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PUBLIC HEALTH PROGRESS AND RACE PROGRESS—ARE THEY INCOMPATIBLE?[1]

THE public health workers, the social workers, the civilizers, we are told, are corrupting the race; are destroying the race. By protecting us from our enemies, the bacteria and the viruses; by removing the sources of disease; by showing us how to avoid unfavorable conditions and to find favorable ones; in short, by bringing us and our enviromnent into harmony, they are promoting the survival of the unfit; they are progressively filling the race with the weak and the degenerate who must hand on their weakness and degeneracy to their descendants. This should all be stopped. In dealing with the delicate and ailing, our motto should be: Treat 'em rough!—Let the environment kill them. That's what will produce a strong race, a fit race.

To one who has spent his life studying the unnumbered devices by which organisms of all sorts protect themselves from their enemies; who sees that their daily, their hourly occupation is the seeking of favorable conditions and the avoiding of unfavorable ones—to such an observer this proposal comes as a paradoxical surprise. The public health worker, the social worker, is not alone in this nefarious business of adjusting the organism to the environment; everybody's doing it. And by everybody I mean our brothers, the birds and beasts, our cousins, the insects and worms and plants; I mean all organisms. We ourselves have been doing this sort of thing for a hundred million years. It's going to be a hard habit to break, if we must break it.

And as we look at it, the difficulties become greater. All organisms are *forced* to defend themselves in all sorts of ways against other organisms that seek to destroy them; against bears and beetles as well as against bacteria. All organisms *must* protect themselves against the injurious forces of nature; against heat and cold and wind and wet; against starvation and against over-eating; against unfit food and drink; against bumps and bruises and broken bones; against plagues and poisons. That's what life is: a struggle for existence. If any organism ceased this struggle, ceased to select its environment, ceased to protect itself—its kind would become extinct in a generation.

[1] Address at the twenty-third annual meeting of the National Tuberculosis Association at Indianapolis, May 24, 1927.

So it is with man, with bird, with fish, with worm, with protozoan, with plant.

We can't therefore hew to the line in this matter; we can't stop this whole business of adjusting ourselves to our environment. If there is anything at all in this proposal, it must be something very special. Are there limitations that must be placed on this protective struggle? Are there certain methods of protection that organisms must not employ; methods that overshoot themselves and fall on the other side; methods that lead to degeneration and destruction instead of to the survival and prosperity that they are trying for? Are the methods of the public health worker of this sort? Or are there certain junctures in evolution when this protective work must stop, on pain of defeating its own aim? How shall we know those junctures? Has man reached one of them now? After unnumbered ages of striving for environmental adjustment must he now give that up?

Well, the point to all this—and it is beyond doubt a piercing point—comes to us from modern work in heredity; in genetics. That has revealed to us that there are perverted methods of promoting survival and propagation; perverted methods of deciding who is to survive and multiply, who to perish without offspring—perverted methods that may and do result in a degenerate population. Such a population has been produced by these methods. The fruit flies of Morgan's laboratory are the pattern and exemplar of the kind of population that the pessimistic eugenicist predicts for man; a population composed of the congenitally defective; the halt, the blind, the weak, the variously deformed and degenerate. Such things then can be done! We must sit up and take notice. What is it that underlies such results? How can they be avoided?

Experimental biology has shown that what underlies them is this. At its beginning the organism is a complex thing, containing a great number of separable substances—what we call the genes. By the interaction of these thousand substances—with each other, with the cytoplasm, with materials brought in from outside, with the forces of the environment—development takes place, the individual is produced with all his later characteristics. In early stages of development, the interactions of the genes produce new chemicals, enzymes, hormones, endocrine secretions; these again react with other products till there result, in a series of successive steps, all that we find in the body: the sex hormones, the thyroid hormone, the hypophysial hormone, epinephrin, insulin, the digestive and other secretions; the blood, the tissues, the organs, the mature individual.

But not all sets of genes are alike. Different individuals start with different sets. Some among the genes may be defective; sets containing these yield defective products. Hormones may be produced that are deficient in quality or quantity, or both; this results in farther defects. If the thyroid secretion is defective, either from poor genes or poor nutrition, the individual fails to develop normally; it becomes that pitiful half formed thing, a cretin, an idiot. If insulin is not properly formed, diabetes results. If the sex hormones are not normal, intersexuality or other discordant condition follows. These are types of the results which follow from the operation of defective genes, or from defective interaction of the genes.

