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A Comparative Study in the Filed of Genetics of the Organic Evolutionary Hypothesis and the Scriptural Account

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A COMPARATIVE STUDY
IN THE FIELD OF GENETICS OF THE ORGANIC EVOLUTIONARY HYPOTHESIS AND THE SCRIPTURAL ACCOUNT

by

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CHAPTER I

THE PROBLEM

Introduction

Since the beginning of the Church Age, the field of Biblical Apologetics has been the battleground for many acrimonious words and hasty conclusions and the scene of many misunderstandings.

Since the advent of the popular exposition of the organic evolutionary hypothesis with Charles Darwin in 1859, many things, based upon a false understanding of the Scriptures or upon a false understanding of scientific evidence, have been said and many accusations made on both sides of the argument. This study has been undertaken to sort from the tons of discussion which have been put forth the few pounds which can be considered truth, and to try to evaluate the dross of unsubstantiated human opinions.

The Problem Presented and Defined

<u>The Existence of the Problem</u>. Before it is possible to examine any problem it is necessary to determine whether or not a problem exists in actuality or merely apparently. It was necessary, therefore, to determine whether there was an actual disagreement concerning evolution between the Christian Scriptures and the teachings of present-day scientists. If such a disagreement were merely apparent, and not real, then there would be no justification for a study such as this except to show the essential unity of both sides of the argument. If,

to the contrary, the disagreement were found to be actual, it would be necessary to determine exactly where the disagreement lay and to determine the exact problem involved. This was done by examining first the basic teachings of the Scriptures concerning inheritance, and then examining the basic teachings of modern scientists concerning inheritance. The agreements and the differences were then noted and it became apparent what the actual problem was.

Definition of Species. Before any examination into inheritance could be profitably undertaken, it was necessary to define the biological term "species." The term has had many definitions since its original use, and has also been used by other sciences to mean altogether different things. This definition shall be limited to the biological use of the term.

In the classification of living creatures according to the common scientific classification, species is the lowest classification. This system, beginning with the lowest group and continuing in ascending order is: Species, Genus, Family, Order, Class, Phylum, Kingdom.[1] Thus, it is essential to define this grouping and to agree in the outset just what a "species" is.

Darwin did not propose a strict definition of the term but left it to the ability of the naturalist to classify individuals, mainly on the basis of habits, appearances, and construction.[2]

Patterson and Stone define species as follows:

> In sexual forms, a species consists of the members of a population, or group of populations which can exchange genes freely with each other, but which can exchange genes with members of no other form (or population) sufficiently to lose their separate genetic identity.[3]

This definition appears to be quite standard in modern scientific literature. Dobzhansky uses the phrase, "physiologically incapable of interbreeding" in his definition, which is almost too inflexible for present day usage as shown in Chapter IV.[4]

Other scientists, such as Montgomery, assume the factuality of the evolutionary process _en toto_ and define species as a "mental section of a line of evolution" but for the purpose of this paper such a definition is begging the question and could not be used.[5]

In this study the writer used the definition given above from Patterson and Stone as a working definition of "species."

A Scriptural Statement Concerning Inheritance. The basic statement concerning inheritance is found in the account of creation, Genesis 1:11-12, 20-25.

> And God said, Let the earth put forth grass, herbs yielding seed, and fruit-trees bearing fruit after their kind, wherein is the seed thereof, upon the earth: and it was so. And the earth brought forth grass, herbs yielding seed after their kind, and trees bearing fruit, wherein is the seed thereof, after their kind: and God saw that it was good.
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> . . . .
>
> And God said, Let the waters swarm with swarms of living creatures, and let birds fly above the earth in the open firmament of heaven. And God created the great sea-monsters, and every living creature that moveth, wherewith the waters swarmed, after their kind, and every winged bird after its kind: and God saw that it was good. And God blessed them, saying, be fruitful, and multiply on the earth. And there was evening and there was morning, a fifth day.
>
> And God said, Let the earth bring forth living creatures after their kind, cattle, and creeping things, and beasts of the earth after their kind: and it was so. And God made the beasts of the earth after their kind, and the cattle after their kind, and every thing that creepeth upon the ground after its kind: and God saw that it was good.[6]

Before going further into the examination of the exact meaning of these references it may be observed that the language of the Scriptures is not scientific; rather, it is popular. By the same token, the language does not have to do with causes, but rather with appearances.

If the language of the Scriptures had been scientific, it would have been written much differently. Likewise, it would have been impossible to prepare a timeless Scripture in the dated language of science. This does not infer that the language of the Scriptures is inaccurate or incorrect but only that it is not always intended to convey technical information but only the basic ideas in certain non-religious fields such as biology.[7]

The language is also phenomenal since it refers to appearances rather than causes. Even today we refer to sunset and sunrise though we are well aware that it is the rotation of the earth which causes the coming of light and darkness rather than the movement of the sun. The "appearance" to us, however, is of rising and setting and such is the language that we commonly use. Another illustration appears in Isaiah 11:12 where the phrase "the four corners of the earth" is used. Though it may be true that the earth does not have corners, we are so used to dividing things into quadrants that we still use that phrase and similar phrases in our modern language. We should recognize that there will be many phrases in the Scriptures which are to be interpreted similarly.[8]

To return to the text quoted above, it is evidently not necessary to interpret the Scriptural word "kind" by the modern biological term "species." First, as above stated, the language of Scripture has

to do with appearances. As defined above, "species" is not a term referring to appearances but referring to relationships. The Hebrew word itself which is here translated "kind" has its root in the thought of "form" or "shape", and does not limit itself to any biological grouping which often requires a breeding experiment to make a correct determination.

"Kind" may refer to the biological "species" but the nature of the Scriptures does not require such an interpretation.

The second observation concerning the teachings of the Bible on this subject has to do with relationships. All plants are spoken of as having their beginning at approximately the same time. Even in their beginnings they are separated into groups, i.e., grass, herbs, and trees. That there are groups within these groupings is very possible and the exact definition of the term "kind" in this respect is not stated. The apparent thing, however, is that they were not descended from each other but that they had parallel origins by creation and that they propagate "after their kind", implying that there is a prearranged, consistent pattern of descent from those created "kinds" which is basically stable.

The same observation holds true concerning the sea and sky creatures and the beasts, cattle, and the creeping things. The problem of whether or not there could, or would, be variations within this basically stable family tree was not mentioned. The limitations of Biblical language mentioned above precludes the necessity of dealing with this problem.

Thus, the Scriptural account insists on at least the following:

In the beginning God created the inorganic universe upon which, by a divine method of His own choosing, He created various kinds of plants and animals which He ordained were to reproduce after their own kind in a relatively stable pattern of descent.

<u>A Statement of Evolutionists Concerning Inheritance</u>. It would have been very advantageous to this study if one statement concerning evolution and inheritance, which all evolutionists would agree to as accurate and complete, could have been found. In the investigation of modern evolutionary literature, however, it was found that evolutionists become as polemical concerning facets of the theory as do theologians concerning various doctrinal interpretations.

As a starting point, the following quotation from one who is a creationist rather than an evolutionist was given:

> ...when a biologist mentions the doctrine of evolution without any qualifications he usually means Charles Darwin's conception of evolution, which amounts to this: All species of plants and animals now in the world, including man, have arisen by a series of changes which are predominantly in the direction of increased size and complexity since the original germ of life is supposed to have been minute and extremely simple. This development is thought to be stimulated by natural forces which can be studied at the present time.[9]

Evolution, broadly speaking, is considered by most of its proponents to include other than biological phenomena. Julian Huxley included several phases in his dissertation on the general subject: first, the cosmological phase which gave rise to the inanimate universe; second, the biological phase which began with the first germ of life as it was developed in the former phase and has developed to the present time; third, the human or psycho-social phase which intro-

duces collective experience and purpose into the evolutionary procedure.[10] His second phase, which was the subject of this study, he elaborated on thus:

> Evolutionary transformation in this sector is brought about by the wholly new method of natural selection, which was not available during the thousands of millions of years before the emergence of living substance.
>
> . . . .
>
> At first sight the biological sector seems full of purpose. Organisms are built as if purposefully designed, and work as if in purposeful pursuit of a conscious aim. But the truth lies in those two words "as if." As the genius of Darwin showed, the purpose is only an apparent one.[11]

Goldschmidt and other geneticists have separated evolution into the two categories of microevolution and macroevolution; the former being the minute changes and developments within rather narrow biological limits, or otherwise defined by Dobzhansky as the evolutionary processes observable within the span of a human lifetime; and the latter being the organic evolution of the species on a geological scale. As mentioned above, however, when the term evolution is used, it includes microevolution only as a part of the macroevolution principle.

There are other concepts of evolution which have been introduced where religion and science have met, including various forms of theistic evolution.[12] Some of these propose that evolution is the _modus operandi_ by which God created the various forms of life; others that God performed various acts of creation at steps along the way but that the major part of the development was taken care of by organic evolution; still others try to instill spiritual life into the theory of evolution (such as Bergson, L. du Nouy, and Julian Huxley) using such phrases as Divine Spirit and Universal Mind to create a religion

of evolution. These, however, need not enter the picture too prominently as they have based their ideas upon the results of scientists in their examination of the basic evolutionary hypothesis. If this hypothesis were shown unsound, the various theistic evolutionary theories would be automatically shown to be unsound.

It must be admitted that present-day Neo-Darwinians and Neo-Lamarckians do not agree any more than the original proponents of these major evolutionary theories did. It is also to be noted that geneticists are in violent disagreement concerning some of the minor facets of the theory, but they all seem to return to the affirmation that there is an organic relationship linking all living creatures by a common ancestry.

Thus, the quotation given above, that "all species of plants and animals now in the world...have arisen by a series of changes from one or a few very simple forms," seems to embody as accurately as possible the modern basic evolutionary concepts of inheritance.

<u>Basic Points of Agreement between Scriptural and Evolutionary Ideas</u>. The Scriptural and evolutionary principles have several points of agreement between them. It must not be supposed, or taught, that the two are so far apart as to have nothing in common from which the two could be examined.

First, the Scriptural and evolutionary statements both teach and depend upon the consistency of physical and biological law. They both admit the existence of inherent laws acting within the universe, including the fields of biology and genetics, which govern all motion and phenomena, including the operation of life on earth, both plant

and animal. They also agree that these laws have been in operation from the beginning and that the beginnings of life took place under the same laws as are in operation today. The conditions may not have been the same, but the basic laws remain essentially unchanged.

Second, it is generally recognized that both plants and animals fall into classes and/or groups, and that individuals do reproduce quite consistently after their own kind. It is also recognized that there are some exceptions to this rule which do appear at various times with greater or lesser frequency depending upon many known and unknown variables.

