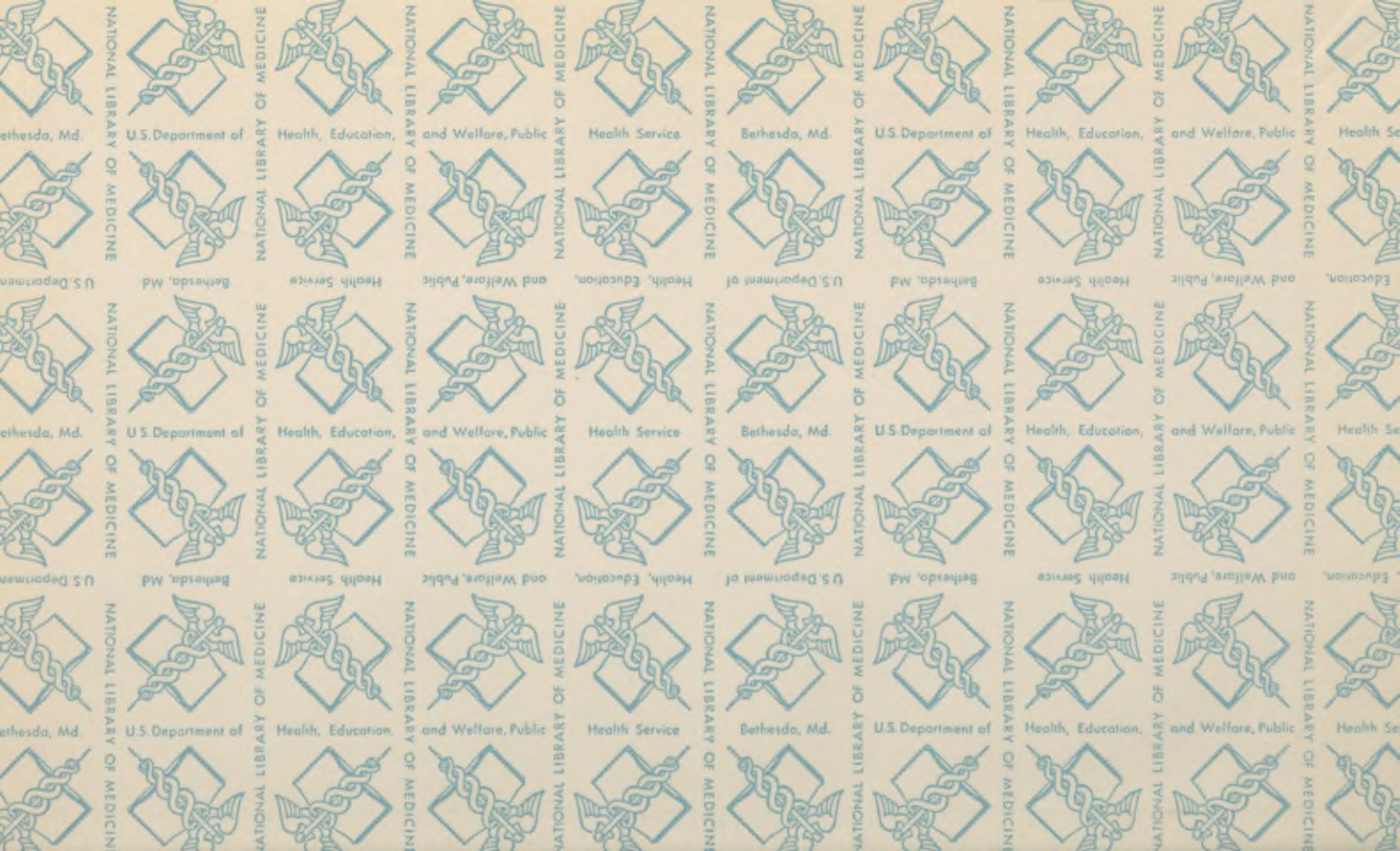
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STUDIES IN EVOLUTION AND EUGENICS

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PREFACE

THE present volume makes no claim to unity of treatment. The topics chosen for discussion represent some of the peculiar interests of the writer which have grown out of several years of occupation with the fields of heredity, evolution, and eugenics. A few of the chapters originally appeared as articles in periodicals, and I am indebted to the editor of the *Scientific Monthly* for permission to reprint Chapter V, to the editor of the *Atlantic* for the privilege of using in a modified form much of Chapters IV and XII, and to the manager of the University of California Press for permission to include the first chapter of this volume which was first published in the University *Chronicle* for July, 1921. Chapter XIV appeared originally in *The Independent* for March, 1923, and Chapter XV in *Hygeia,* July, 1923.

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STUDIES IN EVOLUTION AND EUGENICS

CHAPTER I

PRESENT TENDENCIES IN EVOLUTIONARY THEORY [1]

MANY people nowadays are confused, if not disturbed, in regard to the present status of the theory of evolution. Along with entire agreement on the part of practically all competent scientists concerning the *fact* of evolution, there is a good deal of disagreement over the *causes* of evolution. It is much easier to show that a certain event has taken place than to explain just why it has taken place. Just now biologists are seeking for the causes of the transformation of life, and I can perhaps best give an idea of the present state of the evolution problem by recounting briefly some of the stages through which it has passed since the publication of Darwin's *Origin of Species* in 1859.

In the sixties and seventies interest was mainly centered in the establishment of the doctrine of organic evolution, in discovering new evidence for its support, in working out probable lines of descent among animals and plants, and in interpreting the facts of morphology, palæontology, geographical distribution, and embryonic development from the evolutionary standpoint. This was a period of controversy in which the principle of evolution was gradually winning its way

[1] Reprinted with a few minor changes from the *University of California Chronicle*, July, 1921.

to general acceptance in the world of scholars. It is difficult for us, habituated to looking upon the world and its inhabitants as the outcome of a gradual development, to appreciate the profound changes which were then being wrought in man's outlook upon the problems of life, mind, and society. A great, new, and revolutionary conception of the origin of the existing order of the world of life was brought before the minds of all thinking human beings, filling some of them with apprehension and dismay, but powerfully stimulating others by its grandeur and far-reaching import.

Unlike the evolutionary speculations that preceded it, the doctrine set forth in the *Origin of Species* attracted at once the attention of all serious thinkers. It was soon realized that the struggle between two rival world conceptions was on in earnest. Science had developed to such a point that the hypothesis of evolution could not remain as one among many mere guesses at the riddle of existence. It must be tested in the light of morphology, palæontology, distribution, and embryology, and rejected if not proven worthy of acceptance by critical scholars. Darwin's great work supported the theory with a wealth of facts, drawn from a variety of fields and marshaled with an ability that made it at once apparent to every scientifically trained person that he was face to face with a doctrine to be seriously grappled with. And it was not many years before the battle in behalf of the theory of evolution was won.

The influence of the writings of Darwin in compel-

ling the acceptance of the theory of evolution was due not merely to the abundant evidence with which this doctrine was supported, but also to the fact that they set forth a good working hypothesis as to how and why evolution might have been brought about. The process of natural selection which Darwin regarded as the chief though not the sole cause of evolution presented at least an intelligible explanation of the development of the wonderful adaptations which form one of the most noteworthy features of the organic world. It was the apparent purposiveness manifested in the structure and activities of living beings that afforded the chief argument for the theory of special creation. The evidence of design and contrivance which organisms exhibit in such profusion had long been dwelt upon for the consolation of the faithful and the discomfiture of the skeptic. Now comes a theory which would eliminate teleological explanations in the realm of organic nature, and account for the development of life in terms of the survival of fortuitous variations in the struggle for existence.

Undoubtedly the great import of the theory of natural selection was that it afforded a means of explaining the development of structures exhibiting evidence of creative design in terms of processes which in themselves show no indication of purposive control. In other words, it afforded a very simple way of construing teleology in terms of mechanism. And whether or not we hold with Huxley that teleology received its death blow at Darwin's hands, it is evident that the

theory of natural selection greatly aided the acceptance of the theory of evolution by showing how it was at least theoretically possible to explain by natural means the features of the organic world which had long been held up as incontestable evidences of creative design.

It is not my purpose to dwell upon the controversies over the fact of evolution, as this question is almost universally regarded as settled by the arguments of Darwin and by the vast amount of confirmatory evidence that has been accumulated in different fields by Darwin's coworkers and successors. I shall also pass over the progress that has been made in ascertaining the probable lines of descent of the various groups of animals and plants. And I shall omit all consideration of the light which the theory of evolution throws upon the problems, not only of biology, but of psychology, social science, ethics, and many other fields of human thought. My discussion will be limited to the method of evolution, not only because this problem is one of fundamental importance, but because there seems to be prevalent a remarkable amount of misunderstanding concerning the bearing of recent biological investigation on Darwin's theory.

The doctrine of natural selection early won and has always maintained a wide acceptance among biologists. I believe I am safe in saying that no other theory of the cause of evolution has ever been so widely accepted as the theory of natural selection. Darwin believed that the transmission of acquired characteristics, whose

importance in evolution had been emphasized by Lamarck, was a potent subsidiary factor, and he not infrequently appealed to it in order to help himself out of tight places. But since Weismann made his attack upon this doctrine during the eighties, belief in the transmission of acquired characteristics has steadily lost ground. The so-called neo-Darwinians, with their belief in the "all sufficiency of natural selection" (the phrase is Weismann's) form a flourishing school. During the two decades between 1880 and 1900 Professor Weismann, who was then perhaps the most influential figure in the field of evolutionary speculation, carried on a destructive criticism of the Lamarckian doctrine and, at the same time, built up an elaborate theory of heredity and embryonic development, and manfully struggled to show how the principle of selection, reinforced by his subsidiary hypotheses of panmixia and germinal selection, affords a sufficient explanation for all the evolutionary changes in the world of life. What Romanes has called Weismannism has been a strong stimulus in directing thought and research into what have proved to be very fruitful fields. Weismann represented an extreme type of selectionist—but there are other biologists to whom Darwin's theory made little appeal. A few practically reject it entirely. Some orthogenesists and neo-Lamarckians ascribe to it a minor and merely negative rôle in killing off the weaker members of a species that fall below the average of fitness to their environment. Others, like Spencer, look upon it as an important factor in evolu-

tion but deem it obviously insufficient as a general explanation of either progressive or retrogressive development. And Alfred Russel Wallace, otherwise an orthodox neo-Darwinian, balks at admitting that it is capable of accounting for the development of the mental and moral faculties of man.

There have been few theories which have furnished a target for so much adverse criticism. It has been objected that natural selection cannot create but only destroy; that it cannot account for the beginnings of useful structures; that it cannot explain the development of organs of extreme complexity; that it does not explain how new variations are produced, and hence compels us to seek elsewhere for the real causes of evolution in those agencies, whatever they may be, that give rise to variation. Much has been made of the difficulty that natural selection cannot cause the evolution of organs that involve simultaneous and appropriate modifications in a number of coöperating parts in order that each increment of improvement be of selective value. It has been urged that evolution has proceeded along definitely directed paths, and hence we must seek in some form of orthogenesis for the main cause of evolutionary progress. And then it has been claimed that natural selection is merely an unverified hypothesis,—that, as Lord Salisbury has said, "No man has ever seen it at work."

These and other objections have afforded material for endless discussions. Accessory hypotheses such as panmixia, germinal selection, physiological selection,

the intra-selection of Roux, and the theory of organic selection, have been advanced to meet various difficulties that confronted the theory of natural selection as formulated by Darwin, and these again have contributed further to swell the volume of controversial literature. It is not surprising, therefore, that symptoms of weariness developed in many quarters over the purely dialectical character of much of the writing on evolutionary theory. After the initial enthusiasm over a great conception had passed, and students of biological science endeavored to penetrate more deeply into the workings of the forces which brought about the present order of the organic world, it was found that the problem of the method of evolution was one with which little real headway had been made. The problem seemed more amenable to the ingenuity of speculative thought than to actual investigation by observation or experiment.

One difficulty lay in bringing rival theories to the test of verification. We may study the method of evolution by observing the actual course of evolution in the organic world and then test our theories of the causes of the phenomena in the light of their conformity with the facts, or we may study the causes actually at work in modifying the characteristics of existing species. The first method involves the study of those fields of inquiry which reveal the actual course of evolutionary changes. But even if we had an exhaustive knowledge of these fields we should still be ignorant of the causes which lay back of the unfolding

of life. Knowledge of the way in which evolution has proceeded would be of great service in the search for causes; but however well our theories might account for the course of evolutionary history, we could never be quite sure of their truth until in some way we had brought them to the test of verification.

While the progress of evolutionary theory between 1859 and 1900 failed to realize the possibly over-sanguine hopes of many biologists, it must not be inferred that no important advances had been made. The influence of geographical isolation in the formation of species had been brought out by A. R. Wallace, M. Wagner, L. Gulick, G. J. Romanes, and more recently by D. S. Jordan, C. H. Merriam, J. A. Allen, J. Grinnell, and other American workers on different groups of vertebrate animals. The isolationists had an adequate answer to the objection based on the swamping effects of intercrossing, which Fleeming Jenkin was the first to urge against Darwin's theory of the origin of species. No new variation, according to Jenkin, could establish itself, because it would breed with the parental type and produce an intermediate progeny which would gradually lose itself in the general average of the species. Moritz Wagner, in his well-known essay on *The Darwinian Theory and the Law of Migration,* urged that the only way in which a variation may escape the swamping effect of intercrossing is to become isolated, by migration or otherwise, whereby it may develop in its own way, unchecked by interbreeding with the parent species. The large amount of

careful work on geographical distribution which was stimulated by the problem of the origin of species has yielded abundant and conclusive evidence of the importance of isolation in the formation of distinct types. D. S. Jordan has formulated the principle that, "Given any species in any region, the nearest related species is not likely to be found in the same region nor in a remote region, but in a neighboring district separated from the first by a barrier of some sort." There is no doubt that this generalization, which J. A. Allen has designated as Jordan's Law, is quite generally exemplified in the distribution of vertebrate animals and in many species of invertebrates. It is fairly well borne out in the distribution of the races of man and in many species of higher plants. But it is no less evident that it meets with striking exceptions. In many cases closely allied forms inhabiting the same area do not interbreed. They may have breeding periods at different times, or live in different local habitats, or be in other ways sexually instead of geographically isolated, so that the broader principle of Moritz Wagner, "Ohne Isolierung keine Arten," may still be claimed to apply to them.

Just how isolation works to promote diversity has been variously interpreted. The controversy as to whether isolation *per se* is able to occasion divergence, independently of natural selection or the influence of environment, as maintained by Gulick in opposition to Wallace, we can now decide in favor of the former investigator. It is coming to be recognized more and

more that the various marks which naturalists employ to distinguish species and varieties have no particular value to their possessors. Much has been made of this fact by Eimer and others in attacks upon the theory of natural selection as an explanation of the origin of species. Still under the influence of teleological conceptions, Darwin and most of his contemporaries were prone to look upon everything in an organism as of some use, and, armed with a principle by which the origin of structures might be explained because of their use, they regarded specific characters as quite generally of some service to the organism. The selectionist had to recognize, however, a certain element of unfitness in every species. Darwin, who attempted to explain the origin of species by means of natural selection, believed that species were formed by the preservation of relatively minute favorable variations, and that therefore the characteristics by which one species differs from another represent the summation of a large number of successive improvements in the inherited endowments of the stock. He had read Paley's *Natural Theology* with great admiration and was strongly impressed with the wonderful adaptations of organic structure which are so clearly set forth in that able and celebrated work. Darwin was persuaded that he had to account for a condition of extreme perfection and nicety of adjustment in every organism. While abundantly conversant with the occurrence of sudden and well marked variations, he believed that such variations were of minor significance for evolution,

because he deemed that, except in rare instances, they would be ill adapted and would tend to die out. As one is not likely to fit a peg neatly into a hole by going at it with an ax, so an organism is not apt to secure a close adaptation to its environment by a series of great and sudden mutations. Of course an organism must possess a considerable adaptiveness to its environment in order to survive. But if, as most biologists now hold, the margin of inutility in organic structures is wider than it was supposed to be by Darwin, it leaves a more open field for other theories of the formation of species besides the one formulated in Darwin's celebrated work.

Since species-forming has been so frequently associated with isolation, it might be contended that it has taken place because of isolation. And undoubtedly much can be said for this viewpoint. Recent work in genetics has shown how a species containing a large amount of hereditary diversity may be broken up, through isolation, and quite independently of any selective elimination, into a number of different types. Such a segregation of types is simply an incidental product of inbreeding. Isolated groups tend to become homozygous or racially pure for different characters. And where any strongly heterozygous species is scattered into a number of restricted localities, it becomes inevitably broken up by inbreeding into distinct subdivisions.

The problem of the closeness of fit between the species and its environment has an important relation

also to the theory of mutation. If specific characters are frequently of little or no biological importance, they may have come about full-fledged by a single variation. Whether species have been made by small steps or relatively large ones is, however, of subordinate importance for the larger problems of progressive evolution and the development of adaptations. Darwin attempted to explain the origin of species—which is essentially divergence—and progressive adaptive development by the same method of survival of the fittest, with occasional aid from the transmission of acquired characters. Recent developments of evolutionary theory have tended to treat the formation of species as more or less independent of the progressive transformation of the world of life; and many who, like de Vries, oppose the view that species have arisen by means of natural selection, still hold that natural selection affords an adequate explanation of progressive adaptive development.

It must be admitted that the theory of natural selection is the only hypothesis that has been offered by which the development of adaptations may be interpreted in terms of the known processes of life. Lamarckism, which at best can account only for certain classes of adaptations, has to postulate an organism already provided with the power of meeting its conditions of life by appropriate structural and functional changes. Many who reject the doctrine of natural selection attempt to cut the Gordian knot by espousing some form of vitalism or by appealing to some kind

of supernatural guidance or directive agency in development. For the school represented by Hans Driesch, life is primarily purposive, incapable of being explained in physical and chemical terms, and bent on realizing its own end in the development of the race, as in that of the individual. The problem of adaptation is still in the foreground of interest. Some would solve it in this way and some in that; some avoid it; while others apparently do not see it at all. But there is no doubt that it will remain one of the central problems of biology for many years to come.

The first two years of the twentieth century were made memorable in the history of evolutionary theory by the appearance of the first volume of de Vries' *Mutationstheorie,* and the rediscovery of Mendel's law of heredity. Mutation and Mendelism have been closely associated in recent literature on genetics. The two bulky volumes of *Die Mutationstheorie* contained a great wealth of observational and experimental data that served to impress the fact that the method of evolution is a subject for investigation by the breeder of plants and animals. The doctrine of mutation, which claimed that species had a sudden instead of a slow origin, removed some of the obstacles which Darwin's own theory had to cope with, and it gained acceptance, especially in America, with a rapidity which was quite unjustified, I believe, even by the wealth of evidence which de Vries adduced in its support. It was widely accepted by morphologists and experimentalists, although regarded with extreme sus-

picion by most students of taxonomy and distribution. The search for mutations soon made it apparent, however, that stable hereditary variations were not, as a rule, of large extent. As de Vries himself has stated in his *Plant Breeding,* many of them range down to the limits of detectability even for the experienced eye. Breeding experiments have shown that most of the small individual variations to which Darwin attributed so much importance are purely somatic and have no discernible influence on the next generation. True hereditary variations, even small ones, are more rarely met with. It is often difficult to distinguish such variations amid the large amount of somatic fluctuation by which they are obscured, and it may happen that they will be found to occur more commonly than is generally supposed. The mutationists and the Darwinians may therefore be compelled to draw more closely together in the future, as in fact they have already done to a certain extent.

The precise relationship of the Darwinian theory to the mutation theory as modified by recent observations is differently conceived by different writers. For the larger problems of evolution Darwin and de Vries stand on the same foundation. Many series of breeding experiments have made it evident that most distinct species differ in a number of inherited factors and hence must have been produced by a number of successive steps. But this work also shows that they have probably not been produced by a continuous accumulation of ever present variations, as Darwin supposed.

Much has been learned about variation since Darwin's time, but to set forth the bearing of this knowledge involves a brief discussion of the other important discovery I have mentioned, namely, Mendel's law of heredity.

The essential feature of Mendel's law is that characteristics behave as units in inheritance and are capable of being combined in varied relations and assorted in definite numerical ratios. Mendelizing characters go in pairs, and, on account of the way in which these characters are distributed, Mendel was led to assume that the germ cells are pure for one or the other member of such pairs. This shrewd surmise, although made at a time when nothing whatever was known of the cellular mechanism of Mendelian inheritance, has since been confirmed by a large amount of careful and detailed investigation. Various pairs of characters may be independently assorted, producing Mendelian ratios of various kinds according to the number of independent characters dealt with.

Through a remarkable series of studies on the structure and development of the sex cells it has been rendered exceedingly probable that Mendelian characters have their basis in nuclear bodies called chromosomes. The work of Morgan and his associates has shown that in the fruit fly, Drosophila, characters are inherited in groups; that the number of such groups is the same as the number of chromosomes in the mature germ cells, namely four; that the factors for these characters have a linear arrangement in the chromosomes; and

that occasionally they may pass from one chromosome to its mate in the period of synaptic union. Hypothetical maps are made of the distribution of these hereditary factors, based on their different degrees of linkage and the frequency of what is called "crossing over."

Over two hundred mutations have been found to arise in the fruit fly during the few years it has been kept under observation. When a new mutation arises, appropriate breeding experiments can be made to ascertain if it belongs to the sex chromosome or to the second, third, or fourth chromosome, and then to determine how many units it may be removed from other factors in the same chromosome. While space forbids my presenting the evidence upon which these remarkable conclusions are based, I may say that this evidence has compelled at least the provisional assent of most of the critical students of genetics who have devoted serious attention to the problem.

The penetrating analysis which Morgan and his coworkers have made of variation and heredity in Drosophila has thrown much light, and promises to throw more, on a number of problems of evolution. For an illustration of this one may turn to the recent controversy concerning what may be accomplished by the process of continued selective breeding. As is well known, cultivated plants and domestic animals have been rapidly modified by the process of artificial selection. It was formerly held that such changes could be carried on for a practically indefinite period. But ex-

perience has shown that in practice, while selection may produce results quite rapidly at first, it operates afterwards more slowly and finally comes to a point, usually in a few generations, at which it seems powerless to produce further change. These results are now pretty well known to be due to the gradual production of a homozygous condition for those factors already present in the stock which produce the maximum development of the character in question. It is an affair of shuffling and sorting the cards. And when it is completed, further progress must wait upon the appearance of new mutations, if, happily, they arise.

Much discussion has centered about the question whether or not the basis of unit characters, the genes, are capable of being modified by selection. The work of Castle on hooded rats seemed to show that, through selection, modification might be made in a character that behaved as a simple Mendelian unit in inheritance. As Castle remarks in his *Genetics and Eugenics,* published in 1916:

> There is apparently no limit to the quantitative change which can be produced in the hooded pattern by selection, short of its complete extinction in the all white or all black condition toward which our minus and plus selections respectively are steadily tending. Yet there can be no doubt that only a single genetic factor is here involved. A tentatively adopted hypothesis that modifying factors were concerned in it has been definitely disproved. Any finite number of such modifiers would have been greatly reduced or eliminated altogether by seventeen successive selections,

yet no slowing up is observable in the rate of change of the racial character under selection either plus or minus. The changes effected by selection show permanency under crosses with wild rats. The selected races are changed by a wild cross no more than an unselected hooded race is. A first cross of the selected races seemed to show a partial undoing of the changes produced by selection but a second cross made on a still larger scale, involving over one thousand second generation individuals, showed no further change of this sort, but instead a return to about what the selected race would have been had no crossing at all occurred.

The conclusion seems unavoidable that the single genetic factor involved in this case has undergone quantitative change under the influence of selection.

However, further testing of the hypothesis that the hooded character in rats depends upon multiple factors led Castle to reverse his previous stand, and to agree with Johannsen, Morgan, East, Hagedoorn, Bridges, and others that his results may be explained in conformity with the theory of the constancy of the genes, which is now the favorite form of the doctrine of non-transmutability. In a paper published in 1919 on "Piebald Rats and the Theory of Genes," he concludes that results obtained by the new method of testing the purity of his stock

favor the widely accepted view that a single gene is not subject to fluctuating variability, but is stable like a chemical compound and changes only similarly by definite steps (mutation in the sense of Morgan, not of de Vries) that offer no obstacles to the proposition of Johannsen (ably

supported by East) that a gene terminology is adequate to explain all known varieties of inheritance phenomena.

The extent to which characters may be changed through selection varies greatly in different forms. In some cases selection apparently can do nothing at all. In the experiments on corn which have been carried out at the University of Illinois, it has been found that the protein and oil content has been increased in some strains selected for high content and decreased in those selected for low content during the twenty years in which the investigation has been carried on. In Drosophila it has been possible to demonstrate the existence of modifying factors, to determine their location by their linkage relations, and to show their effect on the character under investigation. Sometimes these modified factors may arise as new mutations in the course of selective breeding. They may be located here, there, or anywhere in the chromosome complex. Occasionally successive mutations occur in the same locus of a given chromosome. This has occurred several times in the factor for eosin eye color and a few times in the factor for bar eye.

Selection seems to have not the least effect upon either the location or the nature of the new germinal variations that make their appearance. A scrutiny of the numerous mutations that have arisen in Drosophila shows them to be of the most varied character and quite without definite relation to utility. Most of them are recessive; several are dominant; others par-

tially dominant. They are just the fortuitous variations which Darwin postulated as forming the raw material out of which selection might build up perfected structures. Some of these variations show much greater viability than others. Several of them are lethal, that is, when present in the duplex state they cause the death of the organism. From the standpoint of utility the majority of these mutations must be treated as failures. Occasionally, however, if not in Drosophila at least in many other forms, the new variations that arise are apparently better adapted than their parent stock and tend to supplant it under conditions of free competition.

Recent work in genetics has furnished us with a much clearer picture than we formerly had of the nature and origin of the variations which constitute the material for the transformation of species. Particular heritable variations are the results of changes in localized parts of chromosomes; they behave in general as Mendelian unit factors; they occur sporadically in various parts of the different chromosomes; and while they may affect predominantly one or at least a few features of the body, there is reason to believe that they change to a certain extent the entire constitution of the organism. A variation in a particular locus of a chromosome may produce as its most obvious result a change in eye color, but it may also influence the development of wing characters or general viability. Particular characters are thus the products of a number of germinal factors, and in selection

experiments characters may be modified, not through any change in the factor or factors to which the character in question is mainly due, but to changes in other modifying factors whose chief influence is upon quite different bodily structures.

The development of any character is dependent upon a number of elements in the germ plasm. We can no longer speak of a localized determinant of a character in Weismann's sense, as a particle of the germ plasm which produces the character much as a seed gives rise to a plant. The term, unit character, so frequently employed a few years ago, is being replaced by the expression, unit factor. And there is reason to believe that not only is every character the result of many unit factors, but that every unit factor may influence to a greater or less extent a multitude of different characters.

What is now known of variation affords little support to the doctrine of orthogenesis according to which variations are prone to keep on accumulating quite independently of selection along definitely directed lines. Variation in any one direction apparently has not the least effect upon the direction of the next variation that makes its appearance. Variations have been accumulated along particular lines in the past, as has been abundantly demonstrated by series of fossil forms, and in some cases the changes in structure have been so gradual as to preclude the occurrence of mutations of any considerable extent. But it is quite possible to account for such development by the theory of

natural selection. The fact of evolution along specific lines tells us very little of the causes by which such changes have been brought about. Orthogenetic development in the etymological sense of the term may be a fact, but that does not prove that living beings possess any inherent tendency to evolve along straight lines.

I have already alluded to the divergent views regarding the potency of natural selection. While one may argue indefinitely as to whether natural selection can or cannot account for this or that structure, the status of the theory has become, I believe, more firmly established than it was in the time of Darwin. Whatever one may think of the adequacy of natural selection to account for the evolution of organic life, there can no longer be any doubt that organisms are preserved or eliminated on the basis of differences of hereditary constitution. The studies of Weldon on Carcinus and Clausilia, of De Cesnola on mantids, of Bumpus on the English sparrow, of Davenport on birds, of Tower on potato beetles, and of the Morgan school on Drosophila, have shown the actual operation of selective elimination, and the studies of Pearson, Ploetz, MacDonald, and various other investigators of the selective death rate in man indicate that, notwithstanding our advances in medicine and hygiene, natural selection continues to operate with considerable vigor. The reproach of Lord Salisbury in regard to natural selection that "No man has ever seen it at work" has now been definitely shown to be without foundation.

It must be borne in mind, however, that natural selection is at best only a proximate category of explanation. It is a general term for a multitude of processes which bring about a differential death rate. The old objection so often advanced with an air of novelty that natural selection does not account for variation may be admitted without reserve. Darwin, who was under no illusions in regard to this point, never attempted to explain variation by natural selection. The occurrence of variation is made one of the presuppositions of his theory, and, for aught that Darwin could see, and for aught that we can see now, variations are pretty much haphazard occurrences. They arise no one knows why, and no one can foretell when. When they appear they are subjected to the action of many forces within and without the organism —forces whose action is generally indirect and in many cases obscure—and the fittest survive, and we call the procedure natural selection. According to the theory of natural selection then, the causes of evolution are the agencies, whatever they may be, which cause the hereditary qualities of organisms to vary, and the agencies which favor the elimination of certain variations and the preservation of others. When we have explained evolution in terms of natural selection, therefore, we have made only a first step, although from certain points of view a very important first step, toward a final explanation.

Considering the fundamental importance of the problem, it is surprising that very little investigation

has thus far been devoted to the discovery of the causes of variability. We may count on the fingers of one hand the researches of any importance bearing on this topic. Tower has claimed to have obtained variations in the offspring of potato beetles by subjecting the parents to different conditions of heat and moisture during the maturation of the germ cells. Stockard has induced what appeared to be true hereditary variations by subjecting guinea pigs to the fumes of alcohol. A few other suggestive results have been obtained with higher forms, but what has been accomplished scarcely represents even a good beginning upon the problem. More success has been attained in the induction of variability in unicellular organisms, especially the bacteria, but the relation of the variation produced in these forms to the congenital variability of higher types is a matter of dispute. Much of it, apparently, is akin fundamentally to the somatic variability of multicellular organisms, and its transmission may be due to quite other causes than those by which the inheritance of higher forms is determined.

Discussion of the nature and causes of variability naturally recalls the address delivered by Professor Bateson on the occasion of his presidency of the British Association in 1914. Professor Bateson, the leading English exponent of Mendelism, took as his theme a general survey of recent work in genetics. He pointed out the fact, now amply demonstrated, that much of what had heretofore passed as variability is merely the product of crossing and the subsequent segregation of

characters in various new combinations. The appearance of novelty in these variations is, as Professor Bateson assures us, quite illusory. Most apparently new forms are just the kaleidoscopic combinations of old elements in new patterns, adding nothing that is really new in substance. Professor Bateson held, however, that not all variation was of this kind. This extreme view had been developed by the Dutch botanist, Lotsy, who, being impressed with the multitudinous variations obtained by crossing distinct types, and by the ways in which variations really due to crossing many generations back appear to arise *de novo,* attempted to account for all variation, and hence the whole process of evolution, as the result of varied combinations of germ plasm produced by hybridization. But Bateson, alive to the weak points in Lotsy's position, and perceiving that there is scarcely any reasonable way of avoiding the admission that real variation occasionally occurs, looks upon variation in a way very different from that in which it was regarded by Darwin. He assures us that

> variation from step to step in the series must occur either by the addition or by the loss of factors. Now, of the origin of new forms by loss there seems to me to be fairly clear evidence, but of the *contemporary acquisition* of any new factor I see no satisfactory proof, though I admit there are rare examples which may be so interpreted. We are left with a picture of variation utterly different from that which we saw at first. Variation now stands out as a definite physiological event. We have done with the notion that

Darwin came latterly to favor, that large differences can arise by accumulation of small differences. Such small differences are often mere ephemeral effects of conditions of life, and as such are not transmissible; but even small differences, when truly genetic, are factorial like the larger ones, and there is not the slightest reason for supposing that they are capable of summation.

The hypothesis that variation is due to the loss of something in the germ plasm is carried out to its logical conclusion. In speaking of the colors of sweet peas he says,

There is no question that these have been derived from the one wild bicolor form by a process of successive removals. When the vast range of form, size, and flavor to be found among the cultivated apples is considered, it seems difficult to suppose that all this variety is hidden in the wild crab-apple. I cannot positively assert that this is so, but I think all familiar with Mendelian analysis would agree with me that it is probable, and that the wild crab contains presumably inhibiting elements which the cultivated kinds have lost.

Thus progressive variation and even dominant characters represent no real additions to the germinal complex; they are due simply to the removal of inhibitory factors.

The point of view developed by Professor Bateson, which some were inclined to believe he did not wish to be taken quite seriously, was soon afterward taken up

by Dr. C. B. Davenport, director of the Station for Experimental Evolution at Cold Spring Harbor, and head of the Eugenics Record Office, who put forward the view that our remote protozoan ancestors were much more complex in their chemical composition than the germ plasm of the higher evolved types of to-day, which owe their rise to the successive losses of inhibitory chemicals.

Such pronouncements from leading investigators of Mendelian heredity, reminding one as they do of the extravagances of the preformation theories of Leibnitz, Haller, and Bonnet in the seventeenth and eighteenth centuries, naturally somewhat startled the public, as they were doubtless intended to do. Professor Bateson, who for many years had been somewhat restive under the rather unsatisfactory state of evolutionary speculation, finding in the recently opened field of Mendelian inheritance opportunities more congenial to his powers than the laborious compilation of meristic and substantive variations, had thrown himself into the work of Mendelian analysis with signal success. In his position as leader of the English Mendelians he doubtless derived a peculiar satisfaction in wielding his iconoclastic club. No one can really understand the address before the British Association which has perplexed so many people, without reading much between the lines, and without making an allowance for the effect of certain instinctive proclivities of human nature, which are not without considerable influence in shaping the stand-

point even of highly trained scientific men. Bateson committed, I believe, the very human error of attributing to recent discoveries in Mendelian inheritance, in which he had taken so prominent a part, an importance for evolutionary theory far beyond what they really possessed. There is nothing in Mendelian inheritance that gives the slightest indication of the nature of those factorial changes upon which the appearance of so-called unit characters depends. That even recessive characters are due to loss is a perfectly unwarrantable assumption, and that dominant characters arise as a result of losses in the germ plasm is a conclusion for which there is not a shred of real evidence.[1] It is somewhat remarkable that Professor Bateson should have presented addition and subtraction as the alternative methods of factorial changes, and that he should have failed even to mention the possibility of factorial modification or transformation, which would seem *a priori* to be a very probable occurrence. The dilemma in which he represents evolutionary theory as being placed through recent discoveries in heredity and variation is one which is entirely fanciful and depends upon reading into nature a purely artificial and symbolic interpretation.