But chemical therapeutics discovers that disorders due to defective genes can be remedied if we know the means, just as other chemical processes may be influenced. The consequences of a defective thyroid secretion are remedied by introducing the thyroid hormone with the food; the pitiful cretin becomes a normal human being. Lack of insulin is similarly remedied, by introduction of insulin from outside. The necessary chemicals can even be synthesized, made artificially, as recent revolutionary researches show. The genes are not something mystical, unapproachable; they are organic chemicals. In principle, it is clear that defects in the store of chemicals given us by heredity may be supplied by other means; that undesirable things in the store of genes may be cancelled or corrected; that reactions among them which take an undesirable turn may be altered, set right. All these things are seen to be mere matters of technique; one needs but to know how. The great advances already made in this direction have come in the last 10 years. How far will they have gone in 100 years? In 1,000 years?

Wonderful possibilities are opened up by this work. Unfortunate human beings that must have suffered in misery, a burden to themselves and others, are made normal, useful, happy.

But consider now the farther results of an enormous future development of synthetic chemistry; of chemical therapeutics. Defects in genes become as open to remedy as defects in nutrition. A defective thyroid product is replaced by manufactured thyroxin; the individual is restored to normality. But his genes are not changed; they remain defective; they are transmitted to his descendants. His descendants too must be treated with thyroxin. The genes of another individual are defective for the secretions of the hypophysis; of another for the suprarenal secretion; of another for the reproductive hormone; of another for insulin. Chemotherapy remedies all these defects—for these individuals. But their descendants, receiving the defective genes, must likewise come under the treatment of the chemist. In time the race thus accumulates a great stock of these defective genes. Every

individual that receives them must be treated with one or more of the substitutes for the normal products of the genes. Each must carry with him an arsenal of hypodermic syringes, of vials, of capsules, of tablets. Each must remain within the radius of transportation of the synthetic chemical laboratory on which he depends. *This* is the result of remedying gene defects.

This picture is not an attractive one. Far better is the later condition of the race in which, through lack of skill in synthetic chemistry, defective genes have been cancelled as they arise; so that each individual bears within himself, in his stock of genes, an automatic factory for the necessary chemicals. That must be our aim; our slogan for future generations must be: Every man his own hormone factory!

How is that end to be attained? Is there no recourse but to strike at synthetic chemistry? Must the unhappy chemist be proscribed, prosecuted, imprisoned, hanged; his books burned, his teaching forbidden, his methods of work prohibited? Must the cretin drag out his life a helpless idiot, the diabetic suffer unrelieved—till their own defects close their lives in misery, and so cancel their stock of genes? Are these the methods that must characterize our policy toward defects in the genes?

It certainly behooves us as rational beings to examine such a situation with care; to search whether there be not peradventure another way of meeting it. And when we do this, we find these proposed measures to be totally and preposterously unnecessary, uncalled for, absurd; nay more, ineffectual. There is another recourse, a simpler one, a more effective one; an infinitely preferable one.

The mere survival of a genetically defective individual—nay, his enjoyment of a full, a useful, a happy, a long life—does nothing to increase the degeneracy of later generations—provided he does not propagate. Not survival alone, but also propagation, is required for the perpetuation of defective genes. Without propagation, survival is harmless, so far as racial deterioration is concerned. Can there be any question as to which shall be the point of attack? Surely we write ourselves down as asses, as doubly and triply stupid, irrational, perverse, if in order to prevent the perpetuation and multiplication of certain genes, we can think of no method better than to stop scientific investigation, to stop humane practices, to force our fellow beings to live and die in misery that we know how to prevent. The lives of persons bearing defective genes may be made as satisfactory, as complete, as the most advanced methods can make them, without the smallest harm to the race—but they must not propagate.

Not the wasting away and death of the bearer of defective genes, therefore, but the prevention of his propagation, is our remedy. The method of allowing the individual's own defects to destroy him is not only hideously repulsive to our instincts, but a knowledge of genetics shows it to be ineffectual; it does not get rid of the defective genes. Most gene defects are recessive; they are therefore carried by ten times as many healthy individuals, not showing the defects, as by individuals in which the defects are manifest. The children of such healthy individuals receive defective genes, as do children of defective individuals. Congenital feeble-mindedness due to a single gene defect presents perhaps the most pronounced and the very simplest case of gene defect that has to be met. Yet East[2] and Punnett[3] have shown that to merely cancel the deficient individuals themselves—those actually feeble-minded—makes almost no progress toward getting rid of feeble-mindedness for later generations. As East pointed out, any really effective action in this direction requires that we learn in some way to distinguish the tenfold larger number of normal individuals that bear the defective genes; and that we prevent *their* propagation. To merely cut out the defective individuals themselves; particularly to do that only weakly, haltingly, ineffectually (allowing them time perhaps to propagate before death overtakes them)—as would result from withdrawal of public health measures—*that* will not touch the root of the trouble.

