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THE PHYSIOLOGIC LIFE[1]

WE know to-day many factors that injure the individual, and a few that seem to injure the race. But in our almost complete ignorance of the mechanisms of race improvement, we seem impotent on the positive side, except that by eliminating those who deviate markedly from the average we may give the latter group more elbow room. By selection and controlled breeding we seem to be able to secure a fatter hog and a faster horse. Have we thereby secured a better hog and a better horse?

Assuming that we know how to achieve fundamental race improvement, is there any agreement as to the goal? Is the super model of *homo sapiens* to be constructed on the line of a Mussolini, a Gandhi, an Einstein, a Dempsey, a Darwin or a Henry Ford? Is he to be "wet" or "dry"? Should he be white, black, yellow, brown, pink or gray? Should he be six or sixty feet tall? Should he be a more rational or a more emotional machine? Is he to be a pacifist or a man fitted to wage bigger and better wars? Are we to aim at a better coordinated society of masters and slaves or a democracy?

The present state of development of man and his fellow animals has come about through the forces of heredity and environment, practically without an iota of conscious direction based on accumulated experience. The time during which we have had even an approximate understanding of our physiological processes, and the factors that favor or impede the same, is so short that it may virtually be ignored in the total time span that man and other animals have existed upon the earth. If we knew what our forebears ate and drank (and how much); if we knew how they worked, rested, loved, we could with greater certainty put the labels "favorable" and "unfavorable" on the manner of living and on the man-made environment of to-day.

We may assume that the present man is the best possible product of past conditions. In what respects do conditions of human life to-day differ from those of yesterday, and do any of the new conditions bode ill for to-morrow?

1. Modern man cooks, preserves, sterilizes and denatures his food to a greater extent than his forebears.

2. Modern man lives under more uniform climatic

[1] Address given at the third Race Betterment Conference, Battle Creek, Michigan, January, 1928.

conditions because of clothes, houses and fire. Also, in consequence of these, he lives less in the open and farther from the sun than did the primitive man.

3. As a consequence of industrial developments and growth of cities a large proportion of men of to-day are more crowded, more subject to polluted air, polluted drinking water and industrial poisoning than our ancestors.

4. As a consequence of the growth of knowledge, particularly of chemistry and medicine, man of to-day is being subjected to a greater variety and quantity of stimulants and drugs.

5. Because of greater knowledge of nature modern man has less fear, but probably more anxiety than the man of the past.

6. The sex life of modern man seems ill-adjusted to prevailing social theory and practice. We do not know, but it seems probable, that the very ancients lived a more biological sex life.

7. In consequence of the growth of knowledge, art, industry and invention, man of to-day is probably subjected to a more continuous, if not more varied, nerve strain than in the remote past. We have accumulating evidence that excessive brain activity may interfere with some fundamental physiological processes, as a powerful gas engine may shake to pieces a less solidly built chassis.

FOODS

We may assume that our forebears (as well as all other animals in all ages) have from time to time been subjected to quantitative under-nutrition, that is, starvation. In tropical climates this is merely a question of the number of animals and quantity of available food. In temperate climates it is also a question of seasons. To be sure, many animals have become adapted in relation to the second factor, they have become accustomed to prolonged inactivity and starvation (hibernation). We have no evidence that man himself ever was a hibernating animal. But we think it is safe to assume that modern man has reached his present stage of perfection (or imperfection) through periods of quantitative under-nutrition as well as periods of gorging in the presence of plenty. There is no reason to think that our ancestors, any more than their fellow animals or modern man refrained from eating far above their actual physiological needs if plenty of food was available. It seems probable that qualitative under-nutrition, that is, diets lacking for a long time in essential salts, essential vitamins, essential proteins and in essential roughage, was probably less prevalent among our primitive ancestors, because cooking and food refining is a late acquisition. If this is correct, it follows that most of our food-deficiency diseases, excepting, of course, those that are brought on as a result of quantitative starvation, are man-made diseases. I refer to the various pathological processes induced by lack of vitamins, by lack of adequate proteins, by lack of roughage in the food and by lack of proper salts in the food. Man has brought these on himself largely through misguided esthetics and perverted taste, and by commercialism not controlled by physiologic knowledge.