The discoveries in the few years that have elapsed since the publication of Bateson's address have not

[1] This view I have defended at greater length in an article entitled *Are Recessive Characters Due to Loss?* Published in *Science*. N. S. 42, 300-303, 1915.

only failed to strengthen the paradoxical position there set forth, but have afforded positive evidence of its unsoundness. In the first place, the discovery of what Morgan calls multiple allelomorphs has created serious difficulties for the "presence-absence theory" upon which Bateson relies and has lent strong support to the view that Mendelian characters are due to factor transformation instead of merely gains or losses. Recent work has afforded further and critically tested evidence of the origin *de novo* of dominant characteristics. It has shown that recessive genes occasionally mutate to form dominant factors. In fact there may be a whole series of changes in what the evidence indicates is a single gene. Recent work has also furnished additional evidence of the effectiveness of selection in gradually accumulating differences as well as in revealing more clearly the precise method by which such results are brought about. We are by no means "done with the notion . . . that large differences can arise by accumulation of small differences." In fact, it has been repeatedly demonstrated that relatively large differences have been formed by this very method. It is becoming clearer that species in a state of nature differ by a multitude of factors for relatively small differences, and that, since there is not the slightest observable tendency toward simultaneous mutation in different genes, these species must have arisen by a succession of small steps. The mutation theory of de Vries has had to be seriously modified, and has been

brought more nearly in accord with the conception of the origin of species by the gradual method as outlined by Darwin.[1]

When we look back upon the progress that has been made in genetics during the past twenty years, we can scarcely fail to recognize the period as one of substantial achievement. The method of evolution has come to be less a matter of philosophical speculation and more a subject for attack by the methods of experimental inquiry. The present is a period in which fruitful researches are being vigorously prosecuted along a number of lines bearing on the central problem. We may or may not be near the dawn of any great and epoch-making discoveries. But a steady advance is going on over a wide front, which no doubt will lead to the ultimate conquest of positions of capital importance.

[1] Dr. T. H. Morgan has stated in a recent article (*Scientific Monthly* 16, p. 239, 1923): "To-day we agree with Darwin that such extreme variations as those he called sports would rarely, if ever, have contributed to the formation of new types in nature. But we also know that minute differences also arise as mutants, and that these are inherited in the same way as are the larger mutant changes. It is also now clear that these smaller mutant variations must be those small heritable variations that Darwin himself appealed to as furnishing the materials of organic evolution."

CHAPTER II

BEYOND NATURAL SELECTION

It is with some hesitation that I venture to add to the copious literature on natural selection. By this time, if ever, one would think, this theory should be well understood and all of its implications, presuppositions and consequences clearly set forth. But a perusal of much writing on the subject in the past, as well as an examination of a number of contemporary discussions convinces me that such is far from the case. I shall not endeavor to set right the various critics who misconstrue or somehow fail to understand this theory. I give them up in despair. My attempt shall be rather one of analysis,—an inquiry into the presuppositions of the theory with an endeavor to evaluate it as a scientific explanation of evolution.

As was pointed out in the previous chapter the adequacy of the theory of natural selection as a means of explaining the origin of species and the evolution of organic life has been the subject of much controversy.[1] The theory is ingenious and very simple. Perhaps its very simplicity served to awaken suspicion as to its soundness. Here is a theory which Darwin

[1] At a recent symposium on Darwinism before the British Association for the Advancement of Science, one member referred to natural selection as an "obvious truism," while another declared that it was "as extinct as the Dodo"!

propounds as to the chief cause of evolution. It is put forward as an explanation of the wonderful adaptiveness of the world of life. What had seemed to be inexplicable except as the result of intelligent design is interpreted as the outcome of the operation of natural forces working on the basis of "fortuitous" variations. How remarkable and how revolutionary it would be if such a theory could be true!

When we look into the component elements of this process of natural selection we perceive for the most part simply well known facts. It was long recognized that organisms vary in their hereditary endowments, and that this circumstance affords the basis for the improvements of our domestic varieties of animals and plants. That organisms compete with each other and struggle with environmental forces is equally obvious. The only factor about which there can be any doubt is what Spencer has called the survival of the fittest. But we should bear in mind that natural selection is simply selective survival based on differences in heredity, and unless we suppose that all hereditary variations are equally apt to survive,—which is very unlikely,—natural selection would inevitably occur.

Moreover, what appears to be the necessary outcome of the struggle between different hereditary variations has repeatedly been observed as a matter of fact. Natural selection is taking place under our eyes. But this tells us very little of its importance as a factor in evolution. Its rôle may be subordinate, or even negligible. On the other hand, it may have all the potency

ascribed to it by Professor Weismann who speaks of the "all-sufficiency" of this agency and thinks that it is adequate to explain the entire evolution of organic life.

These are questions for the future to settle. We are here concerned rather with the presuppositions of natural selection and we may pass on to inquire, granting that natural selection is the cause of evolutionary changes, or even the all-sufficient cause of evolution, in what sense does the theory offer us a real explanation of this process? The theory of natural selection affords a formula in terms of which the explanation of any sort of adaptation is simple and easy. If, for instance, we wish to explain why animals are often colored like their environment, we say that those variations happening to render their possessor more nearly like the color of its environment were preserved; the others perished. By accumulating such variations, generation after generation, we finally get such striking cases of protective resemblance as are furnished by the leaf insect and the Kallima butterfly. The same sort of explanation applies to all other adaptations. The evolutionist can often strengthen his argument by pointing to various degrees in the development of structures or activities, as in the evolution of the remarkable comb-making instinct of the hive bee, and we thus get an idea of the probable, or possible, stages by which the final result has been reached. There seems to be no clearly-defined limit to the perfection or elaborateness of the product which may be "explained" by this simple method. For the neo-

Darwinian, natural selection affords the one key to the development of all the manifold adaptiveness of the organic world.

To many it has seemed that such facile explanations explain very little. It must be admitted that when we have accounted for the origin of anything by the theory of natural selection we have made only the first step in the direction of a full and adequate causal explanation. In these days of analysis in biological investigation, we may be prone to minimize the value of this first step. But we should remember that the law of gravitation enables us to make only a first step towards explaining the motions of the heavenly bodies. The theory of natural selection interprets evolution as the outcome of known processes of heredity, variation, and differential survival. And while even the all-sufficiency of natural selection would not necessarily dispose of teleology, it brings the phenomenon of organic purposiveness within the purview of the student of the biological activities. Given variation, heredity, and struggle, and the natural outcome is adaptation.

The theoretical bearing even of the kind of explanation which the theory of natural selection affords is very important for our outlook on problems of life, mind, and society. As Huxley contended, the old argument for design, so forcibly presented by Paley, loses much of its force in face of the possible operations of this agency. If the theory of natural selection did no more than to show the dependence of the development of organic adaption upon recognized biological proc-

esses, it would be of great significance for both science and philosophy. Nevertheless, we must freely grant that if natural selection is the "all-sufficient" cause of evolution, we have still very much to explain. What our interpretation really means is that evolution is the outcome of: 1, the causes of hereditary variability; 2, the various forces within and without the organism which determine that some of these variations survive while others perish.

Darwin, like most of his followers, had no explanation of the causes of variation. He recognized that variability might be enhanced by crossing, and he thought that it might be produced by changes in nutrition and the environment of the organism. Since Darwin's time, much of importance has been learned in regard to the variability of plants and animals. Most of what appears to be the production of new forms and characteristics is now known to be the product of combining, in different ways, factors already present in the germ plasm of the parents. It is a sort of kaleidoscopic performance in which the same old elements are made to exhibit a great variety of novel combinations. The occurrence of these apparently new products is a matter of combination and segregation of hereditary factors in accordance with Mendel's law of heredity. They are not variations in the old sense at all. They result simply from the shuffling of the cards.

These products of the Mendelian shuffle doubtless play some part in the process of evolution. In fact, a few evolutionists such as Lotsy have espoused the

extreme view that practically all variation is the result of crossing. Not to dwell on the curious logical consequences of this standpoint, it may be said that it is quite well established now that a variation of a different kind sometimes arises and is capable of hereditary transmission. Some have been shown to be connected with variations in the number of chromosomes in the nucleus of the germ cell. Others have been shown, by very ingenious methods, to be very probably due to changes in small parts of chromosomes. The genetics of the fruit fly has been worked out to such a point of refinement that it is possible to specify, with a good deal of probability, the relative position in particular chromosomes of the genes, or factors, for a large part of the two hundred or more variations which have been observed to arise in this form. Variation, in the sense of producing something really new, in contrast to variation which is merely the product of the Mendelian law of heredity, is mainly the result of changes in definitely localized regions of particular chromosomes in the nucleus of the germ cell. By a combination of carefully planned and controlled breeding experiments with the study of the history of the sex cells by improved microscopic technique, variation, at least in the fruit fly, has been hunted down to its local habitat. But here the biologist must stop. What is the nature of the change upon which variation depends he does not know. Not improbably it is a chemical transformation of a small part of a chromosome representing what the geneticist calls a gene or

hereditary factor. We know that there is a great multitude of these genes in the germ plasm. We have learned much of the results of their combination and segregation. The geneticist has made great inroads into regions that a few years ago seemed to be in impenetrable darkness. His exploration into the composition of cell organs is suggestive of the achievements of the physicist in exploring the atom. But while he has traced true variability to its source, he has learned little of its real causes.

Theoretically, it is possible for the vitalist to maintain that variability is the outcome of a teleological process or an Aristotelian entelechy which shapes the formative activities of the organism to its own ends. Design may lurk unobtrusively in the fountain source of change upon which evolution depends.[1] This position has not infrequently been taken by those who look upon the purposiveness of the world of life as something more than the outcome of a purely hit-or-miss process. It is not easy to prove that particular variations are *not* the outcome of some agency that gives them a purposive direction. Darwin, as is well known, spoke of variations as fortuitous. His theory could get along with the assumption that they are fortuitous. But here is a critical problem for the mechanistic interpretation of adaptiveness, and it is instructive to look at the actual facts which have been brought to

[1] For a defense of this viewpoint see J. Ward, *Naturalism and Agnosticism*, and Pauly, *Darwinismus und Lamarckismus*. There is a good critical discussion of the problem in the chapter on Darwinism and Design in Schiller's *Humanism*.

light by the searching study of hereditary changes in plants and animals.

So far as what might be called Mendelian variability is concerned, we have phenomena which are the outcome of very uniform modes of procedure. Mendel's law of heredity is based upon the mathematical laws of chance. In this, it is expressive of the same kind of uniform results which are obtained by shaking dice or throwing coins. The new combinations may be good, bad, or indifferent from the standpoint of the interests of the organism, and the good combinations occur with no greater frequency than any others. They happen for reasons that may be considered no more nor no less teleological than those which give rise to a throw of double sixes in shaking dice. In fact, all the phenomena of Mendelian variability may be paralleled by dice casting or other devices which give a variety of combinations due to chance.

But Mendelian variability may be said to rest finally upon those more fundamental changes occurring in the genes or hereditary factors. We are able to distinguish now, as Darwin and his followers were not, this kind of variability which adds, as it were, new numbers to our dice or new cards to the pack, and gives us, therefore, new possibilities in the way of combinations of characteristics. What does a scrutiny of this more fundamental kind of variability teach us in regard to teleology? The little fruit fly that we see attracted to the vinegar bottle is the form to which we naturally turn for light on this important question. The numer-

ous mutations which this creature has brought forth are mostly of the type I have just mentioned. These mutations affect now the color of the eyes, now the number of bristles on the body, now the length or venation of the wings,—all sorts of changes in all sorts of directions. These occur in no definite order and without any detectible relation to variations that have happened before. They are associated with genes located here, there, or anywhere in the chromosomes. Most of them are recessive and seem to be of no special significance in the life of the animal. Many of them render their possessors weak and unable to thrive alongside of normal flies. A large number result in what are called lethal factors which, when represented by two members, cause the death of the individual. A few variations are of good vitality and are probably able to hold their own in competition with typical members of the species. So far, then, as these more fundamental kinds of variations have been observed, they appear to be, like Mendelian combinations, good, bad, or indifferent, with perhaps a larger proportion that are bad or indifferent. Had Darwin been able to contemplate them, he would have noted with satisfaction that they apparently exhibit the fortuitous character which he had postulated.

So far as investigation has yet gone, there has been revealed no clue as to what causes variations to arise. Apparently they just happen. In the search for causes one's first thought turns toward the influence of the environment, not merely for *a priori* reasons, but be-

cause a number of investigators have reported that hereditary variations have been produced through the action of the environment on the germ plasm. Some of these investigations should now be regarded with suspicion because the variations reported might have been the result of Mendelian segregation. It has now been shown to be very probable that most of the mutations of the evening primrose, *Oenothera lamarckiana,* which had figured so largely in the celebrated mutation theory of evolution are really the remote products of hybridization. It requires critical work to distinguish the types of variation I have been discussing, and in many forms it is not possible to be certain with which type we are dealing. There are decided advantages in working with forms whose genetic behavior is well known and I accordingly suggested to one of my graduate students, Miss Margaret Mann, that it would be desirable to test the potency of various environmental agencies in causing mutations in the common fruit fly. This form has the additional advantages that very large numbers can be easily bred and the generations succeed each other every three or four weeks. Miss Mann worked with a strain long inbred to insure the purity of the stock and the progeny of the flies experimentally treated were compared with the progeny of the flies kept under normal conditions as a control. In the experiments, different groups of flies were subjected for several successive generations to the influence of alcohol, morphine, lead poisoning, methylene blue, arsenic, high temperature, and other

agencies, and their progeny were carefully examined to detect the occurrence of possible variations. In the experiments with alcohol, the flies were made intoxicated by the fumes for six days a week from their first emergence until after they had produced progeny. This treatment was continued for ten successive generations. Out of several thousand flies subjected to such treatment, there were no individuals produced with any defect or other characteristics indicative of any hereditary effect of alcohol. Most of the other agencies were equally ineffective. Two mutations appeared in the 35,000 flies subjected to an abnormal environment; but as two mutations (a rather higher percentage) occurred in the controls, the efficacy of environmental factors in causing hereditary variation was not manifest. No other attempt at producing variation has dealt with such very large numbers of individuals or has been extended over so many generations, and the way in which the investigation was checked and controlled makes it of peculiar significance in demonstrating that the germ plasma of the fruit fly is remarkably resistant to environmental influences. What causes the variations that have been observed to arise in this form seems more mysterious than ever.

With respect to the hereditary action of alcohol in animals, there is the well known series of experiments by Stockard and his collaborators which has given positive results under conditions of careful control. Guinea pigs treated with alcohol were shown to pro-

duce offspring that were less apt to live and which showed a greater percentage of anomalies than the progeny of the untreated animals kept as controls. The offspring of alcoholized guinea pigs, although raised without alcohol, were found to give rise to a second generation of relatively defective animals and these again to a third. Something was apparently passed on from one generation to the next that gave rise to less viable or defective offspring. But it is noteworthy that the defects, such as abnormal digits and eye anomalies, which arose most frequently from alcoholized ancestry, were not transmitted as clearly defined characteristics; what was transmitted seemed rather to be an impaired vitality of which increased mortality and occasional deformities were the symptoms. The same interpretation not improbably applies to the more recent results observed by MacDowell in the progeny of alcoholized white rats. We are left in doubt as to the real relationship of this transmission to the hereditary factor changes inherited in accordance with Mendel's law.

Of somewhat uncertain interpretation also are the recent experiments of Dr. M. F. Guyer on the transmission of lens defects in rabbits. Guyer made an emulsion of the lens of the eye of a rabbit and injected the preparation into the blood of a fowl. After several such injections some of the serum of the fowl's blood was injected into the circulation of pregnant rabbits. In a few cases the young of these rabbits were found to have opaque or otherwise abnormal lenses, or other as-

sociated defects of the eye. These eye defects were observed to be transmitted through several subsequent generations, and to behave much like a recessive Mendelian trait. It is not entirely certain that the germ plasm of the rabbits was altered by the procedure employed, and further experiments on the subject, and their extension to other organ systems will be awaited with interest. That they are indicative of Lamarckian inheritance, as has sometimes been claimed, is at present a quite unwarranted conclusion.

So much for one component of the process of natural selection. If we know practically nothing of why hereditary variations arise, is our knowledge more complete as to why some of these variations survive while others die without issue? We know more or less about the causes of death. Many creatures die simply because they are eaten by larger animals; others are killed by extremes of climate; multitudes perish through disease. Our human mortality statistics class causes of death into 189 groups. We die from causes which, as a rule, are fairly clearly defined, such as tuberculosis, cancer, pneumonia, heart failure, or automobile accidents. In all this, amid much mortality that is purely fortuitous, we may discern the action of natural selection, for whether or not we die of hemophilia, diabetes, Bright's disease, or tuberculosis depends, to a considerable extent, upon our inherited constitution. Natural selection is in no wise concerned with many causes of death. If a vessel at sea goes down with all on board, or if a village is buried by the

eruption of a volcano, there is no selective mortality. It is only where death is a respecter of persons, picking out the constitutionally weak or non-resistant, or eliminating individuals whose inherited stupidity prevents their making appropriate responses that natural selection comes into play. In other words, natural selection operates only when an external cause of death acts or fails to act on the basis of internal or hereditary differences in the organisms exposed to its influence. What then decides the issue between life and death in a given situation in which natural selection occurs is the hereditary difference between organisms. In such a situation, the cause of survival is the cause of the particular variation that is spared by the environment which kills off the others. We may know a good deal about causes of death, but, in so far as our present problem is concerned, it does not do us the least good to know that a million animals were killed by drying up a lake. It does us little more good to know that half a million human beings perished by the plague if we do not know why others, who were attacked by this disease, were spared. Discussions of natural selection commonly place much emphasis on the differential death rate. But what is of real importance is not that some forms die, but that others live and reproduce. *It is not death that is creative.* It is not the failures with which the path of evolution is strewn that explain its course; it is the integrating and sustaining factors in the life process that are responsible for all advance and all adaptiveness. It may advantage the

living that some of their fellows die and get out of the way. Death may thus be a useful *condition* of progress, but we must look elsewhere for the *active causes* of progressive development.

We are thus brought in our search for causes to the problem of why organisms maintain and perpetuate their life. We must know this if we would understand why organisms come to have improvements in the adequacy or completeness of their life-sustaining processes. It is in the summation of these improvements that progressive evolution consists. If we imagine that all organisms that ever lived consisted of the present inhabitants of the earth and those in the direct lines of their ancestry, making abstraction for the moment of all others that have perished,—the dead branches of the tree of life,—we should have many series of forms, all surviving to maturity, but exhibiting, without selective elimination, a marvelously diversified development in adaptation to the most varied conditions of existence. With our attention focussed on the successive steps in advance or retrogression in the living branches of this tree, asking what we know of the forces, internal or external, by which each step has been taken, we can only look upon the spectacle with wonder and confess our ignorance. If, in our picture, we have eliminated elimination, we still have the struggle for existence,—successful struggle,—but what would it mean? It would mean again the action of those self-maintaining activities which constitute life.

Could we ever discover the actual causes of any

section of this evolutionary history, we might find that they were multitudinous. Now one thing might cause a variation and now another. The external influences in adaptation to which the living world has been molded are beyond the possibility of enumeration. Whether or not the environment has any power of modifying the hereditary constitution into harmony with its requirements by any other than the hit-or-miss method of chance, we do not know. Natural selection explains evolution mainly in terms of unknown causes. If there are any other evolutionary factors at work besides natural selection, their existence has not been revealed, and beyond natural selection there is only,—darkness.

CHAPTER III

PANMIXIA AND DEGENERATION

THE word panmixia was first used by Professor Weismann in his essay *On Heredity,* published in 1883. It was coined to designate a tendency of organs to degenerate on account of "the suspension of the preserving influence of natural selection." Nature is full of illustrations of the gradual degeneration of structures after they have ceased to function. The Lamarckians, with their doctrine of the transmission of the effects of the use and disuse of parts, had an easy and plausible explanation of this degeneration. Weismann, who was laboring to show that the Lamarckian doctrine of inheritance was not only improbable, *a priori,* but rested on entirely inadequate evidence, naturally felt called upon to explain the phenomena of degeneration in some other way. Natural selection might under certain conditions favor variations of an organ in the direction of reduced size, especially if the organism came to live under conditions which made the organ positively injurious. The wingless insects of the island of Madeira, it has been suggested, may have been developed through the circumstance that the best fliers would be the ones most apt to be blown out to sea and lost. The small legs once possessed by serpents would

be a positive disadvantage in gliding amid obstacles on the ground. Even the eyes of cave animals would be more or less harmful, as their delicate surface would be liable to frequent injury by collisions with objects in the darkness. Natural selection would therefore tend to favor the further degeneration of these parts.

But there are many cases in which the organ in question seems to be of little consequence one way or the other. In such cases an appeal was made to the principle of economy. Those forms whose energies went into building up and sustaining useless structures would be in a measure handicapped in comparison with others which made a more economical use of their energies. Here degeneration might be explained through natural selection on the basis of "economy of growth."

Weismann, however, considered this interpretation inadequate to meet the situation. In his *Evolution Theory* he tells us that this hypothesis "would be far from supplying us with a sufficient explanation of the phenomenon; the individual variations in the size of an organ which is in process of degeneration are even in extreme cases far too slight to have any selection value." The slight fluctuations in the size of the small rudimentary femur which is buried within the flesh of the Greenland whale can hardly be conceived to have any selection value in the life of this colossal animal. Yet this small organ has gone on degenerating, and in some species of whales it has entirely disappeared.

As Professor Weismann rejected the Lamarckian theory on the one hand and admitted that there were many cases of degeneration that could not be explained by natural selection on the other, he put forward his hypothesis of panmixia in order to account for them. Organs, he contends, have to be maintained in their present state by selection which is constantly removing the minus variations. When selection ceases there is nothing to prevent the minus variations from accumulating. Consequently the organ undergoes a slow degeneration.

The theory of panmixia aroused a good deal of adverse criticism and Weismann later admitted that it could account only for a relatively small amount of retrogressive change. Delage attempted to show by a mathematical computation that the maximum effect of panmixia is to reduce an organ to one-half of its original size. G. Wolf denied to panmixia any rôle whatever. Romanes took more kindly to the doctrine, —he had previously advanced an idea more or less similar to it,—but thought that panmixia could account for the reduction of an organ only to "considerably above one-half its original size,—or probably not through so much as one-quarter." It is a process therefore which cannot explain the final disappearance of an organ. Panmixia, according to Romanes, is more active in the beginning of degeneration than later, but the final disappearance of a disused part is attributed to "the eventual exhaustion of heredity." E. Ray Lankester and Lloyd Morgan would concede

to panmixia a much slighter rôle, the latter author limiting its maximum effect to a reduction of from three to five percent.

Most of those who have criticized the theory of panmixia have done so on the basis of certain assumptions concerning heredity that are highly questionable in the light of modern genetics. It has been assumed that selection works with the ordinary fluctuating variations which occur for the most part with about equal frequency on either side of the mean. It has generally been assumed that these variations are confined mainly to particular organs or parts. And it has generally been assumed also that inheritance is typically blending instead of alternative.

Since fluctuations of a plus and minus character are about equally numerous, it would apparently follow that if such variations form the material of evolutionary changes the cessation of natural selection could make little difference to the character concerned. And here we encounter another assumption that runs through much controversial literature on the method of evolution. It is that selection has acted on the basis of particular characters, picking out variations in a character and improving it quite irrespective of other characters which in their turn are supposed to have been evolved in the same way. Particular parts have commonly been abstracted away from the organism entirely, and it is argued whether a spot on a butterfly's wing can be increased or decreased by natural selection. But natural selection does not deal with the

spot; it deals with the butterfly. And a butterfly with a larger or a smaller spot may be a different kind of a butterfly, not with respect to the spot merely, but throughout its entire organization. Most of the voluminous controversial writing on the utility of specific characters has been carried on by both sides on the assumption that it is the characters that nature is concerned with. The common assumption is that if species differ chiefly in certain characters that systematists find it convenient to employ for purposes of description and discrimination, and if these species have been formed through natural selection, therefore selection must have acted on the characters by which species are distinguished. This, in my opinion, is a colossal blunder. It is due to our very common and vicious scientific habit of making an improper use of our artificial abstractions. The conclusion commonly drawn by one party to the controversy is that since we can neither perceive nor easily imagine what rôle is played by the characters by which we discriminate species, natural selection can have had nothing to do with the *origin* of species. Butterflies' wings present many thousands of variations in their markings. Closely allied species may differ by a few not easily discernible variations in pattern or shade. The one party points in triumph to the small spot on the wing and defies his adversary to explain what value *it* may have in the struggle for existence. And his adversary, if unable to conjecture how this mark might be useful, falls back on saying that our knowledge of the life history of the butterfly

is so imperfect that we are not justified in denying that the spot might have some value after all. What makes the whole controversy ridiculous is the tacit assumption of both parties. It is only a peculiar obsession with their abstractions that makes them imagine that they are saying anything really relevant to the importance of natural selection in the formation of species. If a Chinaman can thrive in extremes of climate that exclude other races is it due to the color of his hair and the slant of his eye? Nature is not as a rule particularly interested in characters. We might have been spared much wordy controversy had it been commonly recognized that characters are symptoms of general organic differences and are not *per se* the causes of survival or elimination.

Much evidence points to the conclusion that variations are organismal and not confined to particular parts, although they may be much more obviously manifested in some regions of the body than others. The specific color markings of butterflies may be of little biological significance in themselves, but they go along with different habits, habitats and food of larvæ and a number of other differences in all stages of the life history. What enables one species of butterfly to supplant another is not the markings on the wings, but one or more of the peculiarities with which the markings are associated. It is not whiteness that eliminates the albino, but the constitutional, chemical peculiarities of which whiteness is the outward and visible sign.

Not only is there evidence that characters are ex-

pressed in a measure throughout the organism, but also that they are influenced by many other parts. This conclusion, in fact, follows from the organismal nature of variation. Variations which have a selective value in one part may entail slighter changes in many other parts. What is known of the action of so-called modifying factors is an illustration of this fact. If one organ is being changed in any given direction this, *ipso facto*, entails modifications, though they may be slight, throughout the organism in general. The accumulation of this latter variability, which is a sort of accessory or incidental product of selection, may give rise to multitudinous characters of little or no value which are tolerated so long as they do not become too injurious.

In order to judge whether this accessory variability is good or bad let us consider the modern as contrasted with the older conception of variation. It is now very probable that changes are not wrought in species by the selection of the ordinary plus and minus variations that are continually met with. These for the most part are purely somatic and not hereditary. The variations which are effective in the hands of selection are discrete, stable changes in particular hereditary factors or genes. These changes may result in large or small,—commonly small,—variations of the organism. They occur in many directions. They cannot be adequately described as plus or minus. They are inherited according to Mendel's law, and are usually recessive, although a great many dominants have been observed to arise.

What is particularly significant in relation to panmixia is the fact that the majority of them are failures from the standpoint of adaptiveness.

The facts of heredity and variability as revealed by recent work in genetics render the older arguments against panmixia irrelevant. The assumptions upon which various mathematical demonstrations of the inefficiency of this factor were based are largely wrong. If purely hit-or-miss variations were allowed to accumulate without regard to their quality the result would be degeneration. And to this degeneration we can assign no definite limits.

When we are dealing with a complex organ whose effective functioning depends upon an accurate adjustment of its parts, it is obvious that a random variation would be likely to do harm rather than good. If my watch is somewhat out of repair I might possibly adjust it by poking a needle about in the works, but the chances are that I would only make matters worse. A variation among the parts of the eye might improve this marvelously adapted but imperfect organ. But consider what would probably happen if several thousand random mutations affecting the eye were to accumulate without regard to their utility. Would we any longer recognize the structure as an eye?

Variations in an organism already fairly well adjusted to its environment are not likely to be in the direction of improvement. Under the assumption that variation is an affair of more or less and that variations in one direction are advantageous while those in

the other direction are disadvantageous, we might legitimately argue for the very limited potency of panmixia. But this is not the situation with which we are confronted.

Romanes has spoken of the "eventual exhaustion of heredity," but we know of no such thing. Heredity does not become exhausted; it simply becomes changed. Heredity left to itself may undergo changes, one after the other, at more or less considerable intervals of time. Just as Romanes believed that his exhaustion of heredity might explain an indefinite amount of degeneration, so it might be assumed that random mutations can do the same thing.

Any one who scrutinizes the mutations which have been observed to arise from time to time in a number of organisms will be compelled to admit that from the standpoint of adaptiveness the majority of these are minus variations. Here is one fact that stands out clearly in regard to the kind of variations that are really effective in producing evolutionary changes. This fact makes it inevitable that any organ left to itself, a prey, so to speak, to all kinds of variations that may arise in it, will undergo deterioration. As there are more minus than plus variations, whenever conditions are such that the minus variations are on an equal footing with any others they will tend to accumulate. The consequences of this simple fact are important in a number of connections, but one immediate and obvious consequence is to place panmixia in a more favorable light. Instead of looking askance at it as

a dubious speculation we must recognize it as an inevitable deduction from our present knowledge of genetics.

In the foregoing discussion I have called attention to two methods of degeneration which I have perhaps not distinguished with sufficient clearness. Degeneration, and probably progressive development also, may occur through the accumulation of what we may call the secondary effects of variations selected for their value in other connections. Each of these major variations may play a useful rôle in building up other organ systems, although more frequently they work the undoing of organs which are no longer of service. The degeneration of the latter would therefore be brought about by natural selection, but only as a kind of incidental side issue, since natural selection was not directly concerned with them. They suffer degeneration, in others words, because of their correlated variability.

Then there is the degeneration due just to the accumulation of variations which changed conditions make no longer disadvantageous. They accumulate simply because selection does not remove them. This is panmixia in the original sense of the term. It would perhaps not be advisable to include the first degenerative tendency under the name panmixia. Were I given to instituting neologisms as copiously as certain well-known writers on evolution I should doubtless designate this process by a distinctive name. But I prefer to exercise forbearance.

It is interesting to find that Professor Weismann

originally believed that panmixia could lead, quite independently of natural selection, to the complete disappearance of an unused organ, but he later gave up this opinion and maintained that panmixia could effect only a very moderate amount of degeneration. In his *Evolution Theory* he says that "this factor does certainly operate, but the more I thought over it the clearer it became to me that there must be some other factor at work as well, for while panmixia might explain the deterioration of an organ, it could not explain its decrease in size, its gradual wearing away and ultimate total disappearance. Yet this is the path followed, slowly indeed, but quite surely, by all organs which have become useless. . . . There must then be something else at work which causes the minus-variations in a disused organ to preponderate persistently and permanently over the plus-variations, and this something can lie nowhere else than where the roots of all hereditary variations are to be found—in the germ-plasm. This train of thought leads us to the discovery of a process which we must call selection between the elements of the germ-plasm, or, as I have named it shortly, *Germinal Selection.*"

After Weismann had developed his theory of germinal selection, panmixia became less indispensable in accounting for degeneration. In germinal selection Weismann believed he had found a means of explaining not only variation, but also why variations keep on occurring in a given direction. According to this theory the germ plasm is composed of numerous vital

units such as biophors, determinants, and ids, all of which have the property of growth and reproduction by division. As these units, like most biological entities, are presumably variable, and as they grow and divide after the fashion of so many minute organisms, they would, according to Weismann, be subject to a struggle for existence and a selective survival. The result of this internecine struggle would be to introduce changes in the composition of the germ plasm and hence variations in the resulting organisms.

The theory of germinal selection is a perfectly logical and plausible speculation, but the most curious thing about it is that it probably is not true. This is the more remarkable since modern genetics has rendered it probable that the germ plasm is composed of discrete, self perpetuating units. While the gene as commonly conceived is not the precise equivalent of any of Weismann's hypothetical units, nevertheless the current conception of the make-up of the germ plasm is sufficiently like that of Weismann to make a process of competition and selective survival as probable for genes as for biophors and determinants. But there is no evidence that such a selective process occurs. The genes (whatever they may be) are apparently arranged in a serial order in the chromosomes, but while they reproduce themselves without limit in the regular course of cell division, they exhibit no tendency to increase at the expense of their neighbors. On the contrary, they seem to get along side by side in entire peace and harmony, each going about its business in

perfect order and propriety. If they grow and multiply why does not struggle and selection occur among them as among independent organisms that grow and multiply? Of course we do not know. It is possible, however, that they are not independent units, but are bound together by functional relationships that keep them in place. In other words, they may constitute integral parts of an organism, the germ cell, and are kept in a definite relation to each other much as the various parts of our bodies are. It is even possible that the same regulative mechanisms function in both cases and at all stages from the germ to the adult. But speculation here is too hazardous to pursue farther at present.

It must be apparent that present-day knowledge of the mechanism of heredity and variation is distinctly unfavorable to the theory of germinal selection. On the other hand it gives strong support to the earlier hypothesis of panmixia. Weismann virtually abandoned the last named hypothesis in favor of the first which he elaborated with much ingenuity and at great length. In the light of the facts then in his possession Weismann was probably justified in abandoning the earlier child of his brain in favor of his later one. New discoveries, however, have put a different face on the matter. Germinal selection doubtless must be abandoned, and panmixia will rank as a factor of greater importance than Weismann, even at first, was disposed to ascribe to it.

CHAPTER IV

OUR DETERIORATING INHERITANCE[1]

WITH many people the idea that our human heredity is possibly deteriorating is apt to evoke opposition if not positive resentment. We are so used to the idea of progress that we are prone to believe that it is the natural and inevitable order of things and must necessarily continue. Perhaps progress *may* continue for a long time to come. It may continue despite a certain amount of hereditary degeneration. But it takes good inheritance to support a high civilization. If most of humanity comes to consist of what is called the dull normal class with an increased percentage of high grade morons the stability of civilization will be in peril.

From what has been said in the chapter on Panmixia and Degeneration it is evident that the downward path is one especially easy to follow. It has been followed times without number in the evolution of life. The world of plants and animals is full of forms that have descended, in the literal as well as the genealogical sense of that term, from more highly evolved ancestors. And if highly evolved plants and animals undergo biological decadence, why may not man? As to that, it is not improbable that some of the lower races of man are degenerate scions of more noble stock.

[1] Reprinted with several modifications from the *Atlantic Monthly*, September, 1914.

Whether or not the hereditary endowment of the civilized races of man is undergoing a process of deterioration is a problem of the greatest possible moment. It is not a simple problem. It is not to be solved *a priori* on the basis of assumptions regarding the withdrawal of natural selection. It is a problem to be solved only by the accumulation of many data and by a knowledge of the factors at work in the modification of the hereditary forces among human beings.

To obtain an insight into the factors of human evolution it is essential to have an accurate knowledge of the factors which are responsible for the evolution of the lower animals. On this subject biologists are unfortunately by no means agreed. The factor of use-inheritance, upon which many biologists formerly laid so much stress, has rapidly lost adherents, and I think it must be conceded that if it is operative at all it is a factor of minor importance. Despite the modern criticisms of natural selection, with which I confess I have small sympathy, the doctrine of selection in one or another of its modifications stands to-day as the only naturalistic hypothesis which contains any principle of explanation of progressive adaptive evolution.

We have no reason to suppose that man, so far as the early stages of his biological evolution are concerned, is a result of the operation of any factors essentially different from those which have brought the lower animals up from the most primitive forms of life. At the present time we have no reasonable re-

course from the conclusion that man owes his origin to selection, and that only by selection in some form can his congenital endowments be improved. But the forms of selection have changed greatly as the result of the development of man's social environment.

The evolution of human society and civilization has gradually brought mankind under conditions of existence which are very different from those prevailing during the infancy of the race. To judge from the remarkable superiority of the brain-power of man over that of the primates, the early periods of human or the later stages of pre-human evolution must have been exceptionally favorable to the selection of individuals of superior mental endowment. So far as our vision can penetrate into the darkness of these times, mankind occupied itself quite largely in the destructive, but eugenically wholesome, occupation of fighting, —fighting not only with large beasts of the field, but also—and this is probably much more important from the standpoint of evolution—with other clans and tribes of the human species.

The advent of man is the expression of the superiority of brains over brute force in the struggle for life. While we may never recover the history of the period between the primates and primitive man, what we know of the general factors of evolution justifies us in the conjecture that it was a period of intense struggle, with a lively elimination of the unfit.

