WORK-IN-PROGRESS (OCTOBER 15, 2019) PARALLEL CHART FOR

# Chapter 24 — Heredity and Environment

from *The Truth About Heredity: A Concise Explanation of Heredity for the Layman* (1927)
by
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## Sources for Chapter 24, in the order in which they first appear

**(1)** Professor H. S. Jennings, "Heredity and Environment," in *The Scientific Monthly,* Vol. 19, No. 3 (Sept., 1924), pp. 225-336

## Key

**(a)** Green indicates where a source author first appears, or where he/she reappears.

**(b)** Yellow highlights most parallelisms.

**(c)** Tan highlights parallelisms not occurring on the same row, or parallelisms separated by yellowed parallelisms.

**(d)** An underlined word or words indicates where the source and Sadler pointedly differ from one another.

**(e)** **Bold type indicates passages which Sadler copied verbatim, or nearly verbatim, from an uncited source.**

**(f)** Pink indicates passages where Sadler specifically shares his own experiences, opinions, advice, etc.

**(g)** Light blue indicates passages which strongly resemble something in the Urantia Book, or which allude to the Urantia phenomenon.

**(h)** Red indicates an obvious mistake, in most cases brought about by Sadler's miscopying or misunderstanding his source.

# XXIV: HEREDITY AND ENVIRONMENT

24:0.1 The closing years of the nineteenth century were characterized by efforts of sociologists and sanitarians in emphasizing the value of environment, education, and training. Wholesome and healthful surroundings were all put forward as the means whereby the human race might be improved and developed.

24:0.2 The opening years of the present century were characterized by the advent of the biologist with his observations and experiments having to do with heredity and resulting in the founding of a new science—eugenics. For some time there has been a tendency of the part of the biologist and his followers to belittle the influence of environment in human culture and to regard heredity as the one and only important influence having to do with race betterment.

24:0.3 Now, we think the time has come to take a more rational and balanced view of this question of heredity and environment. True, in former times, the value of environment was over-estimated, and may we not be in imminent danger at the present time, in our efforts to emphasize the importance of heredity, of underestimating the value of environment—at least, as regards its immediate influence upon the individual?

## CHANGING VIEWS OF HEREDITY

"HEREDITY AND ENVIRONMENT" (Jennings)

[contd] Knowledge of heredity has changed fundamentally in the past few years;

in consequence the relations of environment to heredity have come into a new light.

What has gotten into the popular consciousness as Mendelism—still presented in the conventional biological gospels—has become grotesquely inadequate and misleading; its seeming implications as to the trivial role of the environment have become null and void (J).

[!]

24:1.1 We must not overlook the fact that

the newer knowledge of heredity, those facts which have been developed during the past decade, have done much to change or modify our earlier views of heredity—

views based upon simple Mendelian experiments and observations.

We now recognize that

the more simple laws of Mendelism are not wholly adequate

to explain the complicated inheritance phenomena as observed in the mental, moral, and physical life of human beings.

We can not disregard the influence of environment in the study of human heredity as we can in the study of simple plant life and the lower animal organisms.

We must recognize the practical bearing of the fact that in every phase of human experience, environment, as well as heredity, determines the actual behavior and the final outcome of conduct on the part of any individual belonging to the human species.

[contd] What an organism is first composed of comes directly from its parents; this is the reason why dependence on that composition has been called heredity. But this habit of speech has led to conceiving heredity as something in itself, an entity, a "force,"

24:1.2 We must not come to regard heredity as a "force" or an "entity"

something that itself does things—an error that has induced clouds of misconception (J).

or something that does things separate and apart by itself,

that is, separate and apart from the environment in which every human being must live and carry on its life work.

24:1.3 It would be better for us to recognize that

[R]esearch has shown that the substances passed from parent to offspring, giving rise to the phenomena of inheritance, are a greater number of discrete packets of diverse chemicals, imbedded in a less diversified mass of material.

human heredity is determined by a package of highly diversified chemicals

The masses formed by the grouping of these packets are visible under the microscope as the chromosomes. The number of different kinds of packets that go into the beginning of any individual is very great, running into the hundreds of thousands (J).

which are to found in the chromosomes of the germ plasm, and that these chemicals, or at least the inheritance bodies, are in the human species capable of a far more complicated and diverse sort of combination and association than is the case of simple plants and the lower animal organisms.

In a word, the very inheritance elements in the human species are subjected to a highly diverse and uncertain sort of *inner environment* which may directly determine what sort of association and combinations may take place between these complex chemical elements or organized inheritance factors. A simple change in any one of the thousands of presumably possible directions may result in a very marked and definite change in the hereditary behavior of the resultant human personality.