While this latter fact plays a major part in the evolutionary theories of many scientists, it is almost neglected in the Scriptures. There are Scriptural references to variations, however, such as in Christ's parable of the wheat which gives recognition to the fact that some wheat, apparently under the identical environment, was able to produce more than other wheat. In this instance some bore thirtyfold, some bore sixtyfold, and some bore an hundredfold.[13] This is an exception to the rule of identical inheritance and therefore shows a variation. Other instances of unusual growths, such as the barren fig tree, can also be found in the Scriptures.[14]

Third, there is, behind what we do know about the processes of life and inheritance, much that we do not know about them; and there is no true assurance that we shall ever know all that there is to know about them. A recent writer, discussing the fundamental questions in science, was forced to make this cogent statement:

> And mystery, although science continuously crowds it back, stubbornly and beautifully remains at the core.

> Necessarily, it confronts writers on fundamental questions at every turn.[15]

The Scriptures do not tell all there is to know about the processes of inheritance, and science has been unable to determine even many of the more basic facts about the processes. Humility in the face of an unknown is a trait common to both the evolutionists and those who follow more literally the Scriptural account if they are truly honest.

Basic Points of Difference between Scriptural and Evolutionary Ideas. In spite of the agreements between the two thoughts which were mentioned above, there are some very obvious and difficult differences between them.

First, the most obvious difference is the problem of the limits of inheritance. As stated above, the Scriptural statement calls for the original creation, by God, of all the basic kinds of living things which then reproduce and populate according to the laws of inheritance. Evolutionists insist that every kind of life is a transitory step between some ancestoral form which was different from the present form, and a new form which shall also be different from the present form and shall at some future time descend from this present form. Thus, every kind of life is related to every other kind of life by ancestral relationship.

Second, more difficult than the first difference, is the theistic problem, or the problem of causes. It is a problem to determine whether life itself and its various forms is existent on earth because of the purposeful actions of God, or whether one of the inherent laws of the material universe has caused, through a series of accidents, the existence and diversity of life here on earth.

As has been previously stated, there are those who claim to be theistic evolutionists who will not admit this to be an essential point of difference. For these we must withhold judgment. Nevertheless, as has been shown in chapter two, for the majority of persons it is a very definite part of the actual conflict between the Scriptures and the evolutionary theory.

A Brief Statement of the Problem and the Purpose of this Study. The problem which was discovered as a result of the preceding analysis may be condensed as follows: Does there exist a set of ancestral divisions separating each kind of life from every other kind of life, or is life so unitary that such divisions are ultimately impossible?

On the basis of corollaries to this problem it was determined that the problems of Scriptural authority would be supported if such divisions would be found and would be impugned if they were not found. Likewise, the existence of the God of Creation as revealed in the Scriptures would be supported if such divisions were found but would be subject to doubt if such divisions were not found.

Thus, the purpose of the study was to determine first, the answer to the problem; and second, to establish thereby the above-mentioned corollaries.

The Need for an Analysis of the Problem and Evaluation of the Evidence

> When evolution is mentioned to many a present-day newspaper reader, he suspects that it is a debatable theory and that it may be overthrown in another six months. This is not true. Evolution is here to stay. There is no more chance that it will be disproved or abandoned by scientists than there is that some day we may believe the earth to be disk-shaped rather than spherical.[16]

This quotation, taken from a college text in Industrial Psychology, is typical of the extremes to which many evolutionists will go in their assumptions of the truth of the theory as a whole.

Professor Lindsey freely makes the following bold statement:

> Species were generally regarded as constant and their origin was attributed by every culture to the special creative action of an omnipotent being, a process no longer accepted by scientists....It (evolution) is no longer a theory, but an adequately demonstrated process.[17]

In addition to what these authors have actually said in these statements, the reader is led to believe that the total theory of organic evolution in all of its multitudinous aspects has been so thoroughly proven that no further examination is needed. It was also implied that the philosophical systems of materialism and mechanism which so often accompany the theory of evolution are now likewise established as the true philosophy of the universe.

On the other side of the ledger, some fundamental Christians have been guilty of propounding statements which are just as far reaching and which often resort to "name calling" rather than the presentation of evidence. The following example from Robert Patterson may serve as an example:

> On the authority, then, of Mr. Darwin himself, we unhesitatingly receive his theory as one illuminated by profound ignorance of the subject---a game of blind-man's buff---the blind proposing to lead the blind. Is that science? Belief of any theory devised by such acknowledged ignorance is the basest superstition.
>
> This confessed ignorance of facts and principles, far from producing modesty and patience in building the theory, is followed up shamelessly by the most intolerable pre-

> sumption in assuming facts which never had an existance, and in asserting doubtful principles without the shadow of proof....[18]

Although this situation is probably normal, it is not desirable. For the sake of truth one should seek to evaluate that which is fact, and, on the basis of the facts and the evidences, determine as accurately as possible that which is true. In addition to the overstatements made on both sides of the problem the confusion of the problem itself is presented to the minds of the coming generations.

Another reason for the need of an evaluation of the problem is the philosophical one. Much, if not most, of the evolutionary literature found in present-day popular magazines and textbooks is basically materialistic, if not atheistic, and hence, militates against the religious training of those who read it. Since religion and morals are strongly related, and since the bases of the moral standards upon which our present civilization is based are obtained from historical Christianity, this materialistic and mechanistic propoganda can only have destructive effects upon civilization as a whole, if allowed to continue unchecked and unexamined.[19]

Julian Huxley has made a valiant attempt to reinstate an ethical principle into a philosophy of life based upon evolution which he summed up by saying: "anything which restricts or frustrates development is wrong. It is a morality of evolutionary direction."[20] He would thus plant the seeds of a new religion which he would call Evolutionary Humanism to supplement all present religions.[21]

An ethic upon a shifting basis is contrary to the ethical nature of mankind. A basic postulate of human thinking and reasoning is

this, that there must be something basic and firm upon which to build or the entire structure is questionable. An ethic based upon the desirability of change, regardless of the direction of the change, would be an open door to chaos.

In the religious realm the primary problem which is presented by this present conflict between evolutionary thought and the Scriptural account is the challenge to the basic authority of the Scripture.

The Christian church, from its inception, has been founded upon the Scriptures as its final authority.

> We believe that the Holy Bible, Old and New Testaments, is the word of God; that it reveals the only true way to our salvation; that every true Christian is bound to acknowledge and receive it by the help of the Spirit of God as the only rule and guide in faith and practice.[22]

Any challenge to the accuracy of the Scriptures is, ipso facto, a challenge to its authority, and thus a challenge to the value of the Christian church. The need of a vigorous examination of the problem, both by science and by the church, is therefore essential from both a religious and a social standpoint.

Modern science had its birth in the Renaissance and its progress has gone hand in hand with the progress of evangelical Christianity.[23]

> It is coming to be more and more clearly seen that true science and true religion cannot possibly be contradictory the one to the other, and that such hostility as has existed has been due to imperfection in the one or the other or both, or imperfect understanding of each by the other. As science becomes more complete and religion as doctrine and life becomes more perfectly accordant with the na-

> ture and will of God, we may expect that all seeming lack of harmony between the two will disappear.[24]

Self-imposed Limitations in This Treatment of the Problem

No study of a problem such as this could hope to be exhaustive or even complete. By the same token, it was impossible to attempt a polemical refutation of any theory or idea or to "prove" any other idea. The available evidence was not sufficient to permit such an attempt to be successful. Therefore, it was advisable and even necessary to impose arbitrary limits to this study and to attempt to be thorough and sound within those limits.

First, it was necessary to limit this examination to the field of genetics. There are large and profitable areas of study concerning evolution in the fields of geology, paleontology, embryology, biochemistry, comparative anatomy, and many others, but since they are all dependent upon the natural laws existing within the field of genetics, or inheritance, for their application to this problem, it was felt necessary to eliminate them from the present discussion except as they might fit into a discussion of genetics proper.

Second, it was necessary to deal more with principles and methods than with specific examples and masses of statistical data. Sufficient specific studies were given in the process of the examination to serve as illustrations of the principles under discussion, but there was no pretense that one example should prove a case. It was asserted, however, that the principles discussed were genetically sound and were based upon sufficient experimental evidence to make them, in the very least, highly probable principles.

Third, this was an examination of the literary reports of experimentation, which are quite extensive, rather than a report of personal experimentation by the writer, which has, of necessity, been very limited.

Method of Procedure

Two fundamental studies were made before the examination of the problem itself could be undertaken. One, it was necessary to examine the history and philosophy of the concept of evolution. This was necessary in order to properly understand the evidence obtained.

There is a subjective factor in all scientific work whenever scientists apply themselves to propounding interpretations of the data which they have obtained by their experimental methods. Many times this subjective factor will determine the direction which the interpretation will take. It was a principle of this study to accept any evidence available, regardless of the philosophical persuasions of the scientist, and then to attempt to evaluate the conclusions of the scientist in the light of both the objective evidence and the subjective bias of the scientist in so far as that was possible.

A second preparatory step in this study was an examination of the science of Genetics, *per se*. This was necessary in order to establish its validity and accuracy as well as its limits in dealing with the problem.

In dealing with the problem itself it was necessary to examine the methods and materials of inheritance, or the science of Genetics, and then to examine the processes involved. At this point it was found advantageous to examine not only the processes of change, as

most of the modern geneticists are inclined to do, but also the processes of stability which, in many cases, far overpower the processes of change in the strength of their influence upon the organism or upon the species.

There were some special cases which were considered to be of sufficient importance to merit special attention. These were treated in a special chapter following the basic discussion.

These various evidences were then collected and evaluated and their application to the problem noted in order to answer the basic question of this study and solve the problem of this paper.

CHAPTER II

EVOLUTIONARY HISTORY AND PHILOSOPHY

Introduction

Every idea has a history. Without an understanding of the history of any basic idea it is difficult to come to an evaluation and complete understanding of the idea.

Likewise, since the subjective element cannot be entirely divorced from any science or any study, it is necessary to see the philosophical connections of every idea. No idea can stand alone. It always comes in company with other ideas, which are linked together through a philosophy. These relationships are also important to an understanding of the idea.

The purpose of this chapter was to examine the history of the idea of organic evolution taking special note of its philosophical connections. This will enable one to evaluate the philosophical conclusions which scientists are wont to make based upon their scientific data.