The course of human history as far back as we can follow it is one of warfare of tribe with tribe, and

nation with nation, the conquerors of one age being overcome by new invaders of another lineage in the next. Along with this perpetual conflict, and to a considerable degree because of it, man has not only increased greatly in intelligence, but has developed those attributes of courage, reliability, loyalty, and mutual helpfulness which make for social solidarity and corporate efficiency. Gruesome as the struggle for existence may be to contemplate, and fraught as it has been with pain and sorrow, it is a process to which the race is largely indebted for its congenital improvement. It may be that it is an unfortunate method of bringing highly endowed creatures into the world, but it is Nature's way. And Nature is quite indifferent as to whether we approve it or not. What Nature is interested in, to speak figuratively, is success in the struggle for existence. There is no evidence that she cares a fig for progress; only so far as progress increases the chances of survival, is it any of Nature's concern. And at any time she is perfectly ready to undo all her work, and to reduce a highly complex organism to the most degenerate of creatures, whenever the conditions favor simplicity of organization. The possession of a complex organization is not the slightest guaranty of further improvement, or even of a secure hold on the position that has been attained.

There are many forces in human society which make for degeneration, and our safety lies in clearly recognizing them. Only recently is the civilized world becoming awakened to the deleterious influence of mod-

ern warfare. Dr. D. S. Jordan, in his books on the *Blood of the Nation,* and the *Human Harvest,* and numerous articles and addresses, has set forth in a clear and forcible manner the sad havoc which war has played in eliminating the best of the human breed. In times of conflict, the men of manly vigor, brains, and courage go to the front to die by thousands in the cause of national defense. The weak, the cowardly, the mercenary, the degenerate, remain behind, to multiply. The loss to any nation resulting from the continual draining away of its best blood can scarcely fail to weaken it, until it may eventually fall a prey to the encroachments of its neighbors. Jordan, following several historians of note, attributes the downfall of Greece and Rome, the gradual decay of Spain and other nations, largely to this reversal of selection. Whether or not this is the principal cause of decadence in the instances cited, it is very probable that the continual sapping of strength consequent upon the sacrifice of hundreds of thousands of their best men has been an influence in undermining the physical and mental heredity of these nations.

While modern civilized warfare is a force working toward the elimination of the best blood and the propagation of weaklings, there can be little doubt that this influence of war is limited to comparatively recent times. It is because warfare has become civilized that, eugenically considered, it becomes an influence for race-deterioration. Early struggles were wars of extermination in which the unfit had little chance. The

Polynesians commonly massacred all of the conquered tribe, including men, women, and children. The same practice was common among the primitive Australians, the natives of New Guinea and New Zealand. The Kaffirs and many other African tribes exterminated completely the peoples whom they conquered; and among many tribes of North American Indians such wars of extermination were frequent. Wars of extermination among the more civilized Egyptians, Persians, and Hebrews were by no means rare. Of the Amorites, whom Jehovah delivered into the hands of his chosen people, it is said in Deuteronomy, "And we took all his cities at that time . . . utterly destroying the men, women, and children of every city. But all the cattle and the spoil of the cities, we took for a prey to ourselves." And in the campaigns of Joshua it was the rule that the men, women, and children of the conquered cities should all be put to the sword.

When complete extermination was not practised, the vanquished were commonly enslaved, or subjected to such conditions that they languished or eventually died out, the Hebrew people forming a luminous exception to the rule in their persistence through the vicissitudes of conquest, practical enslavement, and all kinds of subsequent persecution. In the conflict among primitive societies not only was the best-endowed individual most apt to survive in the hand-to-hand encounters which were then in vogue, but the groups in which strength, intelligence, organization, and mutual service were most highly developed, would easily triumph

over groups with less individual efficiency or social coherence. The population was replenished by the most efficient members of society instead of the weaklings, so that the influence of primitive conflict stands diametrically opposed to the effect of modern civilized warfare upon the hereditary endowment of the race.

But apart from conflict, the weak in barbaric times had little chance to perpetuate their defects. In many tribes wives were only to be won after a trial of strength or skill. Among the Chippewa Indians, says Richardson, "any one may challenge another to wrestle, and if he overcomes, may carry off his wife as a prize. The bereaved husband meets his loss with resignation, which custom prescribes in such a case, and seeks his revenge by taking the wife of another man weaker than himself."

Among many primitive peoples it was customary to eliminate epileptics, idiots, lunatics, and persons afflicted with incurable ills; and the practice of putting to death weak, deformed, and sickly children was extremely prevalent. The custom among the Spartans of raising only their stronger children will occur to every one; even Aristotle advocates the rule that nothing imperfect or maimed shall be brought up. And Plato, who elaborated the most rigid eugenic program ever devised, recommends that the children of the more depraved, and such others as are in any way imperfect, be hidden away in some secret and obscure place.

Eugenics is by no means a modern science. The practices of many primitive peoples were more eugenic,

whether consciously so or not, than our own. There can be no manner of doubt that in civilized society the weak, the deformed, the foolish, the insane, and degenerate of all kinds, have a much greater opportunity to survive and propagate their defects than they commonly had among primitive peoples.

It is scarcely necessary to dwell upon the saving of life that has been brought about by the advance of medicine and surgery and the knowledge of how to check and control many epidemics that formerly decimated the human race. Defects of eyesight, hearing, and many other qualities, no longer entail the extinction of their possessors. Natural selection still operates on the human species, and in some respects possibly more stringently than formerly, but our medical skill and our fostering of the weak tend to reduce its potency.

When we compare the present influences tending to improve the human breed with those operative in past times, the prospect seems rather gloomy for the future of the human family. We no longer have the elimination of the weak through tribal strife, but in its place the highly deleterious influence of modern war, which has not only worked incalculable injury in recent centuries, but probably has more evil in store for us. We no longer leave the weak and imperfect infants to perish, but do everything in our power to rear them, and then give them full liberty to perpetuate their defects. Except during their period of actual confinement in asylums, no restriction is generally placed on

the multiplication of the insane. There are few creatures so degenerate but that many of the states of our enlightened country give them full sanction to perpetuate their impure stock, and the conditions in most European countries in this respect are considerably worse than in the United States. Through ignorance, indifference, false ideas concerning "personal liberty," and the absorption of legislators in matters of more immediate political expediency, we are permitting the perpetuation of a vicious and defective heredity which cannot fail to prove a fertile source of many troubles.

This disappearance of most of the eugenic influences operative in the early history of mankind is not the worst danger, bad as it is, that besets us. Society, as at present organized, tends to withdraw its best blood from contributing its share to the heritage of the next generation. While it is unjustifiable to estimate the eugenic worth of a family in terms of wealth or social position, and while what are called the lower ranks of society often contain its best blood, the classes that have become distinguished through their culture or their achievements certainly have a hereditary endowment considerably above the average. Pearson has shown that mental ability is inherited to about the same degree as various physical characteristics. This fact combined with the important conclusion, also established by Pearson, that less than twenty-five per cent of the married couples, or from one-sixth to one-eighth of the total population, produce over fifty per cent of the next generation, shows how very important

it is that this one-sixth or one-eighth should be drawn from the better element of society. If the population is recruited even a little more from the less desirable individuals in each generation, it will not take many generations for the bad stock to replace the good.

It is a well-known fact that the educated classes, represented by such professions as lawyers, clergymen, doctors, and professors, as a rule marry late and produce few children, whereas the feeble-minded, the shiftless, and the imprudent usually have a birth-rate far above the average. Graduates from our colleges and universities do not have as a general rule enough children to perpetuate their families. The average number of children of the graduates of Harvard is less than two, and the record of Yale is no higher than this. The showing of various other colleges and universities is but little better.

Judging from the statistics available on the subject, education is proving a formidable obstacle to eugenic progress. The one redeeming feature about it is that as students are sent to colleges and universities in ever-increasing proportions to the population, those who are selected for higher education are coming to be less representative of the best brains of the country. It is a common opinion that the general quality of our undergraduates is deteriorating, but if this be true the reasons may be found in various influences other than eugenic factors.

Still, the fact that the college communities include so many of the offspring of people of exceptional talent

and achievement is a circumstance that is continually depriving the race of its best blood. There can be no doubt that under our present régime the more intellectual families are rapidly disappearing. It is from mediocrity and from the levels below mediocrity that the population is replenished. The danger of degeneration from this fact is all the greater because the evil is insidious and unobtrusive. If society could be brought to realize how enormous may be the loss entailed by the gradual extinction of those families which furnish the intellectual leaders of the race, it would bestir itself with a great deal more vigor to provide a remedy for the situation.

Society may accomplish much by checking the multiplication of the feeble-minded, the criminals, and the insane; but how to keep from being swallowed up in the fecundity of mediocrity is a much more difficult problem. We can get along with a small percentage of the mentally and morally defective much better than we can afford to lose the priceless blood that gives us our great men.

Most people, I fancy, look upon evolution as an exceedingly slow process in which many thousands of years witness very little change. And there is doubtless truth in this view. Evolution has taken a very long time. Some organisms poke along through whole geological epochs with remarkably little modification. Even man, who must have made a comparatively rapid ascent from his ape-like ancestors during the later periods of the earth's history, has apparently not made

any great advances in his physical and mental endowments during the few thousand years covered by human records.

But although evolution considered in a general and comprehensive way has proceeded very slowly, it would be an error to regard it as always going on at a uniform snail's pace. There is strong evidence that at times it may speed up quite rapidly, at least within small limits, and it may give way at times to a relatively rapid degeneration.

Evidence of the possible rapidity of evolution is furnished in abundance by the work of the selective breeder. Think of the changes that have been made in cultivated flowers, fruits, and grains, and in our domestic animals; compare the greyhound, the mastiff, the pug and the poodle, and you cannot fail to become impressed with the great changes which crossing and selection have effected in a comparatively short period of time.

Recent work in genetics following the discovery of Mendel's great law of heredity has given us a new insight into the development of these diverse types. Where species contain a large number of diverse strains it is possible, through crossing and artificial selection, to make rapid progress in the development of new forms. In species which breed true and present little hereditary variability changes can be made only with extreme slowness. The rapidity and the extent of the changes which man is able to bring about by selective breeding is determined mainly by the hereditary com-

position of the forms with which he starts. If he starts with an ordinary field of corn he could probably produce in a few years varieties yielding only miserable nubbins or strains producing fine, well-filled ears.

Now the human species contains an extraordinarily large amount of hereditary diversity. We have the wise and the foolish, the strong and the weak, the beautiful and the ugly, the bold and the timid. Watch the multitudes that file along the streets of a large city. How different they are in form and feature, in mentality, in disposition and in character. Here is material for the selective breeder the like of which was never presented to any pigeon fancier or stock raiser. It is simply wonderful material with which to obtain quick and striking results. It would not take more than a few generations greatly to augment or deplete its vigor, to make it more beautiful or more ugly, to improve or to breed out its brains. As in corn or cattle, it all depends on the types which are selected for parenthood.

Most people, even most educated people, have not awakened to the realization of the marked hereditary differences that exist among human beings, the profound significance of these differences for our social life, the rapidity with which some types may increase and others disappear, and the great changes which may thus come over a people in a comparatively short time. Things move rapidly nowadays, not only in political and social institutions, but in the biological constitution of mankind. Our social heredity and our biological

heredity are so closely interwoven that an extensive change in the one cannot fail to affect the other. But the unfortunate feature of the situation is that, thus far, civilization has tended to cause the extinction of its best hereditary types. How to counteract the dysgenic influence of progress is the great question which the Sphinx is propounding to civilized man. And the Sphinx will not wait indefinitely for an answer to her question.

I have indicated some of the causes which, so far as can be judged, have been and are making for the deterioration of the race. It may be asked, however: Is it known as a matter of fact that the race is deteriorating? Can it be proved by statistics that the race is really on the down grade?

At the present time it must be admitted that the actual statistical proof of race-deterioration is very incomplete. We simply do not have the statistics to show whether our inheritance has improved or deteriorated. But from our knowledge of the evolutionary factors at work in human society it is scarcely possible to avoid the conclusion that a certain amount of decadence is inevitable. We know that mental and moral defects are inherited; we know that the stocks with a record of intellectual achievement are multiplying with relative and increasing slowness; we know that the physically and mentally unfit reproduce more rapidly than under the conditions of more primitive civilization, and that their progeny are fostered and allowed to continue their defects. Amid all the influ-

ences tending to lessen the fertility of the more desirable classes of human beings there is scarcely any factor except natural selection which is working for the perpetuation of the best blood.

With our present statistics it is difficult to disentangle the effects of environment from the effects of a vitiated inheritance. In the United States there has been during several decades a general increase in crime. How much this is to be attributed to immigration and changed environmental conditions it is impossible to say, although it is known that the second generation of immigrants contribute more than their share to the volume of crime in this country. It is the same with insanity. During the thirteen years before 1903 the insane in institutions in the United States increased 100 percent, while the population as a whole increased 30 percent. Since 1859 the insane in England and Wales have increased over 230 percent while the general population has increased 77 percent. Of these insane, 47,000, over one-third, were married.

This increase, which may be paralleled by statistics from other countries, may be due in part to the fact that a relatively larger part of the insane are put into asylums; it may be due in part to changed conditions of social and economic life; but our rapidly accumulating knowledge of the heredity of insanity makes it probable,—and we can only say probable,—that much of it is due to an increase of hereditary defects. Whether the hereditary defectives are increasing or not, we do not want them; and the duty of society to

check their multiplication by all safe and humane means is perfectly plain.

In order to estimate the probable trend of human evolution it may be instructive to represent in tabular form the various influences tending to modify our racial inheritance at the present time as compared with those affecting mankind in the earlier stages of its evolution.

PRIMITIVE MAN

Natural Selection, actively operating.
Sexual Selection, frequently working for race-improvement.
Elimination of defectives.
War tending to the multiplication of the best stock.
Relative fecundity of best endowed.

CIVILIZED MAN

Natural Selection, reduced in some respects, possibly increased in others.
Sexual Selection, of doubtful eugenic value.
Preservation of defectives.
War tending to elimination of the best stock.
Relative sterility of best endowed.

We are compelled to admit, I believe, that in general the eugenic factors were more potent in primitive than in civilized man. Not only are the forces working for race-improvement becoming weaker as civilization advances, but as a result of civilization there have arisen tendencies which operate strongly against the weakened forces of eugenic progress. About all we

have left to counteract these untoward agencies is a very uncertain measure of sexual selection, which, on the whole, there is reason to think is working badly and the factor of natural selection which we have been doing our best to get rid of.

What it is feasible to do to remedy this unfortunate situation is one of the most important of the problems that confront the human race. My aim at present, however, is diagnosis rather than the prescription of remedies. Nevertheless, I cannot refrain from pointing out that there is one measure, the prevention of the multiplication of the defective classes, which is so obvious a duty and so feasible a project that the continuation of our present *laissez-faire* policy is nothing short of a crime to society. The removal of the pollution of human inheritance that comes from the worst one or two percent of its stock would, in a few generations, go a very long way toward reducing the numbers in our insane asylums, poorhouses, and jails. This much in the way of eugenic reform can easily be accomplished. It is possible to increase our best inheritance as well as to get rid of our worst, but any systematic effort to accomplish this result in a democratically ruled country must wait upon the attainment of much more enlightenment on the subject than the general public now possesses.

CHAPTER V

SOCIAL BETTERMENT AND EUGENIC PROGRESS [1]

THE relation between social progress and the improvement of the inborn qualities of the human race is a question upon which we meet with much difference of opinion. The progress in ideas and institutions which forms so conspicuous a feature of our recent history by no means implies a corresponding improvement in the characteristics that we owe to heredity, and in fact may go along with biological decadence. Civilization, biologically considered, is a comparatively recent and somewhat anomalous racial experience, and it brings in its train a number of agencies which tend to oppose the operation of those selective forces which most biologists regard as mainly responsible for the evolution of organic life. Our modern warfare in leading to the elimination of our best stocks; our fostering of the weak and defective; the decline of the birth rate among those classes of society which have risen into the successful ranks,—all tend to recruit the next generation from stocks of relatively inferior racial qualities. There is little doubt that the most potent of these forces is the relative sterility of those classes whose inheritance of desirable traits of mind and char-

[1] Reprinted from *The Scientific Monthly*, January, 1919.

acter we have every reason to believe is above the average. In the animal world individuals that attain supremacy over their fellows generally succeed in leaving the most numerous progeny. But under modern social conditions this natural relationship between net fecundity and the qualities that lead to supremacy has undergone a curious reversal. Those who succeed leave few offspring, while the failures, the mentally subnormal and the improvident who are restrained by no considerations of prudence from perpetuating their kind and leaving them to the tender mercies of Providence or the poorhouse, continue to multiply with relatively unabated rapidity. Whatever may be the forces working towards the improvement of our hereditary endowments, it is evident that so long as preponderating fecundity belongs to those who drift instead of to those who attain mastery the race stands in very serious danger of deterioration.

It is unnecessary to dwell further upon this situation which has been discussed so frequently in recent years. Our present aim is to inquire whether or not the future improvement of our social institutions, granting that they continue to improve, promises to counteract in any effective way, the forces that are now working toward racial decadence. Most people look forward optimistically to an era of accomplished reform when education and culture will become much more widely spread, when wealth will be more equitably distributed, and when people in general will be good and happy.

Assuming that these sanguine expectations will be in the main fulfilled, what will be the probable effect upon our racial inheritance?

Unless one were a Lamarckian and believed that the results of individual improvement were bequeathed to following generations, the answer to this question would not be immediately evident at least. Most biologists at the present time are not Lamarckians, and their answer to the question would probably depend upon their estimate of the way in which the various selective agencies to which mankind is exposed are affected by social progress. There are many factors, both social and biological, which must be considered in dealing with this problem; and judging from the expressed opinions of a number of biologists one may be pretty sure that the question would be answered in several different ways.

Writers on social evolution often assume a certain antagonism between racial welfare and the general improvement of the conditions of life. Conditions must be bad enough, at least for a goodly number of people, so that the "beneficent working of the survival of the fittest" is not interfered with. Herbert Spencer warns legislators against any artificial interference with the competition whereby the ill-endowed are condemned to "abject misery" and early death. "Manifestly," he says, "an opposite régime, could it be maintained, would, in course of time, be fatal to the species." According to Professor Haeckel,

The theory of selection teaches us in human life, exactly as in animal and plant life, at each place and time only a small privileged minority can continue to exist and flourish; the great mass must starve and more or less prematurely perish in misery. . . . We may deeply mourn this tragic fact, but we cannot deny or alter it. "Many are called but few are chosen." This selection, this picking out of the chosen, is necessarily combined with the languishing and perishing of the remaining majority.

If the weak must be crushed in order that the best types may inherit the earth it is obvious that a condition of society which greatly improves the living conditions of the less highly favored of the human breed would be fatal to the evolution of the race.

It is scarcely necessary to point out that Haeckel's picture of selection in human society is grossly overdrawn. But the central idea expressed, *i.e.*, the necessity for maintaining the struggle for existence in order to insure progress, is voiced by a number of post-Darwinian writers on social evolution. To quote the words of a prominent social Darwinist, Mr. Benjamin Kidd:

We shall perceive, when we understand the nature of the forces at work beneath the social phenomena of our time, that in whatever direction we may cast our eyes, there is no evidence that the rivalry and competition of life, which has projected itself into human society, has tended to disappear in the past, or that it is less severe amongst the most advanced peoples of the present, or that the tendency of the progress we are making is to extinguish it in the future.

On the contrary, all the evidence points in the opposite direction. . . . The races who maintain their places in the van do so on the sternest conditions. We may regulate and humanize those conditions, but we have no power to alter them; the conflict is severest of all when it is carried on under the forms of the highest civilization. The Anglo-Saxon looks forward, not without reason, to the days when wars will cease; but without war, he is involuntarily exterminating the Maori, the Australian, and the Red Indian, and he has within his borders the emancipated but ostracized Negro, the English Poor Law, and the Social Question; he may beat his swords into plowshares but in his hands the implements of industry prove even more effective and deadly weapons than the swords.

These are the first stern facts of human life and progress which we have to take into account. They have their origin not in any accidental feature of our history, nor in any innate depravity existing in man. They result, as we have seen, from deep-seated physiological causes, the operation of which we must always remain powerless to escape.

Individual man, as Mr. Kidd conceives him, is but a pawn in Nature's game—a game in which he as an individual has no particular interest. Nature, "so careful of the type" and "so careless of the single life," is ever ready to sacrifice the individual in the interest of the social organism to which he belongs. "The teaching of reason to the individual," says Mr. Kidd, "must always be that the present time and his own interest therein are all-important to him. Yet the forces which are working out our development are primarily concerned not with these interests of the individual, but with those widely different interests of a

social organism subject to quite other conditions and possessed of an indefinitely longer life."

To induce man to sacrifice his interests and to work for the welfare of his social group is a problem which Nature has solved by endowing him with various social instincts and emotions, and particularly with those traits which make him a religious animal. As only egoism is rational, according to Mr. Kidd, man must be bamboozled into altruism in some way if Nature is to gain her end of promoting human progress for which, it is claimed, there is "no rational sanction." To effect this consummation is the lofty function of religion. By furnishing him with non-rational sanctions for conduct which makes for social as opposed to individual welfare, Nature has made man a willing dupe, content to tolerate a social system in which natural selection has free play and in which much misery must be endured in order that social evolution may continue its course.

This is, I think, a fair statement of Mr. Kidd's view, though expressed in phraseology less dignified and persuasive than that which captivates the readers of *Social Evolution*. It is but natural for Mr. Kidd to conclude that the evolution which is now going on in the human race, and which has been going on for many centuries, is not primarily in the field of intellect, but of instinct. Nature does not favor the development of intellect beyond the point at which the latter becomes unmanageable and refuses to subordinate itself to Nature's ends. The great danger that

comes from the gradual extension of the sphere of individual rights, and the emancipation of the intellect from the reign of dogma is that the subordination of individual to social welfare may become so weakened that the life of the group is seriously imperiled. A discordant individualism is a decided military disadvantage, whatever may be said for it in other relations. Selection would therefore favor those groups in which the instincts that secure subordination and effective coördination were best developed, and in which the intellect was kept in a proper subjection to the instincts which afford the basis of social organization.

From Mr. Kidd's standpoint the prospect of much further advancement of the intellectual endowments of the race is not encouraging. Reason, being essentially anti-social, must be directed to social ends by instinct, or through institutions founded on instinct, which afford the necessary non-rational sanctions for social behavior. It is assumed that whatever advances we may make in the future must be accomplished through intense rivalry and the elimination of the unfit. Rivalry within the group leading to the suppression of inferior individuals, and rivalry between groups leading to the elimination of tribes and nations which have less corporate efficiency must continue to exist unless degeneration overtake the race. Racial progress, like the bloodthirsty gods of the ancient Aztecs, must have its human victims. If our social order does not furnish them we shall pay the heavier price of insidious racial decay.

For a social philosophy of this sort the hope of a future state of society in which there shall be no more war and no squalid poverty, and in which individuals may live with comparative ease and comfort, freed from the hardships of an oppressive struggle for existence, is an idle dream. Fate has decreed that such things cannot be, or at least, that they cannot last. Has Mr. Kidd presented a faithful account of the actual operation of selective forces in human society? Though less obviously overdrawn than the picture given by Professor Haeckel, the presentation of the situation in *Social Evolution* is permeated by the same misconceptions and limitation of viewpoint. There was a tendency among earlier post-Darwinian writers, notwithstanding Darwin's warning to the contrary, to conceive of the struggle for existence in a too literal sense as necessarily implying rivalry, a sort of "Hobbesian war of each against all" resulting in the elimination of the weaker individuals. It was customary to look upon Nature as "red with tooth and claw" and to picture the struggle for existence as an active encounter of rival organisms in which victory came as the reward of strength or cunning. As a matter of fact a very large part of the selective elimination that takes place in the organic world is accomplished in a very peaceful and unobtrusive way. What may properly be termed rivalry, or the struggle of one organism with another, constitutes but a part, and in many species a very minor part, of the selective process. Organisms may survive by virtue of increased resistance, freedom

from organic defect, or the possession of better adaptations to countless environmental agencies, without involving anything of struggle, except in a very figurative sense, of one organism with another. Doubtless the kind of struggle in which the success of one individual is based upon the failure of another, as in actual conflict or rivalry for food or mates, has played a very important rôle in the evolution of animal life, but, like other forms of selection, its incidence changes with circumstances. If it has tended to produce higher types of life among the animals below man, it does not necessarily follow that it will work in a similar way among civilized mankind. Natural selection may favor progressive evolution at one time and degradation of structure and function at another. And we should therefore proceed with caution in applying our biological formulas from one group to another when we are dealing with problems of progressive development. How any form of natural selection operates under the complex circumstances of human civilization cannot be decided *a priori,* but only by a careful study of its actual operation. It is quite possible, therefore, that the biologically novel conditions of civilized life may have involved such modifications of the workings of competitive struggle that its actual effects are very different from what they are in the lower animals.

To conceive of natural selection solely in terms of one of its methods of operation, that of competitive struggle, and to assume that competitive struggle is

necessary for the progressive evolution of man, are two fundamental errors that are only too commonly found in the writings of the social Darwinist school. Upon these doctrines as a foundation has been reared more than one superstructure of social philosophy which has doubtless influenced in no small degree the international relationships of modern states. It is scarcely necessary to dwell upon the extreme importance of the deductions which might logically be drawn if the biological doctrines we have mentioned are of universal validity. We are only too familiar in these days with the policy and practices which a perverted Darwinism has been used to support.

Competitive struggle may take place between groups, or between individuals within a group. In intra-group rivalry, physical encounters have been all but entirely superseded by economic competition, and the latter seems to have increased as civilization has advanced. But competitive struggle within a group seldom leads directly to elimination, although it may give rise to conditions of life which cause an increased death rate. Those who are forced by this struggle into the ranks of the dependent classes, far from being extinguished, respond by an enhanced fecundity which more than offsets their increased death rate. As a result of forces peculiar to our social régime there has come to be established a biologically anomalous correlation between failure and fecundity which deprives of much of their force the pleas for the value of competitive struggle.

We may be told that the reason for the failure of competitive struggle is because we are too humane and extend the helping hand to too many who, in the interest of the race, should be allowed to perish. It is questionable, however, if the withdrawal of all organized and private charity would produce a much higher death rate among the ill-endowed than occurs to-day. But whatever some writers might deem more favorable conditions for racial evolution, it is evident, I think, that the actual workings of competitive struggle are quite different from what have been pictured by most social Darwinists.

The deteriorating effect of unmitigated industrial competition has been clearly brought out by Professor Karl Pearson in his criticisms of those social Darwinists who attempt to use the Darwinian theory of natural selection as an argument against socialism. While Pearson and his co-workers have attempted to demonstrate by statistical methods that natural selection is a potent factor in man as in lower organisms, the contention is made that it is not through the struggle of man with man for the necessities of life that its racial benefits are brought about. Conditions which entail a high death rate among the ill-endowed are apt to prove unwholesome to many others as well, and would therefore produce a general deterioration of the efficiency of the whole social group. A country in which a considerable proportion of the inhabitants are forced by industrial competition into conditions of squalor that sap the energies of mind and body, and in which a still

larger part of the inhabitants suffer more or less injury from the severity of the struggle for existence, can scarcely compete on equal terms with a nation whose population enjoys a higher and more wholesome standard of living. A piece of mechanism which uses up a great deal of energy in internal friction is not an effective product. And a country which permits internal rivalries to waste its resources of human life is poorly equipped for any contest which may endanger its national existence.

In common with many militaristic writers Pearson attributes an important rôle to group selection whether it takes the form of actual war, or competition for markets, trade routes and spheres of influence. It is undeniable that this factor has been a potent one in the progressive evolution of man, but it is dangerous to conclude that it will continue to function in the same way under the peculiar conditions of our modern civilized life. Struggle of group with group has developed the instincts that make for mutual support and corporate efficiency; in a word, it has molded man into a social animal. But our debt to this stern mother of altruism should not be taken as incontestable evidence that her services will always be indispensable.

Under modern systems of warfare it is not so much blood that tells as organization, training, and equipment. Which of the warring nations of Europe is most favored by inherited endowments is still far from being established. Practically all of them are mixtures of ethnic stocks to a degree that a racial analysis is

well nigh impossible. And whatever the issues of future wars may be, there is no assurance that the inhabitants of the victorious nations will multiply more rapidly than those of the vanquished. Among civilized peoples war generally leads to the extension not of a people, but of power, policies, and financial gain. A nation may be vanquished by war, time after time, as Austria has been during the nineteenth century, and at the same time increase in population, wealth and military strength.

Should wars be carried on to the extermination of the vanquished they might be justified on biological grounds, provided of course that the victors owed their supremacy to their innate superiority instead of to organization, equipment, discipline, numbers, or any of the other circumstances that commonly decide the issue between contending armies. To a certain extent it is perhaps allowable to assume that those peoples with the best endowment of intellect and character will, on the average, develop the most efficient preparation for war. Notwithstanding all that has been written from DeGobineau to Houston Chamberlain and Madison Grant on the innate superiority of this or that chosen people, the differences in culture and military efficiency among modern civilized nations are much more clearly traceable to extrinsic causes than to any factors which can be specified by the biologist. Russians and Servians retreat before well-drilled and equipped German armies for much the same reason that the ancient Germans and Gauls were unable to

stand before the legions of the Romans. Nations march forward on the road to civilization at a very unequal pace. And history has repeatedly shown that the backward and relatively defenseless people of one era may prove to be the highly cultured and conquering nation of the next.

It is not to be inferred that civilized peoples have an equivalent inheritance. They differ quite evidently in temperament and instinctive bent, but, while they probably differ also in their intellectual aptitudes, we know too little on this score to distinguish the effects of hereditary from environmental factors. Any successful attempt to evaluate the innate mental differences of peoples would involve a thorough investigation by the best modern methods and on an extensive scale. As no such investigation has ever been made we have no very adequate basis for asserting which of the civilized peoples of the earth are the most highly gifted with inherited qualities.

It may seem very plausible to speak of the advantages accruing from the conflict of nation with nation and the consequent survival of the best endowed stocks. But even if the victory came to the peoples having superior hereditary qualities, it by no means follows that the vanquished would be supplanted by the victor. Should conflict result in placing a nation in a position of economic disadvantage such as would result if it were overrun by its conquerors who monopolize the positions of power and profit, the probable result would be that the conquered would outbreed their conquerors

and regain through the cradle what was lost on the battlefield.

Under other conditions, however, where conflict leads to the expansion of a victorious people who replace the primitive inhabitants of the realm, or where industrial supremacy yields the material support for an increased population group rivalry may effect a racial advance. The Anglo-Saxon people have doubtless profited by both of these means. Conflicts with inferior races in so far as they prove to be directly or indirectly wars of extermination may lead to racial improvement, but the biological effect of war between civilized states is a much more difficult problem.

In view of the many considerations involved in such problems it is evident, I think, that the influence of group selection cannot be determined *a priori* simply by the extension of a biological formula to human society. Group selection, like intra-group selection, may work in very different ways according to circumstances. Social philosophers who seize upon biological formulas and apply them uncritically, as they usually do, to the evolution of human society are apt to be led into very erroneous conclusions on matters of the gravest import. Just as competitive struggle between individuals may, under our present régime, give rise to injurious effects which more than outweigh its advantages, so may the struggle between groups lead to results quite at variance with what is commonly supposed to occur. We have become so imbued with the idea that the struggle for existence simply means that

the weak go to the wall while the strongest and most highly developed come out ahead, that we lose sight of the ulterior consequences of the process, and especially the fact that the changes wrought by selective forces may be progressive or retrogressive as a multitude of attendant circumstances determine. It should always be borne in mind that the course which it is biologically most advantageous to follow is not infrequently the downhill path. Whether warfare, or any other form of group struggle, leads nations along the path of progress, either biologically or culturally, is a question which cannot be solved by abstract and general disquisitions on the survival of the fittest or the manifest destiny of superior peoples. It is a question which must be solved in each particular case by a thorough inductive inquiry.

Investigations of the biological effects of war have been few. It is scarcely to be gainsaid that in modern warfare the most vigorous and efficient suffer the greatest loss of life at the front, leaving the race to be continued by the less desirable parents who remain behind. But for the full determination of the biological effects of war we must pass beyond the effects of individual selection within the group to the biological outcome of the struggle of one group with another. One may contend, with Steinmetz and Schallmeyer, who concede that military selection tends to destroy the best blood of the nation, but who maintain that the biological advantages of the victory of the superior forces more than compensate for this

evil. Satisfactory proof of this thesis, however, demands much more critical work than that which has been devoted to the task. The studies of Lapouge, Ammon, and a few others who have attempted to investigate what the effects of group selection actually have been, have made little more than a feeble beginning of an undertaking beset with many difficulties and full of unexpected developments beyond the conception of most proponents of militarism. It is important to recognize that the imaginary solutions of this problem that have so long passed for the real ones and have been taken as postulates by such writers as Von Moltke, Steinmetz, and Bernhardi in their attempts to justify war on the grounds of biological necessity have little support from inductive investigation. Whatever may be said in favor of war on other grounds, the biological argument is one of very dubious value, especially as applied to the struggles between modern civilized states.

If neither individual competition nor group selection has the unequivocal importance for racial progress that has been attributed to it, the consequences of social amelioration and exclusive devotion to the arts of peace may not, after all, be so disastrous, at least biologically. But if social evolution has so modified the operation of these factors that they can no longer be regarded as obviously making for race progress, to what must we look for further advance? Natural selection is doubtless still operating in various ways. We know as a matter of fact that some hereditarily

degenerate types are on the average short-lived, and that strains with a diathesis to certain diseases tend to die out. Several of the studies on natural selection in man, especially those dealing with the racial influence of infant mortality, have yielded results about which there has been considerable controversy. To ascertain just how natural selection is operating among human beings is a problem involving many technical difficulties that often tax the abilities of the most expert biometrician. There can be little doubt that the advances of medical science will tend to decrease the intensity of natural selection, and that it will continue to decrease with the improvement of the conditions under which people live. In some respects this diminished activity will be racially bad, but if social amelioration should bring about the abolition of warfare and equalize the birth rate so as to check some of the prevalent evils of differential fecundity it is not improbable that the net result would be advantageous.

There is one factor in our problem which we have not yet considered and which, despite its very great importance, has been almost entirely neglected in considering problems of human evolution, and indeed problems of evolution in general. This is the question, How does the changing complex of environmental forces which is brought about by social evolution affect the kinds of variations that are produced as material for the action of selective forces? It is obvious that if hereditary variations did not arise from time to time, selection would be unable to accomplish

anything. It is equally obvious that whatever selection can accomplish is conditioned upon the kinds of variations which are offered for its choice. The selective breeder would never be able to create a race of six-toed cats unless an occasional kitten with more than five digits should happen to present itself. No breeder of plants would try to produce a grass with divided leaves because no trace of such a variation has ever been known to occur in human experience. Natural selection must take what has arrived as a basis for what it may succeed in building up. It is like a builder who employs the stones fashioned for him by some one else, and whose choice is limited to using or rejecting what is supplied to him. A builder could never erect a marble palace if his materials were limited to a varied assortment of cobble stones. And natural selection could never produce anything not already fashioned beforehand by those forces, whatever they may be, that determine the nature of hereditary variations.

