganja. Its purified sap is charas or hashish. The betel nut chewer concocts a mixture of ganja, fresh lime and assorted spices, with the sliced fruit of the areca palm, called betel nut, rolls up the mass in a succulent pepper leaf and stuffs it in his mouth. The bright red saliva is a feature of the eastern landscape. Indian hemp in extreme cases causes a peculiar insanity,

various psychologic disturbances and of course general physiologic symptoms. Obviously all drug habits are closely tied in with personal and public health and have their foundation in environmental conditions.

Few departments of human life have a more thrilling story or one more closely interwoven with man's advance than communications. The romance of transportation is linked with all the means of spread available for ideas and knowledge. Printing, telegraph, telephone, radio and transportation beneath and on the water, by land and by air—it is the story of civilization. Transport problems are always fresh and always urgent. In 1571 Queen Elizabeth rode in a coach to open Parliament, the first time an English sovereign rode in a state coach. Londoners called the new contraptions "hell carts." Ellison Hawks[4] has written a thrilling description of "The Romance of Transport." Distribution of goods and transfer of persons control famines, relieve disasters, determine wars, promote government and cause or prevent economic crises. Commerce is no more dependent on communications than is medicine. Preservation and improvement of health status go hand in hand with good communications. And communications are a direct product of man's ability to control or modify his environment.

Mankind is indeed incurably religious, whether he shows it by empirical fear of nature, by formulated systems or theories of divinity or by worship of a social organization as in Russia. It is to be expected, therefore, that religion will be fundamental, but not of necessity helpful, in all ages and among all nations in the building of disease control and health improvement. And so we find it in fact. Animism, juju and magic so confuse or identify effect and cause that the bases of sanitary practice and preventive medicine can not be laid. Islam offers many strong features in its program and makes medical science contend with fatalism and colossal fanaticism. It shares in the sanitary guilt of unsanitary pilgrimages, which have been sources of anxiety to medical science for many ages, equally in Chaucer's time, the crusades and the modern hadj to Mecca. The pessimism of Buddhism seeks escape from the problem of life by abolishing desire for gratification of the senses, for personal immortality and for prosperity. Such a philosophy has immediate medical connotations.

Hinduism also has its pessimism and its path of escape, by denying reality and teaching the doctrines of rebirth and of Karma. The present state of man is thus unreal and unchangeable, and any effort at change becomes a sin. The doctrine of rebirth leads to callous indifference to the animal world with immediate and tragic consequences in regard to needed food supplies and control of bacterial and animal parasites. Carried to its logical or illogical extreme by the sect of the Jains, it teaches that there is a soul in every object and that the path of escape is only by complete abnegation. Libraries can hardly contain the literatures of the world's religions. Little reflection is needed to realize that religious belief may be the strongest of all friends of medicine and health or the most implacable of all enemies. We are taught to support complete freedom of religious belief and we must of necessity grant the same privilege to other countries as to our own. Persuasion, comparison and knowledge are the ultimate weapons. Yet these are slow and often ineffective against religious strongholds which are hostile to medical science. We see this in the United States of America, even as in India, Turkestan or Africa. Yet we can securely rely on the ultimate victory of truth, and the practical lesson is to add patience to the qualities necessary for success in the long war between medicine and disease. There is a lesson here also for the spread of Christian missions with their invaluable content of medical teaching and practice. Again comparison, persuasion and knowledge are the tools and the object must not be an exotic and foreign-controlled system, but the growth of a native, indigenous system, adapting and using in its own way the new principles learned, and free to develop them in the line of native history and culture.

In the tropical world, man's medical defences are undermined by insidious and persuasive influences, while at the same time the direct agents of disease are multiplied and deadly. Epidemic diseases have laid low ancient empires. Angkor, Egypt, Greece and Rome bowed to the pestilence that walketh in darkness. Ten thousand times 10,000 have fallen before those great captains of death, plague, dysentery, typhus, cholera, malaria. Death comes quickly in low latitudes, borne on the wings of mosquito and fly, concealed in the vermin of rodents, coursing in the blood of man and beast alike. Only by superior knowledge and keen medical weapons can man fend off the attacking hordes and grow strong on their discomfiture. Vaccine, serum and drug—the sanitary engineer, the public health officer and the protection of personal hygiene—are all necessary. For man must again use the tropics, and what he can not conquer, he must use by adaptation.