Appearance in Ancient and Medieval Philosophies

As far as the idea can be traced, the organic evolutionary hypothesis seems to have begun with Anaximander (611-547 B.C.) who was of the early Ionian school of Greek philosophers.[25] His writings have essentially been lost except as they survive in the writings of later philosophers by quotation.[26]

"Empedocles has been called the father of evolution because he first advanced hypotheses to account for the gradual development of different kinds of organisms." (490-430 B.C.)[27] His philosophy included a belief in the independent existence of organs which combined arbitrarily to form creatures and which would be separated again to be reshuffled.[28]

> In spite of the untenable portions of his ideas, Empedocles deals in a primitive way with the logical principles of evolution, including the gradual development of existing species, and need for adaptation, competition among organisms, and the extinction of less perfect creatures which accompanies the persistence of those fitted for life.[29]

Democritus (460-357 B.C.) of the Atomistic school is also credited with holding to doctrines similar to basic evolutionary concepts. He made all existence to be quantitative, rather than qualitative as had some of his predecessors; he thought that all things were made of small, unchangeable units of active matter.[30]

> Democritus did not acknowledge the presence of design in nature, but he admitted that of law. He believed strictly in secondary, or physical causes, but not in a primary immaterial cause. Life, consciousness, thought were, according to him, derived from the finest atoms.... Democritus boldly applied his theory to the gods themselves, whom he affirmed to be aggregates of atoms, only mightier and more powerful than men. The ethics of Democritus set happiness as the aim....The physical philosophy of Democritus was made the base of the system of Epicurus, who reared upon it a structure of ethical doctrine.[31]

His philosophy was both materialistic and mechanistic and because of his lack of faith in senses and thought involves a strong latent skepticism.

Though many evolutionists ignore these early Greeks mentioned above, when surveying the philosophical history of the theory, nearly all evolutionists return to Aristotle (384-322 B.C.). His ladder of existence which places pure potentiality (Prime Matter) at the bottom and pure actuality (The Ultimate, or God) at the top, and all other things composed of a mixture of potentiality and actuality in between in a hierarchical order, can be seen to be a possible portent of the idea of the phylogenetic sequence of life.[32] A quotation from his writings will show that in actuality he did hold to a form of evolution:

> Wherefore, it is not only possible that all things may spring from non-individuality(as matter) by accident, but it is likewise true that all things take their generation from a previous individuality, I speak of what is an existence in potentiality taking its generation from a nonentity in action. (The Metaphysics -- Book II Chapter 2)[33]

Theophrastus (375-288 B.C.) took the doctrines of Aristotle and developed them more fully in his favorite field, that of Biology.

Another who was somewhat Aristotelian is Galen (131-200 A.D.) the anatomist and physician. He further advanced the idea of observation but did not apply the results of his observations very thoroughly in his medical prescriptions.[34] He is generally classed with the eclectic school of ancient philosophy because of his tendencies toward skepticism.[35]

Most evolutionists seem to claim Augustine (353-430 A.D.) as being in their rank along with many other early Christian theologians.

> During this period it is significant that several of the church fathers expressed ideas of organic evolution even though the trend of

> ecclesiastical thought led more readily into other lines of reasoning....Gregory..., Basil. .., Augustine... and St. Thomas Aquinas expressed belief in the symbolic nature of the Biblical story of creation and in their comments made statements clearly related to the concept of evolution.[36]

Though, at a casual glance, it might appear that Augustine implies an evolutionary scheme of life, actually, "he teaches that brute matter is endowed with the germ or seed-force needed to develop it into a determinate species, and that there are as many seed-forces ...insown from the beginning in matter as there are to be species of things; nowhere does he teach that a species develops outwardly into another species."[37] There is a basic difference between this and evolution.

Other philosophers, following in the Aristotelian line, held to basic philosophies which would be friendly to the theory of organic evolution from this time until the sixteenth century saw the rise of science again, but there were no new developments during this period of time which are worthy of note.

This brief survey of the history of the evolutionary idea in philosophy and science reveals that, with but few exceptions, the doctrine was linked with materialism and mechanism and usually an inherent skepticism was present. This is also true of those who followed in the medieval period. Those who were known for evolutionary tendencies based their physical philosophy upon Aristotle and added thoughts from here and there in the writings of the other ancient philosophers, but did very little original thinking.

History of the Evolutionary Theory During the Sixteenth, Seventeenth and Eighteenth Centuries

As the work of the scientists of the sixteenth century progressed, the methods of organized observation and collation were improved and the tools of science were developed. Leaders in this progress included: Vesalius (1514-1564) in anatomy, Harvey (1578-1657) in physiology, Hooke (1635-1703) and Leeuwenhoeck (1632-1723) in microscopy.[38]

It is questionable whether either of the first two men just mentioned could be accurately classed either as evolutionists or as creationists. Their work was in the field of observation rather than interpretation. Hooke was a pioneer evolutionist, but in this Leeuwenhoeck would probably have disagreed with him.[39]

The contribution of Francis Bacon (1561-1626) is in the organization of the inductive method of study rather than in any particular connection with the evolutionary theory.[40]

It is Leibnitz (1646-1716), the inventor of the Calculus, who, in his monadology, re-enters the philosophical realm combining the thoughts of the skeptical atomists with the ladder of Aristotle.[41]

> He believed in a chain of being, and that the different classes of animals are so closely united that there are no gaps between them. He also suggested that by means of great changes of habitat 'even the species of animals are often changed;'[42]

Buffon (1707-1788) was greatly influenced by Leibnitz' views concerning evolution. He was not an investigator, nor even an observer but rather a compiler and popularizer of scientific matters. His popular treatises have multitudinous side references in them referring to

his belief in the mutability of species and the evolution of life.[43]

Erasmus Darwin (1731-1802) followed the course of Buffon in insisting that all animals were derived from a single "filament" and that use, disuse, climate, sexual selection, etc. all influenced the change from species to species.[44] His distinction was gained primarily as a physiologist and poet.[45]

Jean Baptiste Lamarck (1744-1829) was perhaps the first truly adventurous evolutionist and deserves the title of the "true founder of evolution".[46] Though sent to school to enter the clergy, he preferred the army and was active in that work until he was found physically unfit. He then digressed into the field of medicine and finally botany where he worked for many years. In 1794 he turned to the study of invertebrate animals and after six years in this study prepared his theory of evolution. As first published (1809) his theory was expressed in two laws.

> 1. In every animal which has not exceeded the term of its development, the more frequent and sustained use of any organ gradually strengthens this organ,...while the constant lack of use of such an organ imperceptibly weakens it, causing it to become reduced...and end in its disappearance.
>
> 2. Everything which nature has caused individuals to acquire or lose by the influence of the circumstances to which their race may be for a long time exposed, and consequently by the influence of the predominant use of such an organ, or by that of the constant lack of use of such part, it preserves by heredity and passes on to the new individuals which descend from it, provided that the changes thus acquired are common to both sexes or to those which have given origin to these new individuals.[47]

Later he added the idea that necessity in the organism gives

rise to new organs. He presented other corollaries to these theories which modify them somewhat, but the essential belief in the inheritance of acquired characteristics remains.

The next three persons who should be mentioned are not biologists, but their writings in their respective fields have influenced the development of the evolutionary hypothesis.

Thomas Robert Malthus (1766-1834) was an English economist. His training came in Cambridge where he worked diligently in the physical sciences but with growing interest in social problems. In 1798 he published the Essay of the Principle of Population as it Affects the Future Improvement of Society anonymously.[48] In this thesis he argues that the tendency of population is to increase in a geometric ratio while the tendency of subsistence is only to increase in arithmetic progression; thus, population tends to outgrow subsistence. A logical conclusion drawn from his concept which was propounded by some of his followers, though not by himself, is that vice and crime are necessary to maintain the balance between population and subsistence.[49]

Sir Charles Lyell (1797-1875) was a geologist. His three-volume work, Principles of Geology, finished in 1833, propounded the principle of uniformism in geology as opposed to Catastrophism. This principle affirmed that the geological changes which have taken place in prehistoric times were caused by the same laws which are active on the earth at the present time.[50]

Robert Chambers (1802-1871) a Scotch publisher and author, also enters the picture through his treatise, Vestiges of the Natural

History of Creation which he had published anonymously in 1844. Chambers was not a scientist in any field, but did research on many literary, biographical, historical and natural history subjects. The results of his research were published in innumerable papers and books of which the one mentioned above is the best known. It is an exposition of development in the natural world, and it prepared the public for reception of some of the theories concerning development which followed.[51]

Thus, the revival of literature, science and independent investigation have each added to the development of the organic evolutionary theories which have been propounded. No one man, nor any cooperating group of men, is responsible. It is important to remember, however, that these men mentioned are not the only scientists of the period, nor are they in all cases the most brilliant, nor the most thorough in their work. These have been mentioned for the one purpose of showing some of the progress and development of the theory of organic evolution as it has taken place prior to the time of Charles Darwin.

Darwin and the Darwinians

Charles Darwin. Charles Darwin (1809-1882) was the grandson of Erasmus Darwin, mentioned above, and was born in the same year that Lamarck published his theory of evolution.

His early training was in the public schools at Shrewsbury, England, followed by two sessions at Edinburgh and then at Christ College, Cambridge. His training for the clergy, and his personal inter-

est in natural history enabled him to join the scientific expedition on H. M. S. Beagle (1831-1836), during which time he worked diligently in the examination and collection of both flora and fauna wherever the voyage permitted.[52] He was a man of intense curiosity and had trained himself thoroughly to make accurate observations and orderly collections.

After his return to England he busied himself with the collation and evaluation of his work aboard the Beagle and prepared several dissertations upon various scientific subjects suggested to him while traveling, as well as his well-known Journal of Researches.[53]

During this period of time, between his return and 1844, he thoroughly read the works by Lyell and Malthus, mentioned above. Applying the principles suggested by them to the field of biology, and applying also his own observations and discoveries, he began in 1844 to prepare his Origin of Species in which he planned to present his theories of natural selection. In 1858, however, before it was completed, he received from Alfred B. Wallace (1822-1913) a well-known English naturalist, a manuscript containing precisely the same theories which Darwin was embodying in his book.[54] This work by Wallace was much briefer and much less complete than Darwin's Origin of Species.[55]

Darwin completed the book and presented both his work and the work of Wallace before the Linnaen Society, July 1, 1858. Since Darwin's work was the most complete, since he presented both the work of Wallace and his own work, and since it was Darwin who did the principle work in defending and promoting it, the theory of organic evolution bears Darwin's name rather than the name of Wallace or of

some of the others who worked on the idea and prepared the way for both Wallace and Darwin.

Darwin's theory, as he gave it, embodied the following principles:

> 1. Overproduction....
>
> 2. Struggle for existence....
>
> 3. Variation....Hereditary variations are so general that,....variation is the most invariable phenomenon in nature.
>
> 4. Significance of variations....Variations, in short, may be useful, and by the same logic, some may be indifferent and some a handicap.
>
> 5. The basis of survival....
>
> 6. Migration....the pressure of competition may lead some individuals to migrate into adjacent areas in which they are likely to find new problems of adjustment.
>
> 7. Change of habits. The intensity of competition may also lead some individuals to adopt new ways of life within the same area....
>
> 8. Progressive evolution. Successive generations of this process were supposed by Darwin to lead to a progressive development of the useful variations and so to wider and wider divergence from the parent species.[56]

In 1871 Darwin extended his general theory, as proposed in Origin of Species, to man in his work entitled The Descent of Man and Selection in Relation to Sex.[57] It was after the publication of this work that the real conflict between the Biblical account and the theories presented in his former work became known. The remainder of his life was devoted to further research and the preparation of papers in defense of his theories.