The *only* remedy is to stop the propagation of the bearers of defective genes. The public health worker must take this fact seriously; a burden of responsibility is placed on him; he *must* become genetically minded, eugenically minded. If he promotes, in the congenitally defective, propagation as well as survival, his work does indeed tend toward a measure of racial degeneration. But it is the propagation, not the survival, that is the central point. So fast as we can discover individuals that bear seriously defective genes—whether themselves personally defective or not—so rapidly must those individuals be brought to cease propagation.

There are great difficulties, of course. The instincts connected with propagation are strong. But those instincts are readily circumvented. They can be satisfied without the production of offspring. Thousands of individuals in every generation voluntarily relinquish the leaving of descendants. Far different is the case with any method that strikes at life itself, once that is in action. To life humanity clings with every trembling fiber of its being. The difficulties of ending

[2] "Hidden Feeble-mindedness," E. M. East, *Journal of Heredity, 8,* 1917, pp. 215–217.

[3] "Eliminating Feeble-mindedness," R. C. Punnett, *Journal of Heredity, 8,* 1917, pp. 464–465.

the careers of defective genes by preventing propagation of their bearers are as nothing compared with the hopeless proposal to allow defective individuals to waste away and die unaided. Can any one suppose that a race of beings so perversely stupid as to refuse to stop even the propagation of defective individuals can be persuaded to adopt the barborous, needless and ineffectual plan of killing them by the slow, the cruel method of refusing them available help in their distress?

Technically, a greater difficulty lies in the fact that the immense majority of defective genes are stored in normal individuals; and that recognition of these storehouses is not yet possible. Before that can be done, genetics must advance far beyond its present point. For no scientific advance is there greater need. Until that comes, genetics can propose no practicable plan for positive race improvement. But any single case saved from propagation is a gain. A defective gene—such a thing as produces diabetes, cretinism, feeble-mindedness—is a frightful thing; it is the embodiment, the material realization of a demon of evil; a living self-perpetuating creature, invisible, impalpable, that blasts the human being in bud or in leaf. Such a thing must be stopped wherever it is recognized. The prevention of propagation of even one congenitally defective individual puts a period to at least one line of operation of this demon. To fail to do at least so much would be a crime.

But how far is there reason to hold that public health work is indeed preserving individuals with defective genes? There can be little doubt, from the general picture presented by genetic investigation, that diversities in the genes, in the original constitution, of different individuals, affect every characteristic, of whatever sort, without exception. There can be little doubt that other things being equal, some genetic constitutions are more readily attacked by plague, by smallpox, by typhoid, by pneumonia, by tuberculosis, than are others. Certain constitutions yield more readily to extremes of temperature, to exposure to the elements, to unfit food. Certain combinations of genes are more likely to come off victorious in a struggle with a wildcat; or to survive a bite from a rattlesnake. Under such emergencies, those genetic combinations which survive are obviously more desirable. And removing any of these sources of danger—cutting off plague or pneumonia or wildcats or rattlesnakes, or subjection to cold—does permit combinations of genes to survive and propagate that otherwise could not do so. Any radical change in the environment alters the incidence of selective elimination; consequently alters the characteristics of the population in later generations.

But for all such cases the essential question is this: If the environmental agent—whether disease, weather or wild beast—can be controlled, prevented from attacking man—are the individuals thereby saved still undesirable—unfit, in other respects, to be citizens of the world? Are their genes radically defective, inevitably yielding deficient men and women, even though protected from environmental conditions that they are unable to resist? Or are they merely particular combinations that are fitted to one environment rather than another? No combination of genes yields human beings that flourish equally well in all environments. The victims of smallpox, yellow fever, hook-worm, malaria, of sunstroke, frost-bite, lions —must we believe that they are individuals with such serious genetic defects as will make them or their descendants obnoxious, degenerate, members of the community—even when those plagues have been banished by hygiene and invention?

Of course this is, for every separate case, a question of fact, to be determined by investigation. In some cases, as we have seen, it is now clear that the individuals saved *do* bear deficient genes; these are the cases for which the remedy is cessation of propagation. In certain other of the plagues of humanity the question is still open; such perhaps are tuberculosis and cancer. In certain strains of animals, marked susceptibility to cancer is due to a single gene defect; if such strains are to be found in man, their members should not propagate. But we must not fall into the fallacy that was characteristic of the beginnings of knowledge in genetics—the fallacy of holding that because in some cases cancer is dependent upon a serious gene defect—therefore it must be so dependent in all cases. Cancer may be induced in strains that are seemingly quite normal—though less readily induced than in those with defective genes.