## NON-MENDELIAN INHERITANCE

24:2.1 True, these inheritance factors in a general way follow certain well-defined rules, as has already been noted in preceding chapters.

Nevertheless, we are beginning more and more to recognize that

Development we know consists in [the] orderly interaction of these substances—with each other, with the rest of the cell body, or cytoplasm; and with the oxygen, food and other chemicals brought into the cell from outside; all under the influence of the physical agents of the environment. The final result—what the individual becomes—is dependent upon all these things; a change in any of them may change the result (J).

many and diverse influences, when brought to bear at the proper time in the course of early development, may influence in many ways the final product as it is manifested in the adult human being;

and while much of this has to do with development, at the same time, recent biological experiments serve to admonish us that in many ways the environment may actually be able to influence the combination and association of the basic hereditary factors, and thus be able directly to influence hereditary tendencies and behavior.

The first of the rules of distribution discovered was the so-called Mendelian Law; it is the rule according to which the two packets belonging to the same pair are distributed. But when we take into consideration the interrelations of packets belonging to different pairs, a whole set of rules is discovered, covering the distribution of all the packets. These have been worked out in recent years: they are of equal importance with Mendel's Law.

And some of these newer discoveries bid fair in time to acquire the same standing in biologic literature as already has been accorded the laws and procedures of so-called Mendelian inheritance.

24:2.2 We should remember that in the case of the inheritance in the higher animals,

In essence all these laws are simple ... But for genes located in different parts of the system, the rules of inheritance are somewhat diverse; and some of the genes are not paired,

many of the factors or determiners for certain traits or tendencies are not paired,

as we have learned they are in the more simple forms of Mendelian inheritance; so we are coming more and more to recognize the importance of discovering

so that they yield a set of rules very different from those followed by the others (J).

new laws and recognizing new modes of operation for these inheritance traits that are not found to exist in contrastive pairs.

Says one biologist writing on the subject:

The laws of inheritance are not immediate consequences of some fundamental physiological principle, but of the arrangement of the packets of chemicals and their method of distribution (J).

"The laws of inheritance are not immediate consequences of some fundamental physiological principle, but of the arrangement of the packets of chemicals, and their method of distribution."

[!]

And it is this very fact that makes it impossible to explain heredity in the human species in accordance with the simple inheritance of Mendel, and also renders human heredity subject much more to that subtle and inner sort of environment which surrounds the germ plasm, as compared with the germ plasm of plants and the lower animals.

## ENVIRONMENT IN THE LIGHT OF EXPERIMENT

24:3.1 Now, it must be apparent that

Any correct notion of the relation of environment to heredity

any reliable opinion respecting the relation of environment to heredity as regards the human species

depends on proper knowledge of how these packets of chemicals operate in producing the developing organism (J).

includes more or less knowledge of how these inheritance bodies or "packets of chemicals" operate,

and in turn, are influenced at the time they are evolving into the rudiments of a human individual.

Now, we have learned a great deal about how inheritance factors or the chemical substances which are the basis of heredity, are influenced by the epoch-making experiments of Morgan and his associates at Columbia University as they have worked in recent years on the heredity of the fruit fly.

| SOURCE | 24: THE TRUTH OF HEREDITY |
|---|---|
| In certain organisms it has been possible by proper mating and breeding to control the distribution of the packets almost as if they could be picked out and moved about by hand; this is essentially what is done by Morgan and his associates in their work on Drosophila. | 24:3.2 Morgan has found it possible to substitute certain inheritance factors for others in the case of the fruit fly, |
| | and that all such substitutions result in an immediate change in the hereditary characteristic of the individuals which are developed from this modified germ plasm. |
| Substituting one or more packets for others | It has been found that this substitution of inheritance factors |
| is found to change the characteristics of the organism produced; different sets give when they develop, even under similar environments, different physical, mental and moral peculiarities (J). | gives different physical and mental development under similar environment. |
| [contd] The first precise discovery made was, essentially, that when a single one of the packets is exchanged for another, | Every time a "packet of chemicals" is shifted or modified, |
| some definite later character is changed. | invariably a change in character or behavior results in the subsequent developing individual. |
| | 24:3.3 For instance, Morgan, by this manipulation of inheritance factors in the fruit fly, was able to |
| So, changing one packet alters the color of the hair from black to red; | alter the color of hair from black to red, |
| or changes the eye color from blue to brown; | to change the eye color from brown to blue, |
| or makes the organism short instead of tall; | to make the individual long or short, |