Darwinians. In the defense and exposition of his theory, however, Charles Darwin was not alone. Several philosophers and scientists took up the ideas and promoted them, each adding their own corollaries to the subject.

Lyell, previously mentioned, became one of the first supporters of the theory as proposed by Darwin. He was a personal friend of Darwin and realized the influence that his writings had had upon the conclusions of Darwin and was quick to support and promote them.

Another of the early supporters of the theory was Herbert Spencer (1820-1903), well-known as a philosopher and author. His Principles of Psychology was printed in 1855, before Darwin's chief work, and was based upon an evolutionary principle. After Darwin unveiled his theories in detail, Spencer adopted them and expounded them in a philosophical setting rather than within the biological setting in which they had been placed by Darwin. His System of Synthetic Philosophy, in ten volumes (1860-1893), contained the major portion of his life's work. First Principles is his best known work.[58] It is the first volume of his System of Synthetic Philosophy and embodies the basic theses and principles upon which he built the rest of the series.

To Spencer the "law of evolution" was a universal law which affected not only the biological orders but also all matter, space, force, history, religion, sociology and human business, to mention a few. It was the universal organizing factor for all things.

Spencer begins by attempting valiantly to mediate between the "antagonisms of belief...between Religion and Science."[59]

> On both sides of this great controversy, then, truth must exist. An unbiased consideration of its general aspects forces us to conclude that religion, everywhere present as a weft running through the warp of human history, expresses some eternal fact; while it is almost a truism to say of Science that it is an organized mass of facts, ever growing, and ever being more completely purified from errors. And if both have bases in the reality of things, then between them there must be a fundamental harmony. It is an incredible hypothesis that there are two orders of truth, in absolute and everlasting opposition.[60]

From this start, he goes on to develop a system of materialism which believes in the real existence of the world but also believes we can know nothing but the existence of phenomena; we cannot know the world itself. Likewise, concerning religion, we cannot know anything spiritual for what it is; we can only know the phenomena which we experience. His philosophical principle, therefore, as is also his religious principle, is Agnosticism.[61] Put in brutally brief language he would say that for science and religion to get together and come close to truth, they must both admit that neither of them know anything and they neither of them <u>can</u> know anything.[62]

Chronologically, the next Darwinian is Thomas Henry Huxley (1825-1895). He was an English naturalist and anatomist of exceptional ability. He served in his chosen field in various governmental positions.[63]

> Huxley's gifts of exposition were as remarkable as his powers of research. His scientific lectures, like his papers, were models of clearness, as well as accuracy, and he was both cogent and eager in debate, and fascinating in popular address.[64]

He was convinced by the arguments put forth in <u>Origin of Species</u> and threw his reputation and weight into the popular exposition

of the evolutionary theory both through literature (his book, Man's Place in Nature is considered outstanding) and from the lecture platform. He was extremely analytical in his thinking, and though he believed the evolutionary theory, he was able to recognize its weaknesses.

> He pointed out the lack of evidence that any group of animals has, by variation and selective breeding, given rise to another group in the least degree infertile with the first; but he believed this objection might disappear under prolonged observation and experiment.[65]

Philosophically, Huxley was a materialist, as were several other Darwinians who followed in the next few years. As a materialist, his explanations of all problems and phenomena were based solely upon matter and local motion, sense data supplying the only contact between the person and the phenomena of the universe.[66]

Ernst Haeckel (1834-1919) also aided the progress of the theory of evolution in the popular and scientific life of the world during the middle of the nineteenth century.[67] He was a German zoologist and natural philosopher. His training was taken in medicine and natural sciences at Berlin and Jenna. His writings in the field of marine life are extensive and very excellent. His philosophical writings were inspired by Darwin's Origin of Species. In applying Darwin's theory in the field of morphology he formulated what has been called the "biogenetic law"[68] or the "recapitulation theory"[69] in embryology. This theory had previously been referred to by Von Baer, Agassiz, and Fritz Muller but had not been fully developed and popularized until Haeckel adopted it. In 1868 his History of Creation was published which is a popular exposition of the doctrine of evolu-

tion and has had the widest circulation and has done more to popularize Darwinism in Germany than any other book. Philosophically he was a proponent of a materialistic monism based entirely upon organic evolution as the unifying principle of all life.[70]

August Weismann (1834-1914) is another German zoologist. Goldschmidt refers to him as that "great morphologist, ecologist, and experimentalist...combined with a great analytical thinker..."[71] His greatest work was <u>Studies in the Theory of Descent</u> in which he published his germ-plasma theory of inheritance. This was a direct challenge to the "use-disuse" theory of Lamarck and in large part resulted in the overthrow of this latter theory. Though some of his conclusions have been found faulty, considering the thinness of the experimental work and understanding which had existed previous to him, he showed a keen understanding and drew some shrewd conclusions.[72] Charles Darwin, in writing the preface to the English translation of the work mentioned above, wrote: "At the present time there is hardly any question in biology of more importance than the nature and cause of variability (in individuals)".[73] His contributions to the subject of inheritance were very great.

George Romanes (1838-1894) is another writer of the period who sponsored the evolutionary idea. Personally, he was a friend of Charles Darwin and supported his ideas; philosophically, he was a materialist[74] with tendencies toward Atheism.[75]

There were many other scientists and philosophers who supported the evolutionary theory who have not been mentioned here. By the same token, there were many other scientists and philosophers who were just as talented and qualified, who did not support the theories of

Darwin. The issue was not one-sided, but these have been listed to provide the connection between the various philosophies and theories which have existed concerning this subject.

Post-Darwinian Changes and Adaptations of the Theory

Since the days of Darwin, even though the time has been short, much research and speculation has been done in the study of evolution. The study has branched out into every field of science and history including comparative anatomy, embryology, paleontology, physiology, biochemistry, biophysics, cytology, genetics, morphology, geology, etc.

Louis Pasteur (1822-1895) performed his research primarily in the study of bacteria and fermentation. His training was all taken in France, his native country, specializing in chemistry. His work sparked the medical research by Lister which led to antiseptic surgery. They, through their research, struck a fatal blow to the concepts of spontaneous generation, at least to the teaching that it might be possible even today.[76]

Hugo DeVries (1848-1935) made his principle contribution to science in the field of genetics. He was a Dutch botanist and performed research on the evening primrose and other plants to determine the laws of mutation and the extent of mutations in botany. He was quick to apply the title "species" to each of the mutations which he discovered. (His use of the term is different from the accepted use today, and even different from the "taxonomic species" which was a common term in his day.)[77] His theory involved not just a series of very small steps which were selected naturally and collected to form a new

species but rather occasional very large steps, by way of extreme mutations, which would immediately begin a new species.[78] He confirmed the prior work of Gregor Mendel (though he was unaware of Mendel's labors) which was mentioned in the following chapter.

Very little new work has been done on the philosophy of evolution other than to bring forward the concept of either Spencer or Romanes, to put a little more "meat" on it and to publish it again. Perhaps the most outstanding philosophical work is Emergent Evolution by C. L. Morgan (1852-1936).[79]

Geologist Marsh (1831-1899) made contributions in geology; Louis Agassiz (1807-1873 and H. F. Osborn (1857-1915) made definite contributions in the field of paleontology.[80] Thomas H. Morgan (1866-1945) and his coworkers have done excellent work in the cytology of inheritance and the study of genes and chromosomes.

Perhaps the most active contemporary evolutionist in the field of genetics is Theodoticus Dobzhansky. His experimentation has been done primarily with the fruit-fly (Drosophila) with special attention to the chromosome configurations and relationships. His book, Genetics and the Origin of Species, is used as a primary reference work in all studies on this subject.[81]

The most active philosopher for the evolutionist is Julian Huxley (1887-) who until recently was the director-general of UNESCO and author of Evolution, The Modern Synthesis.[82]

Of these contemporaries there are many persuasions. Some believe in inheritance of numerous small changes adding together to form new species. Others believe, with DeVries, that evolution takes place

through large steps. There are some who, because of great problems in the promotion of both of the two previous theories, hold to a reorganized Lamarckian theory of the inheritance of acquired characteristics through natural selection. Instead of the unity which was noted among the Darwinians concerning the processes involved, there is now an extreme divergence to explain these processes, though there is an outstanding unity upon the basic principles of evolution. Because of its influence in modern education, it is being accepted as a fact by many persons today without any examination or evaluation.

Summary

Philosophical History. In ancient history, the evolutionary idea was carried in the philosophies of several of the Greek philosophers. These men are nearly all known as materialists, because of their lack of faith in any spiritual evidence, and also as skeptics, because of their lack of trust in the senses of man.

The scientific additions to the idea, which brought it to the standing of a hypothesis, began in the sixteenth century and are continuing to the present day. Again we see the same philosophical connections with materialism and skepticism. Some of the evolutionary philosophers such as Spencer are agnostic and some would tend rather to be atheistic. There are a few who should be classed as deistic, and this undoubtedly includes some of these who believe in the various forms of Theistic Evolution. In all of these variations, however, the theists are conspicuous by their absence.

The Importance of Philosophy in the Fields of Science. As stated above, the philosophical connections of the theory and ideas of evolu-

tion, as they have existed through the centuries, have been basically materialistic. This philosophy would, by its very nature, prejudice the evolutionary philosophers, scientists and experimenters against admitting any evidence which was not materialistically derived or any alternative explanation of the evidence which is based upon non-materialistic principles.

This statement is not intended to impugn the honesty of the experimenter. The subjective element must be admitted when dealing with scientific conflicts or religious conflicts and also when dealing with conflicts between science and religion.

In the past two generations, growth and change have been phenomenal. Methods of transportation have been completely revolutionized. Methods of communication thought impossible as little as fifty years ago are now commonplace. The change in the standard of living has been tremendous for the peoples of the Western World. This <u>observation</u> of growth has, in the philosophical and popular mind, become a <u>principle</u> of growth and many times in the scientific mind has become almost an obsession.[83] In the minds of many men this principle of growth, which is observed in many of the social, scientific and industrial aspects of modern civilization, is read back into the natural aspects of the universe unconsciously. It often becomes distasteful to a person with the materialistic bias to even consider the possibility of miraculous intervention in the regularity of nature or to consider the possibility that growth is not responsible for everything when it is responsible for so much. This distaste is shown in the following quo-

tation from Julian Huxley:

> There are only three possible alternatives as regards the origin of living substance on this earth. Either it was supernaturally created; or it was brought to the earth from some other place in the universe,...or it was produced naturally out of less complicated substances.
>
> The first suggestion runs counter to the whole of our scientific knowledge. Living substance consists of the same matter as lifeless substance....To postulate a divine interference with these exchanges of matter and energy at a particular moment in the earth's history is both unnecessary and illogical.[84]

It is the subjective element, rather than the objective evaluation of evidence, which causes a scientist or a philosopher to refuse to consider this possibility.