What causes hereditary variations to arise in organisms is a subject about which we know almost nothing. One can number on the fingers of one hand the investigations of any importance that deal with this problem. Beyond the fact commented on by Darwin that changed conditions of life tend to enhance variability, very little is known about the production of variations through environmental changes. One would naturally be disposed on *a priori* grounds to the conclusion that the kinds of variations which arise in organisms are

conditioned by the nature of environmental forces. If this be true, we are naturally led to enquire how the changing environment to which civilization exposes the human race affects the trend of variations that arise in the germ plasm. With our unnatural indoor life, the unwholesome living conditions of a large part of our wage-earning population, the increasing drift of people into large cities, our alcoholism, and our numerous diseases, it can hardly be expected that the germ plasm of the race will escape being affected in some way. But how? Here we are compelled to confess practically complete ignorance. Were we to judge by analogy with what has happened with our domestic animals, which are relatively degenerate from the standpoint of physical vigor and general intelligence, the probable outcome would not be reassuring. We might be disposed to infer that germinal variations arising in response to agencies which impair the vitality of the body would probably give rise to inferior progeny. The disastrous effects of lead poisoning upon the children of workers in lead, even when the father alone is affected, may be an indication of the kind of influence which might be anticipated from the action of an unwholesome environment. We know too little, however, of the permanence of the transmitted effects of lead poisoning to base anything more than a very tentative supposition on these results.

With regard to the important question of the hereditary influence of alcohol our knowledge, although still very unsatisfactory, affords some ground for more or

less probable inference. While statistics show that epilepsy, insanity, and feeble-mindedness occur with much more than average frequency among the offspring of parents addicted to alcohol, this correlation may be due to the fact that parental alcoholism is so often the result of a neuropathic constitution, and that it is the inheritance of this constitution, and not the effect of parental intemperance, that disposes the children of alcoholics to various forms of nervous malady and mental defect. Statistics may discover correlations but they are seldom adequate for establishing causal connections. As the method of experiment to which recourse must usually be had in the endeavor to ascertain causes cannot well be applied to human beings, the most promising field of inquiry is afforded by experiments on animals. If alcohol were found quite generally to produce hereditary defects in animals, we should have a strong argument in favor of its producing similar results also in man.

Of the investigations that have yielded indications of the injurious hereditary effects of alcohol, the recent work on guinea pigs by Stockard and his colleagues is the most noteworthy. The animals employed were bred and shown to be capable of producing normal offspring before they were subjected to the influence of alcohol. Control experiments with untreated animals were also carried on side by side with animals to which alcohol was given, and the offspring of the two sets carefully compared. Without describing the methods of experimentation or giving the details of

the results, it may suffice to state that the alcoholized guinea pigs gave rise to a much larger proportion of still-born offspring and offspring which lived but a short time than did the controls. It is particularly noteworthy that when the male parent alone was given alcohol the percentage of defective offspring was strikingly large, although the largest proportion was obtained from the matings in which both parents were alcoholized. It was further shown—and this is particularly significant in relation to our problem—that when the offspring of alcoholized parents were bred without being subjected to alcohol they gave rise to a large percentage of defective animals. Deformities such as an eyeless guinea pig, animals with a reduced number of digits, dwarfs, and many other kinds constituted 5.23 percent of ordinary alcoholic strains, and 14.81 percent of inbred alcoholic strains, while no deformities appeared among the animals bred from normal parents.

These experiments, unlike most previous studies, were carried out on an extensive scale and with due checks and controls, and they seem to afford strong evidence for the conclusion that alcohol administered to guinea pigs gives rise to degeneracy in the progeny which is capable of being transmitted to subsequent generations. Recently Pearl has applied Stockard's methods to the domestic fowl, but instead of obtaining evidence of inherited injury he found that the progeny of the treated birds were slightly above the controls in fecundity and apparent vigor. These results are

not necessarily inconsistent with those obtained by Stockard, since the germ plasm of the fowl may be much less easily affected by alcohol than that of the guinea pig. Further experimental work on this important topic is much to be desired before we can be entirely justified in drawing conclusions concerning the hereditary influence of alcohol in man. At present, all that we are warranted in inferring is that alcoholism in man is a more or less probable source of hereditary defect.

The same guarded conclusion should be drawn, I believe, in regard to other so-called "racial poisons." The terrible consequences which luetic infection entails upon following generations are primarily due to the transfer of pathogenic germs from parent to offspring, instead of to heredity in the proper sense of this term. Nevertheless, it is a distinct possibility that the toxins carried in the bodies of the unfortunate victims of this common malady may injure the germ plasm in such a way as to give rise to strains with a true hereditary defect. We may have similar suspicions that the same result may be produced by tuberculosis and other diseases; but unfortunately in regard to most of these questions we can only indulge in speculation. Did we know what agencies give origin to our strains of imbeciles, lunatics, and morons we might be able to nip in the bud one of the most serious of our social evils. We may have a shrewd suspicion that our modern régime with all its institutions which conspire to sap the vitality of the race is continually adding new

strains of such undesirables. When experiments on the causes of variability in the lower animals have yielded us a large body of well-organized knowledge, instead of the meager and scrappy information which we now possess, we shall doubtless be in a position to draw conclusions of a high degree of probability regarding the trend of variability in man, and possibly to bring this variability in a measure under control.

Any consideration of the influence of social amelioration upon the evolution of racial qualities has to take into consideration the question of how the trend of variation in human beings will probably be affected. If, as seems not improbable, intemperance, disease, and possibly bad living conditions are productive of hereditary defect, our racial welfare may not be seriously menaced by the reduced action of selection which would probably follow upon the institution of social and economic reforms. On the contrary, the race may be freed from sources of continued contamination which act as a check upon its progress. A social system which presumably favors the "beneficent working of the survival of the fittest" by creating conditions of life that lead to a high death rate among the less successful types, may not only fail to eliminate these types, as we have attempted to show, but may be a means of actually creating the inferior variations which it is supposed to destroy.

Our aim thus far has been to show that the realization of Utopian dreams of a state of society in which the evils of poverty, intemperance, severe individual

struggle and warfare have been relegated to the past does not necessarily entail biological decadence. In fact, there are reasons for believing that such a consummation would do away with many of our present sources of racial deterioration. Would it also set into operation any agencies which would promote racial advancement?

If the cure for democracy is more democracy, it may also be true that the cure for the racial evils of civilization is more civilization. An enlightened society, possessing a knowledge of the principles of its own evolution, and mindful of the welfare of future generations, may accomplish much in the direction of eugenic progress. The control of the birth rate which mankind is now exercising from prudential considerations, or the more laudable motive of giving better advantages to a few children rather than mere maintenance to many, might, in such a society, be utilized more for social and less for individual ends. With parenthood placed upon a voluntary basis we might reasonably expect that the less desirable stocks would show an increased tendency toward elimination and that the rearing of children would be undertaken in greater measure by the classes more amenable to the influence of the sense of racial obligation.

Alfred Russel Wallace entertained great hopes of race improvement through the financial emancipation of women. When women are no longer tempted to marry for support they will, according to Wallace, be more apt to select only superior types of men to be

the fathers of their children. As a means of race improvement doubtless marriage selection has magnificent possibilities. But when we reflect upon the frequency of marriage among the Jukes and Kallikaks on the one hand, and the low marriage rate of women graduates of colleges on the other, it must be admitted that, as a factor in race progress, marriage selection at present is a miserable failure. Mere economic reform cannot be relied upon to improve matters greatly unless it is accompanied by a general diffusion of education; and education will avail little unless it includes the inculcation of a sense of responsibility for the hereditary qualities of future generations. Education is eugenically of value chiefly as affording a basis for the development of a "eugenic conscience" which is now sadly lacking in most people of culture. It is a hopeful sign, however, that here and there among people who have inherited a generous measure of desirable traits eugenic considerations have led to the rearing of larger families. One is therefore encouraged to have sufficient confidence in human nature to believe that the spread of eugenic education, so that people of superior endowments will have the matter of their obligations to the race brought squarely home to them, will not fail to have an effect in checking the evils of our present differential fecundity.

Racial improvement has doubtless very intimate relations to the improvement of the economic conditions which now oppress a very large proportion of mankind. A society with well-marked castes will probably

make little progress if it includes an ignorant and poverty-ridden proletariat. Under a régime which affords better educational advantages and a higher standard of living for the less successful classes, the relatively high birth rate of those who multiply through sheer lack of restraint would probably be reduced. Economic reform is by no means the panacea for racial and social ills that it is apparently taken to be by many socialistic theorists, but it would afford conditions under which the operation of eugenic ideals would doubtless be more effective than under our present social order. Greater equality in the distribution of wealth would tend to bring about greater equality in the birth rate of different classes. With a higher general standard of education and a diffusion of the sense of obligation to transmit socially valuable qualities to future generations, conditions might possibly be changed so that a greater relative fecundity would come to characterize the more vigorous, intelligent, and public-spirited members of the community. Should society succeed in restoring the correlation between fecundity and the possession of superior qualities—a correlation which our present civilization has pretty effectually subverted—humanity would once more be on the highway of racial advance.

CHAPTER VI

HEREDITY AND THE MIND[1]

THE inheritance of mental traits is a subject upon which opinions are commonly influenced by various kinds of bias. Those who believe that the mind is a separate entity, conjoined for a brief period with its physical embodiment, are often averse to admitting that mental characteristics obey the same laws of heredity that hold true for the body. We should hardly expect mental traits to be inherited if each soul were separately created at the time of conception as was held by St. Jerome. Neither should we expect a strict inheritance of mentality if the soul of Cleopatra or Madame Blavatsky might find a subsequent incarnation in the person of Mrs. Annie Besant.

In the eighteenth and nineteenth centuries prejudices of a quite different order swayed the opinions of many champions of the rights of man. From Thomas Paine down to the present time we frequently meet with a great reluctance to admit that human beings differ to any considerable degree in their inherited measures of intellect. Our attitude toward doctrines is largely determined by how they happen to square with our cherished convictions, and it is quite natural that

[1] Originally given as a presidential address before the University of California Chapter of Sigma Xi, Dec., 1922.

those who contended that all men should share equally in the privileges of government, instinctively felt that to assert the hereditary inequalities of intellect would be prejudicial to their case.

In the latter half of the nineteenth century a new interest in the problem was awakened by the theory of evolution. One of the first effects of this theory was to predispose students of ethnology and anthropology greatly to exaggerate the mental differences between the races of mankind, and to place the primitive peoples of the earth on a very low level of mental development. Here we have another bias which we may call the evolutionary bias. A careful study of the mental capacity of peoples with inferior culture revealed the fact that their natural aptitudes were often of no mean order. The reaction against the older evolutionary anthropologists has, I believe, gone too far, some authors contending that even the most backward races are on about the same level of natural ability as our own. But we are endeavoring to study human intellectual capacity by new and improved scientific methods and it is to be hoped that, difficult as the task may be, a just rating of the inborn mentality of various ethnic groups may ultimately be attained. In fact, a very good beginning in this direction has already been made.

Another influence of evolutionary theory was to direct attention to the innate variability in mental endowments existing within a given people. This influence was exerted for much the same reasons that

stimulated the study of variability by the systematic botanist and zoölogist. Variations are the materials with which evolution works. Variations in any of the products of life are what the evolutionist was naturally pleased to find.

It was largely owing to his interest in the evolutionary teachings of his cousin, Charles Darwin, that Francis Galton was led to devote himself to the studies that resulted in his well-known book on *Hereditary Genius*. Galton amassed a large amount of data proving quite conclusively that exceptional mental ability runs in families. Eminent persons commonly have eminent near relatives, and the more eminent the person the greater the number of eminent relatives on the average that will be found in his family.

Galton had become fascinated by the use of the statistical methods which had been applied to anthropological and social phenomena by the Belgian astronomer and statistician Quetelet. He was the first systematically to employ these methods in the study of heredity and he treated his data on the transmission of mental ability in an impartial statistical manner, carefully avoiding the selection of material for the express purpose of proving his case. Taking the list of 286 judges in England between 1660 and 1865 Galton found that 109 of them had eminent relatives. The nearer the relationship the greater the percentage of eminent persons. Thus out of first degree relatives there were 31 eminent sons, 30 eminent brothers, and 22 eminent fathers. Of second degree relatives there

were eminent persons as follows: 7 grandfathers, 9 uncles, 14 nephews, 11 grandsons. Of third degree relatives there were eleven people. As people are more distantly related to a distinguished person their chance of becoming distinguished becomes rapidly reduced.

Much the same kind of results were found by Galton among literary men, commanders, divines, poets, musicians, painters, and men of science. A later book on *English Men of Science* (1874) contributed further data in support of the same conclusion, and the work of Galton and Schuster on *Noteworthy Families* which was based on a study of the family histories of the Fellows of the Royal Society afforded much peculiarly cogent evidence of the transmission of mental ability.

The well-known work of F. A. Woods on *Mental and Moral Heredity in Royalty* in which it is shown that there is a striking tendency for superior ability to run in families follows much the same methods as those used by Galton. According to Woods, royalty affords an unusually favorable field for such studies since environmental differences are not nearly so great as are found in the general population. The parent-offspring correlation for ability based on 494 pairs was .3007, a result very similar to the correlations found by Pearson, Schuster, and Elderton and several other investigators for mental ability and various other human traits. In a later paper Woods pointed out that of the 46 men whose names are recorded in the Hall of Fame 26 had eminent close relatives.

The inheritance of mental ability has been studied by the workers of the Galton Laboratory of the University of London, who have attacked the problem by working out correlations between parents and offspring and between siblings for a number of mental and physical traits. The resemblance in scholarship between siblings in the lower English schools and between fathers and sons in their scholastic records in Oxford and Cambridge was roughly from .3 to .5. It is a noteworthy fact, strongly emphasized by Pearson, that relatives show much the same degree of similarity in various mental traits, such as ability, introspection, conscientiousness, temper, and vivacity that they show in eye color, span, and cephalic index. These correlations it is held constitute a measure of what may be called the strength of heredity, or the degree of hereditary likeness. Since this degree of hereditary likeness is much the same in traits little influenced by environment, such as eye color, and traits commonly assumed to be strongly influenced by environment such as intelligence, we must conclude, according to Pearson, that it is the force of heredity which mainly accounts for the correlations observed in all these traits. The question of the relative influence of heredity and environment has been studied by Pearson and his co-workers for a number of traits by comparing the parent-offspring and the fraternal correlations with the correlations between the traits in question and various environmental agencies to which they are exposed, and the conclusion is arrived at that the influence of

heredity is, on the average, several times as potent as the influence of the environment. There have been many other studies devoted to the problem, but these will perhaps suffice to indicate the methods employed and the kind of results commonly obtained.

The conclusions of the investigators I have mentioned have been attacked by numerous critics. Galton, especially, has come in for a large amount of criticism on account of his effort to minimize the influence of education and opportunity. In this he needlessly exposed himself to attack, and a large part of the so-called refutations of his conclusions consists in adducing evidence of the potency of environment. This is the proceeding followed by De Candolle, Odin, Jacoby, Constable, Ward, Cooley, and a number of other writers. It is pointed out by these writers that the number of great men per century has increased as civilization has advanced, that great men come more frequently from cities where there are educational opportunities, that they come to a preponderating extent from the educated and well-to-do classes and rarely from the poverty-stricken elements of the community, and when they do, in spite of disadvantages, it goes only to show, as Ward maintains, that, after all, genius occurs about equally in all ranks, and waits but the magic touch of opportunity to blossom forth.

Such views commend themselves very naturally to the champions of oppressed humanity; they appeal strongly to the socialists most of whom attribute a large part of our ills to the iniquities of the capitalistic

régime and attempt to explain the differences between human beings as mainly the result of environment and opportunity. Many take a peculiar pleasure in reminding us that the aristocrat is made of no better material than the humblest dweller of the slums, if as good. There is a certain satisfaction derived from destroying other people's pretensions to superiority which, I suspect, has not been entirely devoid of influence in shaping opinions on the natural inequality of man.

The logic of these egalitarians is vitiated by a serious flaw. Notable men, we are told, come from families of education and fair social and financial status. Therefore, they argue, the large percentage of noteworthy persons from these families is a measure of the influence of wealth and education. Odin, Constable, De Candolle, and Ward go calmly ahead speaking of the influence of economics, urban life, and culture on the production of genius without considering that parents may have been educated, fairly well-to-do and living where there are educational advantages because they belong to stocks of more than the average heritage of brains. Several studies have shown that it is in the professional classes—clergymen, doctors, lawyers, educators, etc.—that we find the parentage of a large proportion of our great men. It cannot be denied that these classes are recruited from people of more than the average mental ability. And sons of such parents derive not only opportunity, but

intelligence enough to take advantage of opportunity. We cannot, therefore, use these sons as an index of the influence of environment *versus* heredity.

While many of the arguments of the environmentalists are vitiated by failure to take account of the considerations to which I have alluded, it is perfectly evident that, as a rule, distinction for intellectual achievement depends to a great extent on education and sufficient leisure for scholastic pursuits. Only certain types of genius can break through the impediments of extreme poverty and unfavorable surroundings. Great men have increased in number as civilization has advanced and opportunities for education have become more widely diffused, and the environmentalists are right in saying that there has been no increase in innate ability commensurate with the increase of notable names. But after all, the argument has little real weight in regard to the problem of mental heredity. Most reputations for greatness depend upon some form of scholarly achievement. Where men cannot become scholars they usually cannot achieve this reputation, whatever mental powers they may happen to possess.

It should be borne in mind, in considering our problem, that in our present civilization, there is a strong tendency for good heredity and good environment to become associated. People with energy and good intelligence are constantly rising from the lower classes into the well-to-do and cultured classes, thus

racially impoverishing the proletariat which is further deteriorated by receiving the failures from the classes above.

Children born of educated parents have an ancestry some of whom have succeeded in attaining a fair position in life. If the environmentalists have ground for criticizing the Galton school on the ground that what is attributed to heredity can be explained by opportunity, the Galtonians may retort that differences in opportunity are in most cases the results of antecedent heredity.

There are ways out of this apparent deadlock of argument, notwithstanding the fact that the effects of environment and heredity are very closely interwoven. Let us grant that the individual is a function of heredity and environment including, under the latter, the influence of education. Both are essential, for without either there would be no individual. For this reason, some would brush aside the problem of nature *versus* nurture as a fruitless one, and so it is when stated in abstract and general terms. Narrowed down to a comparison of the effect of specified differences in environment and specified differences in heredity, the problem becomes not only practical but capable of solution. It is fruitless for a farmer to concern himself with which is the more important for growing corn—seed or soil. But it might be important to know whether the difference in average yield between seed A and seed B is greater or less than the differences produced by sowing a given kind of seed in

field X or field Y. Here is a soluble problem and the method of solution is easy to employ. It is also possible to compare the average effect of differences in heredity met with in a given group with the average effect of the differences in the environment in which the group lives. As applied to our problem of nature *versus* nurture in mental development, we may state the matter as follows: Do the differences in mentality between human beings of comparable age in a community depend to a greater extent, on the average, upon their differences in heredity or upon the differences in environment to which they have been exposed? This also is an answerable question, but much less simple than the preceding.

It would, of course, be useful to know just how greatly intelligence, as distinguished from the possession of information, can be developed by the best educational methods. Experimental investigations of this problem have convinced many psychologists that general intelligence can be developed but little in this way. Certainly there is no pedagogical recipe for converting an ordinary dull boy into a Sir Isaac Newton. Experience teaches us, especially those of us who are teachers, that we cannot expect educational methods to do wonders in creating intelligence, however much certain special aptitudes may be increased by training.

The remarkable scholastic progress made by some individuals is frequently cited as a measure of the potency of environment in the development of the mind. But leaving out of account the question as to

how much real development of the mind there has been, it may be said that the capacity for rapid progress is a native endowment. Our problem of nature and nurture in mental development is complicated by the peculiar circumstance that degree of improvability in mental reactions depends upon heredity. The more generously one is equipped by heredity, the more environment can do for him in increasing his apparent mental stature. Environment can do little for an idiot, just as it does little in developing the behavior of many lower animals whose innate equipment of instincts suffices for the needs of their lives. The low grade feeble-minded can learn only simple things. With increasing degrees of hereditary ability there are increasing degrees of profiting by educational opportunities. People reach their definitive mental ages at very different times. Equalizing opportunity, as Thorndike has shown, does not tend to equalize achievements. With the same school drill it was found that pupils who excelled in early school years were relatively more in advance of their fellows in later school years than they were at first. Improving opportunity increases instead of decreases the initial disparity between individuals. You can level human beings down. You cannot level them up.

To point to the rapid improvement of certain individuals under a favorable system of training as an index of what environment can do tells only a part of the story. It may be said also that this improvement is an index of what heredity has already done. With

respect to the benefits of nurture, it is eminently true that to those that hath shall be given. The failure to recognize the fact that degree of improvability depends upon heredity has created much confusion in writings upon our problem. Improvability is a trait that has increased as animals have evolved. It is *par excellence* a characteristic of man and of superior as compared with inferior men. If we count so much upon nurture to carry civilization to greater heights, we should not forget that the primary condition of the greatest of efficacy of nurture is afforded by a rich endowment of natural gifts.

Since the advent of mental tests, data on mental inheritance have been rapidly accumulating. As judged by these tests, people have been found to differ very greatly in their intelligence as was in fact apparent before. These tests are found to correlate fairly well with other standards of intelligence such as performance in school and college, or ratings of general ability by competent judges. Tests of students at various ages show that, as a rule, low or high ratings commonly persist through several years. With improved tests applied at successive ages from youth to maturity to large numbers of persons, we may be able to judge how far the performances of adults are indicative of native endowment as compared with the effects of training and outward circumstances.

Out of the very large amount of measurements now being carried on, we are slowly obtaining a clearer conception of the intellectual make-up of our popula-

tion. Humanity is becoming revealed to us as a most diverse assemblage of differing mentalities. And the recognition of these differences, which was done with so much profit by the Army, is bound to become more prevalent in business, and some day may have an influence even in politics. We shall gradually work out, I believe, a general solution of the problem of nature and nurture as I have attempted to formulate it, and be able to express the results in a quantitative form with a fair degree of accuracy.

But we must pass on to other phases of our subject. Some very interesting facts bearing on the inheritance of mental traits are furnished by the so-called identical twins. This class of twins was first recognized by Galton who pointed out that twins are of two kinds; in the one, the fraternal twins, the resemblance is commonly no greater than it is among ordinary members of the same family; in the other, called by Galton identical twins, there is a remarkably close resemblance in most characteristics. They are always of the same sex, and they are frequently almost indistinguishable even by people who may have known them for a long time. It is the common opinion that identical twins arise from the same fertilized ovum and that they are enclosed in the same chorion and are supplied by one placenta, whereas ordinary fraternal twins result from the fertilization of two ova and have two chorions and placentae. In the first case we have twins of identically the same inheritance; in the second, we should expect hereditary dissimilarity of

the same order that we find among ordinary siblings. Galton, who amassed a great deal of data with regard to twins, had many interesting records of similarities and dissimilarities among them which support his theory that twins really do fall into the two classes he describes. Thorndike, on the other hand, finds no evidence for two sharply contrasted classes of twins. That there should be all grades of resemblance between twins is what we should expect according to the principles of Mendelian inheritance. But Thorndike's results are not what we should expect if his material contained a considerable number of cases of identical heredity. The evidence afforded by double monsters and conjoined twins makes it very probable that many separate twins have arisen from the same fertilized egg. Aside from the peculiar sex ratio among twins, we have little evidence as to the frequency of twins of the identical variety, but that such twins occur is very probable from the evidence of embryology as well as the many recorded cases of remarkably close similarity of twins in many different characteristics.

Cases of insanity in twins show that when both of a pair become insane they usually develop the same type of insanity. In twins apparently identical the onset and course of the disease sometimes presents a startling degree of similarity. There are some cases of marked similarities among twins both of whom are feeble-minded. Occasionally twins, apparently identical, may exhibit exceptional ability as shown by the

Grosvenor brothers. A remarkable case of mental as well as physical resemblance was recently reported by Dr. Gesell in the *Scientific Monthly* for April, 1922. The ancestry was of superior quality as it is stated that "scientific and linguistic ability of high order and physical energy are some of the traits which are found in the two immediate generations." Both were precocious and had begun to talk and walk at eleven months. At three years of age they began French and in less than a year they were reading elementary English, French, and Esperanto. "Formal arithmetic was begun at six and in less than a year they were solving mentally problems in fractions and percentage. At the age of nine both were doing Junior High School work. They speak French fluently, and have made progress in Italian, and embarked upon Russian. They are much alike in their tastes and dispositions. Their mental tests and their vocabulary tests give almost the same scores."

Their physical measurements are remarkably alike. Agglutination blood tests and the reactions to vaccination were practically the same. A striking similarity was shown in their palm prints and in the prints of the soles of the feet, the same formula applying to both. At eight years of age the right permanent upper incisor was in the same incompleted stage of eruption. On the upper lip of both, a little above the outer corner of the mouth, is a minute pigmented mole. In no physical character was there a pronounced dissimilarity between these twins.

The twins here described are remarkable not only on account of their exceptional precocity and high mental development, but on account of their similarity or almost identity in many physical traits, some of which are of a very special kind. The environment was much the same for both, but no more so than for ordinary fraternal twins some of which frequently exhibit striking differences in physical and mental traits. When one compares them with other twins, they are probably to be regarded as showing what the same heredity plus like environment can do in producing likeness as compared with what like environment can do without like heredity. Unfortunately we have little information on how identical twins may develop when they are separated and placed in quite different environments very early in life.

If mental ability is transmitted through inheritance, have we any clue to its particular mode of transmission? Since the resurrection of Mendel's law of heredity in 1900, there have been several endeavors to apply this principle to the inheritance of mental traits. Most writers who have treated of feeble-mindedness in relation to Mendel's law have concluded that this character behaves as a Mendelian recessive. Some have assumed that feeble-mindedness is a definite unit character transmitted, like eye color, in a sharply alternative manner. Were this so, we should expect that if both parents were hereditarily feeble-minded, all of their children would be feeble-minded also. The facts seem to bear out this conclusion. Out of 482

children recorded by Goddard as arising from such unions, 477, or all but six, were feeble-minded. In forty-one such matings of the Kallikak family, there were 222 feeble-minded children and only two considered normal. When we allow for possible illegitimate children, which are not infrequent in such stocks, and the possibility of mistaking congenital for acquired mental defects, this result is perhaps as close to theoretical expectation as we should be likely to find. And the conclusion that two congenitally feeble-minded parents do not produce intelligent children is confirmed by much additional evidence.

Insanity, which often rests on a basis of abnormal inheritance, has been regarded also as a Mendelian recessive. Some forms of insanity such as Huntington's chorea behave quite clearly as a dominant and strongly hereditary trait, but the mode of transmission of other types of mental alienation is more obscure. I am convinced by going over a large number of pedigrees that insanity cannot be regarded as a completely recessive trait, notwithstanding the fact that it may appear in the offspring of normal parents. When both parents are insane, or one insane and the other epileptic, we commonly have most unfortunate results in their progeny.

Where one parent is feeble-minded and the other epileptic, the results are commonly still more disastrous. In 15 matings of this kind studied by Davenport and Weeks 28 of the 55 offspring were epileptic, 26 were feeble-minded, and 1 was insane. In 27 mat-

ings in which both parents were either feeble-minded or epileptic all of the children above 14, about whose condition anything could be ascertained, were classed as mentally abnormal, 43 being epileptic, 58 feeble-minded, 1 insane, 2 migrainous and 8 neurotic.

For several reasons, which I shall not attempt to give here, I believe that mental defect in general is not a unit character dependent upon a particular unit factor in the germ plasm but is rather a symptom of fairly widespread damage in the material basis of inheritance. Feeble-mindedness, epilepsy, and insanity are not clearly defined entities; they are large and heterogeneous classes of defects resting to a great extent upon a hereditary basis, but inherited in no sharply-defined alternative manner. They are to be compared, not with such traits as eye color, but with such characters as skin color and stature which obviously depend upon a considerable number of factors. There are not improbably cases, however, in which a single germinal change may produce an inherited mental defect if it occurs in some factor of peculiar potency in the development of the nervous system. But in most such cases, it is probable that there is a favorable coöperation of other factors forming the basis upon which a particular determiner of defect may operate.

A few writers have attempted to apply simple Mendelian formulæ to the inheritance of superior mental ability. Hurst has maintained that musical ability is a recessive trait, basing his argument on the fact that

musical persons not infrequently are produced from parents neither of whom have exhibited noteworthy musical talent. Davenport in his *Heredity in Relation to Eugenics* adopts the same theory and adduces additional evidence in his support. According to this interpretation, if both parents are musical, all of the children will be musical or at least have musical ability, but I find that this by no means holds true. The latter author holds that superior ability in other lines is also recessive, artistic ability, literary ability, mechanical skill, calculating ability, and memory are all "unit characters that may occur in any combinations." And Professor Bateson in his British Association address says, "I have confidence that the artistic gifts of mankind will prove to be due not to something added to the make-up of an ordinary man, but to the absence of factors which in the normal person inhibit the development of these gifts. They are almost beyond doubt to be looked upon as releases of power normally suppressed. The instrument is there, but it is 'stopped down.' "

All of these theories which would treat of exceptionally great ability of any kind as a simple, recessive, Mendelian unit character are, I believe, fundamentally wrong, and based on a faulty and naïve psychology. I suspect that Bateson's reference to genius may have been suggested by the traditional doctrine that has come down to us from Moreau, and popularized especially by Lombroso and Nordau, namely, that genius is a sort of defect, more or less

akin to insanity and frequently leading its unfortunate possessor to end his days in an asylum. The absurdity of supposing that genius develops out of mediocrity by a simple process of subtraction is only one of the curious logical consequences that follow from Bateson's paradoxical teachings that all variability may be due to the loss of factors in the germ plasm.

The theory that genius is a recessive trait and therefore due to the loss of something receives a certain degree of plausibility from the apparently sporadic appearance of great minds. It has often been remarked in discussions of the inheritance of mental ability that great men frequently arise from undistinguished parents who gave no promise of the genius of their sons. It has been suggested that the man of genius is a sport or mutation standing sharply apart from his ancestors and explainable not in terms of heredity but of variation. In the light of our present knowledge of Mendelian inheritance it is easy to see that it is the lack of such knowledge that has so greatly confused people who have studied this problem. We recognize now that most of what appears to be the *de novo* origin of variations is merely the product of peculiar combinations of Mendelian factors. The black sheep in the flock is not a paradoxical new appearance that forms an exception to the laws of heredity. Its origin is strictly in accordance with such laws. We recognize in the diversity of traits found in children of the same parents, not a failure of

heredity, but the expression of heredity. And when we find many instances of distinguished fathers with undistinguished sons, or of great men produced from ancestry only a little above mediocrity, such phenomena are no longer mysterious.

To look upon great ability as a unit character is, from the standpoint of psychology, absurd. It is a complex never twice the same, formed by the coöperation of factors making for a rare combination of intellectual powers, emotions, tastes, traits of character, and peculiarities of physical development. We are not in a position to lay down precise rules which would enable us to predict from a given parentage the appearance of a great man. There are, however, several conclusions which, even with our present knowledge, we are justified, I believe, in drawing. Some of these I shall venture to set forth in a more or less categorical fashion:

1. Mental development depends upon a great multitude of hereditary factors in the germ plasm. Perhaps it might not be going too far to say that all hereditary factors which influence physical organization have some effect, however small, in the determination of mentality.

2. Inherited mental endowment is strictly correlated with physical organization, especially of the nervous system, but also with the system of endocrine glands and less directly with other parts of the body.

3. Since human beings are of mixed or heterozygous heredity to an extent probably not paralleled by any

other species, they present almost unlimited possibilities for the combinations of factors influencing mental development.

4. Some hereditary factors make for the production of low mentality; others for high mentality. Other factors probably have a preponderative influence on instinctive and emotional traits.

5. Superior mentality that leads to achievement and reputation depends upon a fortunate combination of hereditary factors. Great intellect, to achieve success, must be combined with energy, determination, and other traits of character, the lack of any one of which might prevent the achievement upon which a reputation for greatness depends.

6. That since hereditary ability of a superior kind is due to a complex of qualities, the chance of such a complex being repeated exactly in offspring is relatively small.

7. The chance of similar complexes occurring in near relatives is much greater than in unrelated individuals, and rapidly diminishes with the remoteness of the relationship.

8. Since superior ability is a complex, we should expect it to be manifest in individuals neither of whose parents possessed superior ability; but we should expect to find most of the components of ability represented in the parents or their near ancestry.

9. Ability of a very superior kind being dependent upon an unusual number of factors making for high mentality, or on the combination of factors of great

potency, or possibly also upon combinations which *per se* are particularly fortunate, we should expect a larger number of distinguished persons among the near relatives of such illustrious individuals than among the relatives of less distinguished great men; and this we actually find.

10. The factors producing superior ability are not uniformly distributed in the general population, as Constable and others contend, but they are concentrated much more in certain strains than in others. Some lines such as the Jukes and Kallikaks are poor in them; others such as the Herschels, Bernouillis, Adamses, Lees, Edwards, Darwins, and Balfours are unusually rich in them. Occasionally we may have genius arising from very mediocre stock, although this, as one would expect, is relatively rare.

11. Most of the factors making for high mental development behave as dominants or partial dominants in heredity. This is quite consistent with the appearance of great men in families which have shown no marked excellence in intellectual pursuits. It avoids the somewhat unnatural doctrine that ordinary ability is dominant to defective ability and also to ability of a high order, and allows us to subsume all the phenomena from the transmission of genius to that of mental defect under a common standpoint.

12. That superior mental ability is never found in the offspring of parents both of whom are mentally below par. We might perhaps consider such an occurrence as a rare possibility from the standpoint of

genetics, but I have not been able to find a record of a single well authenticated case. Whatever we may say of mediocrity, dullness never produces genius. Great men do not rise from the valleys; they usually come from the high plateaus.

13. Human beings vary greatly in their hereditary endowments of brains, the general distribution of intellect following much the same distribution as height, weight, and various other physical characters.

14. That on account of their great variability in inherited mentality the average mental development of a people can readily and rapidly be raised or lowered by selective breeding.

These conclusions, somewhat dogmatically set forth, are, I believe, very probable from the general standpoint of our present knowledge of genetics, and from the standpoint of the actual distribution of mental characteristics in the population. They enable us to see some order in the phenomena that formerly appeared more or less chaotic and to suggest explanations of apparently exceptional cases. Balzac once remarked that heredity is a maze in which science loses itself, but we can thread our way through the maze much more successfully since Mendel and his followers have afforded so remarkable and unexpected an insight into the principles to which the facts of heredity conform.

In the light of the above fourteen points it is instructive to study the ancestry and the descendants of great men. As a rule, biographies do not give sufficient data concerning the characteristics of the ances-

tors of great men to enable us to trace out the origin of their component qualities. The very things one most wants to know are frequently omitted. Nevertheless, much light is often thrown on the make-up of a given individual by the investigation of his family tree.

I may mention here, chiefly by way of illustration, a study made by Miss Stanton on the inheritance of musical talent. Professor Seashore, with whom Miss Stanton was formerly associated, has attempted an analysis of musical talent, specifying a number of component factors which make up this complex endowment. Miss Stanton chose four component factors of musical talent: sense of pitch, sense of intensity, sense of time, and tonal memory, these being susceptible to quantitative measurements and being likewise characters little susceptible to training. These special traits appeared to be quite strongly inherited and apparently more as dominants than recessives. They show a considerable degree of independence in their occurrence and in their transmission. In persons of high musical ability, these factors are mostly well developed, while the reverse is the case with persons of low mental ability.

In a paper which was written before that of Miss Stanton appeared, one of my students, Mrs. Weidemann, worked out the pedigrees of twenty-five of the most famous musicians and attempted to apply Professor Seashore's analysis of musical talent in tracing the component factors in the ability of these men. I may quote, purely as a matter of illustration of method,

what is said about the ancestry of the great composer Johann Sebastian Bach: "He was the result of the union of two great strains, . . . his father representing those gifted in musical sensitivity and action and his mother, a cousin of his father, representing the most noted strain of the family which was most noted for creative ability, musical intellect, and feeling. This is an example of good qualities being magnified by intermarriage in a family." Four of Bach's sons became noted for creative ability in music.