| SOURCE | 24: THE TRUTH OF HEREDITY |
|---|---|
| or even changes a person from a normal individual to a feeble-minded one; or the reverse. | or to change the individual from an apparently normal minded one to a freakish or apparently feebleminded type of organism; |
| | and it should be remembered that |
| Characters changed by altering a single packet were the so-called "unit characters" of Mendelism (J). | in some of these cases in which changes were wrought by these experiments, we are dealing with supposedly Mendelian "unit characters." |
| | Thus it will be seen, we are beginning to take into account some of the practical bearings of the "factorial hypothesis" of heredity, more fully discussed in a preceding chapter. |
| | 24:3.4 We must freely admit that |
| It is to this doctrine [that arose from studies of the "unit characters" of Mendelism] that the prevailing ideas as to ... the powerlessness of the environment are due. | environment is almost a negative influence in so-called Mendelian inheritance, |
| But it has turned out to be a completely mistaken one (J). | but, as we know more of the fundamental laws of inheritance as manifested in man and the higher animals, we come to see that we are not warranted in so wholly discarding the influences of environment. |

## MORE RECENT VIEWS

24:4.1 We cannot any longer maintain the position that

| SOURCE | 24: THE TRUTH OF HEREDITY |
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| From the fact that the "unit characters" changed when a single gene changed, it was concluded that in some ill-defined way, each characteristic was "represented" or in some way condensed and contained, in one particular gene. There was one gene for eye color, another for stature, another for feeble-mindedness, another for normal-mindedness, and so on. Every individual therefore came into the world with his characters fixed and determined. | an individual comes into the world subject to a sort of Mendelian predestination |
| His whole outfit of characteristics was provided for him at the start; what he should be was preordained; predestination, in the present world, was an actual fact (J). | in which all his traits and characteristics—physical and mental—are predetermined |
| | by concrete inheritance determiners, as suggested by Mendel's experiments with peas. |
| | We now recognize that many traits, both physical and mental, are probably determined by the interassociation of many different inheritance factors, and that it is highly probable that some of our more complex characteristics are determined by numerous hereditary chemicals or factors so that a given trait is subject to numerous and diversified inheritance influences in the germ plasm and further, we must not overlook the fact that our more recent experiments go to prove that these highly complex hereditary factors are subject to certain environmental influences. |
| | 24:4.2 Jennings, of Johns Hopkins, is perhaps the most outspoken of present day biologists in his emphasis of the necessity for a change of opinion in these matters. He says: |

| SOURCE | 24: THE TRUTH OF HEREDITY |
| --- | --- |
| But this theory of representative particles is gone, clean gone. | But this theory of representative particles is gone, clean gone. |
| Advance in the knowledge of genetics has demonstrated its falsity. | Advance in the knowledge of genetics has demonstrated its falsity. |
| Its prevalence was an illustration of the adage that a little knowledge is a dangerous thing. | Its prevalence was an illustration of the adage that a little knowledge is a dangerous thing. |
| The doctrine is dead—though as yet, like the decapitated turtle, it is not sensible of it. | The doctrine is dead—though as yet, like the decapitated turtle, it is not sensible of it. |
| It is not true that particular characteristics are in any sense represented or condensed or contained in particular unit genes. | It is not true that particular characteristics are in any sense represented or condensed or contained in particular unit genes. |
| Neither eye color nor tallness nor feeble-mindedness, nor any other characteristic, is a unit character in any such sense. | Neither eye color nor tallness nor feeble-mindedness, nor any other characteristic, is a unit character in any such sense. |
| There is indeed no such thing as a "unit character," and it would be a step in advance if that expression should disappear (J). | There is indeed no such thing as a "unit character," and it would be a step in advance if that expression should disappear. |
| [contd] What recent investigation has shown is this: the chemicals that were in the original packages derived from the parents—the genes—interact, in complex ways, for long periods; and every later characteristic is a long-deferred and indirect product of this interaction. | What recent investigation has shown is this: the chemicals that were in the original packages derived from the parents—the genes—interact, in complex ways, for long periods; and every later characteristic is a long-deferred and indirect product of this interaction. |
| Into the production of any characteristic has gone the activity of hundreds of the genes, if not of all of them; and many intermediate products occur before the final one is reached. | Into the production of any characteristic has gone the activity of hundreds of the genes, if not of all of them; and many intermediate products occur before the final one is reached. |