This bias has been considered in the examination and evaluation of the scientific evidences and conclusions which have been collected in the study of this problem.

CHAPTER III

THE SCIENCE OF GENETICS

Introduction

As stated in the first chapter, one of the preparatory steps to the study of evolution was to establish the validity of the science of genetics in dealing with the evolutionery problem. It was also necessary to determine the limits of the science of genetics. This evaluation of genetics was presented quite briefly but with sufficient thoroughness to demonstrate its importance and its authority to speak in the solving of the problem under examination.

Definition

Briefly stated, genetics is the science of inheritance. As such, it has a close relationship with cytology, biochemistry, physiology, embryology, agriculture, horticulture, and many other branches of knowledge. Genetics is both a pure science and an applied science: i.e., much of the research has to do with theoretical and hypothetical problems and apparently impractical conclusions;yet, at each step comes added information which is of direct use to plant breeders, cattle raisers, and others who work with either plants or animals.[85]

As a science, genetics must deal with the following questions: What is the mechanism of inheritance? What laws govern inheritance? What is the relationship between the species? What is the process of species improvement, and how can it be controlled?

In answering the first of these questions the geneticist must deal with the problem of how a single cell can multiply and differentiate to become a complex individual and with the problem of how the genes affect this development.

Description

Characteristics of individuals are known to be influenced by inheritance units known as "genes". This is an arbitrary term to define an indefinite entity. No one is exactly sure what a gene is;but just as in most other sciences, we know how it acts and that is sufficient to enable us to use it and predict it.

From experimental evidence, discussed later, it has been determined that genes exist in pairs, known as alleles. Usually they are dominant and recessive to each other, which means that the recessive allele is only allowed to act in the absence of its dominant allele. Each individual has two representatives for each allelic pair; they may both be dominant or both recessive or one of each.[86] In sexual reproduction these two genes are, by the laws of chance, separated and only one combines with the one gene from the other parent which entered the combination under the laws of chance also, to give the new individual its quota of two genes, one from each parent.[87] These two genes then influence their particular characteristic during the development of the infant individual according to the rules of dominance or according to whichever rules apply to that particular allelic group.[88]

The above paragraph refers only to the allelic pair which af-

fects one characteristic. It must be remembered that there are thousands of allelic pairs involved in each process of fertilization. These sometimes go in groups and sometimes assort at random.

There are corollaries to this treatment of the genetic and fertilization processes which were discussed in a later chapter,but these principles stated above will suffice for the present purpose.

History and Development

Early Studies. There had been very little organized examination into the science of inheritance until the time of Darwin, and even then, the examinations were more from the standpoint of collecting specimens than with truly organized research which would enable the examiner to have an insight into the mechanics of inheritance.

Mendel. Gregor Mendel (1822-1884) was an Austrian of a middle-class family. While apparently not rich, the family sent several of their children through the public school. His early education was so successful that he was later sent to the gymnasium at Troppau.[89]

> At Troppau one of the teachers was an Augustinian, and it is surmised that perhaps his description of the scholarly tranquillity of the cloister may have turned Mendel's thoughts toward a monastic life. However that may have been, when his time at the gymnasium was ended he became a candidate for admission to the Augustinian house of St.Thomas in Brunn, an institution generally spoken of as the Konigskloster. His application was successful...[90]

After entering the cloister he was sent for two years to the University at Vienna studying mathematics, physics, and natural sciences.

As Darwin's views came into full prominence, Mendel found that he was not in agreement and so sought to determine more about the problem for himself. This embarked him on his research with peas. A short time prior to his starting this research, it is reported that Dr. vonNiessl was taken to see his garden, in which he was already raising plants under controlled conditions. He was shown two forms which we now know as varieties of Ranunculus Ficaria which had been cultivated for several years side by side. Mendel jokingly said: "This much I do see, that nature cannot get on further with species-making in this way. There must be something more behind."[91]

In addition to his peas, he also kept fifty hives of bees under observation for additional information concerning inheritance. His notes on this research cannot be found and apparently have been destroyed.

In 1865 he prepared his paper, Experiments in Plant Hybridization, presenting it to the Brunn Society, and it was published by their organ in 1866 but passed unheeded. A later paper on Hieracium which appeared in 1869 met a similar fate.[92]

In 1868 he was elected Pralat (Abbot) of the cloister and was, because of his heavy duties, forced to forgo his further research.

His papers included the basic Mendelian laws upon which the science of genetics is now based.

> He found that in the inbreeding of hybrids the offspring followed a definite mathematical relationship. If one crossed a tall pea with a dwarf, both purebred, all the offspring were tall. The characteristic of tallness is said to be 'dominant'. In the second generation twenty-five percent are talls and breed tall forever, twenty-five percent are

> dwarfs and breed true, and fifty percent are tall but are not pure-breds and when planted, break up twenty-five percent tall that breed true, and fifty percent which are tall, but when planted break up in the 25-50-25 percent ratio.[93]

These conclusions are based upon the unit characters or genes.[94]

If more than two characteristics are involved, the process is more complicated but is statistically predictable and merely a mathematical expansion of the above conclusions.

DeVries (mentioned in the previous chapter) published a paper in 1889 under the title Intracellulare Pargonesis in which he proposed much the same theory as Mendel had earlier, though his exegesis of it was not as thorough or based upon as much evidence as was the work of Mendel.[95]

Again, in 1897, Sir Francis Galton (1822-1911), a cousin of Charles Darwin, carried on extensive studies in human heredity and through a statistical study of the Basset Hounds, formulated his theory which, if correctly understood, was the same as Mendel's; but he did not analyze his statistics thoroughly enough to actually propound a scientific law.[96] [97] In his research and writings, however, he was able to lay the foundation for the statistical treatment of genetic data which has been applied in the modern science.[98]

In the spring of 1900, within a period of a few weeks, the three papers of DeVries, Correns, and Tschermak were presented, each giving the substance of Mendel's long-forgotten research and treatise.[99] From that time, the study of genetics was able to continue in a reasonable and organized manner as a quantitative science rather than as an immature qualitative science.

Later Studies. Since the time of Mendel, research has added many new concepts to his basic laws which he did not happen to meet. One of the early discoveries was the discovery of chromosomes. They were first studies during the period between 1866 and 1900; but their connection with the mechanics of inheritance was not immediately noticed. As late as 1915, T. H. Morgan and his co-workers in *Mechanism of Mendelian Heredity* stated that it was still questionable that chromosomes were the bearers of the hereditary factors, though becoming more likely as research continued.[100] Even today we have yet to determine the exact relationship between genes and chromosomes and more than one theory has ardent followers. That genes are in some way carried on the chromosomes, however, has been quite well established.

Another concept which has been added to the Mendelian law is the existence of multiple alleles. Mendel showed that most characteristics were caused by the presence or absence of a combination of two different genes (alleles), the one dominant over the other. It is now seen that there is occasionally a group of three or more (as many as eleven have been known) alleles which all affect the same characteristic in the individual.[101]

The most common example of this situation is found in human blood types. There is a dominant gene which will give a blood type A and another dominant gene which will give a blood type B. There is also the recessive gene which, in the absence of both dominants, will give a blood type O. Genes A and B do not happen to be dominant to each other. Therefore, if a person has only two recessive genes,

his blood type will be O; if he has a dominant gene A, his blood type will be A; if he has a dominant gene B, his blood type will be B; while if he has both dominants, his type will be AB.[102]

In addition to the AB types there are several other blood types which are controlled by multiple alleles; and there are also many other characteristics which are the result of multiple alleles; some of them form a complete system of dominance, one over the other; and others do not seem to exercise dominance in all cases, but mix their effects.

Another aspect of genetic action is the interaction of two or more allelic pairs in the determination of a characteristic. An illustration could be given from the color of Duroc Jersey pigs. This color is controlled by two allelic pairs; R and r, and S and s. If both dominants are present (R and S), then the pig will be red. If only one of the two dominants is present (either R or S), then the pig will be sandy colored. If neither of the dominants is present (the genetic combination, known as the genotype, being rrss), the pig will be colored white.[103]

This is a simple example of the situation. It often happens that three or more alleles are involved in a particular characteristic, making the prediction of the results of cross-breeding quite difficult, but experimentation and statistical methods used jointly have given unusually fine results in determining the causes for the particular relationship in any given instance.

There are other characteristic types of genetic action which have been discovered by various groups of geneticists in the last fifty years, such as sex-linked characters, sex-influenced characters,

linkage, lethal genes, and others, but these are but adaptations of the above mentioned situations. Some of these were brought up in more detail in a later chapter.

The Importance of Genetics to the Study of Evolution

By way of introduction to this topic, two quotations will be given, the first from an evolutionist;

> Further, if evolution has and is occurring, we must show that the system of inheritance will account for both the stability and the plasticity of organisms, and establish a genetic system which makes both evolution and its systems statistically predicable.[104]

the second from a creationist:

> The proof of the evolutionary hypothesis, then, in the last analysis, rests on the question as to whether heritable variations capable of producing evolution are occurring today in nature or can be shown to have occured in the past.[105]

In order to prove, or disprove, evolution, or to get an indication and implication of the truth or falsity of the theory, one must examine the mechanics of the theory which must be in the field of genetics. Whether the evolutionist wishes to believe in evolution by monstrous mutations,as some do,or by the collection and improvement of minor mutations, he must believe that these mutations are inheritable or he has no evolution. Likewise, he must believe that these inheritable mutations are improvements over the former genetic structure. Otherwise the law of natural selection, to which a creationist will also agree, would soon eliminate it from the species.

Thus, as above stated, only in the field of genetics can the final support or destruction of the evolutionary theory be found.

Limitations of the Science of Genetics

Every field of knowledge, whether it be theological or scientific, is subject to limitations. These limitations must be recognized by those who would be efficient and honest in their study and interpretation. These limitations may be classed in two groups, i.e., the scientific limitations and the philosophical limitations.