The case of tuberculosis illustrates the complexity of the biological situation met in dealing with most of the plagues of mankind. This is not my field of work and I can not speak authoritatively on the details, but to try to state the apparent situation from a general biological point of view may be of interest, and provide a basis for discussion.[4]

It is clear that environmental conditions play a very large part in the incidence of tuberculosis. The rôle of the tubercle bacillus is beyond question; yet its presence is so nearly universal that it plays a relatively small part in deciding who shall, who shall

[4] Discussions of this matter that are based upon sound and adequate biological foundations are given by Lenz, in Baur, Fischer and Lenz's "Menschliche Erblichkeitslehre," sec. ed., pp. 254–258, and by J. Bauer, in his "Konstitutionelle Disposition zu inneren Krankheiten," 1917, pp. 52–59. It is much to be desired that these works should become available in English translation.

not, succumb to the disease. There is positive evidence[5] that closeness of association with active cases of the disease tend to make the individual succumb; in other words, frequent infection with large numbers of the organism more readily produces active disease. Again, under-nutrition, exposure, any conditions that markedly lower the vitality, tend to increase the number of cases of the disease. All these may be classed as environmental conditions. On the other hand, there is strong evidence that hereditary, that genetic factors—many diverse genetic factors—play important rôles in determining who shall be affected with tuberculosis. Certain races are more prone to tuberculosis than others. Within a given race, it seems clear that individuals bearing certain genes, or certain combinations of genes, are more susceptible to tuberculosis than are those with others. But there is no single gene, no single combination of genes, to which alone can be attributed the greater susceptibility to tuberculosis. Various genetic types show higher susceptibility; those that yield the asthenic constitution, those that yield what is called infantilism. Any gene or combination of genes that seriously interferes with proper nutrition lays the organism open to attack of the tubercle bacillus; thus diabetics (whatever the cause of that disease) are prone to tuberculosis. A great number of diverse genes are involved in such effects; and these genes are beyond doubt mainly recessive. We do not, therefore, get rid of them by the destruction of tuberculous individuals; much the greater proportion of them is present in normal persons. Here as elsewhere in the operation of inheritance, individuals that are themselves healthy may, and often do, produce offspring that are genetically defective; individuals that are themselves defective, and for genetic causes, may and do produce normal offspring.

Further, genes that tend to give high susceptibility to attack of the tubercle bacillus may coexist with genes that give high vitality and efficiency in other respects; this Wright[6] demonstrated in his experimental work with guinea pigs. A parallel situation exists in mankind with respect to tuberculosis and intellectual qualities; the De Morgans, the Robert Louis Stevensons, can not be considered inferior types, in other respects than their proneness to tuberculosis.

Such then is the biological situation; a great complex of variable factors of many kinds, each having its influence on the incidence of tuberculosis. To attempt to meet such a situation, to attempt to get rid of tuberculosis—merely by allowing the ravages of the disease to remain unchecked, appears unintelligent, feeble, hopeless. It is possible that a time may come when certain well-defined particular genes shall have been identified as strongly predisposing to tuberculosis, and when the carriers of those genes can be identified. When that time comes, if it ever does, the individuals bearing such genes, whether themselves tuberculous or not, should cease to propagate. Only in this manner can the genetic factors be effectively attacked. And in the meantime, the war on the environmental factors must continue. It seems probable that the genetic factors can never be practically dealt with until the environmental factors are largely controlled; this is the teaching of most practical work in genetics.

A similar situation would be met in an examination of other plagues combatted by public health measures. But for many of the matters with which the public health worker deals, there appears to be no indication whatever that the individuals preserved are undesirable, or at a disadvantage, in a world in which the attacking agent has been controlled; no indication that defective genes are playing an important rôle. There is not ground in man for holding that all differences in genes imply defectiveness in one or the other. We can not in man (as perhaps we can in the fruit fly) set up for each particular gene one type as the only normal one, compared to which all others are defective. There are many types for each gene, some adapted to one method of life, some to another. There are millions of diverse combinations of these different types, some flourishing better under one set of conditions; others under another set of conditions; none of them requiring to be considered pathological.

Our question here merges into a general biological one. Can it be maintained that *any* protective or defensive action, *any* selective control of the environment, is harmful to the race, as leading to degeneration, through the cessation of selective elimination?

Various dangers have been suggested. Increased propagation resulting from environmental control of disease may result in a greater population than the environment can comfortably support. Here the remedy, if one is required, is again obviously to slow down the rate of reproduction, as most civilized communities are doing.