| SOURCE | 24: THE TRUTH OF HEREDITY |
|---|---|
| In the fruit fly at least 50 genes are known to work together to produce so simple a feature as the red color of the eye; hundreds are required to produce normal straight wing, and so of all other characteristics. | In the fruit fly at least fifty genes are known to work together to produce so simple a feature as the red color of the eye; hundreds are required to produce normal straight wing, and so of all other characteristics. |
| And each of the cooperating packets is necessary; if any one of the fifty is altered, the red color of the eye is not produced (J). | And each of the cooperating packets is necessary; if any one of the fifty is altered, the red color of the eye is not produced. |
| [contd] And this is what gave rise to the idea of unit characters represented by particular genes. | And this is what gave rise to the idea of unit characters represented by particular genes. |
| For suppose that one parent has all the fifty packets necessary to produce the red eye, while the other has but forty-nine of them, the fiftieth containing some substance that will not work in producing red. | For suppose that one parent has all the fifty packets necessary to produce the red eye, while the other has but forty-nine of them, the fiftieth containing some substance that will not work in producing red. |
| Then this parent will not have a red eye, but perhaps a white one, although it differs from the other in but one gene. | Then this parent will not have a red eye, but perhaps a white one, although it differs from the other in but one gene. |
| When these parents produce descendants, the red and white eyes follow in heredity the distribution of that single pair of genes of which one is altered: wherever the altered gene alone goes appears a white eye; wherever the unaltered one of the pair, a red eye. | When these parents produce descendants, the red and white eyes follow in heredity the distribution of that single pair of genes of which one is altered: wherever the altered gene alone goes appears a white eye; wherever the unaltered one of the pair, a red eye. |
| So the red color and the white color, inherited according to the Mendelian law, were called unit characters; each was supposed due to a single gene (J). | So the red color and the white color, inherited according to the Mendelian law, were called unit characters; each was supposed due to a single gene. |
| [contd] But actually, fifty or more genes are required to produce either, as is discovered when some other one of the fifty is changed off for an altered one. | But actually, fifty or more genes are required to produce either, as is discovered when some other one of the fifty is changed off for an altered one. |

| SOURCE | 24: THE TRUTH OF HEREDITY |
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| Then, although the first pair of genes is now unaltered, still the red eye does not appear. | Then, although the first pair of genes is now unaltered, still the red eye does not appear. |
| Now the eye color follows the distribution of another pair of genes (J). | Now the eye color follows the distribution of another pair of genes. |
| [contd] By successively altering genes of different pairs, or by altering genes of two or more pairs in the same parents, certain general relations of the greatest significance are discovered—relations which are commonly ignored. | By successively altering genes of different pairs, or by altering genes of two or more pairs in the same parents, certain general relations of the greatest significance are discovered—relations which are commonly ignored. |
| A certain characteristic, such as the red color, may, with a given pair of parents, follow a given gene, being inherited according to a particular rule—say the "typical Mendelian" rule. | A certain characteristic, such as the red color, may, with a given pair of parents, follow a given gene, being inherited according to a particular rule—say the "typical Mendelian" rule. |
| In other parents it follows a different gene, and is inherited in a different way—perhaps as a "sex-linked" character. | In other parents it follows a different gene, and is inherited in a different way—perhaps as a "sex-linked" character. |
| There are fifty or more separate and independent ways by which the red character can be altered, and each yields a somewhat different rule of inheritance. | There are fifty or more separate and independent ways by which the red character can be altered, and each yields a somewhat different rule of inheritance. |
| Or in the same individual two or more of the genes affecting color may be altered; then the color is no longer inherited as a "unit character;" its inheritance is now of the "multiple factor" type. | Or in the same individual two or more of the genes affecting color may be altered; then the color is no longer inherited as a "unit character;" its inheritance is now of the "multiple factor" type. |
| In some cases it will follow the rules for two-factor cases; in others for three, and so on indefinitely, until the inheritance may not be distinguished from the "blending" type. | In some cases it will follow the rules for two-factor cases; in others for three, and so on indefinitely, until the inheritance may not be distinguished from the "blending" type. |
| Such cases are typical. | Such cases are typical. |