If we make excursions into the genealogy of great men, we can frequently pick up threads of hereditary composition which may enable us in a measure to account for the appearance of the given individual. But probably no geneticist, even with the fullest knowledge that could be obtained about ancestry, would be so bold as to predict a man of genius in advance. There are many cases of genius whose occurrence from the standpoint of heredity we must frankly acknowledge to be unaccountable. Doubtless many of such cases may be laid to the shortcomings of biographers. We may point to the educational disadvantages of parents, the repressive influence of routine occupation, unfavorable health, and many other reasons why the parents of great men failed to impress others with their powers. It is particularly unfortunate that so little knowledge is commonly available concerning the female members of distinguished families through whom ability seems so frequently to be transmitted without its becoming manifest to possibly undiscern-

ing observers. Perhaps no one, whatever be his equipment for the task, can ascertain the exact method by which mental ability is inherited on the basis of data now available. Like many other problems of human heredity, it must wait upon the slow accumulation of facts, and the accumulation of facts can only occur when there is a considerable body of trained observers interested in the problem. In some fields of research there seems to be little to expect from brilliant illuminating discovery. Progress must be made by slowly grubbing along without the alluring prospect of striking achievement. The inheritance of mental traits presents a field in which we have much to learn, one which presents many complex and baffling problems, and in which it is not feasible to follow the methods of experimental analysis. But it is a field in which there is urgent need for more knowledge. One of the most important things for us to know in grappling with many of our human problems is how to gauge the innate intellectual capacity of human beings. Our present mental tests give us only an uncertain measure of inherited mentality. In attempting to estimate the natural ability of races and peoples, we are constantly handicapped by the possible effects of environment and training. There can be no question that our immigration should be controlled mainly on the basis of the hereditary qualities of our various incoming stocks. We need a measure of innate mentality in order to solve the vexed but very important question of the effects of the intermarriage of different races and

peoples. We need this measure in carrying out schemes for racial improvement. Civilization tends to extinguish its best stocks and thus to impoverish its racial inheritance. As fast as the hereditary factors for superior mentality combine and manifest themselves in individuals of distinction they tend to disappear. These factors are the most priceless possession of the race and they are undergoing a heavy drain. All this is brought about by the simple fact that intelligence has discovered the means of outwitting nature by sacrificing posterity to present welfare. Intelligence, like time, devours its own offspring. As matters now stand, the greatest obstacle to the further evolution of mind is the mind itself. And yet it is to mind that we must look to get us out of our predicament.

CHAPTER VII

IS INFANT MORTALITY SELECTIVE?

NATURALLY one would expect that, other things equal, a hardy and vigorous infant is less apt to die than a weak and puny one. It is well known that infants, and especially very young infants, are exceedingly variable in their hold on life. Some survive all sorts of untoward conditions that make one marvel how they managed to escape, while others require the most careful nursing to tide them over their early perils if haply all care is not bestowed in vain. The first year is by far the most dangerous period of life. Within that year the first month is the most dangerous month, and the first week is the most dangerous part of the first month. Even the first day sees more deaths than any subsequent day of the first week. As the days pass, the infant's hold on life becomes more and more secure. In the second year the average American baby is exposed to only one-fifth the risks of death which beset its first year of life. Thereafter life becomes safer, until about the eleventh year when the curve of death begins to rise, going up slowly through the period of adolescence, then rising more and more rapidly with advancing years and finally in the 'eighties or 'nineties shooting up with a steep ascent.

A fascinating subject for contemplation, this curve

of life. Its form may vary somewhat from country to country and from age to age, but its chief features are remarkably uniform for all peoples and in all periods of time. In recent years infant mortality has been cut down and the average length of life considerably prolonged, but the initial fall of the curve in the first year, the slow fall to the minimum death rate, the initial slow rise followed by a more rapid rise in later life are constant characteristics of this curve, and will probably persist so long as man remains man.

The particular details of form of this curve are a product of the peculiarities of human heredity and the environment in which human beings live. Improvements of the environment may alter the form of the curve somewhat, but the general type of the curve is determined by heredity. A curve of life among people in which conditions were the worst possible under which the race could live at all would be much the same sort of curve that would be found in the best of all possible worlds for the maintenance of life.

Death may be regarded as a product of internal and external causes. The relative potency of these factors vary of course in particular cases, but in general it is the internal causes that make the first year more dangerous than the second, and the eightieth more dangerous than the fifteenth. Dangers from environmental agencies are not greatly different between the fifth and the eighty-fifth year, and whatever differences there may be are probably in favor of the latter. It is the internal changes, the slow resistless workings of

the vital energies of the body speeding on toward their own dissolution that give the man of eighty-five an expectancy of only four or five more years of life.

It is the internal factors also which are mainly responsible for the great hazards of infancy. We are like clocks wound up to run our allotted span of three score and ten or thereabouts, but easily thrown out of gear in the first part of our course, and liable in the latter part to be stopped through the slow accumulation of rust. Our initial frailties make us succumb readily to many inimical influences of the environment. It is quite natural, therefore, to find the environment charged with being the *cause* of most infant mortality. Here is a fertile source of confusion in discussions of the possibly selective character of the infant death rate. Infants die from poor milk or other improper diet; they succumb readily to several diseases; they are easily killed by exposure; and they often fall victims in various ways to the ignorance and stupidity of their parents. Even a naturally healthy baby may not survive a severe attack of diphtheria or a diet of indigestible food.

Environment is the apparent cause of most infant mortality because the infants are weak, and their weakness is an incidental product of the way in which the young human animal develops. The same environment that would be fatal in the first year of life might be quite harmless in the second. The congenital weakness of the infant makes it an easy prey to outward agencies. To attribute the high death rate in infancy

to environment is therefore misleading. Like the death rate at any period of life, it is the product of a set of internal or constitutional factors which are constantly changing with age.

All this, it may be said, is very obvious, but what does it have to do with natural selection? Even if internal causes were the predominant factors of the infant death rate, it would not of course prove that this death rate was selective. To be selective in the Darwinian sense death must act or fail to act on the basis of *differences* in heredity. Can it be shown to do this in the mortality of infants?

On this point there is much disagreement. Infants differ greatly in their robustness and resistance to disease, but in most cases there is little to indicate that these differences are hereditary. Infants prematurely born are apt to have a hard time of it. Congenital malformations of various kinds are responsible for many early deaths, but in most cases these are not traceable to ancestry. Death may take a heavy toll of weaklings, but if their weakness is not based on inherited tendencies there is no true natural selection.

If there are many non-hereditary variations that are apt to cause elimination in the struggle for existence, it does not preclude the possibility of *some* selection in the Darwinian sense. Some writers maintain that this kind of elimination is relatively unimportant and insignificant compared with the indiscriminate and non-selective mortality that is constantly going on.

There is no doubt that sentiment has influenced

opinions on this subject to no small degree. Many are disturbed lest it should be shown that saving infant lives will result in a gradual weakening of the race. I do not know of any one who has seriously proposed that we keep the infant death rate high in order to insure the toughness of the survivors. But many write upon the subject as if such persons were not uncommon and should be refuted. It is not infrequently recognized, however, that the reduction of the infant death rate may have its dysgenic effects. The same may be said about reducing mortality in the subsequent years of life, at least to the end of the reproductive period. Whatever may be the effect on natural selection, we shall doubtless go on reducing the death rate in all periods of life, infancy included, so far as our knowledge permits this to be done. There is no reason for singling out the period of infancy for the ravages of natural selection.

How far hereditary differences influence the infant death rate is a problem presenting serious difficulties. One is reasonably safe in assuming that since human beings differ hereditarily and that since some hereditary diatheses certainly enhance the death rate of their possessors in later life, it is probable that some of the hereditary differences between infants have a similar selective effect. But such deductions add little to our positive knowledge. One child dies of diphtheria or whooping cough under conditions very similar to those under which another child recovers. Was the recovery

of the second child dependent on its heredity? Possibly so, but it is difficult to get at the proof.

One way in which our problem has been attacked is to ascertain whether or not a relatively high death rate in the first year is followed by a relatively low death rate in the same lot of children in the second or some subsequent year. If so, it would indicate that the reduced mortality of the second year was caused by the removal of an unusually large proportion of the weaker children in the year before. Such an investigation was undertaken by Mr. E. C. Snow who based his studies on the records of infant mortality in England and Prussia. The outcome of Mr. Snow's elaborate mathematical analysis of the statistics of these countries was that when corrections were made for the disturbing influences of various factors there was a correlation between high death rate in infancy and a low death rate in childhood a few years later. In other words, mortality in infancy, it was concluded, is probably selective and leaves a healthier group of survivors in subsequent years. Similar studies made by Professor Karl Pearson yielded much the same results.[1]

[1] The method employed by Snow and Pearson in studying the action of natural selection by ascertaining the correlation between the mortality of the first year of life and the mortality of a later period of childhood is not free from a source of error on account of the influence of immunity to infectious diseases. Let us suppose an unusually high mortality in the first year to be caused by diphtheria, scarlet fever, and other diseases that confer an immunity upon their survivors. In a subsequent period, say five years afterward, this lot of children would

There have been several studies of the relation of infant mortality to later mortality which were made by comparing the death rate of various countries in different ages of life. Some of these studies have shown that in localities where the infant death rate is high the death rate in childhood and later life is also high. The conclusion is then drawn that the early death rate could not have been selective because the death rate of subsequent years was not lower than the average.

The argument, however, is quite inconclusive, not to say irrelevant. Where environmental conditions are very bad, we should expect a heavy death rate not only in infancy but all along the line. When we compare the life tables in different countries and different periods we commonly find that, while they differ less for advanced ages than for the earlier years, one table shows an improvement over others in most age groups. The death rate may have been selective, nevertheless, in all periods of life. Causes of death vary much with age. Certain epidemic dis-

have an advantage over other lots not previously exposed to these diseases, because they had become immunized by having contracted them. The reduced death rate of the first group as compared with the others would not necessarily be due to the selective working of their previous high death rate, but to the direct protective effect of their acquired immunity. It is unfortunate that the method referred to is vitiated by the peculiar effect of certain causes of death in *directly* causing immunity, else it might be legitimate to argue that the low death rate of a group previously exposed to unusually fatal conditions is due to selective elimination. Where immunity-conferring causes of death are not concerned, the method is apparently perfectly valid for studying the operation of natural selection.

eases that affect childhood are rather infrequent in infancy, and from middle life on people are subject to attacks of cancer, diabetes, Bright's disease, and heart troubles which are much rarer in earlier years. Many of these troubles depend to a certain extent on a hereditary diathesis, although they may be occasioned by outward circumstances. They may be reduced by improved modes of life. Nevertheless they are selective in their action. Where a population lives under unwholesome conditions it will suffer a higher infant mortality as well as from these later causes of death from which a high infant mortality does not afford an adequate protection.

We should expect that a high infant mortality would confer immunity in later life in some respects much more than others. A high general vitality is doubtless protective at all times. Narrow pelvis in women, for instance, may enhance the mortality from child-birth and would tend to be eliminated by natural selection in so far as it depends upon heredity. A woman with narrow pelvis may have been as an infant quite as vigorous as any other, so that infant mortality may have no relation to the prevalence of this characteristic in womanhood. Early feeding and other circumstances doubtless have much influence upon this characteristic and we are uncertain as to how far it usually depends upon heredity, and I am using it chiefly to illustrate my point. But whether or not the illustration is a good one, it is very probable that many causes of death which affect adults and which depend to a

considerable degree upon a hereditary diathesis would be little influenced by a selective infant mortality. The hereditary proclivity to their production, like many other hereditary traits, comes out only in a late period of development.

Human beings differ, however, in general vitality and longevity, and these traits are correlated with a low infant death rate. Pearson found that long life in parents was correlated with a low infant mortality in the offspring. Ploetz found the same relation both among the middle classes and royal families in Germany. A. G. Bell's studies of the Hyde family showed that long life of parents went along with low mortality of their children. In these cases we probably have a heredity of high vitality in the stock that expresses itself in long life of parents and constitutional toughness of their offspring.

It occurred to the writer that one way in which light might be thrown upon the operations of the selective death rate in infancy would be through the study of the relative mortality of the two sexes, under different conditions of environment. Accordingly with the cooperation of Miss Jean Goff [1] an investigation was made of the death rates of male and female infants under a variety of conditions which produce marked differences in the general infant mortality. This was done in the following ways:

[1] Holmes, S. J., and Goff, J. C., "The Selective Elimination of Male Infants Under Different Environmental Influences," in *Eugenics in Race and State*, pp. 233-251, 1923.

1. By comparing the sex mortality of infants during a series of years in which the rate of infant mortality had been improving.
2. By comparing the sex mortality of infants in countries with low infant mortality with the sex mortality of infants in countries with high infant mortality.
3. By comparing the sex mortality among infants of native-born parents in the United States with the sex mortality among infants of foreign-born parents.
4. By comparing the sex mortality of infants among negroes and whites in the United States.
5. By comparing the sex mortality of legitimate with that of illegitimate children.
6. By comparing the sex mortality of infants in city and country.

The first year of life sees the death of many more boys than girls. It is true that more boys than girls are born, but the proportion of boy deaths is much greater than the sex ratio at birth. The sex ratio at birth, which is from 103-106 boys to 100 girls, is remarkably uniform in most races and in most periods of time. The ratio of deaths in the first year varies commonly from 110-140 boys to 100 girls.

As we go from periods of time in which the infant death rate is high, as it was in fact in all countries until recent times, we find that, along with the general decrease of infant mortality, there is an increase of deaths of boys relatively to that of girls. The statistics of all countries tell the same story. The countries in which there has been the greatest improvement in infant mortality are those which show the

greatest change in the ratio of male to female infant deaths.

In accordance with the preceding results we find that in countries having a high infant mortality the ratio of boy deaths to girl deaths approaches equality, while in those with a low infant mortality, the *relative* mortality of boys becomes increased. New Zealand with the lowest infant mortality in the world shows the highest ratio of male to female deaths.

The children of foreign-born parents, frequently raised as they are in the crowded parts of our cities, show a higher mortality than children of native-born parents and also a lower proportion of boy deaths. The same relation comes out more strikingly in the infant mortality of the negroes which is very much higher than that of the native whites.

The sex ratio at death is higher for legitimate than for illegitimate infants as we should expect from the relatively high mortality of the latter class. When we compare the sex ratios of infant deaths in city and country we obtain varied results according to the relative severity of the infant death rates in these localities. Formerly infant mortality was higher in cities where children were frequently supplied with poor milk and were exposed to more frequent epidemics, but owing to improved sanitation the infant death rate in cities has been reduced so rapidly that in many cases it is less than in the surrounding country. Formerly the ratio of male to female deaths was lower in the city

than in the country, but in many cases the relation has been reversed owing to the rapid reduction of urban infant mortality.

Data from all these sources of information agree in supporting the general conclusion that a low infant death rate removes *relatively* more boys than girls, while with a higher death rate the deaths of the two sexes become more nearly equal in numbers. The hand of death is laid more heavily upon the male; apparently he is the frailer creature. When we study the effect of the several causes of infant mortality we find that, barring the doubtful status of gonococcus infection, there is only one disease, whooping cough, which is responsible for more deaths among girls than boys. Girl babies probably contract gonococcus infections through bath tubs and otherwise more readily than boys, but the number of deaths caused by this disease is very small. Measles, scarlet fever, diphtheria, syphilis, intestinal infections, tuberculosis, meningitis, pre-maturity, diseases of the heart, circulation, and nervous system, congenital malformations, and even accidents are more fatal to boys than to girls in the first year of life.

What does it mean? It means, I believe, that the male is congenitally the weaker sex. When he is exposed to diseases he has less power to withstand them. The male is hereditarily different from the female in that he possesses a different complex of chromosomes which appears to be the reason for the determination of his sex. He is different from the female in every

cell of his body, since each nucleus lacks a certain amount of chromatin material present in the other sex. Natural selection can therefore be said to discriminate against the male, but he is fortunately saved from eventual extinction by virtue of the peculiarities of sex inheritance.

The relative frailty of the male sex is manifested not only in infancy, but also to a greater or less degree throughout life. The higher mortality of males continues, although to a diminishing degree, through childhood, and soon overcomes the initial numerical preponderance of this sex. In negroes, in fact, owing to their high infant mortality, the balance turns in favor of the females as early as the end of the first year. But throughout life, except sometimes in adolescence and the child-bearing period, the females of practically all ages show a lower death rate and a greater expectancy of life than the males. And there are more women than men in the extreme old age groups between eighty and ninety.

While the incidence of mortality after infancy affords additional evidence of the congenital weakness of the male sex, the same conclusion is strongly supported also by the mortality of pre-natal life. It is significant that the sex ratio of still-born infants is exceptionally high. For deaths occurring earlier in embryonic development the sex ratio is higher still and the earlier the death the higher is the proportion of males. Bertillon gives the following data on the sex of abortions occurring in Paris:

Months	*Sex Ratio*
Four	180
Five	118
Six	112

Prinzing, by compiling records of 24,300 abortions, obtains a sex ratio of 162.1 males to 100 females. What the sex ratio is at the time of conception we do not know, but from the earliest period at which the sex of aborted embryos is recorded, there is a gradual reduction of the sex ratio of embryos that die.

The sex ratio in early embryonic life must have been rather high, because with a high male mortality the boys still outnumber the girls at birth. The general course of the death rates of the sexes in the first year and throughout later life simply continues the general trend of sex mortality observed in the pre-natal period. The attempt to explain the greater male mortality of infants as a result of increased difficulties of delivery is entirely inadequate to meet the situation. We are dealing with causes of differential death rate which are the most potent with the *youngest* and *smallest embryos,* and which continue after birth to a certain extent throughout the whole natural span of life. Male frailty is a constitutional matter correlated with the fundamental causes of maleness,—a germinal characteristic dependent on the peculiar chromosome complex of the sex.

I have already alluded to whooping cough as the one conspicuous outstanding exception to the rule that causes of death are more fatal to male than to female

infants. This exception which has often been commented on in medical literature is very interesting. I have compiled and summarized all the data on the subject given in the United States Mortality Statistics as far back as data have been published.[1] If we follow through the ratio of male and female deaths from whooping cough from the first year of life on through successive years to the straggling cases in the older age groups (for even old men and women *sometimes* contract the disease) we find that, although more females die in the first year than males (108 females to 100 males), the ratio of female to male deaths is higher in the second year (140 females to 100 males), and keeps on increasing to near adolescence after which it is fairly stationary. Whether the exceptional character of the sex mortality from whooping cough is due, as has been suspected, to the different conformation of the male larynx (this being one of the secondary sex characters of the human species) or to some other factor associated with sex we do not know. It is noteworthy that *relatively* more males die as compared with females in the first year than in subsequent years. In this respect whooping cough is just like other diseases, despite its peculiar sex incidence. The *relatively* high male mortality of the first years *as compared with later years* is due, I believe, to the same constitutional weakness that is exhibited in relation to other causes

[1] Holmes, S. J., "The Mortality of the Sexes in the First Years of Life with Special Reference to Whooping Cough," *American Journal Public Health 12*, pp. 378-381, 1922.

of death. Whooping cough affords the kind of exception which proves the rule, for along with its special virulence for the female sex the distribution of its sex mortality with age points to a constitutional factor in the male infant which in a measure offsets its specific action.

We may summarize our results on sex mortality of infants by saying that in *periods* in the history of the individual in which infant mortality is high the ratio of male to female deaths is high, but in *places and peoples* where infant mortality is high the ratio of male to female deaths is low. We may understand this curious relation if we bear in mind that death is commonly the product of environmental and constitutional factors, and that what varies with *place* are the environmental factors and what varies with *time* are the constitutional or internal factors.

As we pass back in the history of the individual, the constitutional disparity of the male as compared with the female increases. This is a part of his inheritance. In so far as death is a function of hereditary variation, it results in natural selection. In so far as death is a function of environment *per se* it is non-selective. When organisms are placed in situations where the death rate is very high many naturally vigorous forms perish; death becomes less *stringently* selective. When we multiply non-selective causes of death we tend to cause a relative increase of female deaths. When non-selective or slightly selective causes of death are removed the death rate that remains becomes more indic-

ative of the constitutional ability to maintain life. In places with a low infant death rate, *i.e.*, where the external factors of mortality are so far as possible removed, the deaths which occur in spite of improved conditions depend to a relatively larger extent upon differences in constitution. Hence the males, constituting as they do the frailer sex at this time, perish in *relatively* larger numbers.

This consideration of sex mortality gives us an insight, I believe, into the general operation of natural selection. What the male is to the female, a congenitally weaker individual of either sex is to a congenitally stronger individual of the same sex. The more the death rate can be reduced by the elimination of unfavorable conditions the more stringently or discriminatingly selective it becomes. In other words, the greater is the difference between those who perish and those who survive, because only the very weakest of the group will succumb. Increase the mortality and fairly vigorous individuals will be eliminated along with the weaklings.

Of course a death rate may be too low for the permanent welfare of the species, but every species would probably gain by being shielded from all those causes of death which are as apt to remove the strong as the weak. Causes of death vary greatly in their selective influence, and all those which are indiscriminate in their incidence are a hindrance rather than a help to natural selection. If it were in the interest of the species that the best 10 percent always survived, this

result could not be assured in the presence of non-selective agencies of elimination.

Infancy in man is exposed to several kinds of selective mortality:

(1) The elimination on the basis of somatic or non-hereditary variations, a racially sterile form of selection.

(2) The elimination of infantile weakness which may not be correlated with weakness in later life. Many very puny babies have grown into exceptionally vigorous persons. As man has advanced from lower forms infants became weaker and required more care for their rearing. Not all variations in the direction of infant weakness are racially injurious if allowed to accumulate.

(3) The elimination of infant weakness which is correlated with adult weakness or defect. There is little doubt that a good deal of infant weakness is so correlated, as is indicated by the work of Ploetz and others previously mentioned.

(4) The elimination of infants not in themselves weak, but which perish on account of the low mentality of their parents. There is certainly much infant mortality of this kind, and, like the preceding variety, it is racially advantageous. Degenerate families have a notoriously high infant mortality. It is through their high infant mortality that natural selection is working most vigorously toward the eradication of such stocks. The correlation of high infant mortality with a high birth rate which the Neo-Malthusians attempt to show is due to the fact that a high birth

rate is the *cause* of the high death rate, is doubtless largely a result of the circumstance that both spring from a common cause in the ignorance, improvidence, or mental inferiority of the parents. The child of the high grade moron is probably as vigorous as any other. Since the death rate of such children is high it might be said to be due to environment merely and not to natural selection, but this would be incorrect. The bad environment of such a child, *i.e.*, its unwise rearing owing to the low mentality of the parents, *is a result of the heredity of the stock.* Natural selection tends to eliminate such stocks, because heredity manifested in the adult creates an environment that is highly deleterious to infancy.

Of all the forms of selective infant mortality this last is probably from the eugenic standpoint most advantageous. Ashby remarks that the one great factor in saving infants even under unfavorable conditions of poverty and bad environment is the intelligence of the mother. It is perhaps this last kind of selective mortality which will be reduced most by our organized efforts to lessen the infant death rate. The more or less imaginary advocate of a high infant mortality rate might maintain that children should be shielded from the ignorance of their parents but not from their folly. The fool killer is the personification of that form of natural selection which, in various ways, is the most active in our present social régime. He can never be eliminated altogether, whether or not it is desirable to do so.

CHAPTER VIII

HAS CIVILIZATION DIMINISHED THE RIGOR OF NATURAL SELECTION?

It has almost universally been assumed by writers on natural selection in man that the action of this agency has been greatly reduced, if not almost done away with, by improvements in medicine, hygiene, and the various arts of prolonging life. Conklin speaks of natural selection as "so far as possible nullified by civilized man." Guyer states that "we have done away with the factor of natural selection." Professor E. Ray Lankester says that the mental qualities of man have assumed such unprecedented power "that they have, to a very large extent, if not entirely, cut him off from the general operation of that process of natural selection and survival of the fittest which up to their appearance had been the law of the living world." And I must plead guilty to having expressed myself on a former occasion to much the same effect in commenting on, "the remnant of natural selection which medical science has not succeeded in disposing of."

Further reflection on the ways in which natural selection is working out in our modern society has led me to doubt if, after all, it is not acting as vigorously as ever, and in some respects even more so. It is

obvious, of course, that we have made great advances in the arts of prolonging life. Several diseases have been practically conquered; cures for several maladies have been discovered, and epidemics which formerly swept away multitudes of human beings are now kept under control. One of the most striking achievements of modern science is its success in checking disease. The average length of life has been increased in the United States about fifteen years during the last century, and similar or even greater achievements have been made in other countries.

But does this increased saving of life prove that the force of natural selection has been reduced? The obvious answer to this question would appear to be yes. Nevertheless there is, I believe, ground for doubt that this is the right answer. In the first place we should bear in mind that mere reduction in the number of deaths per thousand of the population does not necessarily mean that the action of natural selection has suffered a corresponding reduction, or even any reduction. How natural selection is affected depends entirely upon how the reduction occurs, and it may even occur in such a way that the action of natural selection would be increased. The removal of purely adventitious causes of death, or causes depending in no way on the hereditary constitution of the individuals concerned, would make the mortality that remained more selective on the average than before. Causes of death vary greatly in their selective action. Earthquakes and strokes of lightning probably discriminate

but rarely on the basis of differences of hereditary constitution. On the other hand, many epidemic diseases are probably more fatal to the congenitally weak. Bright's disease and diabetes are more prone to eliminate individuals with a hereditary predisposition to these maladies. Hæmophilia (bleeding) which is commonly inherited as a recessive sex linked characteristic is responsible for a high percentage of the deaths of those afflicted by it. There are many pathological conditions transmitted by heredity which result in reducing expectancy of life, all of which are indicative of the active rôle which natural selection is playing in our midst.

An important part in selective elimination is probably played by hereditary diatheses or proclivities to different infections. Diseases caused by micro-organisms are not properly described as hereditary, although they may be more prone to attack some hereditary stocks than others, and it is well known that some human races are comparatively immune to diseases to which other races readily succumb. For these reasons some writers have maintained that it is on the basis of ability to withstand diseases that natural selection in man chiefly operates. Dr. G. A. Reid has maintained this thesis at some length in his book on *The Present Evolution of Man,* as well as in more recent writings. And in a recent number of the *Eugenics Review* Mr. Carr-Saunders, in speaking of natural selection, says that "it has been very largely concerned with the selection of disease resisting characteristics."

Aside from occasional war, whose value as a selective agency is open to question, there is little *direct* struggle of man with man that results in the elimination of the weaker contestant. The once formidable wild beasts with which primitive man had to contend are now reduced to quite negligible elements in the struggle for life. We solicitously care for the weak in both body and mind, and doubtless enable many more of them to perpetuate their stock than could possibly have done so in primitive society. Natural selection rarely obtrudes itself upon our notice, and it is not surprising that it is so frequently spoken of as reduced to what President Cleveland would have designated a state of innocuous desuetude.

Natural selection, however, is not difficult to discover if looked for in the right way. Its action is shown in the inheritance of longevity and the correlation of longevity with fertility and low infant mortality. It is shown in the hereditary character of general health, and the existence of hereditary defects and diatheses to which allusion has been made. As was pointed out in the preceding chapter, its action is clearly indicated in the relation of infant mortality to parental intelligence. In fact, it is on the basis of intelligence that natural selection is acting with the greatest potency at the present time.

Human beings in our industrial world are exposed to very different hazards. There are dangerous trades and unsanitary employments which greatly reduce the average longevity of those engaged in them. But

aside from the direct danger or demonstrable injury of occupations as such, there is a great difference in the average expectation of life among those following different employments. This is one fact that becomes apparent when we study tables of occupational mortality. In the subjoined table it may be seen that the death rate among clergymen is low not only in general, but in the several age groups. A common city laborer of twenty-five years of age is more apt to die within the next ten years than is a schoolmaster or a farmer. These differences of death rate which a table of occupational mortality exhibits are by no means of small magnitude. They represent a high degree of lethal selection.

OCCUPATIONAL MORTALITY IN ENGLAND AND WALES, 1900–02, EXPRESSED IN MEAN ANNUAL DEATH RATES PER 1,000

Occupations	*Age Groups*		
	25–35	35–45	45–65
Clergymen	2.72	4.09	15.53
Schoolmasters	3.64	5.54	15.76
Coal miners	5.08	7.97	23.22
Carpenters	4.76	8.30	20.03
File makers	9.70	18.96	40.04
General shopkeepers	11.08	20.71	30.17
Inn keepers	13.87	22.50	35.90

In judging of the extent to which selection on the basis of differences in heredity comes into play here

we should bear in mind that people not only select occupations, but occupations select people. Different employments make very different demands upon those who pursue them. To qualify for the position of an engineer a person has to possess more than the average amount of mental ability. Almost any one above the level of a low grade moron can find a place somewhere in the ranks of unskilled labor. A fair amount of native ability is required to become a machinist or a carpenter. Men of superior native talents are found in all occupations, but there is nevertheless a tendency for human beings to become segregated into different occupations on the basis of mental ability. In other cases the basis for selection may be strength, endurance, agility, or some other natural aptitude. Men of deficient vitality do not become stevedores, and clumsy-fingered individuals are not apt to become typesetters. It is probable that this segregation of human beings would be carried out more in accordance with natural aptitudes as society develops a stabilized population and has been subjected for some generations to a fairly uniform industrial régime.

Modern industry has greatly diversified the activities and living conditions of our population. For great multitudes of human beings, especially in the denser centers, it has made conditions of life distinctly bad. Between unwholesome conditions of labor, crowded and unsanitary homes, low wages, and the various drawbacks which these things entail, no small proportions of the inhabitants of large industrial cities are exposed

to an environment which exacts a heavy toll of death. Added to the direct effect of these agencies on the adults there is the still greater effect upon their offspring. When we read that the infant mortality of the industrial city of Chicopee, Mass., in 1912 was 177 per thousand births while that of Brookline was only 55 we can realize to what an extent the differentiation of occupation and status goes along with differences in the rate of infant mortality. This is shown more clearly by the relation between the infant mortality and the wages of the father. In Manchester, N. H., according to Duncan and Duke, where the fathers earned $450 or less annually the infant mortality was 242.9 per thousand born. With those earning $650 to $850 annually the infant mortality rate was 162.6, while those earning $1,250 or more lost only 58.3 per thousand. It is in infant mortality more than in any other way that occupational selection shows its greatest effect.

Probably human beings are more unlike in their native endowments of intelligence than in any other quality. We are coming to realize as never before the great importance of these differences in industry. Consider the natural industrial fate of the large group of persons belonging to the D class of the Army mental tests. These are persons with a mental age of less than twelve years, and unless especially favored by fortune, as most of them are not, they work into various subordinate and poorly-paid positions for which they are qualified. From the D and E classes of hu-

manity come a large part of our tramps, vagrants, prostitutes, and offenders of all sorts among whom natural selection, in one way or another, is active in its work of destruction. The infant mortality of the D class is often appallingly high. Of course we may blame the unwholesomeness of the occupations which the D class often enters and the poor conditions under which the D class often lives for its high death rate. People who are fond of explaining social phenomena in terms of environment would probably be entirely content with this interpretation. But in human society heredity has much to do with making the environment, or at least in determining in which of several environments a person comes to live. A bad heredity creates a bad environment, and a bad environment means a high death rate.

We should not lose sight of the fact, however, that many occupational diseases and causes of death pick out people of good or superior native quality. Several dangerous trades require persons of skill and training that can only be acquired by those having good minds. The high mortality of such persons is a racial misfortune. But aside from exceptional cases, there is in general a higher mortality among those who follow employments demanding little intelligence; and there is a relatively higher mortality among their children.

While in some respects natural selection has acted on primitive man more severely than on his civilized congeners, it is doubtful if primitive man was so rigidly selected on the basis of intelligence. Perhaps the low

grade mental defectives would have been eliminated more quickly, but the dull normal class, which is very much more numerous, would probably get along nearly as well as the rest. Life is relatively uniform throughout the group in most primitive peoples; there is little diversity of occupation, and living conditions are much the same for the great majority. When one becomes ill there is little scope for the intelligent choice of doctors or methods of treatment. Infants when afflicted by their peculiar disorders are treated by all classes of parents by methods which are equally ineffective.

With the development of civilization and the diversification of industry people become exposed to conditions of life which are associated with marked differences in their rates of mortality, and there are reasons to believe that these differences are correlated to a considerable degree with levels of intelligence. I am not sure, but I strongly suspect that a man in the D class of intelligence ratings is discriminated against *relatively* more in our modern industrial régime than he would be if he were one of a tribe of savages. I suspect that an A class man would live relatively longer compared with his fellows in our present civilization than he would if he were a Bushman or a Patagonian. Civilization tends to put the A men and the D men into very different stations, and it has not treated any too well the men who toil at the humbler tasks of life. While it has greatly reduced the general death rate it has probably made it more selective on the basis of

intelligence. The D man may more than compensate for his handicaps through his greater birth rate, but that is another matter.

Note on the racial effect of prostitution. Prostitution is sometimes spoken of as a disease of civilization. It draws off in each generation a not inconsiderable number of the female sex. Although not listed in the official enumeration of occupations issued by the United States Government, prostitution is nevertheless an extensive and well-organized business. Numerous recent studies of the mentality of women of this calling have shown that a high proportion are mentally defective, or at least of low intelligence. While the widely-circulated statement that the prostitute lives on the average but seven years after she starts on her downward career is sheer pious invention, she is not what life insurance companies would consider a good risk. As a rule she soon becomes diseased; she has a weakness for liquor; and she is commonly imprudent in the care of her health. Among the relatively few offspring born to such women the mortality in the first year of life is frightfully high. Unquestionably were it not for their occupation and the diseases and hardships that it involves these same women would be producing very much larger numbers of children. Probably in a primitive society they would have formed the most prolific class. We have here another instance, and a very conspicuous one, of the way in which civilization is intensifying the elimination of stocks on the basis of levels of intelligence.

CHAPTER IX

SEXUAL SELECTION: ITS PRESENT SHORTCOMINGS AND FUTURE POSSIBILITIES

In a previous volume on *The Trend of the Race* I have discussed at some length the present operation of sexual selection in man and compared it with its operation among primitive peoples. It was pointed out that in primitive man sexual selection was in the main eugenic. The strong and valiant man, or the man who had won success by virtue of his native talents, was the one most apt to acquire a wife, to say nothing of several wives. Among many peoples it was required that a man demonstrate his prowess in some way before he was allowed to marry. Strength, courage, and beauty (according to the standards of the tribe) were the qualities valued by the women, and to the extent that the women were allowed freedom of choice in the matter of marriage, to that extent their ideals became a force working toward their own realization in the inheritance of the race.

But with modern civilized man the character of sexual selection has changed. The women, it is true, still admire and tend to choose the strong, manly, and handsome men, and the men tend to choose beautiful, sweet-tempered, and attractive women. The ugly and the disagreeable of both sexes are, as always, at a dis-

count. Ideals of manhood and womanhood continue to be important factors in marriage selection, but to get at the net results of the matings of human beings we must compare the average quality of the mated and the unmated. Unfortunately we do not possess the data that would enable us to do this in any thoroughgoing way. In the *Great Unmarried* (to use the title of Mr. Gallichan's book) there are numerous hoboes, vagrants, fallen women, and human derelicts of all sorts. There is also an alarmingly high percentage (40-50) of female college graduates, and numerous other women of high intelligence and character who have qualified themselves to earn a comfortable and independent living. Whether the proportion of the more intelligent and successful men among the Great Unmarried has been increasing we do not know, but it is quite evident that the higher types of women have been abstaining from matrimony in ever-increasing numbers. The loss of this fine material for motherhood is a very serious misfortune to the race. With the higher education of women, their increasing economic independence, not to mention the feminist movement, the evil, in the near future at least, promises to increase.