One of the most difficult problems of environmental medicine is the acclimatization and adaptation of the white man in the tropics. Of the discussion of this, too, there is no end. Climatic conditions bring monot-

[4] Ellison Hawks, "The Romance of Transport," Thomas Y. Crowell, 1932.

ony and lack of stimulation physiologically. The easy tendency is an attempted compensation in spicy food and strong drinks. A vicious circle arises, increased by insufficient exercise. Predisposition is established for infectious, contagious and deficiency diseases.

Man's greatest health enemies are ignorance, indifference, poverty and certain religious systems. Contact with a different and often inferior native race leads to mental isolation and distorted perspectives of social values. Poor communications and enervated physiology weaken moral stamina and lower social and intellectual standards. Mental slackness follows on physical slackness. Latent weaknesses become patent. Adaptation and acclimatization require clear understanding of the dangers, improved communications and rigid maintenance of personal standards. The British dinner jacket has become a symbol of morale.

Understanding of the environment is necessary to avoid disaster. Food, clothing and housing must combine local facilities and customs with the requirements of medical knowledge. Balance of work, rest, play and intellectual interests must be attained. Mental and sex habits must be coordinated with the program. Such complete control of and adaptation to tropical surroundings has seldom been fully achieved. But in proportion to the completeness of this adaptation rests the ability of the white man to live in the tropics. It is becoming easier as medicine leads the way. The culture of higher standards must always prevail by absorbing the proved virtues of the indigenous native culture. Such synthesis is the hope of the future, in world civilization, in religion, in all human activities.

The value of organized study in the field of tropical medicine has been recognized by the governments of England, Germany, Italy, France, Belgium and more lately of the United States. The army and navy medical corps and the federal Public Health Service have a brilliant record worthy of the pride of every American. The field, however, is broader than these services, and to-day we find some thirty-five universities, numerous public health bodies, various foundations and other government agencies actively engaged in the study and practice of tropical medicine. The American Academy and the American Society of Tropical Medicine correlate and strengthen all these activities under the American flag, worthily matching similar organizations abroad. The practical work is in three divisions, research, clinical care and study of the sick, and education of doctors, nurses and non-medical persons. The three chief geographic centers are in New York, New Orleans and San Francisco. In the University of California, the Pacific Institute of Tropical Medicine is a cooperative Pacific coast enterprise, supported by commerce which recognizes the foundation necessity of medicine, which has community pride and which joins with the American government in recognizing the international values of tropical medicine in joining nations in a program of common advantage.

Four thousand five hundred years before Christ, the physician Iemhetep in Egypt served the third dynasty of pharaohs. His name is translated, "He who comes in peace." His successors to-day are ambassadors of peace. They open international doorways of friendship. Those dedicated to this service find satisfaction and reward beyond the measurement of gold and more lasting than can be expressed in words.

# OBITUARY

## HENRY FAIRFIELD OSBORN[1]

OUR beloved former president, Henry Fairfield Osborn, died suddenly of heart failure at his home at Garrison-on-Hudson, on Wednesday, November 6, 1935, at the age of seventy-eight years. It is exceedingly difficult to express adequately our sorrow in losing this steadfast friend and great leader. His human contacts were so numerous and so uniformly helpful to others that a great many people will deeply mourn for him. In fact, his good deeds on every side were so manifold that we know not where to begin. Nevertheless we must attempt a brief outline of his life, as follows:

He was born on August 8, 1857, at Fairfield, Connecticut, the son of William Henry Osborn and Virginia Reed Sturges Osborn. His ancestry on both sides was of the best and his very able and devoted parents left nothing to be desired in the influences that moulded his childhood. While he was still quite young (1881) his father built a house, "Wing-and-Wing," near his later residence, "Castle Rock," at Garrison, N. Y., overlooking the Hudson River, opposite West Point. In this delightful home and environment the young Fairfield early showed his interest in natural history. As a student at Princeton he came under the influence of the famous Dr. McCosh and was so much attracted by the subject of philosophy that he undertook several studies in psychology and philosophy which were published as brief papers at intervals from 1880 to 1884.

Meantime, however, through Professor Guyot of Princeton, he became interested in paleontology and in 1877 he, together with his friends W. B. Scott (who was destined to remain as his life-long colleague) and Francis Speir, Jr., organized and carried to a very

[1] Read at a meeting of the Scientific Staff of the American Museum, on November 7, 1935.