We should add in all fairness that as man is now distributed on the earth various types of food preservation or sterilization is a necessity, not only preservation from season to season, but such preservation that food can be shipped long distances from one country to another where the density of population is in excess of the ability of the country to feed it. The problem of food preservation and a food purification is one of commanding importance to our race to-day, because in this respect industrial processes and dietary habits of long standing are only slowly brought under control of physiologic knowledge. We still mill our grain and feed the bran to hogs and cattle. This may help to develop super hogs and super cattle, but it is no aid to the physiologic life of man.

On the basis of our present knowledge of the physiology of man, the old question of vegetarianism *vs.* foods of animal origin has little or no merit in fact. There is no doubt that the individual man can injure himself temporarily and possibly permanently by the overeating of meat. Possibly our very remote ancestors were strictly herbivorous; the earliest animals must, perforce, until they turned cannibals, have been herbivorous, but man, as we know him to-day, can use food of animal origin with impunity and physiological profit. We should say that the more nearly omnivorous the human individual is, the more certain he is to avoid diseases due to faulty diets. Indeed, it would be more conducive to the physiologic life if we set about, through education, to remove the present human prejudices against certain species of animals as sources of food than to keep alive the "religious" superstitions that some or all foods of animal origin are taboo. I refer to such notions as "clean" and "unclean" animals handed down to us by the laws of Moses, the abstaining from meat on the basis of "transmigration of souls," the eschewing of certain animals as food because they look repulsive or disagreeable or because they are friends of man. Almost any species of animals, by proper training, can be made the apparent friend of man. If the present rapid increase in population continues we should contribute more to the physiologic life by teaching universal omnivorousness than by clinging to ideas

handed down to us by the ignorant past or dictated by the whims of imagination. The eel is not a poisonous article of food merely because it has the body form of a snake; the snake itself is not bad eating despite the alleged rôle of the snake in the "fall of man." By omnivorous I do not mean food of animal origin alone; I mean also a much greater extension of the use of the vegetable kingdom. Sailors learned to cure scurvy by a decoction of pine needles when nothing else was at hand. It is hinted that the eating of grass by Nebuchadnezzar was a "curse of God," while, as a matter of fact, it was part of wisdom.

With every new advance in the knowledge of the specific rôle or of specific needs for food elements, there blossom forth commercial enterprises whose advertising tends to confuse the public mind. Thus, we are urged to buy vitamin concentrates over the drug counter instead of natural foods at the grocery store. We eliminate roughage from the food and try to palliate constipation by mineral oils. We are made to believe by persistent advertising that we are on the brink of an abyss unless cod-liver oil, yeast or nuxated iron is ingested daily. We are taught to identify whiteness or absence of color in many foods with purity and, by inference, wholesomeness of such food articles.

The problem of obesity in the human individual is largely a question of overeating and under-exercising. To what extent overeating may contribute to race deterioration it is difficult to say, because that implies injury to the germ plasm; the possible injury to the individual is of little racial significance.

WORK

If we survey the animal kingdom as it exists today it seems, by and large, that except for the play of the young, the only exercise taken is that rendered necessary for the securing of food, the propagation of the species and escape from pain. Of course, in all animals living in temperate or colder climates, cold itself, for the warm-blooded animal like man, is efficient physical exercise. But when not driven by hunger or sex most animals (including man) are lazy. It is highly probable therefore that man has reached his present state of development on the basis of exercise largely determined by physical necessities. This rule still applies to the majority of humans the world over. The majority have no accumulated food reserves. Most of us have to do physical work every day for a living. The problem of race deterioration from physical inactivity applies therefore only to a small portion of society, the so-called well-to-do, who can through their wealth command the satisfaction of most needs without individual physical exertion. There is no question in the case of many of the body organs that a certain amount of atrophy and deterioration follows in the wake of disuse, and consequently, activity, however caused, is within limits beneficial. But does such physical inactivity cause deterioration of the germ-plasm? And at what point does excess of physical work lead to germ-plasm degeneration? Biology has as yet no clear answer to these questions.