The last century has seen a great change in the composition of the celibate class. This class continues to receive, as it always has, the persons who are rejected for their lack of traits which are attractive to the other sex, but it has also come to receive a greatly increased proportion of recruits from the highest types of hu-

manity. To the extent that sexual selection has changed it has changed mainly for the worse.

It may be objected that the increasing abstention from marriage by educated and intelligent women is not properly described as due to sexual selection, but this is merely a matter of nomenclature. Whether a woman does not marry because she is not sought after, or because she does not wish to marry, the effect on the race is the same. A single career is often chosen because of an elevated standard to which few men measure up. A man, on the other hand, may not aspire to a woman whom he considers his superior, and he may find that such a woman does not appeal so strongly to his mating instincts as the sexually attractive, butterfly type of female. Nearly all mating in these days is on the basis of choice, but considerations other than the ability to secure a mate decide much more frequently than formerly the question of marriage or non-marriage. However, probably most women of marriageable age would marry if just the right man presented himself.

The more intellectual classes, in addition to their increasing celibacy, are also coming to marry later in life. The racial effect of this is the same as if a larger proportion of them did not marry at all. A difference of a few years in marriage makes a very large difference, as Galton has shown, in the average number of children per family. The inevitable upshot of all this unfortunate development is to cause a loss to the race of a vast amount of native ability. It is an unavoid-

able conclusion, I believe, that the loss so incurred is much greater than what is gained through the rejection of undesirables in the choice of mates.

The changing operation of sexual selection is leading not only to a lowering of the general mental level of humanity, but it has other bad effects also. Let us consider its relation to beauty. It is quite obvious that those possessing beauty of face and figure are the most sought for as mates by the members of both sexes. The natural and primary effect of sexual selection, therefore, is to enhance the beauty of the human race. But, as in so many other cases, the institutions of man have seriously changed its influence. To a certain extent, of course, selection for beauty still functions in the normal way, but let us look at some of the secondary results of its action.

Several of these have been discussed by Dr. Knight Dunlap in his small volume on *Personal Beauty and Race Betterment*. Dr. Dunlap emphasizes the idea that personal beauty is an index of the possession of characteristics which are racially valuable. Peculiarities which make up sexual attractiveness are signs of the ability to produce strong and healthy offspring. Personal beauty, therefore, has a very important biological significance. Its enhancement in a people means the development also of a number of valuable associated traits.

In our modern social life there is much beauty that from the racial standpoint simply goes to waste. As an illustration, which has been cited by Dr. Dunlap,

we may take the stage. Not only in actresses, but in chorus girls and dancers, there is a demand on the part of the public for beauty of face and form. This demand is the expression of sex choice that normally results in the selection of wives. But the women of the stage bear few offspring. Their occupation makes children an undesirable encumbrance. Through the very qualities that attract the other sex they are drawn into a mode of life which condemns them to relative sterility. Their beauty of face and figure and the other valuable qualities of which these are an index are not handed on.

There is a demand for beautiful and attractive women for mistresses for the rich, and these women also form a relatively sterile class. Beautiful women tend to marry men of wealth and are thereby elevated into a social stratum in which very small families are the fashion. Those with beauty and intellectual gifts which make them leaders in society have added temptations to limit their families. A number of influences have thus arisen in our social life which tend to associate beauty with sterility. Like intelligence, beauty is a social and economic asset. For this reason its transmission is sacrificed to the egoistic enjoyment that it brings.

So much for the present shortcomings of sexual selection. It is perfectly evident that the operation of this agency could be very greatly improved. If sexual selection ever comes near being the force that theoretically it might become, it must function in a

society of a relatively high degree of culture. It can never succeed well in a society in which extremes of wealth, education, and social position form a prevailing condition. Such a society is eugenically impossible.

We need only look into the families of intellectual and cultivated people to observe that marriages commonly take place between persons on approximately the same mental and social plane. An intellectual seldom marries a woman mentally below par, and *vice versa*. A typical woman of the Juke or Kallikak family would have relatively small chances of marriage in a community of fairly high intellectual level. Even if she were educated to the extent of her capacity her chances of marriage would be limited to men somewhere near her own intellectual caliber, or to men of good stock who were ignorant and of low social status. In a relatively homogeneous community of comfortable financial circumstances and high average education the lower mental levels of humanity would probably tend to be relegated more than they are now to the celibate class. The more people in general are given the advantages of education the more apparent do their differences in innate capacity become. We may not easily distinguish an ignorant or secondarily stultified person of fair native ability from a high grade mental defective, but if both had received the advantages of training they could be much more readily recognized. Conditions under which mental inferiority becomes more apparent would probably lead to a greater discrimination against the ill-favored class. The ugly do

not mate with the ugly simply because others reject them. To a considerable extent they remain unmated on account of their ugliness.

Sexual selection is a method by which ideals of manhood and womanhood may find embodiment. In order that sexual selection achieve the best results these ideals should be high and fairly prevalent throughout the community. Choice should be free, uninfluenced by the endeavor to secure wealth or support, and unhampered by class distinctions. One obvious measure of great eugenic importance is the inculcation of high ideals of marriage selection. In proportion as these can be diffused and made effective the race will tend to be reproduced more from its better types. As a method of improving the race sexual selection has magnificent possibilities. But their realization must go along with the elevation of humanity to a higher cultural and ethical plane.

CHAPTER X

DO EARLY MARRIAGES PRODUCE INFERIOR OFFSPRING?

FROM the days of Aristotle, if not before, early marriages have been condemned on account of the belief that young parents are apt to produce inferior offspring. Children, it was commonly held, should be begotten in the prime of life; it is then that the parents are able to transmit the greatest vigor of mind and body. If the parents are in the period of their decline, their children were held to be inferior owing to their inheritance of deficient vitality. These were very natural conclusions according to the older way of looking upon heredity as the transmission of characteristics from the bodies of parents to the bodies of their progeny. From this viewpoint children would be expected to reflect, in a measure, the condition of the bodies of their parents at the time of conception.

Our changed ideas of the mechanism of hereditary transmission have now put the matter in a quite different light. If the germ plasm is as sharply set apart from the somatoplasm, or body plasm, and as free from the influence of the latter, as it was conceived to be by Professor Weismann, we should not expect that age of parents would have any influence on characteristics of progeny that are due to heredity. But even if we

deny the transmission of acquired characters, there is the possibility, which is quite consistent with the essential features of Weismann's views, that bodily changes due to age might occasionally affect the germ cells so as to produce transmissible characteristics. Experimental support for this conclusion is, however, lacking, but this may be because there has been almost no systematic investigation devoted to the subject. Old bodies, with their accumulated toxins, may afford an environment less favorable to the vitality of the germ cells than younger bodies, but there would not seem to be a corresponding injurious influence from bodies that are too young. On the other hand, there is a possibility of injury to offspring owing to their derivation from germ cells that are immature. But we are lacking in positive knowledge on these matters both in man and in lower organisms.

Quite apart from the possible influence of the age of parents on the germ cells, there is the influence of maternal age on the offspring during their development. This is a purely somatic matter and has nothing to do with heredity. Nevertheless maternal age may have a very important bearing on the welfare of progeny, not only in infancy, but throughout life. Children of old mothers are apt to experience greater difficulties at birth, and their mortality in the first year of life is relatively high. Children of very young mothers are also liable to injuries incidental to parturition, and they are apt to suffer from the drawbacks of maternal inexperience.

One complicating factor influencing the characteristics of offspring is the effect of order of birth. First-born children show a higher percentage of still births than the second or third born. After the third or fourth child, the percentage of still-born infants increases with successive births. There is a parallel increase in the death rate in the first year of life as the birth rank increases. Since first-born children come from mothers who are, on the average, younger than the mothers of second or subsequent children, one may easily be led to attribute to age what is really due to order of birth and *vice versa*. Were we to limit our inquiries to the first or any subsequent birth rank, we should find that the percentage of still births shows an increase with the age of the mother after about her twentieth year of age. When we consider the influence of maternal age on the mortality of children in the first year of life, it will be found that after the effect of order of birth has been eliminated there is a rapid rise of the infant death rate as maternal age increases from the early twenties to the end of the child-bearing period. This is a general fact borne out by all available statistics from a variety of countries. Data from New South Wales dealing with 277,799 confinements show a fall in infant deaths to the twentieth year of the mother's life, and then a gradual rise with later years, the infant mortality of mothers over forty being over four times as great as that of mothers of twenty years of age. The statistics compiled by Gini show that, considering only first births,

the mortality of infants of mothers between thirty and forty years of age is over twice, and, of mothers over forty, more than five times that of mothers at twenty.

Do the handicaps of the offspring of older mothers persist in later years of life? Ewart has presented some statistics showing that the height and weight of six-year-old children, and to a less extent the height and weight of 13.5 year-old children, decrease with the advancing age of their mothers beyond the period of twenty-five years. The data were not very extensive and the influence of social and racial factors was not eliminated, so that these results are by no means conclusive. It is a matter of very great importance to ascertain to what extent early inhibitions of growth and development persist in later periods of life. What is known of the effects of these early inhibitions on the development of animals renders it probable that human beings may be injured for many years, if not permanently, by untoward influences in th period of infancy.

One test of the influence of parental age would be to ascertain if the later born members of a family live longer on the average than the earlier born who were therefore begotten by younger parents. The data on this subject have led different authors to quite opposite conclusions. The subject is one which presents opportunity for being misled into statistical fallacies, and new critical investigations are required finally to settle the question. Mr. Caspar Redfield has been writing for several years in support of the thesis that great men are usually born of parents of fairly ad-

vanced age. On the other hand, he tells us, "Children of young parents are lacking in physical stamina and mental power. They are reckless, careless, sometimes vicious, and frequently drift into drunkenness and crime."

Mr. Redfield is a Lamarckian. In his opinion, children who are the product of immature parents inherit little mentality, while children born to parents who have acquired wisdom due to the experiences of a long life receive on the average a superior endowment of native intellect. Mr. Redfield has collected many instances of great men born to parents who were much beyond middle age. He finds that persons distinguished for intellectual eminence have parents several years older than those of the average of humanity. Old parents, he concludes, are much more apt to produce distinguished offspring than young parents are. The Jukes and the Kallikaks, he tells us, are degenerate and of low mentality because of the early marriages that prevail in these notorious families.

One may grant Mr. Redfield's facts without accepting his conclusions. As a rule, early marriages are apt to occur in stocks of a low cultural level. These stocks only rarely produce people of intellectual distinction. A much more probable explanation is that the Jukes and the Kallikaks were not degenerate because they married early; they married early because they were degenerate. People of primitive races, to which Mr. Redfield refers, marry early because that is the primitive thing to do; it does not follow that their low

development is a consequence of their custom of early marriage.

Investigation of the ancestry of great men discloses the fact that they come to a preponderating extent from the professional and fairly well-to-do classes among whom late marriages are a custom. The average age of the fathers of the men in Ellis' *Study of British Genius* was 37.1; of one hundred cases of Galton's *British Men of Science,* 36; and of thirty-nine cases cited by Yoder, 37.78. These do not differ greatly from the average ages of fathers of men of professional and allied classes given by Ansell, *viz.*, 36.5. The age of marriage in the professional classes is relatively high. According to Rubin and Westergaard it averages over five years higher than in the working classes, and among the latter, as Rowntree and others have shown, it is considerably higher among the skilled workmen than among the unskilled. Great men are not great because they have relatively old parents; they have relatively old parents because their parents, as a rule, marry later in life than the average of the population. Mr. Redfield's argument for the importance of having children born to old parents is vitiated by a fundamental fallacy. He has assumed as a cause of greatness what is merely one of the characteristics of the stocks from which greatness commonly arises.

Mr. Redfield's conclusions, moreover, are directly opposed to what is known of the relation of greatness to order of birth. Several studies have shown that

among the children of a family the man who achieves eminence is more apt to be the first born than a member of any subsequent birth rank. This was found to be the case by Galton, Yoder, Gini, Havelock Ellis in his *Studies of British Genius,* and Cattell in his investigations of American men of science. My own studies, together with those of some of my students, have yielded additional evidence for this conclusion. Now the first born is produced by younger parents than the second or any subsequent child. According to Redfield, he should be the least apt to achieve eminence of any one in the family. Whether the reasons for his success are biological or social may not be certain, but the fact of his preëminence nevertheless remains, and stands out as a strong argument against the assumed potency of parental age in producing superior minds.

One cannot help associating the predominance of greatness among the first born with the increase in the number of still births and infant deaths as the mother increases in age. Are these things possibly the expression of a tendency of offspring to deteriorate as their mothers pass from youth to old age? If there be such a tendency, it is an important thing to know. Why is a woman who bears a child after forty, more than four times as apt to lose this child in its first year as a woman who bears a child at twenty? Is it because the milk supply of the older woman is inferior in quantity or quality? Is it because women who have children after forty are apt to belong to stocks of

inferior status among whom infant mortality is unusually high? Is it in any way an after effect of the greater difficulties of parturition which older women experience? Or is it a result of the reduced vitality of the child due to the environment of an old body which has supplied its food and removed its waste? This latter conclusion is one that has considerable probability, although there may be an element of truth in the preceding ones. It is generally recognized that if the vitality of the expectant mother has been impaired through misfortune or disease, it may be reflected in the weakness of her child. Then should we not expect that the natural waning of vitality due to age would also impair the vigor of her offspring?

So far as the vitality of offspring is concerned, the available evidence points to the years between twenty and thirty as the best period for motherhood. Perhaps the lower limit might be reduced a year or two for women of more southern climates who mature more quickly than those farther north. In regard to fathers, there is no evidence of a reliable kind that age produces any effect on the offspring one way or the other. But young mothers would probably bring forth a more healthy crop of children; and a healthy childhood may signify much,—we do not now know how much,—for the subsequent development of the individual.

From many standpoints, and especially from the standpoint of racial welfare, it is, I believe, a mistaken policy to discourage early marriages. And I wish to

be clearly understood as not presuming to offer advice as to marriage on any other ground than its influence upon progeny. It is quite possible that full reproductive maturity comes before years of discretion. It may not be amiss to point out, however, that the postponement of marriage greatly increases the chances that marriage will be sterile. The liability of women to conceive falls off quite rapidly after the twentieth year. For the sake of progeny, therefore, it is well that people marry early, as Nature intended them to do.

CHAPTER XI

IS BIRTH CONTROL AN AID OR A MENACE TO EUGENICS?

THE subject of birth control is arousing a deep and widespread popular interest. It is a subject that touches every family. It not only affects the pocketbook; it is a matter that concerns the health and happiness of a large part of mankind. And by no means the least of the reasons for the great interest it awakens is its relation to the strong instinct of sex.

The command, "Be fruitful and multiply," was all very well in its time and place considering the presumably eugenic quality of the persons to whom it was addressed. But the world is now much more populous than it was in the days of Adam, and the people it contains differ greatly in their possession of desirable hereditary qualities. The inhabitants of many countries are altogether too numerous for their own good. One of the best things that could possibly happen to the over-crowded districts of China, India, and Japan would be for the people to declare a sort of procreative holiday in which the arrival of new babies would be held up until the overcrowding was in a measure relieved.

Undoubtedly the Neo-Malthusians are right in their contention that unrestricted multiplication is a potent

cause of war, much misery, and a high death rate. Human beings, like other creatures, tend to increase in numbers until conditions due to over-crowding become so bad that further increase is automatically checked. At times the surplus population may be drained off through migration, but as other localities usually have their human inhabitants who have to be dispossessed, this usually means war.

As civilization has advanced, science has made the earth yield in greater abundance the materials which men require to sustain life. The world supports many more people than it did a century ago, especially in the regions under what is commonly called western civilization. Probably through further advances of science the yield of nature will be increased still more. But the process cannot go on indefinitely. Soil becomes exhausted and its fertility instead of being restored to it is commonly drained off through sewers into the sea. Of course we do not know what discoveries may be made that will increase our supplies of food. But granting the contentions of the most obdurate optimists, the evil day is only postponed. Sooner or later the people of the earth will have to limit their numbers voluntarily or go on fighting and starving and dying of epidemics as they have done throughout history.

There are those who defend this sort of thing and oppose limiting the birth supply because they hold that it is through over-population, strife, and starvation that the race has evolved. Such it is said is the

order of nature. Through this continual strife and the survival of the fittest mankind has developed to higher stages, and it must continue to employ the same methods if it evolves at all.

When mankind in general gets to be sufficiently enlightened to appreciate the effects of unlimited fecundity it will, I believe, pay little heed to the preaching of this doctrine. It will simply balk. It will reap the rewards of present freedom from overcrowding and let the future take care of itself, as considerable sections of civilized mankind are now doing.

The populations of most countries of Europe, and certainly of all countries of North America, are not at present near the saturation point. The evils of overfecundity are rather to be found in certain classes and within particular families. These maladjustments enable the Neo-Malthusian to make a strong appeal on humanitarian grounds. The pamphlet written by Mrs. Annie Besant on *The Law of Population* which had an enormous sale of several hundred thousand copies made a strong point of the misery among poor wage-earners which is greatly aggravated by their frequently large families. The industrial conditions prevailing in England when this pamphlet was written do not present a pleasing picture. Mrs. Besant's essay was written to afford a measure of relief to the spawning, exploited masses. It was written in behalf of over-worked mothers and under-fed, poorly-clothed, and uncared-for children. Too many workers, too much competition, low wages, squalor, ignorance, ill-

ness, and over-crowded homes in which death was a frequent visitor,—such was the chain of consequences flowing from unrestricted multiplication which were vividly set forth in this celebrated essay. And the remedy proposed was family limitation which would reduce the population, decrease competition, increase wages, improve living conditions, reduce disease and death, and make people in general more enlightened and happy.

Whatever we may think of the efficacy of this simple remedy it cannot be denied that family limitation would be a great boon to many struggling parents among the poorly paid working classes, and would enable them to give proper food, clothing, and education to a small number of children. There is no use in preaching Malthus' remedy of late marriages to unskilled labor. Unskilled laborers marry younger than skilled laborers and they may be counted on to continue to do so. Family limitation is less practised among the unskilled. Those who have the largest number of children are generally those who can least afford them, while those who can afford to have the most children and rear them well have the least.

This situation is bad socially, economically, educationally, and morally. Worst of all it is bad eugenically. Despite protests from certain quarters, I venture to express the view that there is a certain degree of association between success, economically or intellectually, and the possession of good native ability. While the lower industrial classes include many good

minds, which from various untoward circumstances are kept in the ranks of unskilled and poorly-paid labor, these classes also receive the naturally dull, unenterprising, unreliable, and incompetent who are inherently unqualified for holding any positions involving responsibility and intelligence. It is into these ranks that people of subnormal mentality—and there are many of them—inevitably gravitate. Unfortunately both for themselves and for society these people are unusually prolific. Their unrestrained fecundity lowers the general level of the race and aggravates our economic and social troubles. They form the class which birth control has not yet reached in its downward course through the strata of society.

The impelling force of the Neo-Malthusian movement was the effort to better the condition of the toiling masses. Family restriction, however, was practised long before this movement was launched, but it was a private and prudential custom largely confined to the educated and well-to-do. Neo-Malthusianism, on the other hand, comes as a sort of gospel. Its devotees are inspired with all the enthusiasm of the adherents of a new religion and some of them willingly suffer martyrdom for the cause, at least to the extent of being subjected to occasional fines and imprisonment. Dr. Drysdale, its chief British apostle, sees in birth control the one great remedy for crime, poverty, and prostitution, to say nothing of numerous lesser evils. In fact over-population is held as responsible for so large a proportion of our woes that we are led to infer that

the adoption of Neo-Malthusian methods would almost usher in the millennium at once.

Considerations of eugenics were originally quite outside the purview of most of the earlier Neo-Malthusian propagandists. After eugenics came to be more in the public eye a number of Neo-Malthusians, Dr. Drysdale included, claimed that birth restriction, in addition to its other virtues, was distinctly eugenic in its effects. The same thesis has more recently been supported by Mr. Havelock Ellis and Mrs. Margaret Sanger. In Mrs. Sanger's latest book, *The Pivot of Civilization,* there is a very clear presentation of our dysgenic situation which is brought about by the present differential birth rate. There is also a recognition of the great importance of differences in heredity in our social and economic life and the urgent need for curtailing the propagation of our subnormal classes. The mental defectives should be sterilized or segregated at once. The fecundity of the next stratum above them should be limited by the dissemination of safe and effective methods of birth control, thus equalizing more nearly the birth rates of the various classes of the population. Unless this is done the classes of greater eugenic worth will continue to be outbred and the race will deteriorate.

The trouble with birth control is that it is practised least where it should be practised most. As it is at present employed its racial effect is undoubtedly strongly dysgenic. But its advocates contend that their great aim is to spread its benefits throughout all ranks of society and thus restore the balance of

births. Were this done the natural increase of our population would doubtless be reduced, but this *per se* may not be an evil. If the general birth rate were reduced to the level of that of the intellectuals, however, the population would be decreased, and this would be an evil. In the United States we can comfortably support, and we should support, a much larger population than we now possess. Each country should endeavor to increase its population to as large a number as can be maintained under conditions which are the most favorable for the development of its individuals, but no farther. Life is an end in itself, but it should not be allowed to increase until its quantity deteriorates its quality.

Most Neo-Malthusians apparently fail to take into account the fact that birth control has been carried so far in stocks of higher social worth that it is rapidly leading to their extinction. The classes which there is every reason to believe are coming short of perpetuating themselves are the graduates of colleges, teachers, scientific investigators, members of the learned professions and the leaders in the social, economic, political, and intellectual life of the nation. We are suffering a frightful drain of our best blood. We can only conjecture how great is the loss of those stocks that furnish our intellectual leadership. Curtailing the propagation of morons and dullards will come very far from affording an adequate compensation for this loss.

It is this situation which so many of the Neo-Malthusians fail to face. They are so carried away with

their enthusiasm for preventing people from being born that it apparently has not occurred to them that restriction might be carried too far. Dr. Drysdale's book, *The Small Family System,* contains no recommendations regarding how small the family should be. Mrs. Sanger in her latest book makes no plea for an increase of the birth rate among the better stocks and derides the proposal that they enter into a "cradle competition" with the admittedly too fertile subnormals. There is an apparent reluctance to admit that considerable sections of the population are having too few children, even though it may be evident that they are not reproducing themselves. Even educated women remark glibly that "two children are quite enough" and express astonishment at a "large" family of four, quite unconscious of the fact that they are betraying only the shallowest notions of the most important function of their sex. And yet those who talk in this way are not stupid—at least all of them are not—else we should be quite content to see their breed become extinct. They are simply incredibly ignorant and unreflecting in regard to the perpetuation of life.

That our racial inheritance will deteriorate unless people of good hereditary qualities have at least the minimum of three or four children needed to keep up their stock is a proposition seemingly too obvious to require stating. Nevertheless it is something that needs to be said. It is something which most people probably do not know. And it is something about which

the Neo-Malthusians seem curiously reluctant about informing them.

The birth control movement would gain greatly in moral force if it placed more emphasis upon the responsibilities of those who take into their own hands the regulation of the birth supply. There are multitudes of people of good inheritance whose financial circumstances easily permit them to rear fair-sized families, but who are suffering their lines to become extinct through ignorance or wilful disregard of one of the most fundamental of all duties. Birth control is a biological innovation of great moment in the history of the race. Mankind has evolved without it, although at the cost of much suffering and loss of life. Its unwise employment for a few generations would have a disastrous effect on our racial inheritance which it has taken untold ages to build up. If so powerful an instrument for good or for ill is placed in the hands of human beings there should be some endeavor to induce them to use it wisely. If the Neo-Malthusians presume to undertake the rôle of guiding the unenlightened public in this regard they should do something more than simply preach restriction.

Nothing will be gained by attempting to force humanity back into reckless and unrestricted breeding with all the misery and high death rate which this would entail, whatever may be said for it from the standpoint of natural selection. Birth control has come to stay, and consequently it should be accorded decent treat-

ment. Attempts to put it under the ban by legislation or otherwise are productive only of harm. Its advocates are doing a good work in their efforts to abolish our fanatical laws which make the diffusion of certain kinds of knowledge a crime. They are making a useful plea for a wider knowledge of sex. They are doing humanity a service in extending the benefits of birth control to the over-burdened mothers among the toiling masses. But their remedy is very far from a panacea for social ills, and while it may mitigate some of the evils of the differential birth rate, our inheritance is bound to deteriorate unless the fecundity of superior types can somehow be increased.

There should be no need of a "cradle competition." With birth control carried out most where it would do the most good the race could still increase in numbers without burdening the capables with more than an average of three or four children per family. Birth control can be made an important adjunct to eugenics, however far from being so it may be now. Alone it is entirely inadequate.

CHAPTER XII

WILL BIRTH CONTROL REDUCE FERTILITY?

If birth control is to become a more widely prevalent custom, as now seems inevitable, the problem of its biological effects on the race becomes one of profound importance. These effects are many, but they may be considered from two standpoints: 1, in relation to the health of the individual, and 2, in relation to the inherited qualities of the race. It is not my intention to discuss the influence of birth control methods on the physical welfare of the individual; that is a matter of individual hygiene which is involved in much controversy, and I prefer to leave it to the discretion of more competent writers. And I cannot do justice to so large a topic as the relation of birth control to heredity. My discussion will be limited to one aspect of the latter subject which, though generally neglected, is one of much significance for racial well-being. This is the influence of birth control on the hereditary fertility of the race.

However greatly fertility may be modified by environment, it is nevertheless a hereditary character. It tends to run in families like blond complexions or short noses. Breeders are familiar with the striking variations in the fertility of different breeds of ani-

mals. The Dorset Horns and Hampshire Downs sheep are much more prolific than the Scotch Black-faced or Leicester varieties. Many kinds of poultry are poor layers, while the Leghorns are prized for their high production of eggs. Careful selection of stock for breeding is therefore essential if the poultry man would obtain the maximum yield of eggs from his fowl.

It is probable that the human species which contains so much hereditary diversity varies more in natural fertility than most species of animals and plants. The tendency of certain human families to produce twins has long been recognized. To a certain extent fertility in man is correlated with vitality. Pearson and his co-workers have not only shown that general health is hereditary but they have given statistical support to the common opinion that we tend to inherit long life. Life insurance companies have good reason, as they know from experience, for inquiring into the longevity of the ancestors of their policy-holders.

Now long life means, as a rule, not only health, but an unusual degree of fertility. Of course if people are cut off in middle life they are prevented from producing large families, but taking only those cases in which parents survive the child-bearing period, the longest-lived tend to show the highest fertility. Powys finds among the population of New South Wales that of mothers over forty-five years of age those who have had from five to seven children may expect to have the longest life. Similar results are reported by Pearson for other populations, and Alexander Graham Bell

found in his study of the genealogy of the Hyde Family that the greatest longevity occurs in families of ten or more children. Other things equal, small families come from parents with less than average vitality or resistance to disease. The inferiority which Pearson and others have found in the first-born children of a family is doubtless due largely to the fact that, since there is a first-born member in every family large or small, first-born children are members of smaller families on the average than are the children of any subsequent birth rank.

Where the natural course of reproduction is not meddled with the larger families with their superior vitality play a relatively larger part in perpetuating the race. There is a tendency for natural selection and what has been called reproductive selection, or the preservation of the prolific, to go hand in hand. But with the decline of the birth rate there has come to be a change. The large families have become more rare, and are found more commonly among people of subnormal intelligence and shiftless habits. There has developed a custom of standardizing the size of the family, and consequently the larger families suffer the greatest curtailment. If procreation were checked after the fourth child was born, the stocks which are the most prolific would suffer a loss proportionally much greater than those which are less prolific. It would thus be brought about that a relatively larger part of the population would be born of stocks of low natural fecundity. The more fertile types would still have an

advantage, but the average fertility of the race would certainly be reduced. Most Neo-Malthusians probably would not regard this result as anything to be deplored. But we should bear in mind that, along with this diminution in natural fertility, there would tend to go also a decline in the physical vigor of the population. Relatively larger numbers would be born of parents lacking the physical stamina to produce large families.

Notwithstanding all that may be said in favor of birth control, I do not see that there is any way of avoiding this conclusion. It can only be claimed that there are compensating advantages that outweigh this particular dysgenic influence. For the sake of the race it would be desirable if couples who are physically and mentally well endowed and who are in a position to give their children fair advantages in life were to rear large families of eight to ten children. Were all families to produce the four children which Mr. Roosevelt told us are required to keep up the race the result would be anything but fortunate. It is somewhat to be deplored that Mr. Roosevelt, whose appeal to the sense of racial duty is worthy of all praise, was not more discriminating in his plea for fecundity; his main interest apparently was in numbers without much emphasis on quality. It is scarcely necessary to point out that the interests of future humanity require that many married couples have no children at all. Others are quite justified in limiting their children to a very small number. Health, poverty, and many other circumstances may afford entirely adequate grounds for

family limitation. Family welfare as well as the racial welfare should be given its due consideration. But it is important for those favored by both heredity and environment to realize that they have it in their power through the production of large families to improve the physical and mental qualities of their race. If human beings assume the responsibility of regulating the birth supply, it should be done in the light of as full a knowledge of all the consequences as can be secured. The responsibility is a grave one, and nations and peoples may rise or fall according to the wisdom they show in discharging this trust.

CHAPTER XIII

SOME MISCONCEPTIONS OF EUGENICS [1]

It is often a misfortune for any good movement to become a fad. When this happens it is pretty sure to enlist the support of that object of Mr. Roosevelt's wholesome dread, the "fool reformer." And when the "fool reformer" gets to work, prejudice against what he advocates is inevitably aroused.

The eugenic movement has perhaps its worst enemies in its over-zealous and ultra-radical friends. The advocacy of doctrines strongly at variance with established ideals and social customs makes an impression on the public mind that is not likely to be effaced by any amount of sane and sober-minded teaching. Eugenics is in a somewhat unfortunate position in that, through a little misrepresentation, it may easily be made to appear in an unfavorable light. Pearson tells us that Francis Galton, toward the close of his life, had come to fear that the new science of eugenics would do more harm than good. And considering the volume of nonsense on the subject that is published largely for the purpose of appealing to popular interest in sensa-

[1] Reprinted in part from the *Atlantic Monthly*, February, 1915. The article is reproduced here because several of the misconceptions that are discussed continue to be more or less in evidence in popular writing on the subject.

tional things, there is more or less ground for Galton's rather gloomy foreboding.

The facility with which eugenics lends itself to caricature and cheap ridicule affords a temptation which is too strong for many writers to resist. No one would wish to deprive the editor of a country paper of his opportunity to wax facetious over "eugenic marriages" and "eugenic babies"; but it is a different matter when the same spirit of caricature is shown in articles purporting to give a serious and scholarly discussion of the subject. There are few questions of greater import than those relating to the forces which are molding the innate qualities of the human race. There is no knowledge which it is more important to have widely diffused than the knowledge of the means by which our human inheritance can be improved. And a peculiar obligation, therefore, rests on those who discuss this subject, to be guided, whatever their opinions may be, by a spirit of fairness, and to avoid the temptation, so often yielded to, of sacrificing strict accuracy of statement to rhetorical effect.

The more I read controversial literature the more I am impressed with the frequent employment of the device of setting up a man of straw in order to demolish the object of attack with a great show of effectiveness. Such a performance is doubtless the outcome of a common psychological failing: we all wish to be victorious in our encounters and to experience the feeling of triumph, even though we are led to expend our energies upon purely imaginary antagonists.

The best illustration of this method of attack which I have met with in the literature of eugenics is contained in an article by Mr. Fielding-Hall on *Eugenics and Common Sense,* which appeared in the *Atlantic Monthly* for September, 1914. The writer states that "the eugenist takes man purely as a plant or as an animal; he wants to breed him just as animals are bred"; and then, after attempting to show that domestic animals and plants have been rendered inferior to their wild ancestors through selective breeding for particular qualities, he draws a melancholy picture of what would happen if the "eugenists" were to put their ideas into practice. "Therefore, suppose the eugenists had their way and established a state, what would the inhabitants of that state be like in a few generations? They would be tall, broad, muscular, beautiful, delicate to a degree, useless save for athletic contests or beauty shows, always in the doctor's hands,—eugenic doctors, of course,—brainless, incapable of affection, almost wanting in courage, to a great extent sterile." And further on we are told that "the eugenist omits love. He knows nothing about it or about the world"; and we are given a forecast of what the world would be if "the Eugenists could have their way and banish love."

One would naturally suspect that all this was written purely for the sake of humor, but a perusal of the entire article leaves no doubt of its serious purpose. Nevertheless I have found myself recurring from time to time to certain passages with the uneasy consciousness that

after all I may have mistaken the intent of the author. When one criticizes the doctrines of the eugenists the implication certainly is, if no one is singled out for attack, that the opinions combated are typical or representative of eugenic teaching. Nothing could be more manifestly unfair than to attack extreme or generally discredited doctrines under the implied assumption that such views are shared by eugenists in general. But this is precisely the kind of tactics which our author pursues with apparently a naïve unconsciousness of the impropriety of such controversial methods.

As the author quotes, near the beginning of his article, from "what he calls a leading eugenic textbook," which, by the way, is Davenport's *Heredity in Relation to Eugenics,* the unsuspecting reader might be led to suppose that the various extreme doctrines which are discussed were advocated in that volume. But not only are such doctrines not found there, but there is much that implies precisely the reverse. Where then are we to find the "eugenists" whom our author would hold up to scorn?

I have had occasion lately to make a bibliography of articles and books on eugenics in which I have endeavored to include the titles of all contributions of any scientific value on this subject. Surely a representative publication like the *Eugenics Review,* the official organ of the Eugenics Education Society of England, ought to voice the opinions of Mr. Fielding-Hall's "eugenists," in abundance; but after running through the files of that journal from its inception to the present

time, I have failed to find a single expression of what our author represents as typical eugenic doctrine. In a similar survey of the chief German journal of racial biology, the *Archiv für Rassen-und Gesellschafts-Biologie,* my search was equally fruitless. So also was an examination of the publications of the Galton Laboratory in London, of the bulletins of the Eugenics Record Office in this country, and of various journals devoted entirely or in part to human heredity and social evolution. A few years ago there was an International Eugenics Congress held in London. One would naturally look to this widely representative body for authoritative expressions of eugenic doctrine. But if "eugenists" of our author's type were represented at the Congress at all, they failed to make a single communication that found its way into the two volumes of the published proceedings. Probably no one has a better right to be regarded as an authoritative exponent of eugenic doctrine than the late Sir Francis Galton; but no one was more careful to disclaim the advocacy of any measures that are antagonistic to established social usage.

Who then are these "eugenists" against whom Mr. Fielding-Hall does battle? I do not deny that some might be found, for almost every imaginable absurdity has its exponents. Our critic had sedulously refrained from mentioning any of the "eugenists" by name. One escapes a certain measure of responsibility in attacking doctrines which are attributed to no one in particular. But in combating the views of people loosely

referred to as "eugenists," one should direct his arguments against opinions that are held by the majority, or at least a large percentage, of his opponents. It is scarcely to be supposed that any one who presumes to write on eugenics is unacquainted with the literature to which I have referred. But the author has chosen to ignore these sources of information, and has set up a eugenist man of straw who knows nothing of love, who would breed human beings as cattle are bred for points, and who is altogether a very ridiculous sort of person.