| SOURCE | 24: THE TRUTH OF HEREDITY |
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| The fact that in an observed instance a characteristic is inherited as a “unit character” does not show that in other cases it will be so inherited. | The fact that in an observed instance a characteristic is inherited as a “unit character” does not show that in other cases it will be so inherited. |
| If a characteristic is observed in a given case to be inherited as a sex-linked character, we can not be certain that it will be sex-linked in other cases. | If a characteristic is observed in a given case to be inherited as a sex-linked character, we can not be certain that it will be sex-linked in other cases. |
| If it is recessive in some stocks, it may be dominant in others (J). | If it is recessive in some stocks, it may be dominant in others. |
| | **THE CHEMISTRY OF HEREDITY** |
| | 24:5.1 There seems to be a tendency in recent years to attach more importance to the freer chemical activity of the so-called inheritance factors. |
| | Many biologists believe that |
| In producing [the typical pattern of structures of the complex adult body], the genes interact, not only with each other, | the inheritance factors or genes interact, not only with each other |
| the cytoplasm, | and with the protoplasm of the germ cells, |
| | but that they also are influenced by |
| with the oxygen from the surrounding medium, | the oxygen from the surrounding medium |
| and with the food substances in the cytoplasm: | as well as by the food materials present in the cell plasm. |
| | Still further they believe that the inheritance factors may be chemically influenced and possibly modified by |

| | |
|---|---|
| but also, what is most striking and important, with products from the chemical processes in neighboring cells (J). | the nature of the chemical reactions taking place in the surrounding body cells, |
| | and it is in this way that environment—environment of this subtle and inner sort—is believed to be able to influence heredity. |
| | 24:5.2 We well know that |
| The process of development shows itself not to be stereotyped, as at first appears to be the case; it varies with changes in conditions. | environment does influence the process of development |
| | after the inheritance factors have initiated the reactions which constitute the beginning of any individual. |
| What any given cell should produce, what any part of the body shall become, | As to just what part of the body a given embryonic cell shall become, |
| what the body as a whole shall become— | and even as to what the individual body as a whole shall develop into, |
| depends not alone on what it contains—its "heredity"— | depends not alone on the hereditary predisposition |
| but also on its relation to many other conditions; on its environment. | but also upon many other environmental conditions and influences. |
| This is well shown in the development of our close relatives, the amphibia. | This is illustrated by the behavior of development in the case of the frog, |
| The frog or salamander begins as a single cell, | which begins as a single cell. |
| which divides into two. | Soon this cell is divided into two cells, |
| Usually one of these two produces the right half of the body, the other the left half. | one cell developing into the right half of the body and the other, the left; |

| SOURCE | 24: THE TRUTH OF HEREDITY |
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| | but it is a well-known fact that |
| But this depends on the relation of the two cells to one another; separate them, | if these two cells are split at this time, |
| and each produces an entire animal instead of half a one (J). | that each one will produce an entire animal instead of but half the frog. |
| | 24:5.3 Studies of development in the salamander have shown that |
| [contd] Somewhat later in development the young salamander has become a sphere of many small cells, differing in different regions.... The cells that will produce brain, eye, ear, spinal cord, skin, can be pointed out (J). | when certain parts of the body tend to develop into skin, nervous system, eye, etc., |
| The recent brilliant work of Spemann shows [how] if before this has happened the disk of cells is cut off and turned sideways, or completely around, the differentiating and adjusting influence creeps through it from the same point as before, but now in a different or reversed direction, so far as the cells are concerned. The cells that were to have formed skin produce spinal cord; those that would have produced eyes may form midbrain, or skin or ear, ... and so of the others. Or, transplant a small piece of prospective skin to the center of the eye-forming region; it now transforms into eye instead of into skin ... (J). | that they may be transplanted and, as the result of chemical influences, |
| | cells which had already started to form skin may be so changed as to turn to the formation of nervous tissue, |
| | and in this way we get a glimpse of how even in later life, |
| There comes a time after the wave of differentiation has gone over [the cells], when they no longer can be altered; their fate has been accomplished (J). | after the cells have been so differentiated as to forever settle their constitution, |

In later stages we know something of the nature of the cell products which help determine what other parts of the body shall become. There are a vast number of such intermediate products ... ; some of them are the internal secretions, hormones or endocrine products which are now the reigning sensation in biology (J).

I say, we may see how the hormones—the secretion of the ductless gland system—

may result in influencing their subsequent behavior.

## HEREDITARY ELASTICITY

24:6.1 We begin to see that in its practical bearing then,

Not only what the cell within the body shall become but what the organism as a whole shall become, is determined not alone by the hereditary materials it contains,

an individual's character and behavior is not absolutely and exclusively determined by what the cells may contain within themselves as an inheritance legacy,

but that in its practical outworking, life conduct is

but also by the conditions under which those materials operate (J).

also influenced and determined to some extent by the conditions under which these cells must unite, develop,

and finally by the environment which surrounds their activities after reaching the stages of mature and adult life.