HOUSING

The only abodes of our most ancient forebears that have survived to historic time are natural caves, but even assuming that humans were not very numerous in those days, I doubt whether there were caves enough to house them all. And it is not unlikely that our forebears lived in trees for some time before they stepped down into caves. The caves of our forebears were probably no healthier than modern apartments. Some type of hole in the ground, or on the ground, seems necessary as a protection against the rigors of climate. But modern industry demands and creates these holes in ever-increasing numbers of horizontal layers. The influence of city life on the race is a large problem, without an answer as yet. It is a question not only of sunlight and pure air, but of crowding, of infections, of immunity, noise, glare, mimicry and exhaustion. A place under the ultraviolet lamp may be a safe substitute for the place in the sun. Many species of animals have not only survived but apparently made continued progress in almost total absence of sunlight. I do not refer to animals living permanently in caves, because in many of these we see some signs of degeneration, probably because the cave of life has been adopted too suddenly, but I refer to animals that during the day live in caves or holes in the ground and hunt for their food during the night. Pollution of air and water by modern cities and modern industry is on the increase, and the probable danger from these conditions seems only partly appreciated by society. Formerly, lead poisoning was largely confined to workers in lead industries. Now lead is blown into the air from the exhaust of nearly every automobile. Lead and arsenic are taken into our system with the apple and the pear. We may not inhale enough lead in our breathing or consume enough lead and arsenic in our fruit to produce acute poisoning and tissue injury, but who is there to say that this slow assimilation of metallic poisons brought about by modern industry is without danger and ultimate injury? The only factor of safety that I can see in this situation is the phenomenon of tolerance, that is, the capacity of the living organism, if it is not seriously wrecked by the poisons, to so adjust the internal processes as

to render the poisons less and less injurious. Tolerance means physiologic compromise, but such continued existence does not necessarily mean the higher life. Continued increase of population means increased growth of cities, increased industrial concentration and increased industrial poisoning, despite all measures to eliminate the latter.

THE SEX LIFE

One of the fundamental physiologic processes that at present seems to be out of adjustment to a greater extent in man than in our fellow animals is sex life. We are not agreed as to what is the normal sex life of modern man, but ethical leaders in all races have on the whole tended to the view that sex activity should and can be repressed or consciously controlled by the individual or society to a greater extent than the urge of hunger and thirst or the call for evacuation of the bowels. In many if not most animals the essential sex urge is seasonal and closely associated with reproduction, and, as a rule, the reproductive processes in animals start with sexual maturity and continue throughout the sex life of the individual. In most parts of the world human society is now so organized and human habits fixed in such a way that approved sexual intercourse can not start with sexual maturity in our children. This means a long period of sex repression, "illegitimate" sexual intercourse, or perverted sex practices. It is held by many, though in most cases physiologically unproved, that these three sequelae of our modern social orders as related to sex life are injurious to body and brain. The physiologist may view the mental gymnastics of the Freudians with wonder, but he is not in position to state that the present social practices as to sex are the best possible for the present or future of the race. The physiologist is puzzled by the evidence in modern man of a sex drive in excess of the need of reproduction. He is aware of the speculation that the sex drive means more than reproduction, that it is the basis of all progress in inventions, in art, in warfare, in practically everything in which modern man seems to have exceeded the ancients. If this is the case, the physiologist should not concern himself with the means of controlling or delaying the sex urge. The solution is birth control. The greater continuity and persistence of the sex urge in man than in most of the other animals may be related to the greater brain development (memory, imagination). If this is correct we have here an instance of uncorrelated development, that is, development of one organ or process leading to discoordination or injury of another.

STIMULANTS AND NARCOTICS

The indulgence in narcotics and stimulants antedates chemical knowledge, but chemistry and commerce have greatly enlarged the field. We not only isolate and concentrate new drugs from plant and animal tissues, but almost every day records the synthesis of new drugs in the laboratory. Individual and organized greed extends the facilities for drug addiction.

Do not expect me to say anything new and true on the alcohol question as related to race betterment. People have imbibed alcohol in the past, have lived and reproduced. It is not difficult to prove the deterioration of the individual, and in some cases the offspring, by excessive alcoholic indulgence. Man appears, by and large, to be the only animal with the alcohol habit. All human races can become alcohol addicts unless checked by ethical considerations. "Tolerance" to alcohol has not yet been acquired by the race as a whole. Alcohol may be indifferent in race improvement, but if the issue is forced to-day, the physiologists must vote against alcohol on the basis of probable injury.

No word can be said in defense of the other narcotic drugs. Their influence on normal life seems to be uniformly injurious, except possibly in the direction of protection of the brain against the overstimulation and over-fatigue of the modern man-made environment. There are instances from experimental laboratories of morphine, barbital or ether protecting the brain or parts of the brain from fatal effects of such stimulation or from otherwise fatal effects of acute poisoning.

I know of no evidence that the alkaloids of coffee, tea and tobacco improve the individual or the species. Whether they are factors leading to race deterioration is an open question. Many people believe that this is the case, but belief is not knowledge. Some weight should be given to the fact that during the period that many humans have indulged in these substances, man has made rapid progress in externals, but this progress has probably been made despite this indulgence rather than because of it.