Mr. Fielding-Hall objects to the conclusion that the laws of the improvement of corn and race-horses hold true also for man. We are told that there is much yet to be learned regarding the laws of heredity (which almost any one would cheerfully admit), and that the result of breeding domestic plants and animals is to produce races that are imperfect or degenerate in many respects, however highly they may have been developed in others. But when he passes to the statement that the attempt to improve the human race by selective breeding would end only in disaster, the conclusion by no means follows. Man improves animals and plants in certain directions to serve his own selfish purposes, and it is not to be wondered at that they are usually rendered less adapted to thrive in a state of nature. Animals are not bred for general intelligence, nor as a rule for general vigor, and hence they are usually, though in many cases not markedly, inferior in brain and general physique to their wild progenitors. Man,

however, is an animal molded to live in the somewhat artificial environment of civilized society; and if he has lost something of his ability to thrive under the conditions of primitive savagery, the loss is of no particular disadvantage under what is now his normal mode of life. But why, if human evolution should be directed by eugenists, man should become "tall, muscular, brainless, and wanting in affection," is incomprehensible, unless the "eugenist," with all his other stupidities, should deliberately set out to create so stupid a product.

Few appreciate the enormous advances made in recent years in the study of heredity, and the large degree of "scientific precision" that has already been attained in our control of the heredity of plants and animals. Our author indeed admits that "there must be something in heredity," but he candidly adds, "I have no idea what it is." With all the doubt and uncertainty that attaches to many questions of human inheritance there is no doubt that any one who had a fair knowledge of the principles of genetics, and who was given control over the matings of human beings, could, in the course of a very few generations, produce a large number of very diverse types. He could breed a race of idiots, a race of dwarfs, a race of giants, an albino race, an insane race, a race of moral imbeciles, a race which would almost invariably get drunk in the presence of alcohol, a race of preëminent mental ability, or a race of unusual artistic talent. The task would

be easy, as it would involve only the isolation of existing strains of the human species.

The possibilities of improving our inheritance, even with our present imperfect knowledge, are great. The difficulties are chiefly those of ways and means. Most eugenists agree that it is highly desirable to prevent the propagation of degenerate human beings. We know enough of the inheritance of feeble-mindedness, insanity, and several other defective traits to justify us in preventing those in whom these defects have been inherited from producing offspring. In regard to many other features of human inheritance we are still much in the dark, as eugenists realize as well as, if not better than, almost any one else. One need not fear that "the eugenists would eliminate all disease and with it all ability"; nor is it probable that "they would have prevented Lord Bacon from being born." Only an imaginary eugenist would be likely to do anything so unwise.

Any one familiar with current discussions of the policy of restricting parenthood cannot fail to be impressed by the general counsel of caution which is given by those most prominent in the eugenic movement. But no one with an adequate knowledge of human heredity can have any doubt that there are several forms of human ills which could be very materially reduced by the proper restrictive measures.

Several years ago, in the valley of the Dora Baltia, there were many cretins and people afflicted with goiter. These people were allowed to marry among

their own kind and the result was the production of children who were defective like their parents. As David Starr Jordan, who visited the place several times, remarks, "They were breeding a special type of man utterly incompetent to take care of himself and utterly useless for all sorts of purposes." A few years ago a policy of segregation was adopted: the cretins were confined during the reproductive period and not allowed to marry. At present they are nearly extinct. An opponent of eugenics might have warned us that our knowledge of the laws of heredity is not sufficient to warrant any meddling with the perpetuation of life among these people, and counseled the policy of *laissez-faire*. But if he had had his way, the idiots and imbeciles would still be with us.

While many of the critics of eugenics admit that it is not only feasible but a social duty to eliminate our hereditary defectives, they offer various objections to any attempt toward the further improvement of the human race. There is a more or less prevalent conviction that most eugenists would have marriages determined by the state in order to develop the desired type of man. People, and especially the American people, are naturally hostile toward any system which would impose restriction or regulation of freedom of marriage. And in so far as they have been led to look upon the eugenist as a person who aims to bring about matings which will tend toward the realization of a particular eugenic ideal, they are apt to experience resentment against such an infringement upon their natural rights.

Who is to decide, it is often asked, what is to be the eugenic ideal? In this connection it is well to recall the remark of Francis Galton: "Society would be very dull if every man resembled the highly estimable Marcus Aurelius or Adam Bede. The aim of Eugenics is to represent each class by its best specimens; that done, to leave them to work out their common civilizations in their own way."

There is a sufficient consensus of opinion as to what kind of human beings are desirable in an ideal state, so that we need not trouble ourselves about further details for some time to come. Health, good nature, moral stability, social sympathy, and intellectual ability, I think almost every one would agree, we could well have in much greater measure than at present. We want more of such stock as the Lowells, the Lees, the Edwardses, the Adamses,—the stocks that have given us our authors, statesmen, educators, and successful men of the world; and we want less of such stock as the Jukes, the Tribe of Ishmael, the Kallikaks, and other degenerates who help fill our almshouses, insane asylums, and jails. We are confronted by the fact that families that fall within the first-mentioned classes are not on the average producing enough children to keep up their present number, while many of the least desirable stock are maintaining a relatively high degree of fecundity. The recent decline of the birth-rate among the classes of society that have achieved success is a serious menace to our racial welfare. And there is no escaping the conclusion that

such a decline has occurred during the past fifty years in most civilized countries of the world.

The conservative eugenist wishes to effect a change in the differential birth-rate in such a way that fecundity shall be correlated with those qualities that are socially desirable instead of with qualities which we wish to eliminate. Most eugenists are keenly alive to the difficulties of effecting such a change, and they are quite generally agreed that any success in this direction must be preceded by a general enlightenment of the public, and an awakening, in those who are physically and mentally well endowed, of a sense of obligation to perpetuate the gifts which nature has bestowed upon them. In the catalogue of sins of omission there is none greater than the sin of racial suicide in a splendidly endowed strain. As Major Leonard Darwin has remarked, "We of this generation are absolutely responsible for the production of the next generation, and therefore of all mankind in the future; and to make every citizen realize his great racial responsibility in all things connected with marriage, to make him feel this as a deep-seated sentiment greatly affecting his actions, this is the eugenic ideal."

Eugenics is often attacked on the ground that, since we have much to learn of the factors of organic evolution, any attempt to improve the innate qualities of men is premature. According to Mr. J. P. Milum, who contributes an article, "The Fallacy of Eugenics," to the *London Quarterly Review,* "Eugenics is an application to human life of the current form of the evolu-

tion theory. The weak link in the evolution theory has been the attribution of creative power to selection. It is upon that very link that the eugenist has hung his case. Natural selection having failed in human life, it must be replaced, he declares, by conscious selection. And now we find that selection has no power whatsoever! It would appear, therefore, that eugenics is an untimely birth!"

Here we have the "fallacy of eugenics"! And since the subject can be disposed of in so simple and summary a way, it is not a little remarkable that so many of the leaders of biological thought should have been deceived by its fair promises that have no hope of realization. It is a great mistake, however, to conclude that the mutation theory, which the author represents to be orthodox evolutionary doctrine, precludes the possibility of progressive evolution through natural or any other kind of selection. This theory simply substitutes relatively large and stable variations for the minute ones to which Darwin ascribed the gradual formation of species. So far as the problem of progressive evolution in general is concerned, Professor De Vries, the chief exponent of the mutation theory, maintains that his doctrine "is in fullest harmony with the great principle laid down by Darwin."

No intelligent evolutionist ever held that natural selection creates the variations which must be presupposed before selection can produce any change. Darwin understood this obvious fact as well as any one at the present time. Whatever may be said of the crea-

tive power of selection, it is a demonstrated fact that selection has played an important rôle in the improvement of many varieties of plants and animals. Certainly the animal-breeder who refused to breed from his runts and scrubs would not be very "untimely," even in the present backward state of the science of genetics.

Whether one adopts the theory of mutation or adheres to the original form of Darwinian doctrine should not make the least difference in his policy in regard to checking the multiplication of defectives and incapables or endeavoring to increase the fecundity of the better breeds of human beings. It is in these two measures that the eugenic program essentially consists.

The fact that in certain pure lines selection has not proved sufficient to produce modification beyond a certain point has little direct bearing on eugenic measures, for the near future at all events. It is generally admitted by mutationists that the ordinary process of selection applied to a mixed population is easily able to raise the stock to the level of its best strains. Humanity presents a mixture of strains to an extent that probably occurs in no species in a state of nature; and if selection means no more than bringing out those that are most desirable and eliminating the inferior breeds it is capable of untold benefits to society. When the human species has been raised to the level of its best specimens Nature will probably be kind enough to supply us with further mutations in the direction of progress.

CHAPTER XIV

IMMIGRATION AND THE FUTURE AMERICAN [1]

THE last few years have witnessed a striking change in the prevailing sentiment of the American people on the subject of immigration. It has only recently come home to us that we are suffering from an attack of acute indigestion. Immigrants have been pouring in upon us more rapidly than they can be assimilated. Much of this influx assimilates with difficulty,—in fact scarcely at all in the first generation. Instead of the English, Scotch, Irish, Germans, and Scandinavians who made up the bulk of our immigration before 1880, we have been receiving hordes of Poles, Southern Italians, Greeks, Russians, especially Russian Jews, Hungarians, Slovaks, and other southern Europeans,—stocks less closely related to us by blood than the northern Europeans and less readily imbued with the spirit of our institutions. Our immigrants lodge chiefly in cities, forming little communities speaking their own language, and preserving, so far as possible, their customs and traditions. They show a very high percentage of illiteracy and they furnish a great part of the unskilled labor of our mines, factories, and streets.

Undoubtedly the immigrant is an economic asset to the country. His labor adds to the wealth of those

[1] Reprinted from *The Independent*, March, 1923.

who employ him and increases the total wealth of the nation. On the other hand, he may impoverish those who have to compete with his labor. He takes the job of the native American, and the native American goes elsewhere, often, fortunately for himself, into a better position. The big financial interests of the country have very naturally been in favor of abundant immigration. The steamship and railroad companies want passengers; the mining and manufacturing companies want cheap labor. Immigration has been encouraged because, it is claimed, the resources of the country needed to be developed. There were railroads to be built, forests to be cut down and virgin soil to be tilled. The average American likes to see things go ahead. He is fond of bigness of all kinds and he likes to brag about it. Immigration, moreover, makes business, and business, it goes without saying, is a good thing to increase.

But in addition to the economic motives for encouraging immigration the Americans have been actuated by a more generous desire to extend to the downtrodden workers of the old world the blessings of freedom and opportunity which this country affords. The average American used to believe that he lived under the most glorious government that ever existed under the sun. He felt himself a prophet of liberty. He would like to see his own political institutions replace the effete monarchies of less progressive nations, but in lieu of this, he would hospitably open the gates of his own country to the oppressed of other lands.

But the attitude of the average American is changing. He is suffering from an overdose of the unassimilated foreigner. He is finding that the foreigner creates many difficult problems and aggravates many existing evils. And with our increased growth of foreign population he is finding that political power in many localities is passing out of his hands into those of aliens whom he has but very imperfectly indoctrinated with the ideas and ideals of American democracy. With continued influx of immigration at the pre-war rate and especially at the more rapid rate that would occur were no restrictions placed upon it, the American is beginning to wonder how long American traditions will last. Good old Puritan Massachusetts, which is no longer Puritan, by the way, but Roman Catholic, has according to the 1920 Census, 28 percent of foreign-born population, and but 31.9 percent of native-born of native parentage. Immigrants and the first generation of their children make up over two-thirds of her population. New York City, which is the largest Italian city and the largest Jewish city in the world, to say nothing of being the largest Negro city, has only 20.7 percent of native-born population of native parentage. We have hitherto gone on the theory that, however ignorant the foreigner might be, whatever may have been the institutions under which he lived, or whatever the stock from which he was derived, he or at least his children would become thoroughly Americanized in time. We had counted on America changing the foreigner instead of the foreigner changing America. The

latter possibility is coming now to loom up in a portentous manner. Of late years we have made frantic efforts at Americanization. The process we found had been taking place much more slowly than we would like, and we went out of our way as never before to hasten it along. No nation can be a great nation without a spirit of unity,—a certain degree of like-mindedness among its people. It is desirable also that it contain much diversity, but it should be diversity on approximately the same level. An infiltration of a moderate number of people from other countries is a wholesome influence in counteracting the tendency to fixity which is a natural proclivity of social groups. But carried too far it would result in making a people a mere hodge-podge of heterogeneous elements.

Quite aside from the native quality of our immigrants there is a danger in admitting them in such numbers as seriously to disturb the economic and social stability of the communities in which they come to live. If we were to receive the millions in Europe who, we are told, are ready and anxious to emigrate to America, we should have such an overwhelming mass of ignorant, poverty-stricken humanity on our hands that "Americanization" in any reasonable time would be a hopeless task. Conditions in our cities are bad enough now. With unrestricted immigration they would become almost intolerable.

The greatest permanent danger, however, lies in the likelihood of receiving stocks of inferior inheritance. The American is beginning to suspect that some of our

racial immigration is of low racial value.[1] Just as there are families on a low mental level, so there may be peoples on a low mental level. Unquestionably we have been getting much of this kind of human material. Our laws forbid the entrance of the insane, epileptic, and feeble-minded, but we detect only the most obvious cases. At the pre-war rate of over a million immigrants a year only the most cursory examination was possible with existing facilities. Consequently many undesirables slipped through only to find their way later into poor houses or asylums for the insane, or otherwise prove themselves burdens on the community.

Immigration has been and may be again probably the most potent factor in determining the quality of the future population of this country. If it is to be regulated in the interests of posterity the task should be begun as soon as possible, even though, through lack of knowledge, we may come far short of regulating it in the proper way. We cannot afford to wait until we have all the facts in our hands before taking action. Several writers in dealing with this problem have advocated what I should describe as a misplaced caution. Professor J. W. Jenks, after commenting on the complexities and difficulties of the problem and urging a study of it in an impartial spirit, tells us, "When the facts are clearly established, we have then to answer the further question whether we shall admit or exclude or make a distinction among the races.

[1] This suspicion has been strengthened by the results of the mental tests applied to the recruits for the United States Army in the late war.

Whatever the decision may be, we have the extremely difficult question of how we can make legislation and enforce legislation that shall do justice to all and inflict no needless suffering."

The quotation reveals, I think, an entirely wrong attitude. The writer implies that other peoples have a sort of vested right to come here and that we have to act very carefully and gingerly about excluding any one desiring to enter. Why should we assume the burden of proof that certain stocks will make undesirable additions to our population? We may need twenty years of meticulous investigation before we can prove our case to the satisfaction of critically-minded judges. In the meantime these questionable stocks will be pouring in upon us. Why not shift the burden of proof to the other fellow and require some assurance of his desirable qualities before admitting him to the country? We do not encourage people to enter our homes because we cannot prove that they are *not* criminals or imbeciles. We generally have some grounds for believing that they are at least respectable before we take them in. In regard to the immigrant the question should be not who can be proved bad enough to be sent away, but who can prove himself good enough to be admitted. The basis for selecting immigrants should be positive, not negative.

In dealing with the admission of aliens we should assume that immigration is not a right, but a privilege, and that we are under no obligations whatever to extend it to all peoples even of the white race. We may

be loth to make invidious distinctions between different nationalities, but no foreign people has any more basis for objecting to such discrimination than some of our neighbors have for not being invited to our parties. In our three percent rule we are now making discriminations, but it is under the cloak of a general mode of procedure. The proper regulation of immigration would probably compel us to abandon all pretense to impartiality and frankly state that there are several peoples that we do not want. Should we strongly suspect that the immigrants from any country are deleterious to our welfare, either socially or racially, we should take measures to debar them and revise whatever agreements on immigration we have made with the countries concerned. Whether these countries like it or not is a very secondary consideration compared with the preservation of the worth of our own future population.

It may, however, be unnecessary to undertake the delicate task of discriminating against peoples or nations as such. There is a growing consensus of opinion among unbiased students of the problem that we should have higher standards of admission. We let in altogether too many who are mentally below par. Our literary test could well be made more than the very meager requirement that it now is. It would undoubtedly help matters greatly if all incomers were compelled to undergo a series of thorough mental tests given in the language of the persons examined. Despite present defects in the art of mental testing and despite an occasional in-

justice to the immigrant, a test designed to exclude every one up to and including the level of a high grade moron would insure a much better result than we are now getting. Of course more thorough examination would involve great additional expense, but this would be a relatively small item compared with the gains from a more carefully selected immigrant population.

Australia, New Zealand, and Canada have regulated their immigration much more wisely than we, and consequently they are not suffering from some of the embarrassments with which we have to contend. We may well follow their example in many respects. As Mr. Roosevelt said, we want immigrants of the right kind, and it might even pay us to import them and give them a bonus for coming besides. We need good, healthy, intelligent, and enterprising stocks, provided that they do not come too fast for proper assimilation, and we could well afford to put up with considerable difficulty in getting them assimilated. But to import poor human material for cheap labor is not only bad economic policy in the long run, but a crime against future generations. In our over-emphasis of money getting and our neglect of the human values of our people we are in danger of selling our birthright for a mess of pottage.

Every American who is ambitious to see his country a truly great nation should be guided in his attitude toward immigration neither by considerations of wealth to be derived from imported cheap labor, nor by a sentimental desire to make this country an asylum for the oppressed of other lands, but by the ideal of an America,

peopled by strong, healthy, and intelligent men and women having the normal and wholesome instincts that make for sound character and harmonious social life. It is no charity to extend the opportunities of living here to the failures of the old world. A policy of free admission would rather be a crime against the future children of our own land, for these have their rights as well as our contemporaries. It is to our descendants that we owe our first obligation. No misguided sympathy for the unfortunate inhabitants of other countries should ever permit us to jeopardize the welfare of our future population.

The policy here advocated is not mere selfish nationalism. Were we to put the matter solely on the basis of how best we can serve the great masses of mankind living outside of our own borders I should say, without hesitation, that our wisest course would be to solve our own problems in such a way as to become a healthy, intelligent, and prosperous people. A nation which succeeds in doing this will perform the greatest possible service to the whole world. The example set and the methods employed to realize this end will encourage other nations to follow the same path. If a nation may seem selfish and exclusive in its efforts to attain the ends I have indicated, it is nevertheless taking the course which is the most altruistic in the end.

CHAPTER XV

THE BIOLOGICAL EFFECTS OF RACE MIXTURE[1]

THE subject-matter of the present chapter is closely related to the theme of the preceding one. Immigration brings about sooner or later the mixture of peoples and frequently also of distinct races. For the proper regulation of immigration, therefore, we should know whether the mixture of peoples and races is good or bad, both from the biological and the social standpoint.

In regard to the mixture of peoples within the limits of the white race there seems to be little ground to be apprehensive of harm on the basis of what is known of biology. There are, I am convinced, considerable differences in average inherited ability as well as in temperamental traits among the nations of Europe which are contributing to our population. Some of these apparently stand below others in native intelligence, and it is not likely that anything will be gained by assimilating them. But this does not imply that the mixture is bad *per se*. It simply means that a superior stock had better breed among its own kind than mingle its blood with that of a people on a lower level.

Most European peoples are the product of many

[1] Reprinted from *Hygeia*, July, 1923.

strains. An Englishman, Frenchman, German, or Austrian might number by the dozen the racial stocks that have contributed to his inheritance. Were we to confine our attention to men of the highest order of genius a long list could be made of those who are the product of diverse racial ancestry. With all the diversities occurring within the subdivisions of the white race it would indeed be difficult to say whether it would be better biologically for the French, English, and Germans to marry within their own groups or to marry with other Europeans of their own general level of development. All that can be said is that some of these inter-group marriages would result well and others ill, and the same could be said of marriages within any of these countries. Besides, the products of these cross marriages could scarcely represent much greater mixtures than the component parental stocks themselves. The hereditary diversities within each country are ample to prevent any injurious effect of inbreeding for a long time to come.

To ascertain the results of the intermarriage of distinct races such as the Negro and white, or the white and Mongolian, is an undertaking that should be carried on in a critical and scientific manner and on an extensive scale. At present the whole subject is in a confused and most unsatisfactory state. The many observers who have studied the problem have arrived at the most diverse opinions. Quatrefages and Novícow regard the mixture of races as biologically advantageous. Agassiz, Lapouge, Schultz and others

have been emphatic in their condemnation of the products of race crossing. A favorite criticism of the half-breed is that he has the vices of both races and the virtues of neither.

There is an extensive literature on race mixture, but from the scientific standpoint most of it is exceedingly superficial and disappointing. It is frequently marred by prejudice, and rarely is any attempt made to separate the social and the biological factors that conspire to determine the status and the characteristics of mixed breeds. Both those who favor and those who oppose the mixture of races appeal to the results of crossing varieties of plants and animals in support of their position, and succeed in finding biological analogies of the desired kind. Darwin and others have shown that crossing plants of related varieties frequently results in offspring of greater size, vigor, and fertility than the parental types. Numerous experiments have shown that the highest yield of corn comes from the crossing of different strains. The mixed or heterozygous state in corn is the condition of greatest growth and fertility. Inbred strains tend to deteriorate, but two such strains when crossed produce a hybrid whose yield commonly far exceeds that of either parental stock. The hybrid state *per se* seems to bring about an enhancement of vigor. It is not improbable, as has been suggested, that this phenomenon results from the increased number of separate factors in the hybrid, but, however hybrid vigor is caused, it is a very common occurrence in animals and plants. There have been some obser-

vations on human crosses which indicate, at least for stature, that results similar to those found in plants and animals sometimes occur. The measurements of Boas on the height of Indians, whites, and half-breeds showed that the latter averaged taller than either whites or Indians. Similar results have been reported by Fischer in his study of the Boer-Hottentot hybrids of South Africa. For the most part, however, there seems to be little to suggest that human crossbreeds exhibit that hybrid vigor seen so conspicuously in the crosses of corn and many other plants.

Not infrequently, however, cross breeding in plants produces hybrids of greatly diminished vitality. The products of crossing some varieties of tobacco are small and weak forms. Many tobacco crosses of fair vigor are sterile. Others scarcely do more than germinate before they die. Parallel phenomena may be cited from crosses between varieties of animals. If we attempt to draw conclusions, therefore, regarding race mixture in man from the effects of hybridization among animals and plants we are on very uncertain ground, for we can find analogies for almost any kind of result.

Topinard has made the plausible suggestion that the crossing of related racial stocks might have no bad results, but that the union of distantly related races might produce a deteriorated hybrid progeny. Spencer has claimed that wide racial crosses produce constitutional disharmonies, and Mr. Seth Humphrey in his book on *Mankind* has elaborated on the same idea. These views, however probable they may seem, are

based mainly on *a priori* consideration, and these are a very unsafe guide.

When we turn to a consideration of the actual facts we find that the evidence is inconclusive and in some instances contradictory. Hoffman has reported on the favorable results both physical and mental of the crosses between whites and Chinese in Hawaii. Many favorable comments have been made on crosses between whites and Japanese. The Anglo-Polynesian hybrids of the Pitcairn and Norfolk Islands have been described as a healthy and prolific stock. Crosses of Indian and Negro, on the other hand, have been condemned as a most unfortunate combination, but the evidence from the biological standpoint is not conclusive. Half-breeds between Indians and whites do not seem to be deficient in vitality, and the observations of Boas indicate that their fertility is even greater than that of either pure race. The reasons for this difference may, however, be more cultural than physiological.

The mulattoes which represent about the widest possible racial cross have been credited with a relatively weak physique. The measurements of recruits during the Civil War showed that in chest expansion, lung capacity, and general strength the mulatto was on the average inferior to both whites and Negroes. The opinions of most of the examining surgeons of the army at that time were distinctly unfavorable to the mulatto as a physical product. We have no adequate data on the fertility of the mulatto as compared with that of either component race, although it has been repeatedly

asserted that the mulatto tends to be sterile. The Boer-Hottentot hybrids studied by Fischer had families averaging 7.7 children apiece, and this is certainly not indicative of waning fertility. The mulatto's cranial capacity, according to Hunt and Topinard, is intermediate and depends roughly on his proportion of white blood. Intellectually there is abundant evidence that the mulatto is superior to his black brother. Almost everywhere the leaders of the race have white blood, and the same is true of almost all of the race who have achieved distinction in any field. The evidence of the army mental tests goes to show that not only does the mulatto score higher than the Negro but that he makes a rating according to the proportion of white blood in his composition. Confirmatory evidence is also furnished by mental tests of Negroes and mulattoes in schools.

Information furnished by mental tests concerning the inheritance of mental traits is as yet meager. An impartial consideration of the available data on the mentality of inter-racial crosses will, I believe, lead one to the view that the mentality of the crossbreed is somewhere between that of the parental stocks. Hereditary factors influencing mental development are probably very numerous. Under these circumstances, as in the inheritance of skin color, we should expect inheritance to approach the so-called blending type. Superior races have nothing to gain and much to lose by amalgamating with those on a lower level. When it comes to distinct races on approximately the same degrees of in-

tellectual development, such as, for instance, the best of the Caucasians and the best of the Chinese, the product of race crossing may be on the same high plane of mentality. It must be confessed that our knowledge on this score is neither extensive nor critical, and we need much fuller information before drawing conclusions which would influence practice in regard to the fusion of races.

Much of the condemnation of the crossbreed doubtless results from his infusion of inferior blood combined with the frequently demoralizing influence of his unsettled social status. There may, however, be certain crosses which are unfortunate simply as combinations. Quite apart from intelligence, there are numerous possibilities, through the combination of affective traits, of producing proclivities to all sorts of moral character, good and bad. These results are commonly evaluated not from the biological standpoint, but in their relation to harmonious and effective social life. Here is an almost unexplored field which must await the development of a better technique for studying the instinctive and emotional traits of man before such progress can be made. At present no more than a good beginning has been made in this direction.

The student of human heredity may not be in a position to prove that in general the crossing of races, even very distinct races, is to be condemned *per se*. Aside from the alleged inferior physique of the mulatto there is little to indicate that human hybrids are very conspicuously inferior because of their hybrid origin.

They may be inferior to the superior race. They are probably superior, at least mentally, to the inferior race. The crossing of races on different mental levels is therefore inadvisable. But before advocating or encouraging the mixture of different but equivalent races we should have fuller knowledge than we now possess of just what the results will be. The inheritance of a superior race is a very precious possession to be conserved at all costs. *The argument from ignorance should not be used to defend race crossing because we cannot prove that it is bad; it should be used rather to counsel caution because we do not know that it is not bad.* In the light of our ignorance about race crossing, the wisest course is to go slow and play safe. Our ignorance is no justification for taking a leap in the dark.

This needs especially to be emphasized in the light of other considerations drawn from our knowledge of Mendelian segregation. Formerly inheritance was considered to be typically blending, and the subsequent generations of a racial cross were thought to be very much like the first. This is now known to be far from correct. Characters that appear to blend in the first generation of a cross segregate out in various combinations in the second and subsequent generations, and we get in wide crosses a motley array of the most diverse forms. This is because the parent types differ in a considerable number of hereditary factors. The more different factors there are the larger the number of different combinations that can be made from them. And

however harmonious the blend made in the first cross, the second generation is apt to produce many unfortunate combinations of traits.

In the structures that go to make up the human head and face there are many characters that segregate out in various ways in the second generation of a racial cross. In each race there is a fairly harmonious adjustment of shape of skull, relative size of facial bones, size and shape of jaw, size of teeth, etc. In a cross of different races owing to the varying dimensions of these several characters and their segregation in different combinations one may observe narrow jaws with broad head, small jaws with large teeth, and various other jumbles of anatomical characteristics, which certainly detract from comeliness if not effectiveness of physical organization. Kingsley, Talbot, and other writers on dental anomalies attribute a large part of our dental maladjustments to the intermarriage of different racial stocks. Large teeth set in small jaws are a fertile source of trouble, and there are other maladjustments of an analogous kind.

Where species crosses are very wide or when species of distinct genera have been found to produce fertile hybrids the progeny in subsequent generations may revert almost completely to the parental type. This is a very peculiar phenomenon and quite different from what would be expected according to the principles of Mendelian inheritance if all possible germinal combinations were able to develop. Goodspeed and Clausen have developed the idea of special reaction systems charac-

teristic of the several species. Such systems consist of harmoniously functioning groups of factors, but in the second generation of a wide species cross those forms with a part of one system and a part of another do not survive. Only those succeed in developing which have a fairly complete system belonging to one or the other parent species.

Comparatively little scientific study has been made of the second generation of human hybrids. The most detailed investigation of the subject is E. Fischer's work on the Rehobother hybrids of South Africa and these give much evidence of the alternative inheritance of many traits, and a high degree of variability in physical characters and intelligence. One cannot look over the photographs of the many faces of the hybrid population that are given in Fischer's book without noting the almost kaleidoscopic combinations of ancestral features which they exhibit. If among the great diversity of human beings which follow the first racial cross a considerable proportion should prove to be undesirable products—as one might reasonably expect —the result would be unfortunate. It would take a very long time for a population resulting from race mixture to become a fairly homogenous group, and in the meantime it might suffer from the embarrassment of a considerable proportion of poor grade humanity.

By way of summarizing our discussion of race mixture we may present the following tentative conclusions:

The crossing of distinct races is not demonstrably

followed, except possibly in the case of the mulatto, by a marked decrease in vitality in the hybrids.

There seems to be no good evidence, on the other hand, except in the height of certain half-breeds, that there is any enhancement of vigor in human hybrids such as occurs not uncommonly in crosses among animals and plants.

There is no clearly demonstrated loss of fertility, despite many assertions to the contrary, in crosses of the most divergent races of mankind.

The mentality of crosses between races of different degrees of mental development seems to be somewhere between the mental levels of the parental races.

Even when two distinct races are on the same mental level extensive crossing should not be encouraged until more is known concerning just how it is likely to work out. Not only is our knowledge of the blending in the first generation insufficient, but we have little accurate information on the more important subject of the varied products of subsequent generations. Here we find broken up those combinations of ancestral heritages which have been worked out through a long struggle for existence. There is good ground for believing, on the basis of our knowledge of genetics, that a great many of the products of Mendelian segregation are not particularly happy combinations. This suspicion is more or less confirmed by a casual inspection of the motley products of the so-called race fusion. There may, however, be advantages in the crossing of some races, but the fact should be established before crossing

becomes so extensive as to threaten the persistence of either pure race. Concerning race mixture in general it is well to adhere to the old maxim: Be sure you are right before going ahead.

For many nations of the earth the problem of race crossing is a very practical one. In many parts of the globe the amalgamation of distinct races is actively going on, and the process, if carefully studied, would yield information as to what to follow and what to avoid. We have in the United States a great variety of laws on race mixture. In the Southern States quite generally the marriage of Negroes and whites is prohibited, frequently under severe penalties; and we find in different states varying percentages of Negro blood are specified as a bar to marriage with pure whites. Many states in the North place no obstacle in the way of Negro-white marriages. Nevertheless such marriages have never taken place in any considerable numbers. Some states prohibit the marriage of white and Mongolians, and there are various laws as to the marriage of whites and Indians.

Should these laws be repealed or kept in force? Should all states pass laws prohibiting inter-racial marriages? Or should marriages between certain races be allowed and those between others forbidden? From the nature of the case a uniform policy would seem to be most advisable. And for reasons previously stated I believe that our policy should be one of restriction. This policy should be followed until our knowledge of the effects of race mixture is sufficiently exact to enable

us to tell whether or not these effects are injurious. We do not need to experiment in this matter. There is enough race crossing of all kinds going on in various parts of the earth to furnish abundant material for observing how the process is working out. It may take some generations before the problem is satisfactorily solved. But in face of an issue of such importance for the racial welfare of mankind we can well afford to wait for more light.

CHAPTER XVI

THE BIOLOGICAL FORTUNES OF THE NEGRO

THERE are some topics upon which I have sometimes thought that people should be forbidden to write unless they have something particularly important to say. But in lieu of such a regulation for the protection of the reading public one should be guided by the consideration that the importance of the subject may justify even very minor contributions to its discussion provided they aid in placing it in a somewhat clearer light.

The Negro problem is one of the most pressing that confronts us as a people. The problem is unfortunately a perennial one, but it presents new phases from time to time. Of the several "solutions" that have been offered none has met with general approval. Amalgamation, deportation, segregation within a limited area, and even sterilization have all been advocated and condemned either as undesirable or impracticable. Through no fault of his own the Negro is on our hands, and we must make the best of the situation somehow, with no very encouraging outlook ahead for relief from its difficulties and embarrassments.

When the biologist considers the Negro problem he naturally directs his attention to birth rates, death rates, migrations and other component factors of the

biological struggle for existence. For a struggle involving actual conflict the Negro race is one of the most poorly equipped on earth; but for the ability to propagate under untoward circumstances it is apparently one of the best. Chiefly through peaceful methods of propagation the Negroes have taken much of Cuba and most of many other islands of the West Indies, considerable sections of Brazil, and a good part of our own Southern States. In climates to which Negroes are adapted other races have seemed to be unable to compete with them. If given an opportunity, the Negroes would probably replace the Polynesians in the Pacific, as they have largely replaced the Indian stocks on many of the islands of the West Indies; and they may ultimately form, in the tropics, a black belt encircling the globe.

In the United States their increase has been rapid. Since 1860 they have increased from 4,441,830 to 10,463,131 in 1920. Nevertheless their rate of increase has rapidly declined between 1910 and 1920 when it fell to only 6.5 percent of the 1910 enumeration. Most of the additions to our Negro population have come by birth, but there has also been a Negro immigration from abroad that has shown a notable augmentation during the past several years. These Negroes come chiefly from the West Indies and the Barbados, and they are more in demand than our native products on account of their better training and tractability. During the past decade we have received annually somewhere between 5,000 and 10,000 Negroes from these

sources. There has been a slight emigration to Canada and other countries, but this has not been nearly enough to balance the gain.

While the total Negro population of the United States has increased by 635,368 (as compared with an increase of 993,769 between 1900 and 1910) there are several states in which Negroes have actually decreased in number. Thirteen states have shown a decrease in their Negro population in the last census, whereas only six (Connecticut, New Hampshire, Missouri, Maryland, Kentucky, Tennessee) showed a decrease between 1900 and 1910. Curiously enough, some of these are southern states having a large Negro population. It is somewhat surprising to find that between 1910 and 1920 Alabama lost 7,630; Mississippi, 74,303; Louisiana, 13,617; Kentucky, 25,718, and Tennessee, 21,330. In all these states except Kentucky and Tennessee there was an increase in Negro population in the previous decade, Kentucky losing 23,050, and Tennessee losing 7,155. Excepting the five states just mentioned, and Delaware, which lost 846, all of the other states losing Negroes in the last ten years were in the north and west; and as their Negro population was small their losses were not great.

One very important cause of the decrease of Negroes in the southern and border states was the extensive migration of Negroes into the north and west. Previous to their emancipation Negroes were chiefly confined to states in which slavery was a legalized institution. Climate, habit, inertia, and many other causes

have kept most of the Negroes in the South, but the opportunities and privileges afforded them in the North have been luring ever-increasing numbers away from their old homes. The late war by creating numerous opportunities for labor in the industries of the northern states has greatly accelerated this migration. Mr. H. H. Donald, who has made a thorough study of Negro migration during the late war period, states, "When the Great War came and suddenly removed thousands of the aliens from the industries of the North, employers experienced such an urgent need that they were only too glad to draw freely from the Negro population of the South to meet their demands. As the economic interests here were paramount, racial prejudices were apparently swept aside, and the Negroes by the thousands were admitted into industries hitherto closed to them."