Again full success in protection by one method makes it unnecessary to develop other methods. The oyster, protected by his thick shell, has not developed ingenuity, inventiveness, intellectual power. Coming in contact with another organism that has, it may go to the wall, as the oyster shows signs of becoming extinct in contact with man. This somewhat specu-

[5] See Pearl: "Constitution and Tuberculosis," in "Studies in Human Biology" (1924), pp. 273–297.

[6] "Factors in the Resistance of Guinea Pigs to Tuberculosis, with Special Reference to Inbreeding and Heredity." *American Naturalist*, 1921, vol. 55, pp. 20–50.

lative difficulty suggests no practical measures for our own case.

More palpable is the following: Complete success in any one method of defense against a particular enemy makes other methods unnecessary; the organism is no longer selected with reference to those other methods, and may lose them. Completely destroy certain pathogenic bacteria, or develop external methods of protection against them; in consequence the internal protective action of the body fluids is no longer necessary; it might in the course of generations be lost. If by clothing, houses, fire, we keep our bodies at the optimum temperature, we may or might lose in later generations the power of resisting high and low temperatures.

The extent of the occurrence of this sort of action is rather speculative. But assuming that it occurs, the result in first instance is merely that the organism no longer retains the power of resisting an enemy that does not attack it; a harmless change.

If, however, by a later change in conditions, as by a sudden overwhelming alteration in climate or an increase in the virulence of a bacterium, the methods of protection hitherto employed become ineffectual, then the organism might be driven back on its second defense; its internal power of resistance to infection, or to cold. If this has been lost, the organism might become extinct. Speculative ingenuity may suggest that this has been a cause of the extinction of some organisms that have disappeared.

But in view of the fact that control of the environment is the very fabric of life; that organisms can not live without it; that they have been practicing it assiduously for uncounted ages; and that some of them are still flourishing, it appears idle to suggest that such control must be abandoned; it appears whimsical to look for imminent degeneration or extinction through that method of action. If such were its necessary consequence, organisms must have disappeared long ago; nay, they never would have appeared. Any organism *must* admit to itself, draw to itself, seek out, those conditions that are favorable to its physiological processes; this is the daily business of life. The practice of hygiene, of public health is but one farther link in a chain that goes back to the beginning of life. Amoeba covers itself with a semi-permeable membrane, admitting some chemicals, excluding others. Protective coverings become in other animals more and more efficient—the skin, hair, feathers, the heavy shell of the oyster, the armor plates of dinosaur and armadillo. Microscopic enemies that penetrate these defences find the body fluids charged with destruction. Elaborate internal mechanisms are developed for keeping the temperature high and uniform. Strength of body, quickness, agility, the development of claws and teeth—these seize the advantage by transforming the defensive into an offensive. Acuteness of senses, cunning, inventiveness, supplement all these methods; supply the lacks in any of them. Cooperative action registers an enormous advance. Shelters, clothes, are found or devised; fire taken into service; food cultivated; weapons invented, machines produced; the properties of substances tested; new ones compounded. Devices come into existence for recording the results of tests once made; for preserving knowledge as it is gained. Some organisms proceed to that systematic elaboration of methods for discovery and application of knowledge that we call scientific research; the most powerful aid yet devised for bringing the environment under control. If environmental control is harmful, the first thing to do is to stop scientific research; only so can we strike at the root of the evil. Hygiene, medicine, the arts of public health—these are not something new in kind; these are but later terms in the long series that begins where Amoeba takes in certain substances and rejects others. With the other practical arts, they result in adapting the organism more and more completely to the environment. Along this road we must indeed watch for the sporadic appearance of defective genes, and these we must cancel by the only possible method—by stopping the propagation of their bearers. But defective genes are not the characteristic result of this process; degeneration and extinction are not its normal consequence. Abandonment of environmental control; cessation of the process of adjusting ourselves to the conditions—this is unnecessary, undesirable, impossible, unthinkable. The proposal for such abandonment is merely a characteristc instance of that modernism or "modernistic-ism" so rife in art and literature, that insists at any cost of sense or plausibility in saying something that has not before been said; doubtless in the hope that by trying all propositions, some time one that is worth while will be hit. The proposal to abandon control of the environment is not a serious contribution to the practice of life.

H. S. JENNINGS

THE JOHNS HOPKINS UNIVERSITY

DR. FRANKLIN P. MALL[1]

I FIRST knew Mall in 1884 (or '86?) when I was an assistant to Professor Welch in the pathological laboratory of the Johns Hopkins University. The laboratory was a small building which stood on the grounds

[1] Contributed to a collection of material relating to the life and work of Dr. Mall, gathered by L. B. Schmidt, of the Iowa State College of Agriculture and Mechanic Arts.