Modern chemistry has opened up another avenue of poisoning the human system through the field of food preservatives and food substitutes. We have the problem of the harmfulness or the harmlessness of the various baking powders, of benzoic acid as a permissible food preservative, of saccharine as a substitute for sugar, etc. Many of the experiments purporting to prove the permissibility or harmlessness of the substance or preservative, even those carried out by competent scientists, seem to me wholly inadequate. I have in mind, as an example, the experiments and finding of the Remsen Consulting Board, on the question of saccharine in foods. Under the direction of this board, composed of leading biochemists and chemists, varying quantities of saccharine were fed to

a small number of healthy young men, daily, for periods up to nine months. The board concluded that the daily ingestion of this food substitute below a certain quantity (.3 gram per day) is without injurious effects; above this saccharine produces injury. This conclusion became guide to federal legislation and regulation. Was the above conclusion warranted by the experiments performed? We think not. All the experiments proved was that the substance (saccharine) when taken by healthy young men over this period did not produce any injury that the commission could detect by the tests used. Society is composed of individuals other than healthy young men, and nine months is a short period in the span of human life. There are many deviations of physiological processes that can not be detected by body weight, food intake, or the chemical examination of the urine. Most of the organs in the body can be injured a great deal before we become actually sick. It would seem a safer principle for governments and society to insist that the burden of proof of harmlessness falls on the manufacturer or the introducer of the new food substitutes rather than on society, and the test of the harmfulness or harmlessness should involve all physiological processes of man.

THE INVISIBLE ENEMIES

There are people who believe that the future progress of the human race will be measured by our success in eradicating infectious organisms (preventive medicine), and in such complete understanding of physiological processes as to enable us to control the processes of immunity. Paleopathology furnishes no conclusive evidence that races or species now extinct were slain by infectious diseases. Far be it from me, as a worker in one corner of the medical garden, to minimize the importance of medical science both in the preservative and in the curative aspect of race betterment. But I can not see how mere prolongation of the individual life span or mere multiplication of human individuals will enhance human evolution. Indeed the reverse argument is not easily met, namely, that medical science to-day helps to deteriorate the race by helping the biologically weak to survive and reproduce. Knowledge of the processes of immunity sufficient to enable us to augment this factor in the individual, apart from what we already know in a general way of hereditary strain, improved nutrition and hygienic surroundings, seems far afield; but, again, it may come faster than the most optimistic prediction.

Eradication of infectious organisms or complete control of the individual infection by chemotherapy seems Utopian. The scientist who ventures to prophesy to-day has a good prospect of being shown up a fool to-morrow. But it seems likely that the human race will survive (and in fair if not improved shape) all now known infectious organisms, not by the process of eradication or scientifically controlled immunity, but by the process of tolerance and symbiosis. Whether this prospect is cheerful or abhorrent depends on whether the symbiosis involves the loss of any essential element of further evolution of our species.

CLIMATE AND HUMAN EVOLUTION

Some one has remarked that our planet is better fitted for pisciculture than for human culture, since water covers the greater area of the earth's surface. The cradle (or cradles) of the human race is not yet located, hence the climatic conditions of early human evolution is one of the many unknowns in the process. But to-day, man (as well as the rat, the body louse and the English sparrow) covers practically all of the land, so that we have all the possibilities for favorable and unfavorable evolution so far as evolution is conditioned by climatic factors alone. This gigantic experiment in human ecology is, however, becoming increasingly complicated by man-made modifications of his environment. We have scarcely made a beginning in the study of the influence of climate on human physiology. The sporadic appearance of the externals of human culture in diverse places of the earth in the past is probably not primarily a matter of climate. Heat and humidity can be depressing on some physiologic processes. Because of the factor of basal metabolic rate man is less able to adjust to the extremes of heat and humidity than to extreme cold. We know some of the favorable effects of sunlight (*e.g.*, bone growth, killing of bacteria, etc.); we have hints of unfavorable effects on the blood, the blood pressure and the retina, and the skin. The latter may not be fundamental and there is no evidence that the germ plasm is unfavorably influenced.