There were, according to the last census, 472,418 more Negroes in the North and West in 1920 than in 1910. Donald states that "it is clear that a smaller number went north for there was some natural increase," but I am disposed to believe that a considerably larger number migrated, because some of the migrants died in the North, others (we do not know how many) returned before the 1920 enumeration, and the natural increase, for reasons to be given later, was probably a minus quantity. The number of Negro migrants in the war period has been estimated from 150,000 to over 700,000, but the latter figure is probably the more nearly correct. The states in the North

and West which gained most in Negro population were those of the greatest industrial development. The gains in several of the states that increased most in Negro population are shown in the following table:

INCREASE OF NEGROES IN SEVERAL STATES IN THE LAST TWO DECADES

States	*1900–1910*	*1910–1920*
New York	34,959	64,292
Massachusetts	6,081	7,411
New Jersey	19,916	27,372
Pennsylvania	37,074	90,649
Ohio	14,551	74,735
Indiana	2,815	20,490
Illinois	23,971	73,225
Michigan	1,299	42,967
Missouri	−3,782	20,789
Arkansas	76,035	29,329
Kansas	2,027	3,895
Oklahoma	81,928	11,796
Nebraska	1,420	5,553
Maryland	−2,814	12,229
District of Columbia	7,744	15,520
Virginia	10,374	18,921
West Virginia	20,674	22,172
California	10,600	17,118
Texas	69,327	51,645

Previous to 1910 the bulk of the northern Negro migrants came from the border states of the South. This explains why Kentucky, Tennessee, and Missouri had an actual decrease of Negroes in this decade, and

why Virginia's Negro population increased by only 1.6 percent as contrasted with a much higher rate of increase of most states further south. In the war period Negroes were drawn more plentifully from all of the southern states. Estimates have placed the migrants from Alabama at 90,000, from Mississippi at 35,291, from Georgia at 48,897, from Louisiana at 16,912, from Florida at 10,291, from South Carolina at 27,560, from North Carolina at 35,570, and from Virginia at 49,000. These are of course only rude approximations, but they are indicative of the general trend. Mr. Donald believes that there has been a "movement of the Negro population from the southern cities to the northern industrial centers, while there was going on at the same time a movement of the rural Negro population from the rural districts in the South into the depleted cities to take the place of those migrating to the North."

The general character of the Negro migration is an important factor in its biological influence upon the colored race. It has consisted chiefly of people in adolescent or middle age, and it is of peculiar significance that it has included a considerable proportion of women in the child-bearing period of life. In many of the cities and some of the states of the North, female Negroes outnumber the males. The South is therefore losing to the North the elements of the colored race that would contribute most to its natural increase. The effect of this movement on the colored race as a whole depends on how the net increase of the migrants is affected by their change of environment.

It is a fact of much significance for his racial prospects that in the North the Negro becomes predominantly a dweller in cities. The 152,467 Negroes in New York alone would make a fair-sized city. Philadelphia and Chicago have each more than 100,000 Negro inhabitants, and Detroit has witnessed a phenomenal increase in Negro population from 5,741 to 40,838 in the last inter-censal decade. The extent to which the Negroes flock to the cities is best shown by the percentages of Negroes living in urban communities in the northern states. According to the last census the percentage of Negroes living in cities in several of the northern states was as follows: Massachusetts, 95.9; New York, 93.3; Pennsylvania, 84.3; New Jersey, 78.8; Ohio, 83.8; Indiana, 88.9; Illinois, 88.7; Michigan, 91.6; Wisconsin, 83.7; Minnesota, 93.7; Iowa, 80.7; Kansas, 72.7; Nebraska, 91.5. It is of interest to compare with these the percentages of urban white population in some of the same states, *viz.*, New York, 82.5; Pennsylvania, 63.6; Ohio, 63.2; Indiana, 49.5; Illinois, 67.3; Michigan, 60.7; Wisconsin, 47.4; Iowa, 36.1; Kansas, 33.6; Nebraska, 30.7; Minnesota, 44.0. In all of the northern states except Rhode Island and Nevada the proportion of their race living in cities is greater among Negroes than among whites, while the reverse is true of a majority, although not a large majority, of the states of the South, the exceptions being Virginia, West Virginia, North Carolina, Alabama, Kentucky, Tennessee, and Oklahoma, most of which are border states.

That it is the mulattoes that are most prone to migrate is indicated by the fact that most of the Negroes of the North have some white blood. The states having the highest proportion of mulattoes in 1910 were Michigan, Maine, Wisconsin, Minnesota, New Hampshire, and Massachusetts. The 1920 census shows the highest proportion of mulattoes in the New England, the Pacific, and the East North Central and Mountain States. The decreased proportion of mulattoes in the North revealed by the last census is due to several reasons. The migration of more of the darker Negroes, the dying off of previous mulatto migrants in the North during the inter-censal period, the low birth rate of the northern mulatto, and possibly a diminished amount of miscegenation have all conspired to reduce this ratio.

The pure or nearly pure black is much more willing to remain amid his old surroundings than the Negro with a considerable infusion of white blood. The superior intelligence of the mulatto and his greater enterprise spur him on to improve his condition and to escape from the drawbacks of his status in the South. The mulatto has a better opportunity than the black in the more genteel occupations of Pullman car porter, waiter, barber, and house servant, all of which are preferable, at least in his opinion, to working in the cotton fields. Even in the North the mulatto is a Negro among Negroes, but he does not have to send his children to special schools or ride in Jim Crow cars. Economically and educationally the North holds out ad-

vantages that make a strong appeal to the more ambitious spirits of colored extraction.

Our knowledge of the birth rate of the Negroes is very incomplete.[1] That it has been high is evident not only from direct observation but from the rapid increase of the Negro population in spite of a high death rate. Until recently there were no federal statistics of births, and now they are tabulated only for the Registration Area in which most of the southern states are not included. In the Registration Area the Negro birth rate, to judge from rates of increase, is lower than in the states not included in it. In 1920 the Negro birth rate was so low in several states of the

[1] An index of the falling birth rate of the Negroes is afforded by the percentages of children under one year of age for the decades in which data on the subject are given. The proportions were as follows: 1860, 2.9; 1870, 3.1; 1900, 2.8; 1910, 2.6; 1920, 2.2. The percentages of children under five are: 1850, 16.5; 1860, 16.3; 1870, 16.2; 1880 not given; 1890, 14.0; 1900, 13.8; 1910, 12.9; 1920, 10.9. The following table affords significant data regarding the multiplication of the Negroes as compared with that of our native and foreign born population:

PERCENTAGES OF THE CLASSES OF THE POPULATION IN DIFFERENT AGE GROUPS

Age group	*Native white of foreign parentage*		*Native white of native parentage*		*Negro*	
	1910	*1920*	*1910*	*1920*	*1910*	*1920*
Under 1 year....	2.8	2.5	3.1	2.5	2.6	2.2
Under 5 years...	13.2	12.6	14.2	13.1	12.9	10.9
5–9 years.....	11.8	11.9	12.3	13.0	12.7	12.1
10–14 years.....	10.8	11.1	11.8	11.4	11.8	11.8
15–19 years.....	10.3	9.6	11.7	9.6	10.8	10.4
20–44 years.....	35.6	35.9	37.5	36.3	37.3	38.2
Over 45 years...	18.1	18.8	12.6	16.6	14.3	16.4

North that more Negroes died than were born. This is what happened in Indiana, Kansas, Maine, Michigan, Minnesota, Nebraska, Ohio, Oregon, Washington, Wisconsin, and Kentucky. In the entire Registration Area the Negro birth rate was 26.3, whereas the death rate was 18.4, the large and increasing colored populations of Virginia, North Carolina and South Carolina compensating for the losses in some northern states. In the same area the whites had a birth rate of 23.5 and a death rate of 12.8. Barring migrations (which of course we cannot do) this would leave a rate of increase of 7.9 per 1,000 for the blacks and 10.7 per 1,000 for the whites. From the ages of the Negro migrants to the North one would expect a relatively high birth rate. It is our foreign immigrants that keep the birth rate of our cities as high as it is, but the Negro influx has a different effect. That city life is proving destructive to the Negro is clearly indicated by a comparison of births and deaths in the northern cities into which he is migrating. The following table showing the proportions of Negroes in certain age groups in rural and urban communities of the South, North, and West tells very convincingly of the destructive effects of urban and northern migration, and especially urban migration in the North and West.

The Negro suffers a very severe handicap in the struggle for existence on account of his high death rate. According to Glover's life tables based on the 1910 census the average expectation of life for the Negro male is 35.05 years, and for the Negro female 37.67

years, while for the white man it is 50.23 years and for the white woman 53.62 years. Statistics of about one and three-quarter million policy-holders of the Industrial Department of the Metropolitan Life Insurance

PERCENTAGE OF NEGROES OF CERTAIN AGES IN URBAN AND RURAL COMMUNITIES OF THE NORTH, SOUTH AND WEST

Ages	*Total*	*Rural*	*Urban*
Total United States			
Under 5	12.9	14.5	8.6
5–14	24.4	27.3	16.9
25–44	26.8	23.2	36.6
South			
Under 5	13.4	14.6	9.0
5–14	25.6	27.5	18.3
25–44	25.3	22.9	34.3
North			
Under 5	8.1	10.3	7.5
5–14	15.3	20.4	13.8
25–44	38.8	28.8	41.7
West			
Under 5	6.4	6.1	6.4
5–14	12.2	13.2	11.9
25–44	44.3	41.5	45.0

Company give the average length of life of the colored male as 37 years, and the colored female as 39 years. White male policy-holders of this company average 46 years, and white females 52 years. According to Dr. Dublin, the statistician of this company, "the death

rate of colored persons is about 60 percent in excess of that of our white Industrial policy-holders."

The most frequent cause of death in Negroes is tuberculosis. Dublin states that the death rate from this disease "is more than twice as high among insured negroes as among white policy-holders. The disease is a veritable scourge among young negroes. At the ages between 10 and 14 years the tuberculosis death rate among colored boys is eleven times as high as it is among the white boys of the same ages. Colored girls at the same age period show a tuberculosis death rate eight times greater than that of white girls. . . . After age 35, there is not much difference in the effect of the disease between the two races."

Pneumonia ranks high as a cause of death among Negroes, especially in northern cities, but the influenza, possibly on account of a certain degree of racial immunity, was much less fatal to the Negroes than to the whites during the recent epidemic. Typhoid fever, hookworm, and malaria cause much sickness and death among the Negroes, and some of the degenerative diseases of later life, such as Bright's disease and heart disease, are especially prevalent among them also. Even homicide is no inconsiderable factor in the death rate of young males. The statistics of the Negroes insured in the Metropolitan Life Insurance Company show that "from 15 to 35 years of age, negro males have a homicide rate approximately ten times that of white males. At these ages, homicide ranks third as a

cause of death, being exceeded only by the figures for tuberculosis and the acute respiratory diseases."

Venereal diseases among the Negroes are notoriously common. The examination of army recruits for the late war showed a rate for gonococcus infection about six and one-half times as great for the Negroes as for the whites, and a rate for syphilis about seven times as great as for the whites.[1] In the Negroes the rates for both these diseases were greater in urban recruits than in those from the country. The well-known effect of the first of these diseases in causing sterility in both sexes is doubtless of no small influence in reducing the birth rate among the members of the colored race. The disastrous effects of syphilis are more far reaching. It is one of the chief causes of abortions and still births, and one of the most potent causes of infant mortality. In later life, although it is not recorded as a cause of death in a very high percentage of cases, it is nevertheless a contributory cause in a very large number of deaths ascribed to some other malady. It strongly predisposes people to contract tuberculosis and makes the course of that disease especially severe. In all probability, the high Negro death rate from tuberculosis is to a considerable extent a secondary consequence of syphilitic infection.

Since the period of slavery the biological status of the Negro has undoubtedly changed for the worse. There are no general statistics of Negro mortality be-

[1] See the Report of the Surgeon General, Part 2, p. 2,349, 1920.

fore emancipation, but a few cities have kept records which are probably fairly reliable, and these records indicate that Negro death rates were higher after emancipation than they were before. Records from Charleston, S. C., which are the most complete, show that from 1822 to 1860 the Negro death rate was 26.45 per 1,000, and in the post-war period, from 1866 to 1894 it had increased to 43.33 per 1,000, the white death rate having decreased by 1.56 per 1,000 during the same interval. Mobile had a Negro death rate of 30.31 per 1,000 from 1843 to 1855, and 35.60 per 1,000 from 1876 to 1894. Savannah, Ga., showed also a higher Negro mortality after the Civil War than in the period from 1856 to 1860. It is not improbable that the trend of mortality in these cities prevailed quite widely in the cities of the southern states. The examining surgeons who compared Negro and white recruits for the army at the time of the Civil War were almost unanimous in their favorable opinion of the Negro's fitness for military service. Dr. J. Streeter finds that "in muscular development and freedom from physical disqualifications they are superior to the average white man I have examined." Another medical examiner, Dr. Stevenson, describes them as "physically well developed, muscular, and strong and quite as free from diseases as the whites." In general, from the standpoint of physique and general health the Negroes were found to compare very favorably with the whites. Statistics of rejections from the United States Army showed for all diseases that 264.1 per 1,000 were rejected among the white

recruits and only 170.2 per 1,000 among the Negroes.

According to Hoffman, "The opinion of southern physicians who practised among negroes before the war was almost unanimous that consumption was less frequent among the colored population than among the whites." The death rate for consumption in Charleston, S. C., from 1822 to 1848 was a little lower among the Negroes (342 per 100,000) than among the whites (347 per 100,000), but from 1865 on it was over twice as high among the Negroes. Between 1865 and 1894 the death rate was 213 for whites and 576 for Negroes. During the same years in which the tuberculosis death rate was falling rapidly for the whites it was actually rising for the blacks.

It is significant that of Civil War recruits 11.4 per 1,000 were rejected because of consumption among whites, and only 4.2 per 1,000 among the Negroes. About the same percentage of cases occurred among white and colored troops during the Civil War, but the death rate from this disease was considerably higher among the latter (6.31 as compared with 2.18 per 1,000). In Africa the Negro is reported to be little susceptible to tuberculosis. His native freedom from this disease he continued to enjoy to a certain extent under slavery. In the period following emancipation he suffered a rapid increase of this scourge which has now become a chief cause of death.

Venereal diseases among the Negroes have had a similar history. During slavery they were much less common than they subsequently became. More Ne-

groes were rejected as recruits during the Civil War on account of syphilis than whites (10.7 per 1,000 colored, 3.8 per 1,000 whites), but there were fewer discharges per 1,000 for this disease among the colored troops, and a less proportionate admission to hospitals during the war. Both gonorrhea and syphilis were less prevalent among the colored troops. But it did not take long until venereal diseases became widely disseminated. "The fact is clearly proven," says Hoffman, "that immediately after the war scrofula, syphilis, and other venereal diseases were excessively prevalent among the colored as compared with the white population."

By no means the least important of the factors affecting the biological fortunes of the Negro race is its increasing infusion of white blood. It is not improbable that this infusion has a direct effect in reducing the vitality and fertility of the mulatto, as has so frequently been claimed. But, as I have already pointed out, this is a question upon which we are in need of more information which can be furnished only by careful and critical research. As to the relative increase in the numbers of mulattoes as compared with the blacks there can be no doubt. The following table showing the relative proportions of blacks and mulattoes in the decennial enumerations since 1860 indicates that the mulattoes have increased about twice as fast as the Negroes:

There is, of course, no clear dividing line between Negroes and mulattoes, and the personal standards of classification of the census enumerators are doubtless

subject to a considerable amount of variation. There is no good reason for supposing that these standards would change on the average in successive decades, unless, as suggested in the report of the census, the gradual whitening of the race would tend to increase the number classed as blacks. Doubtless very large numbers classed as black have some white blood in

INCREASE OF MULATTOES IN THE UNITED STATES

Years	*Per Cent Mulattoes*	*Mulattoes to 1,000 blacks*
1850	11.2	126
1860	13.3	153
1870	12.0	136
1890	15.2	179
1910	20.9	264
1920	15.9	188

them, so that the census figures for mulattoes represent less than their actual number.[1] One of my anthropological colleagues tells me that he has not seen a really pure African type for a long time. There may still be many pure Negroes in the South, but it is evident, even to the casual observer, that in the North and West by far the majority of Negroes have some white blood.

[1] According to the census report on the Negroes, "It is probably true that a much greater proportion than 20.9 per cent of the Negro population in 1910 were of mixed parentage. The proportion more or less affected by the dissemination has been estimated as high as three-fourths, and although no adequate data are available to substantiate such an estimate, the estimate is not in itself improbable."

As a matter of fact, then, the American Negro is well on in the process of absorption. Probably he is somewhere near one-fourth bleached already. Will the absorption go on until the black race is completely fused with the white? Human history has shown repeatedly that when different races are brought together in the same territory, whether as masters and slaves, conquerors and conquered, or as sharers in common rights, mixture of blood almost invariably follows. Even the Jews who have endeavored with remarkable persistency to maintain the purity of their race have come to exhibit many of the anthropological characteristics of the races among whom they dwell.

From the period of emancipation until the census of 1910 the trend of the Negro population was clearly in the direction of eventual absorption. Another fifty years of the same relative increase of mulattoes would have produced great changes in the black race. Where the effective rates of increase of two stocks differ so greatly as those of the mulattoes and the blacks it does not take many generations to bring about extensive modifications in the composition of the population. Unlike the Jews, the Negroes present little resistance to amalgamation. Sexual selection favors the individuals with a larger admixture of white blood. The Negroes are coming to be scattered more extensively through the white population, thus increasing the opportunities for racial mixture. Will the mulattoes, then, keep on gaining on the blacks?

In regard to this question the returns of the last

(1920) census are of peculiar interest. They show a relatively *smaller* number of mulattoes than would be expected in accordance with the previous increase of mulattoes over the blacks. What is the reason for this change?

The increase in the number of mulattoes is due in part to the natural increase of the mulattoes themselves and in part to the unions of whites and blacks. The greater part of the latter unions are illegitimate, since in most of the southern states and in some states of the North marriages of whites and Negroes are prohibited by law, and where they are legal they rarely occur, and they have been on the decrease for several years. It is encouraging to believe that the lack of the expected increase of mulattoes may be due to education and the development of a better type of morality in both whites and blacks. Possibly the crop of mulattoes represented an after effect of the period of slavery which is now beginning to wane. There is undoubtedly a growing realization of venereal dangers in illicit sexual relations, and especially with members of the colored race. In many sections of the South, I am informed, such relations with Negroes are less countenanced than they formerly were.

There are also other factors. One of the chief of these is the decline of the birth rate among the mulattoes. In the North most of the mulattoes live in cities under conditions which make a large family an inconvenience. They are rapidly learning to limit their families. The drawbacks of their peculiar status make

some of them loth to bring children into an environment where they will be subject to the restrictions which their parents sometimes feel so keenly. Undoubtedly venereal infection which prevails so widely among urban Negroes contributes not a little to the reduction of the birth rate. And the many other diseases which sap their vitality and whose effects are [illegible] by their high rate of mortality work toward the end.

Physically the Negroes have been running down hill since the Civil War.[1] Venereal diseases have increased among them. In the North and West Negroes become crowded into cities and subjected in an enhanced degree to the unwholesome conditions that have made cities in the past destroyers of men. The high percentage of mulattoes in the North is due not so much to the fact they are produced there as to the fact that the mulatto, who is more intelligent and enterprising than his darker brother, is more apt to seek his fortune by emigrating from the South. The South will continue to breed Negroes and mulattoes and pour them into the [illegible] of our

[1] Prof. J. W. Glover's recent work, *The United States Life Tables 1890, 1901, 1910, and 1901-1910*, issued by the Bureau of the Census contains some interesting data on the death rates and the duration of life among Negroes in 1901 and 1910. These tables are based on returns only in the original Registration Area which did not include any of the southern states. The expectation of life for Negroes has increased somewhat since 1901 when it was 32.54 for males and 35.04 for females. The greater expectation of life in 1910 is due almost entirely to reduction of the mortality of infancy and early childhood. The proportion per 1,000 dying in the first year is given for 1901 as 253.26 for males and 214.75 for females, and for 1910 as 219.35 for males and 185.07 for females. As Glover states: "The expectation of life was lower among Negro males in 1910 than in 1901 between ages 1 and and among Negro females between ages 8 and 85."

North. Here they will encounter relatively unfavorable climatic conditions which will decimate their ranks. To a certain extent they will be further bleached by mingling with the whites. Although there may be certain economic and educational advantages in coming North, it may be said as a general fact that when the Negro [illegible] goes North it goes to its destruction.

It [illegible]able that the northward migration of the Negro will continue to occur in large numbers, although eventually he may learn his lesson and remain where he can best thrive. When Negroes become scattered more widely over the country opportunities for race mixture will be multiplied, but whether this dilution will actually increase race mixture will depend upon the attitudes of the races concerned. To what extent illegitimate race mixture is going on in the cities of the North is difficult to ascertain. But the northern people have not adapted themselves to the Negro. It is perhaps too soon to venture to say how the northern migration of the Negro will affect his fusion with the white [illegible]. Apparently there is less concubinage in the South [illegible]ly. McCord[1] states, "The fact that sexual [illegible]tween the races is becoming more and more [illegible]ed to dissolute white men and Negro prostitutes [illegible] in common with all prostitutes, bear few children [illegible] rear fewer of them, is rapidly curtailing the infusion of white blood. The further fact, also, that children from such unions suffer both from vicious environment and degenerate heredity tends to make them less

[1] McCord, C. H., *The American Negro.*

prolific, even if they reach maturity, and to eliminate them by early death, thus cutting off their future propagation." And Duncan[1] expresses the opinion that "the whites who cohabit with Negro women to-day are generally white boys, usually under the age of twenty years, and old, broken-down, worn-out men, neither of whom are fit to beget children. This was quite different from before and for some years after the Civil War, when the best blood was infused into the Negro."

Whatever miscegenation is now going on in the North probably results in the infusion of white blood of a particularly undesirable kind. The Negro sections of our cities are commonly close to the "tenderloin" districts. And the Negro with his strong passions, weak inhibitions and his habit of living only in the present is typically a ready prey to vice. Du Bois has declared, "The Negro Academy ought to sound a note of warning that would echo in every black cabin in the land. Unless we conquer our present vices they will conquer us. We are diseased. We are developing criminal tendencies and an alarmingly large percentage of our men and women are sexually impure."

Doubtless a large amount of race fusion will continue to occur for many years to come. The effect of this fusion on the white race will depend in large measure upon the way in which it is brought about. As Mr. H. H. Laughlin has pointed out in a paper on

[1] Duncan, H. G., *The Changing Race Relationship in the Border and Northern States.* Philadelphia, 1922, p. 97.

Race Assimilation by the Pure-Sire Method,[1] where the males of one race are constantly given preference over the males of another race, while the females of the first race do not mate with the second, there will be brought about a gradual disappearance of the second race. To a certain extent this would occur on the basis of permanent marriages between the races. Marriages between white and colored are a negligible factor in the United States, but in matings within the colored race there is a tendency for colored women to select men of a shade lighter than their own. Dr. C. B. Davenport who has made extensive studies of the heredity of skin color in Negro-white crosses says that "in Bermuda and Jamaica dark males have a smaller chance of becoming fathers, and this selection against darker males must have a real effect in causing the hybrids to become, in successive generations, lighter." In 93 matings observed it was found that "in 65 the mother is the darker and in 28 the father is the darker."

Should this type of marriage selection prevail in the United States it cannot be counted on to produce a very rapid whitening of the colored race, although it would constantly tend in that direction.[2] The blacks

[1] *Journal Heredity,* 11, 259-263, 1920.

[2] The white blood in the mulattoes of the United States will probably become slowly disseminated throughout the Negro race. In the volume on *The Negro Population in the United States, 1790–1915,* it is stated that "whatever proportion mulatto future censuses may show for the Negro population, it is inevitable that the dissemination of white blood within the Negro population shall continue to embrace from period to period a larger proportion of that population until in fact the entire Negro population is affected," p. 209.

are probably becoming whitened more rapidly through illegitimate unions between the races. If a colored woman has a child by a white father, she is prevented, for a time at least, from having a colored child by a colored father. The white father does not suffer from a corresponding disability; he may still have white children from white mothers. If inter-racial unions were confined to those between white fathers and Negro mothers, or to those between relatively white fathers and darker mothers, while the multiplication of the whites went on unimpaired, racial assimilation would occur entirely at the expense of the colored race. These are not the precise conditions that actually exist, although they are approximated in the way in which race mixture is now working out. Offspring of white mothers and black fathers are relatively rare. The illegitimate race fusion now going on cannot be said to cause no interference with the production of white children,—it may do so in various ways,—but undoubtedly it bleaches the blacks much more than it blackens the whites. Needless to say, I am not advocating race fusion of the kind described. There is an appalling damage to both races in the miserable procedure of amalgamation,—damage morally, and damage physically through venereal disease, and in many other ways besides. Unfortunately these results seem to be the usual consequences of contact between whites and more primitive races all over the world.

Some have thought that the Negro race in the United States is destined to dwindle away and either even-

tually disappear or become a minor factor in our problems of population. This is the position taken by Mr. E. Eggleston in his book on *The Ultimate Solution of the American Negro Problem.* Dr. Raymond Pearl[1] in discussing the vital index of the Negro (the vital index is the ratio of 100 births divided by deaths) states that "except in the rural districts of the southern states, practically never does the vital index of the negro population rise to a value of as much as 100. But plainly any population with a vital index under 100 is a dying population. . . . Even in rural portions of the B. R. A. [Birth Registration Area] the negro index does not approach in magnitude the total white index nor the native white index for the same communities. This is true in the southern states as well as in northern. It would be difficult to find a more complete and critical demonstration than that furnished by these indices of the fact that the negro is biologically a less fit animal, *in the American environment, physical, social, and general,* than the white. . . . Under conditions *as they are,* Nature, by the slow but dreadfully sure processes of biological evolution is apparently solving the negro problem in the United States, in a manner which, when finished, will be like all Nature's solutions, final, complete, and absolutely definite. Just in proportion as the negro becomes anything but an agricultural laborer in the southern states does he hasten the time of his final extinction in this country."

I suspect that the early incompleteness of federal

[1] Pearl, R., *American Journal Hygiene,* 1, p. 664-665, 1921.

statistics on Negro births has led Dr. Pearl somewhat to exaggerate the tendency of the Negro race toward extinction. Some of the states with the largest Negro population have been very recently added to the Birth Registration Area. The statistics of Negro births in 1915 (the first year of the reports on births) showed that the Negro birth rate was lower than that for the whites, but the subsequent reports indicated a rise of the Negro birth rate over that of the whites where it has since remained. This was in part due to the addition of new states to the Registration Area. The vital index has risen to over 100 in several (7) of the states which had been running below this from 1915 to 1918 inclusive, and it was upon the data for these years that Dr. Pearl's conclusions were based. The figures for Negro births, as the reports themselves state, are probably too low, and they cover for the most part states in which the Negroes are thriving least.

The Negro race is still on the increase in the United States, but perhaps the census of 1930 will show that it has passed the turning point and begun to diminish in numbers. The factors upon which the biological fortunes of the Negro depend are many, and they present a varied complex of biological, economic, social, and ethical influences that range from the depredations of the boll-weevil to the awakenings of the Holy Spirit. The few factors which I have briefly discussed vary much in their action at different times. Some of them will doubtless increase in importance, *viz.*, urban migration, and perhaps, for a time at least, northern and

western migration. Tuberculosis and other respiratory diseases will probably decrease. Syphilis also will probably decrease. Already life insurance companies are recognizing the benefits accruing from improved methods of treating this disease. The Negroes will probably receive more of the benefits of the active efforts that are being made to reduce infant mortality. On the other hand, birth control will probably become much more prevalent among the Negroes, especially the mulattoes, and the residents of urban communities. With increasing numbers of Negroes going into industries this procedure may soon reduce their birth rate until their deaths outnumber their births. The Negroes will have to make their way in the future against an ever-increasing pressure of the white population. The checks to population growth which automatically limit the natural increase of human beings will bear with especial severity upon the Negro. He will be likely to encounter increased race prejudice in the North if he continues to come in increasing numbers. Prediction of the eventual fate of his race in the United States is a precarious undertaking, but at present it must be admitted that his prospects are not good.

THE END

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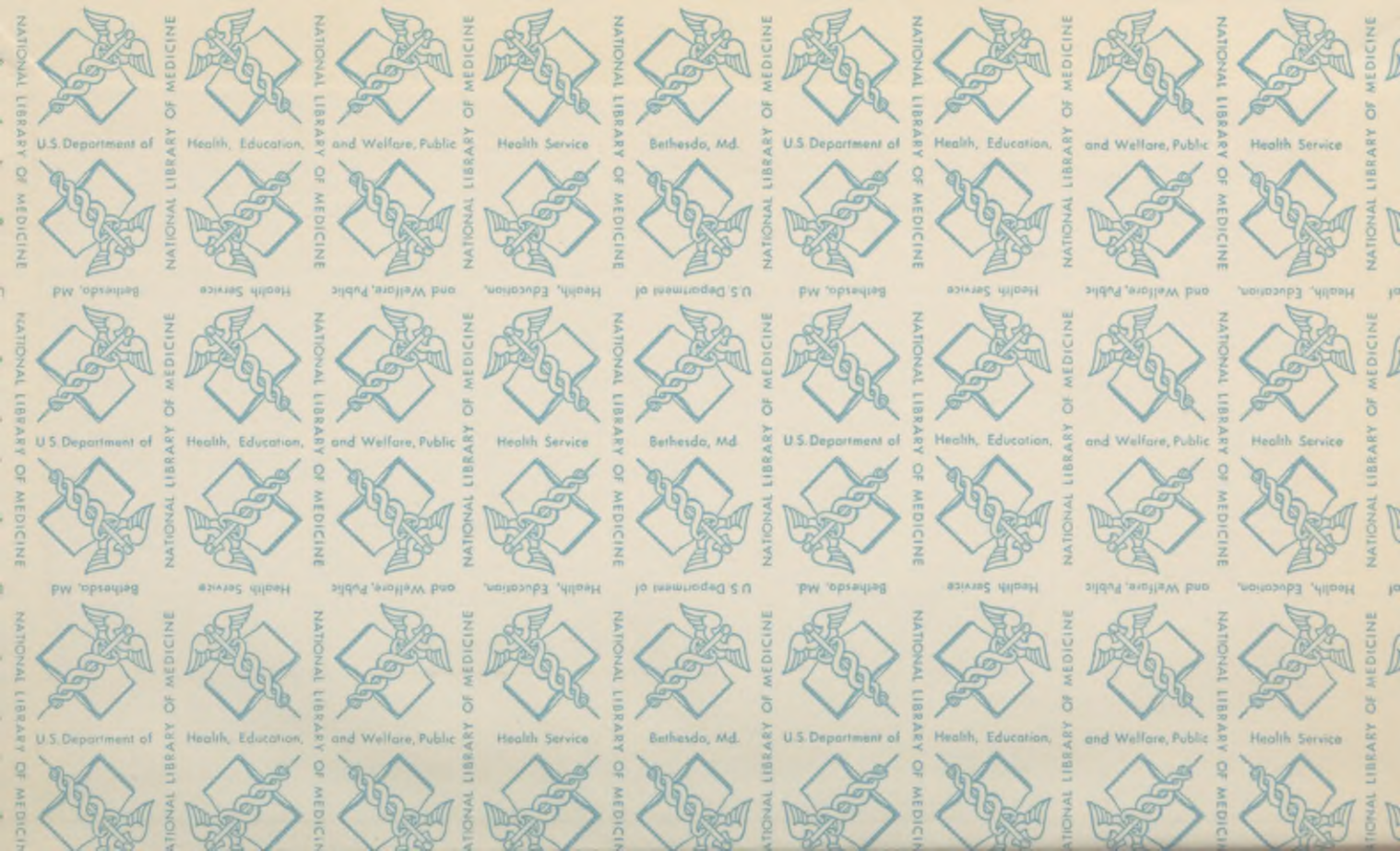
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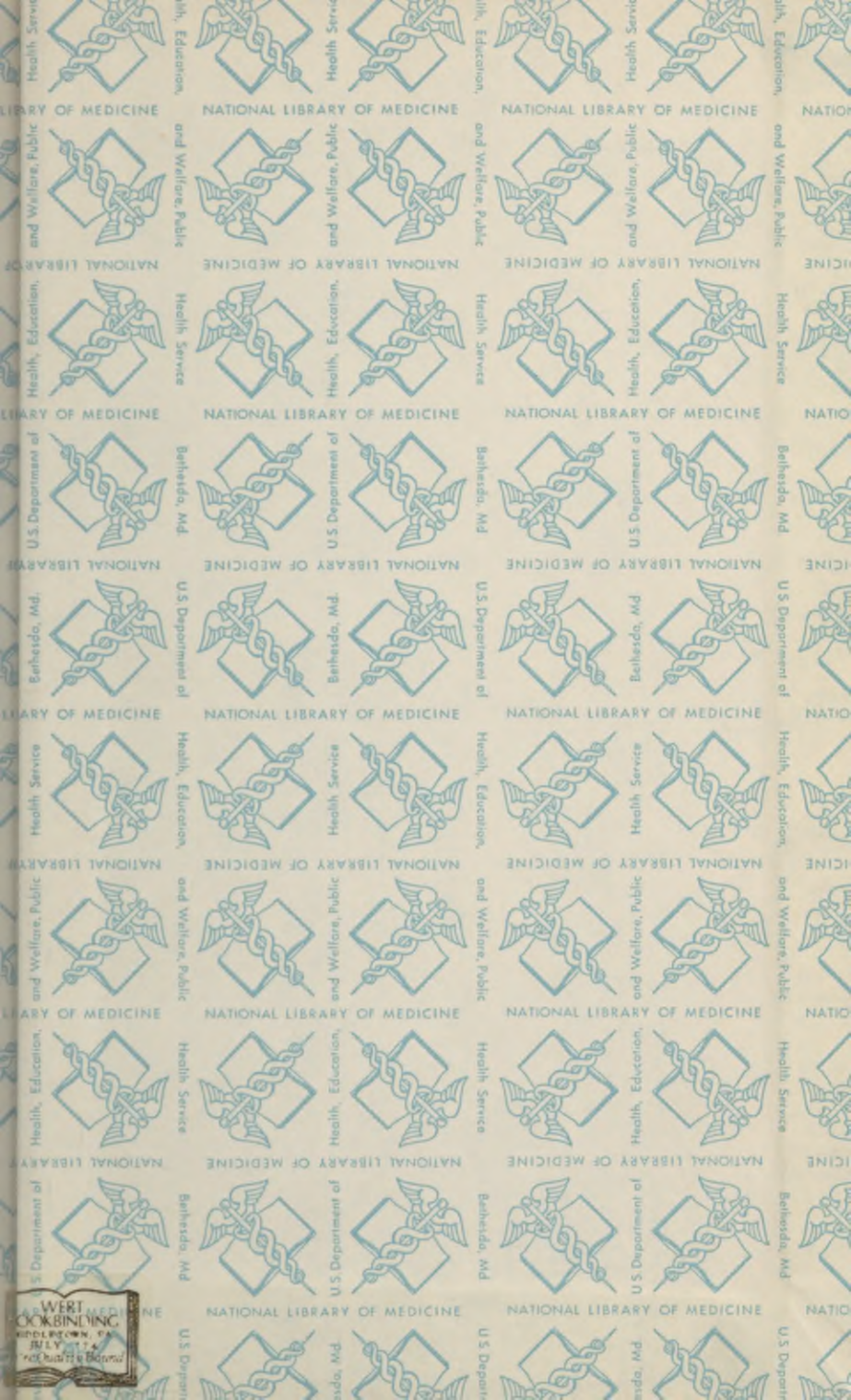
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