Again, in commenting upon these newer views of inheritance, let us quote Jennings:

Under diverse conditions the same set of genes will produce very diverse results.

24:6.2 Under diverse conditions the same set of genes will produce very diverse results.

| SOURCE | 24: THE TRUTH OF HEREDITY |
|---|---|
| It is not true that a given set of genes must produce just one set of characters and no other. | It is not true that a given set of genes must produce just one set of characters and no other. |
| It is not true that because an individual inherits the basis for a set of characteristics that he must have those characteristics. | It is not true that because an individual inherits the basis for a set of characteristics that he must have those characteristics. |
| In other words, it is not necessary to have a certain characteristic merely because one inherits it. | In other words, it is not necessary to have a certain characteristic merely because one inherits it. |
| It is not true that what an organism shall become is determined, foreordained, when he gets his supply of chemicals or genes in the germ cells, as the popular writers on eugenics would have us believe. | It is not true that what an organism shall become is determined, foreordained, when he gets his supply of chemicals or genes in the germ cells, as the popular writers on eugenics would have us believe. |
| The same set of genes may produce many different results, depending on the conditions under which it operates. | The same set of genes may produce many different results, depending on the conditions under which it operates. |
| True it is that there are limits to this; that from one set of genes under a given environment may come a result that no environment can produce from another set. | True it is that there are limits to this; that from one set of genes under a given environment may come a result that no environment can produce from another set. |
| But this is a matter of limitation, not of fixed and final determination; it leaves open many alternative paths. | But this is a matter of limitation, not of fixed and final determination; it leaves open many alternative paths. |
| Every individual has many sets of "innate" or "hereditary" characters; the conditions under which he develops determine which set he shall bring forth. | Every individual has many sets of "innate" or "hereditary" characters; the conditions under which he develops determine which set he shall bring forth. |
| So in man, the characteristics of an educated, cultured person are as much his inherited characteristics as are any that he has (J). | So in man, the characteristics of an educated, cultured person are as much his inherited characteristics as are any that he has. |
| [contd] These sweeping statements are substantiated by precisely known facts in many organisms. | 24:6.3 These sweeping statements are substantiated by precisely known facts in many organisms. |

| SOURCE | 24: THE TRUTH OF HEREDITY |
|---|---|
| In that animal whose heredity is better known than is that of any other organism, the fruit fly, individuals occur with hereditary abnormalities. | In that animal whose heredity is better known than is that of any other organism, the fruit fly, individuals occur with hereditary abnormalities. |
| The abdomen is irregular, deformed; the joints between the segments are imperfect. | The abdomen is irregular, deformed; the joints between the segments are imperfect. |
| This is sharply inherited as a sex-linked character, so that it is known to be due to a peculiarity of one of the genes in the x-chromosome. | This is sharply inherited as a sex-linked character, so that it is known to be due to a peculiarity of one of the genes in the X-chromosome. |
| If the father has this abnormality, all his daughters inherit it, but none of his sons do so. | If the father has this abnormality, all his daughters inherit it, but none of his sons do so. |
| The daughters hand it on to half their sons and half their daughters, and so on (J). | The daughters hand it on to half their sons and half their daughters, and so on. |
| [contd] But the fruit flies in the laboratory usually live in moist air; this inheritance appears under those conditions. | 24:6.4 But the fruit flies in the laboratory usually live in moist air; this inheritance appears under those conditions. |
| If they are hatched and live under dry conditions the abnormality doesn't appear—even in those daughters which indubitably inherit it. | If they are hatched and live under dry conditions the abnormality doesn't appear—even in those daughters which indubitably inherit it. |
| Clearly, it is not necessary to have a characteristic merely because one inherits it. | Clearly, it is not necessary to have a characteristic merely because one inherits it. |
| Or more properly, characteristics are not inherited at all; what one inherits is certain material that under certain conditions will produce a particular characteristic; if those conditions are not supplied, some other characteristic is produced (J). | Or more properly, characteristics are not inherited at all; what one inherits is certain material that under certain conditions will produce a particular characteristic; if those conditions are not supplied, some other characteristic is produced. |

[contd] Similarly, some of the fruit flies inherit, in the usual Mendelian manner, an inconvenient tendency to produce supernumerary legs.

But if those inheriting this are kept properly warmed, they do not produce these undesirable appendages.

In the cold, only those individuals acquire the extra legs that have inherited the gene to which such are due; but even they need not do so, if conditions are right.