We know something of the favorable and unfavorable influence of diets, work, behavior, natural and man-made environments, poisons, etc., on the physiologic processes of the individual. But this is merely limiting or permitting full development of individual growth and functions. Unless these factors modify the germ plasm (rapidly or slowly) they are not significant in relation to race betterment. The only clear instances we have of rapid modification of the germ plasm by experimental (drugs) or environmental means seem to be injurious or destructive. Man to-day is like a curious and clumsy and very ignorant child tinkering with the watch; will he to-morrow con-

trive a superior mechanism? The lesson for the present seems clear: *The germ plasm can be injured; some phases of the present man-made environment seem to enhance such injury.* Are the ablest the strongest, the wisest men merely grave-diggers in disguise? Is it possible to detect the factors and abort the danger so that man himself may not deflect or impede the river of life?

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A REVISION OF THE FUNDAMENTAL LAW OF HABIT FORMATION[1]

THE principles of learning, or habit formation, as they are taught by contemporary psychologists, include as fundamental the principles of recency and frequency. It is true that there are considerable differences in the relative emphasis placed on these principles by different authors—few, for example, going as far as Watson and the present writer have gone in the past in the ascription of importance to frequency. Nevertheless, the importance of these factors has been emphasized by almost all contemporary psychologists (with the possible exception of Carr), who seem to have assumed that they are of some positive value in the fixation of a response into a habit.

Behind these principles, however, there is a more fundamental assumption, which was sharply indicated by William James, but which has seemed too obvious to need statement by those of us who have nevertheless continued in the Jimmian philosophy. This assumption is as follows: *A response* (that is, even a single response) *to a given stimulus pattern definitely increases the probability that on the reoccurrence of the same, or substantially the same, stimulus pattern, the same, or approximately the same, response will occur.* This principle I shall call the *alpha-postulate* of learning.

That this principle underlies the "law of frequency" is obvious, for if one response had no positive effect, then the summation of an indefinite number would have no effect, the sum of zeros being zero. The pictorial statement of this assumption is to be found in the formulations of the old "brain path" superstition, with its analogies to the flow of water eroding a channel, the fold in a coat sleeve, etc.

It has not been denied by any one, so far as I know, that the positive effects of repetition might not be neutralized by other factors, nor that certain other factors may be, in some cases at least, more potent positively. But running through all our disquisitions on learning has been the implication that repetition itself, aside from other factors, has a positive effect; and in our practical work with adjustment cases, this implication has always been respected.

For nearly twenty-five years the present writer has been teaching, explicitly and implicitly, this orthodox doctrine, and attempting to fit the facts somehow to the theory. Even the contradictory results of the Pavlovians failed to shake his faith, because obviously (at least, so far as references in English indicate) neither Pavloff nor his students have ever performed the critical experiment of feeding the dog by stomach injection, without odor or other "conditioning" stimulation, during the period during which the newly formed associative response ("conditioned response") is being tested. The Russian work on this particular point (of the effect of repetition) is therefore beside the mark, and did not even suggest to the present writer a revision of the laws of learning. Psychologists, in fact, have long been acquainted with cases in which habit-tendency disappears in spite of repetition of the stimulus, and this phenomenon has offered no difficulties to the orthodox theory.

The cumulative effect of the difficulty of fitting facts to the theory, however, has, although no longer ago than last summer, suggested that it would be much simpler to fit the theory to the facts. It has seemed well, therefore, to question the fundamental assumption on which we have proceeded.

If we no longer take the assumption of the positive effect of response as a divinely revealed truth, but as a mere postulate, it is at once seen that there are two other postulates possible. One of these, the *beta-postulate,* as I shall call it, is that response, in itself, has *no* effect on the future probability of the same stimulus pattern producing the same response; the other, the *gamma-postulate,* is that response *decreases* the probability. Although the latter of these postulates is more consonant with our present-day neurological theories, and, as I shall show later, has interesting applications to a difficult psychological problem, a certain conservatism, which I think is intelligent, leads me to consider seriously the beta-postulate first.

If "repetition" has in itself no effect, but is important merely in that through it certain positive factors have their chance to operate, then it at once becomes a live possibility that negative factors also may be allowed to operate through repetition. Thus would be explained the apparent "neutralizing" of the effects of repetition, not as actual neutralization in this sense, but as either the operation of negative factors in the absence of positive, or the prevalence of the negative over the positive.[2]

[1] Read before the Section on Psychology, the American Association for the Advancement of Science, Nashville, December 27, 1928.

[2] I am informed by Dr. T. V. Moore that Thomas Aquinas enunciated this doctrine. I should certainly feel honored if I am in any wise treading in the footsteps of the *Doctor Universalis.*