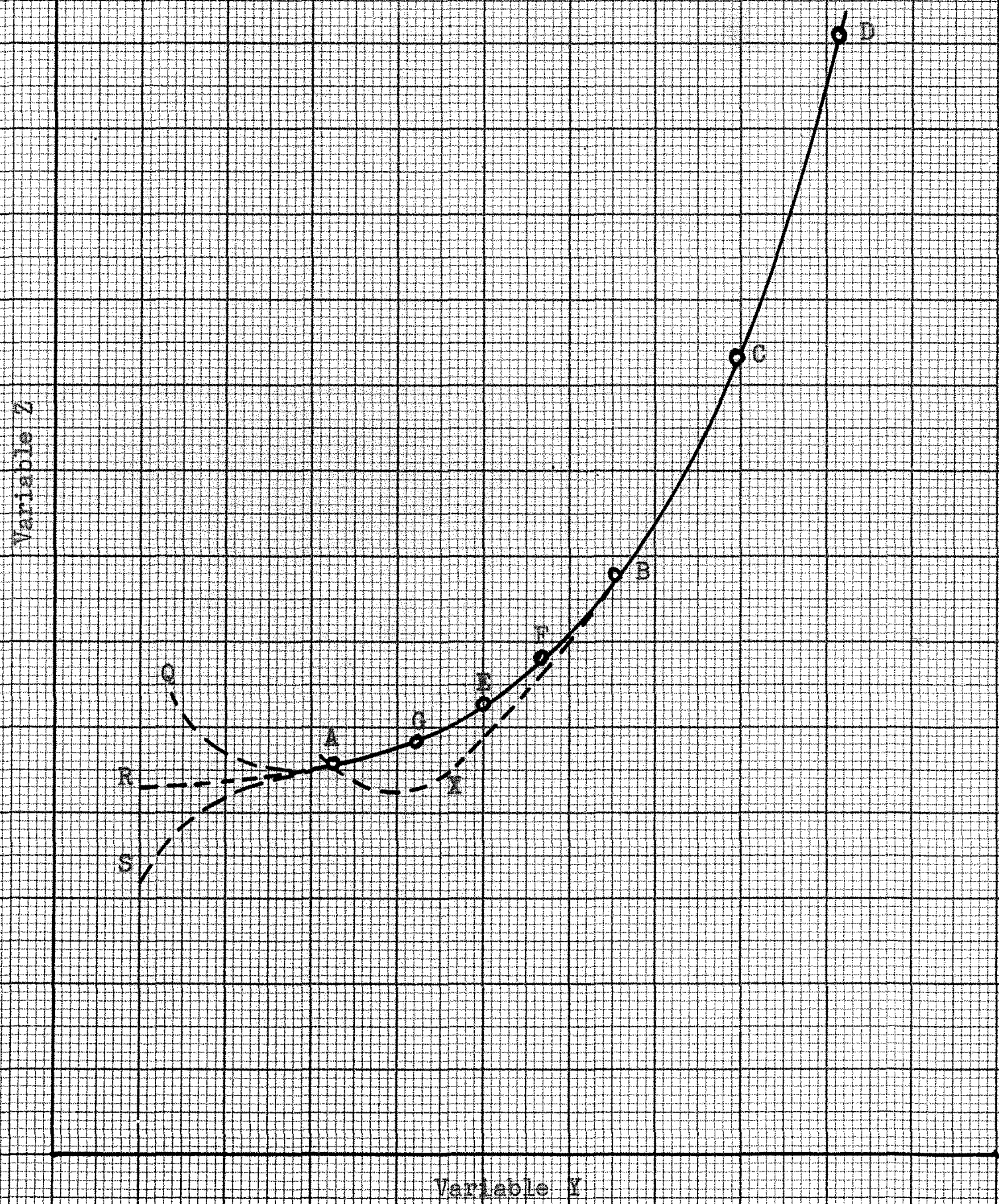
Scientific Limitations. Limitations in this category can best be illustrated by a preliminary discussion of the process of "extrapolation".

By extrapolation is meant the process of extending the preliminary conclusions drawn from a set of data beyond the limit of those data. This may be demonstrated mathematically as follows: (see figure I) from given points A, B, C, and D obtained from some particular scientific data, a valid conclusion (in this case the solid curve) may be drawn to connect the various datum points. The section of the curve between any two points is "interpolated" or placed between, and there is good reason to do so although even that may be subject to error (notice, for instance, that curve x could be a valid interpretation of the same data). Taking more evidence between the points (points E, F, G) will increase the probability of correct interpretation of the data. To extend the line back beyond A, however, is known as extrapolation and is greatly subject to error (notice that curves Q, R, and S could all be valid interpretations of the evidence given).

So it is with genetics; extending the science back beyond observable data in order to attempt to examine the beginnings of life

Figure I

THE PROBLEM OF EXTRAPOLATION
(See Explanation in Text)



is extrapolation and is subject to grave error, and since it is beyond the realm of human history, it is impossible to obtain any additional data in that area.

Extrapolation has also been used, with the same questionable results, in applying data (and conclusions) obtained from one of the many segments of the vast field of life, which genetics covers, to some other segment of that vast field. The application may be valid; but then again, it may not, for it is basically an extrapolation.

A third case where this questionable process is used is in "backing down the family tree". Some have assumed that relationships that hold true between species will also hold true between genera and between families, orders and phyla. This is another case of extrapolation and, thus, is subject to great error.

Philosophical Limitations. Genetics is a science. Science is defined as meaning "that approximate knowledge we possess of Nature and its phenomena...",[106] thus, genetics would be defined as the approximate knowledge we possess of the nature of inheritance and its phenomena. It is also the work of science to theorize about the relationships between various collected data and about the laws and principles which control the phenomena which are being observed. This is an essential part of the scientific method.

Philosophy, however, deals with the relationships between the sciences. Philosophy does not deal with phenomena as much as it deals with theories and principles which control phenomena; and just as science pools all the available evidence into its proposal of a scientific hypothesis, philosophy pools all of the available hypotheses into its proposal of a philosophic system.

It is not the purpose of science, nor is it a valid field of activity, to hypothesize concerning things which cannot be examined by the scientific method, such as the existence of God, the existence of the human soul, the spiritual characteristics existent within the universe, and the problems of the relationship between sciences.[107]

When scientists begin to philosophize, they are no longer scientists but philosophers; and they should recognize this. As philosophers, then, they are subject to the rules of philosophy rather than the rules of science, which may make a difference in their adoption of any final system.

Genetics, as such, does not enter into the field of philosophy. It deals with life on earth and its inheritance. In no way may it attempt to deal with life before the origin of the earth, nor may it deal with spiritual life or spiritual phenomena. Likewise, it may not deal with life in the distant future. These are tasks of philosophy, not genetics.

Summary

Genetics is the key to organic evolution. Within the science of genetics is found the process by which evolution must take place if it is to take place at all; therefore, it is the final proving ground for the theory. It has, as a science, advanced beyond the stage of a qualitative science and become a quantitative science; thus, it is able to speak with definiteness and authority within its own field. This field, however, must be limited by both scientific limits and philosophical limits. Scientifically it is limited from

going beyond its data, and philosophically it is limited from going into philosophic data.

In the first chapter it was pointed out that there is a very definite need for an analysis of the problem which exists between the organic evolutionary hypothesis and the Scriptural account. It was also observed that in the science of Genetics is found the ground for examination which will enable the student to analyze and evaluate the problem objectively in order to more correctly determine truth.

CHAPTER IV

HEREDITARY TENDENCIES EXAMINED THROUGH MODERN GENETICS

Methods of Reproduction

Reproduction is one of the four essential characteristics of all living matter, the others being growth, metabolism, and irritability. The methods of reproduction vary in some particulars; but the end result is the same, i.e., a new individual; all types of reproduction fall into one of two categories, either asexual reproduction or sexual reproduction.[108]

Asexual Reproduction. This form does not involve the union between the egg and the sperm but owes its origin to one parent only. This may take place by budding (a new individual growing from a small outgrowth of the parent), fission (equal division of the parent into two separate individuals), or parthenogenesis (by an egg but without benefit of any sperm). Within these three types there are also other forms of differentiation, but the basic divisions cover the processes quite thoroughly.

For this type of reproduction the science of genetics has little to say, for the "genetic" make-up of the new individual is identical with the make-up of the parent.[109]

Sexual Reproduction. Sexual reproduction always involves a mixture of hereditary factors from two lines. In spite of the several methods of asexual propogation it is interesting to note that in nearly all cases where a species normally reproduces asexually, there

is also a method by which they reproduce sexually upon occasion.[110]

Bacteria and protozoa and some others usually reproduce asexually, but frequently two individuals will unite for a period of time causing a partial exchange of cell materials. Both of the individuals are changed by this exchange and their descendents then inherit these changes.

Some species merely alternate between sexual and asexual reproduction; the Hydra would be an example of this. In addition to this method of sexual reproduction there are many species which are hermaphroditic; that is, they are able to produce both eggs and sperms. Usually self-fertilization is hindered or impossible, but this is not always the case. One type of mollusk is completely self sterile; others emit their eggs and their sperm at different times, so there is little or no chance of self-fertilization; both of these methods serve the same purpose. Most flowering plants fall into this category for within the blossom the pistil and the stamen mature at different times or are of such different lengths that self-fertilization is difficult.

The most familiar form of sexual reproduction is that of gamete formation. In this method there is a difference between male and female individuals and when mature, the males provide the sperm and the females provide the eggs; one sperm penetrating an egg completes fertilization and the cell then begins to grow and multiply until the adult individual has been developed, assuming that the proper care and nutrition have been provided. The methods of providing nourishment and protection to the developing fertilized egg are quite varied

in different species.

The Materials of Inheritance

Genes and Chromosomes.

> A living cell, animal or vegetable, has a nucleus within which is a certain number of chromosomes, the number depending upon the species or animal or plant. The nucleus may occupy anywhere from less than one hundredth to more than two thirds of the volume of the cell; the rest of the material is the cytoplasm. The chromosomes have individuality: each one differs from all the others in the same set. Within the chromosomes are the genes, arranged in a linear order.[111]

This briefly describes the three major materials or units which are involved in inheritance, i.e., cytoplasm, chromosomes and genes.

The genes were discovered, or at least postulated, from mathematical data. Chromosomes were discovered with the microscope as was the cytoplasm.

Chromosomes seem to be composed of three kinds of chemicals: namely, protein, desoxyribonucleic acid (DNA), and ribonucleic acid (RNA); the later is only a minor component in the chromosome though it is an important part of the cytoplasm. It is interesting to note that both the molecule of protein and the molecule of DNA are arranged upon basically the same geometric pattern, that of a helix (a spiral staircase). The basic line of this helix is composed of a repeating series of molecular units linked chain-fashion for an indefinite length. Both inside and outside of the helix,thus formed by this chain, are attached different molecular groups, called radicals.

DNA has a chain composed of a complex sugar and a phosphate

group alternating indefinitely. The side components are the bases; adenine, cytosine, guanine, and thymine; and they may be connected to the chain in any order whatever. The molecule is complete when there is a basic radical at every side position on the chain. A change of the order of these basic radicals, however, will change the chemical characteristics of the molecule.

The protein has a hydrocarbon chain with any of twenty-two different amino acids attached as side components in irregular order. Again, while the molecule is complete regardless of the order,as long as there are connections in every required place, the characteristics of the molecule differ with every different arrangement.[112]

> Indeed, the number of possible shapes that proteins might take is so vast that a mathematical brain might conclude that from a statistical point of view life is completely improbable.[113]

The basic structure of the chromosome is not yet certain, but it appears to be true that the protein molecule forms the backbone of the chromosome and holds the DNA molecules in place upon it. Some theories of the method of operation of the molecules and the method of formation of new molecules have been given,but they are still subject to much confirmation before they can be depended upon to any extent.