In the same animal, some individuals have fewer facets in the compound eye than do others.

The number of facets is found to be hereditary, in the sense that under the same conditions parents with few facets produce offspring with few facets, in the Mendelian manner.

But the number also depends on the environment; individuals with the same inheritance show different numbers of facets, depending on the temperature at which they develop (J).



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## THE RACIAL ASPECTS OF ENVIRONMENT

24:7.1 We believe in restricted or selected immigration, at the same time, it is not fair, in our discussion of these racial problems, to affirm that

The same fallacy reappears in discussion of immigration problems. The recent immigrants show certain proportions of defective and diseased persons; and we are informed that "these deficiencies are unchangeable and heredity will pass them on to future generations.

certain diseases or deficiencies which appear in the newly arrived immigrant, are destined to be reproduced in subsequent generations.

True, disease conditions are inherited, but diseases as such are not.

Certain defects and deficiencies are most positively hereditary,

There is no warrant in the science of genetics for such a statement; under new conditions they may not appear (J).

but other minor deficiencies may disappear under new conditions, a changed environment.

We clearly recognize that

We are warned not to admit to America certain peoples now different from ourselves, on the basis of the resounding assertion that biology informs us that the environment can bring out nothing whatever but the hereditary characters.

environment cannot bring out anything that is not in the heredity,

but we also recognize that heredity is such a vastly complex and subtle thing that different sorts of environment are able to bring out different sorts of characteristics—to incite an entirely different behavior on the part of the organism.

24:7.2 In other words, although environment cannot create new characteristics, separate and apart from the heredity, it can determine the development or the specific manifestations of different sorts of hereditary tendencies, all of which are contained in the original inheritance endowment.

Such an assertion is perfectly empty and idle; if true it is merely by definition: anything that the environment brings out *is* hereditary, if the word heredity has any meaning.

But from this we learn nothing whatever as to what a new environment will bring out.

It may bring out characteristics that have never before appeared in that race. What the race will show under the new environment cannot be deduced from general biological principles. Only study of the race itself and its manner of reaction to diverse environments can give us light on this matter (J).

Did not painful experience demonstrate the contrary, it would appear obviously unnecessary to emphasize that nothing in this paper has any bearing on the traditional doctrine of the "inheritance of acquired characters" (J fn).

One biologist has truly said,

"Anything that the environment brings out *is* hereditary."

24:7.3 But we never know what a new environment will do by way of modifying the development of hereditary characteristics in the case of a given organism

until we have subjected it to the experiment of living and developing amidst these new surroundings.

24:7.4 It should be made clear to the reader that those biologists who are beginning to modify their opinions regarding the all-importance and influence of the earlier Mendelian inheritance,

are not in any sense inclining to a belief in the inheritance of acquired characters.

While recognizing the possible influence of certain sorts of environment on the germ plasm and its inheritance factors, they do not believe in the time-honored teachings of Lamarck that the thoughts and acts of the parent are transmitted in representative fashion to the offspring.

| SOURCE | 24: THE TRUTH OF HEREDITY |
|---|---|
| | 24:7.5 As to the influence of environment in determining the out-working or development of the innate tendencies of an organism, Stockard's experiments with fish are very suggestive. |
| In fish, for example, two eyes, one at each side of the middle line, form as distinctly an inherited characteristic as in man, | Ordinarily a fish develops two eyes, one on either side of the middle line, |
| yet fish can be subjected so early to changed conditions (as Stockard and others show) | but this experimenter has subjected to the developing embryo to such influences |
| that the animal has a single median eye instead of two lateral ones; | that a single median eye appears instead of two lateral ones. |
| and many other striking changes are producible by changes in the chemical environment (J). | This, together with many other remarkable changes, have been brought about by modifications of the chemical environment. |

## THE CONCLUSION

| SOURCE | 24: THE TRUTH OF HEREDITY |
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| | 24:8.1 It would seem to be the position at the present time of most biologists, that |
| [contd from 24:7.3] All characteristics, then, are hereditary, | while all characteristics are hereditary; |
| | in the case of the highly organized animals such as the human species, that |
| and all are environmental. | all characteristics are also environmental. |
| | Now, it might appear at the first glance that such teaching tends to confusion— |
| Does this deprive the study of the distinctive parts played by the two all sense and value? | that it more or less deprives the terms of heredity and environment of any distinctive meaning; |