The chromosomes are known to be self-duplicating with near perfect accuracy. They are able to form an exact image of themselves and then, by cellular processes and division, form the nucleus of a new cell. The chromosomes always appear in pairs (with but a few specialized exceptions) and when the process of cell division begins, each of these pairs duplicates itself thus doubling the number of chromosomes within the nucleus. The chromosomes then separate themselves, form two nucleii, and then form two separate cells.[114]

Another fact concerning chromosomes is their numerical consistency.

> The number of chromosomes per nucleus is as a rule constant for all the individuals of a species, and varies from one species to another. Man has forty eight, the fox thirty four, the rabbit forty four, the rat forty two, the mouse forty, red clover fourteen, garden peas fourteen, corn twenty, tomatoes twenty-four, and so on.[115]

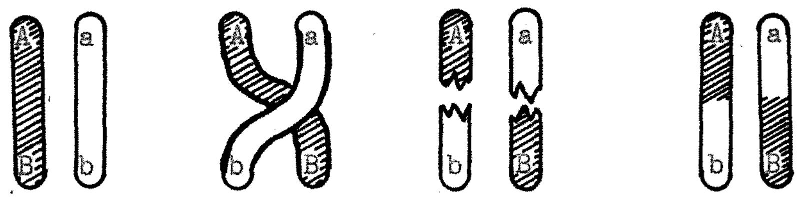
There is variation of chromosome numbers within groups; for instance, tulips usually have twenty-four chromosomes but occasionally have thirty six, forty eight, or sixty chromosomes.[116] These numbers are not different within the same species but within the same group. Within the species the chromosome number is uniform.

It is also known that inheritance units (genes) are aligned linearly upon the chromosomes. Through breeding and statistical methods, it has even been possible to map the chromosomes of some species and locate upon them, within limits, the particular genetic regulator or gene for many individual characteristics. Nevertheless, it appears that genes are not entities, as such, but that they are in some way connected with the organization of the side arms upon the molecules of DNA which, with the proteins, compose the chromosome. Briefly stated, it appears that a gene is a particular configuration of the chromosomal molecule located at a particular place upon the chromosome.

In fertilization the two sets of chromosomes, one set from each of the two parents, come together within a single cell. They must be able to align with each other with homologous portions adjacent. When they are able to do this, they are able to reproduce by

division and, through multiplication and differentiation, form the complete new individual. If the chromosomes are not sufficiently alike in their organization so that each part of the one is able to line up with a like part from the other, the cell cannot live or reproduce; or if it does, the offspring are generally sterile. There are two species of Drosophila (fruit fly), for example, which have the same chromosome number, but have chromosomes so unlike that they cannot produce a fertile hybrid.[117]

The aligning of the genetic units upon the chromosomes suggest one more phenomena which has been shown to be a definite factor in inheritance; that is, that genes do not always assort completely independent of each other. Generally speaking, all of the genes upon a single chromosome will go together into the fertilization process. Thus, if an individual parent had mixed genes (heterozygous), with a dominant and a recessive gene for one characteristic and a dominant and a recessive for another characteristic, and both the dominants were on the one chromosome and both the recessives were on the other chromosome, the next generation would be expected to receive either both dominants or both recessives but not one dominant and one recessive. In practice this is generally the case, but if these two genes are far apart on the chromosome, there is a possibility of the chromosomes "crossing-over" between the two genes, (see figure II)i.e., both chromosomes breaking at approximately the homologous place and the broken ends rejoining to the opposing chromosome rather than the original chromosome. This happens frequently but still remains as an exception to the rule.



(a) (b) (c) (d)

Figure II

DIAGRAMATIC RECONSTRUCTION OF THE CROSSOVER PROCESS

Cytoplasm.[118] It has been determined chemically that the RNA component mentioned above is quite similar to the DNA component which is basic in the chromosome. This RNA component exists within the cytoplasm primarily along with other hypothetical units known as plasmagenes. The exchange of this cytoplasm has been shown to influence heredity in several cases, mostly with bacteria, protozoa and the lower forms of plants and animals.

Cytoplasmic inheritance is also to be noted in some plants and animals where characteristics are passed on from the maternal side only and continually. Some of these interact with some Mendelian inheritance unit,but the cytoplasmic inheritance is definitely involved.

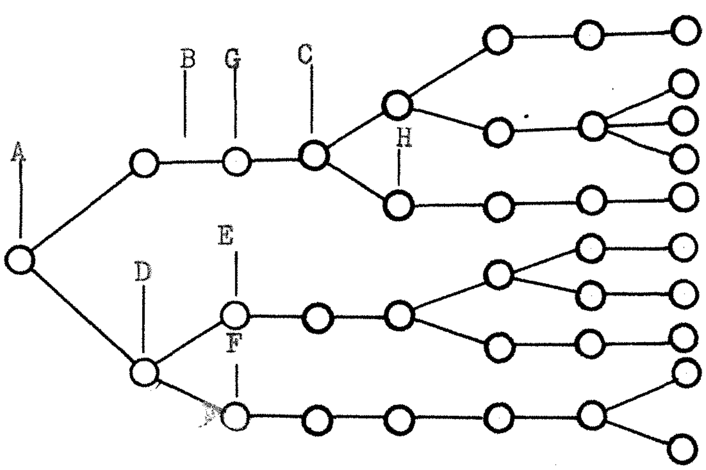
This method of inheritance is still but little understood. There are some indications that plasmagenes may be similar to viruses or, that a virus is merely a plasmagene in the wrong host. Whatever the detailed process or existence involved in cytoplasmic inheritance, the experimental evidence which has been obtained leaves no doubt but that it is definitely a factor to be reckoned with, though it is not nearly as evident or effective as chromosomal inheritance.

<u>Embryonic Development</u>.[119] The processes involved in the fertilization of the egg and the development of the embryo into the mature individual are too technical and detailed to be of advantage in a study such as this. They are embodied in a science of their own, Embryology.[120] It is essential, however, that the relationship of the gene to the process be briefly given.

Genes are chemicals. Whether or not they are "living" chemicals is a matter of definition or argument, but their chemical constituency is at least partially known.

The cell is an organized system and not just a "homogeneous blob of protoplasm" having in it a nucleus.[121] There can be a high degree of differentiation within a single cell. As the fertilized egg which is a complete cell begins to divide and grow, the genes are enabled to react with the various portions and various new cells in their appropriate manner.

Fertilized egg



Differentiated cells

Figure III

DIAGRAM ILLUSTRATING THE EFFECT OF GENES IN THE DEVELOPMENTAL PROCESSES OF THE EMBRYO

Figure III shows, in a very brief and inexact way, the general process. As the fertilized egg begins its growth, one of the genes (A) within the nucleus provides it with the necessary chemical by which it can correctly differentiate into two different types of cells. As these cells then continue the growth, another gene (B) is on hand to enable the one type of cells to develop correctly while another gene (D) is able, in the different environment, to act to further differentiate that type of cell. Thus, the process continues with some of the genes acting to aid development and some acting to aid differentiation. All of the genes are in all of the cells at all times, but only as the need arises do they make their contribution to the development and differentiation of the organism.[122]

This also shows what a great effect one gene may have upon the development of the organism, for if one of the genes is absent (gene D for instance) the other genes which follow (genes E and F) will be unable to act and complete their work; and thus, the organism will be deficient and deformed. All of the genes must work together in the development of every organism.

Processes of Change

It is not difficult to observe that there are many variations within the groups or species of nature. Upon this observation Charles Darwin built the theory of the origin of species. These variations fall into several categories which shall be discussed individually.[123]

Environmental Adaptations. Most obvious are the environmental

adaptations which take place in individuals. Use and disuse do affect greatly the development of organs and individuals. Lamarck based his evolutionary theory upon the heritability of these variations and Herbert Spencer is reported to have said: "Close contemplation of the facts impresses me more strongly than ever with two alternatives---either there has been inheritance of 'acquired character', or there has been no evolution."[124]

All persons agree that there are variations caused by environment, but the problem is their heritability. This problem was summed up by A. W. Lindsey as follows:

> We know that the exercise of bodily functions results in an increase of the powers involved and that complete inactivity results in atrophy....Unfortunately we also know that the effects of such reactions in the individual do not reappear in its offspring as a result of heredity, and so Lamarck's theory fails as an explanation of evolution.[125]

In spite of this evidence there has been a recent resurgence of modified Lamarckianism, but was discussed in chapter five.

Minute Variations. These small differences between individuals exist in every conceivable direction. There are variations in pigmentation, size, bodily proportions and many other things within the species. Some of these variations are heritable, but they were discussed below under the category of Mendelian variations. Most minute variations are the result of an interplay between environmental (including prenatal)and genetic forces and are all merely variations around a norm to which the offspring always tend to return. These variations have nothing to do with inheritance but, rather, are a prob-

lem in development; and so are a subject for the embryologist and biologist.

Mendelian Variations. The basic principles of Mendelian inheritance have been discussed in a prior chapter so will not be brought forward in detail at this time. It will be noticed, however, that there is vast room for variation within Mendel's laws within a given species. Some of these varieties breed true as long as they are bred with a like individual, but they very easily breed back into the basic stock again so no new species has been originated. Most of the various types of dogs are an example of this. There are big dogs, little dogs, hairy dogs, and hairless dogs, and all types of dogs in between. They are well defined in their characteristics and there is great variety among them; but if one or two individuals of each variety were put into a pen together with representatives of all the other dog varieties and allowed to breed and reproduce promiscuously, there would eventually come out of such a situation a fairly consistent type of dog which had some of the characteristics of all types which were originally represented as well as occasional individuals in the group which represented each of the parent types.

To put this illustration in reverse, if two dogs were somehow separated from the group, mentioned above, and placed by themselves in a certain geographic area and allowed to propogate, they would become a race (or variety) distinct from the general group of dogs.

This is not evolution; it is Mendelian variation and all must take place within certain inherent limits which are determined by the species itself rather than by any external forces. The Mendelian

characteristics all exist genetically in the population and by selective breeding may be sorted out in any desired manner whether for improvement or for retrogression.[126]

Genetic Mutation. Originally the genes were considered to be absolutely unchangeable entities, but now it is known that this is not quite true. Mutations, or changes in the genes, do occur occasionally. There is no way of knowing exactly how frequently they do occur because all mutations do not become known, but that they do occur occasionally is generally accepted. Only if there is a mutation in reproductive tissue which will be carried on to the place of forming a new individual, will the mutation enter into the species and affect the organism's posterity. Dr. Snyder sums up the known factors concerning gene mutations in a series of twenty-one statements of which the following are the most cogent to the present discussion:

> 1. Most genes are exceedingly stable....Even in the laboratory among organisms chosen for their capacity to produce mutations, a high stability of genes is found. Muller...has recently estimated that the mean life of a gene ...approximates 100,000 years....
> 2. Different genes have different rates of mutation....
>
> ....
>
> 5. A mutation is a change in a gene, not the loss of the gene....
> 6. More than one change may occur in a given gene, producing multiple alleles....
>
> ....
>
> 10. The changes in genes appear to be chemical processes....
> 11. Gross mutations are usually harmful to the organism....
> 12. Mutations are usually recessive to the wild type....
> 13. Mutations do not ordinarily occur in more than one gene at a time....
> 14. Two identical genes at corresponding loci in a pair of chromosomes mutate independently, just as different genes do....