| SOURCE | 24: THE TRUTH OF HEREDITY |
|---|---|
| It does not. | but we trust, in the light of what has gone before, that these words will still carry a characteristic significance, |
| [!] | although in the case of human heredity, it is not always possible clearly to designate which characteristic, and to just what extent each character, may be due to the working of heredity in the one case, or to environment in the other.[1] |
| | We are simply forced in practical, every-day life to recognize the tremendous intricate interplay between the forces of hereditary endowment on the one hand and of environmental development on the other. |
| It is of the greatest importance to know in what different ways diverse stocks respond effectively to the same environment; and how these diversities are perpetuated; what limitations the original constitution puts on what the environment can bring out; this is the study of heredity. | 24:8.2 The real problem we find in the study of heredity is to determine just what are the limitations of the germ plasm and its hereditary endowment, |
| It is equally important to know what differences appear among stock of the same original constitution under diverse environments; how great the possibilities of environmental action are with a given stock (J). | and as to just what is the influence of diverse environments in developing, modifying, and displaying this inherent potential. |
| | In further comment on this subject, one biologist says: |
| The concepts of the hereditary and the environmental can not be employed in the absolute way now practiced; | 24:8.3 The concepts of the hereditary and the environmental can not be employed in the absolute way now practiced; |

| SOURCE | 24: THE TRUTH OF HEREDITY |
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| but they can be used with entire precision if they are applied, not to characteristics-in- themselves, but to the diversities between different particular concrete cases. | but they can be used with entire precision if they are applied, not to characteristics-in-themselves, but to the diversities between different particular concrete cases. |
| Though stature is always dependent on both heredity and environment, the difference in stature between Mr. Jones and Mr. Smith may be purely a matter of heredity; | Though stature is always dependent on both heredity and environment, the difference in stature between Mr. Jones and Mr. Smith may be purely a matter of heredity; |
| the difference between the same Mr. Jones and Mr. Brown may be purely a matter of environment. | the difference between the same Mr. Jones and Mr. Brown may be purely a matter of environment. |
| If there is clarity as to what comparison is made, there need be no ambiguity as to what is due to heredity, what to environment. | If there is clarity as to what comparison is made, there need be no ambiguity as to what is due to heredity, what to environment. |
| By statistical extension, such comparison may be made for large classes. | 24:8.4 By statistical extension, such comparison may be made for large classes. |
| But it is essential here as elsewhere to keep in mind that we are dealing with comparisons between concrete cases, not with propositions of absolute validity. | But it is essential here as elsewhere to keep in mind that we are dealing with comparisons between concrete cases, not with propositions of absolute validity. |
| Are the differences between men due more to heredity or to environment? | Are the differences between men due more to heredity or to environment? |
| If we compare ourselves with our ancestors of 10,000 years ago, they are due mainly to environment—if it is correct, as generally admitted, that the fundamental constitution of the stock has not appreciably changed since that time. | If we compare ourselves with our ancestors of 10,000 years ago, they are due mainly to environment—if it is correct, as generally admitted, that the fundamental constitution of the stock has not appreciably changed since that time. |
| If the comparison is of ourselves with the Bushmen of South Africa, possibly the differences are mainly due to heredity. | If the comparison is of ourselves with the Bushmen of South Africa, possibly the differences are mainly due to heredity. |

| SOURCE | 24: THE TRUTH OF HEREDITY |
|---|---|
| If the comparison is between the diverse races of Europe, or between the individual citizens of the United States, the answer is to be obtained only from a much greater amount of precise study, with critical statistical treatment, than has yet been made; | If the comparison is between the diverse races of Europe, or between the individual citizens of the United States, the answer is to be obtained only from a much greater amount of precise study, with critical statistical treatment, than has yet been made; |
| and there is reason to think that it would signify little when reached, since it would be merely an average of a very great number of individual comparisons, many falling to one alternative, many to the other. | and there is reason to think that it would signify little when reached, since it would be merely an average of a very great number of individual comparisons, many falling to one alternative, many to the other. |
| Certainly the answer is not to be deduced from any alleged biological principle that the characteristics of organisms are due to heredity and not to environment. | Certainly the answer is not to be deduced from any alleged biological principle that the characteristics of organisms are due to heredity and not to environment. |

1. *Compare:* If the individual A has a certain number of facets, while B and C have a different number, the same in both, it may be found that the difference between A and B is due to inheritance, while the same difference between A and C is due to environment. Such facts are typical; differences due in one case to heredity may be due in another to environment. There is no characteristic distinction between hereditary diversities and environmental diversities; whether a given instance belongs in one or the other category can be determined only by experimental analysis (J).