> 15. Mutations with slight effects are more common than those with marked effects....
> 16. Mutations with no visible effects are the most common of all mutations....
> 17. Radiation (X rays, radium rays, ultraviolet light, and others) may greatly increase the natural mutation rate....
> 18. Certain chemicals may also serve to increase the mutation rate....
> 19. Genes are ultramicroscopic in sise.... [127]
> ....

In this same section Dr. Snyder states that mutations are undoubtedly due to an induced change in the structure of the gene molecule, either by the knocking off of an atom or the exchange of one type of atomic configuration for another within the genetic molecule.

In discussing the effects of mutations such as these, Dr. Goldschmidt presents a multitude of examples and evidences and sums them up with this statement:

> We have already expressed our opinion that we agree with the taxonomist that these aberrations cannot play any major role in evolution. But this does not mean that they may not contribute to microevolution, to diversification within the species. It is quite conceivable that under definite circumstances such a commonplace mutational type might establish itself either by supplanting the original form or by occupying an independent area.[128]

As has been observed by nearly all geneticists, the number of favorable mutations is extremely small at best. Julian Huxley estimates that of all the mutations which occur, only one in a thousand might possibly be favorable.[129] Most of these "favorable" mutations are favorable <u>only</u> under extremely altered environment (very hot, very cold, very wet or the presence of chemicals which are normally poisons) and have very little,if any, effect upon the fertility or viability of the species under ordinary circumstances. There is no known

mutant which is improved over the wild type in ordinary environment, but there are many which have very little harmful effects, or none at all, which are in existance throughout nearly every species; only an extreme change in environment may, through natural selection, bring these changes to the fore.

An interesting side-light upon the effects of radiation upon mutation, specifically human mutations, is the study of the children born to parents who were exposed to the extreme radiations at Hiroshima and Nagasaki. The results of very extensive investigation in this showed "no substantial evidence of genetic damage."[130] The only place where there was a difference between irradiated parents and non-irradiated parents was in a very small difference in the sex ratio. The report also adds, however, that there may be effects which will show up at a later time which are not apparent at this time.

<u>Chromosomal Aberrations</u>.[131] Besides the chemical changes known as gene mutations, there is another class of genetic changes known as chromosomal aberrations. These aberrations are generally in one of four classes: deletion (where some part of the chromosome is lost and the chromosome is transmitted with a deficiency), duplication (where some part of the chromosome is duplicated and appears twice instead of just once), inversion (where a segment is found in an inverted order compared to the usual order), and translocation (where a portion of a chromosome is transferred to some non-homologous chromosome. None of these are point mutations or, as they have been labeled above, genetic mutations.

There is one other occurance which is sometimes known as chro-

mosomal aberrations; the polyploid condition. This, however, was discussed in a later place.

Most of the chromosomal aberrations are a result of the "crossing over" process mentioned above. Occasionally the cross-over does not take place in exactly homologous places on the two chromosomes, with the result that one of the chromosomes does not receive all of the necessary genes (a deletion) and the other receives an extra segment of the chromosome (a duplication).

The inheritance of a chromosome which contains a deletion may have more or less severe results upon the individual depending upon the particular genes which are deleted. The general rule, however, is this:

> Usually, if a chromosome is deficient in any considerable number of gene loci, lethality results, even in the presence of a complete homologous chromosome.[132]

Organisms which are deficient in the same genes on two homologous chromosomes are much less likely to be viable than are those which are deficient in only one chromosome. While occasionally a deletion will occur which will not seriously harm the species, there is no deletion known which is of help to a species. This, of course, stands to reason since in the loss of a gene, one of the units which controls the development of the individual has been lost; thus the development is somewhat incomplete or retarded.

Duplications in chromosomes are also heritable and have large effects upon the development of the organism. Frequently the effect is to increase the effect upon the organism of the genes which are duplicated (pigments are darkened, etc). It has not been demonstrated

that this has any selective advantage for the individual.

The same general effects sometimes occur when whole chromosomes are duplicated; the Jimson weed examples examined by Blakeslee show that instances have occurred where there is one extra chromosome within the nucleus of an individual.[133] When a different chromosome was duplicated, the effects were somewhat different upon the individual; duplications of several different chromosomes were observed.[134] These did not produce new species or even new races, however. The one extra chromosome could not pair, and thus could not take part in the production of the next generation. Also, the individual itself was less viable than the wild type; hence, any natural selection which would occur would be to its disadvantage.

There is a narrow possibility that the extra chromosomes or extra chromosome material in the form of duplications might take part in the production of the new generation. If this were to occur, there would be the possibility of the origin of a new species with two more chromosomes than the parent species. Relative to this possibility, the following quotation taken from a paper by W.S. Stone and A. B. Griffin is of interest:

> In all of these cases the hyperploid male (those having the extra chromosome material) shows a reduction in viability. Despite this fact stocks of all may be maintained with proper care. In stocks with the chromosome number increased, selection must be carried out each generation since nondisjunction will produce some males which are not hyperploid. These are much more viable than the hyperploid males and therefore will replace them in the stock except for selection.[135]

Another type of aberration, inversion, is also quite evident in laboratory populations and also in wild populations of both plants

and animals. This type of aberration occasionally causes marked differences in the individuals which inherit it. If the inversion is not extreme, the individual is completely fertile with the parent species; but if the inversion is complex, it may be difficult for the chromosomes to pair their homologous portions; and the resulting generation will probably be either sterile or of reduced viability. There is a possibility of species formation taking place by this process in which the descendent species caused by a series of inversions would become, through separation and inversion, infertile with the parent species. This will not be common, due to the controlling influence of the presence of the wild-type (except when there is distribution and separation), and due to the difficulty of the first individual having an inversion successfully mating with another individual in order to provide for the continuance of the inversion.

Translocations must also be included in this discussion. They are similar to inversions but cause even more difficulties in fertility than do inversions and for the same causes. Dobzhansky reports, concerning translocations:

> As pointed out by Muller (1928) the majority of the translocations are inviable when homozygous. The reasons for this are not yet understood. It seems to be possible that a breakage of a chromosome, which is necessary for the occurrence of any translocation, may take place only in case the chromosome is injured by some agent. Or, to the contrary, the breakage itself is likely to do injury to the chromosomes.[136]

Later research has not changed the opinion of the experimenter concerning this conclusion, rather,

> ...more recent work merely accentuates the fact that the overwhelming majority of trans-

> locations in the fruit fly are either inviable, or reduced fertility, or less vigorous when homozygous.[137]

In spite of the negative selection pressures upon translocation bearing individuals, it occasionally happens that such an aberration will become established in a population. If distribution separates the individuals having the translocation from the parent population, the new population may become a separate species, provided that enough other translocations or inversions also become established in the new population. These further chromosomal aberrations may prevent hybrid fertility with the parent species.

Examinations into wild populations show that in a few cases this has apparently happened, but there is generally no major difference between the two species except for the hybrid sterility.[138]

Position effect is the final chromosomal aberration which is of evolutionary importance. Due to the complicated interaction of the genes, the position of a given gene upon the chromosome seems to make a definite difference in the action of that gene and, therefore, in the development of the individual. Goldschmidt has gone to extensive lengths to make this effect the sole cause of evolution.[139] Most other geneticists disagree with him, though they do realize its importance.[140] Actually, however, there is only a matter of difference in means between the genetic mutation and the position effect. They both are subject to selection in the natural population, hence there is no difference between the effect of position effect upon a population and the effect of the genetic mutation or chromosomal aberration upon a population.

Summary. These various processes by which changes in the genetic inheritance of a species or of an individual take place are all important in any study of hereditary tendencies. There is an obvious tendency toward diversity within living things; however, from the foregoing discussion it is to be observed that, with but very rare possible exceptions, this diversity is limited to diversity around a norm. This norm is commonly known as the "wild-type" and is nearly always the more viable form of the species and most readily propogates itself. This is true regardless of the method of inheritance which is involved in the given case.

The real advantage of change is in the case where there is an extreme change in environment. There is then a possibility that one of the mutations may be more suited than the wild type to the new conditions. Recently, experimentation on the heredity of bacteria, which claimed to demonstrate evolution, was actually a demonstration of natural selection in the face of an extreme environment chance.[141]

Processes of Stability

Too often the geneticist, and especially the evolutionist, becomes so fascinated by the processes of change that the equally important processes of stability are ignored. These processes are just as real and are actually more pronounced than the processes of change.

Random Mating. The most elemental factor in maintaining stability within a species is the sexual system itself. The existence of sexual reproduction provides the means by which all of the processes of change and stability are able to be efficient in the main-

tenance and continual adaptation of any given species. Because of sexual reproduction, there is a continual flux of inheritance factors appearing in different combinations, some of which are advantageous and others are deleterious, to add their part to the welfare of the species.

Within each species there are a certain number of gene types which are available for reproduction. True, there are new mutations occurring occasionally, but most of these mutations are not truly new, for they have occurred before.[142] In a natural population these genes, through random mating, are thoroughly mixed among all of the members of the population. Statistically, they remain in approximately the same ratio from generation to generation unless there is some truly selective factor involved.

If there is some selective factor involved in a particular gene, it is most likely negative; that is, it is more likely that the particular gene is deleterious than that it is advantageous to the population. Those individuals who receive two copies of that harmful gene will likely be eliminated early in life or else their fertility is reduced so that they do not propagate that gene to the same extent that the "wild-type" individuals would propagate its genetic inheritance.

All of this takes place, however, through the process of sexual reproduction and random mating.

In laboratory work or in agricultural work certain characteristics are desired above certain other characteristics. Through inbreeding and selection these characteristics are chosen and propagated within a limited population. The variety of domesticated an-

imals is tremendous, much greater than the variety in natural populations, and this selection procedure is the cause of such variety. In natural populations there is variety, also; but there is a much larger percentage of normal individuals (in the sense that they are near to the norm for that species) than in the domesticated and selectively bred species.

The continual mixing of the chromosomes also provides that each gene type will continue to exist within the population whether it is advantageous or deleterious. The more advantageous genes will tend to exist in a higher ratio than the deleterious genes, but they will all be maintained.[143]

Genetic Balance. As has been discussed before, the chromosomal and genetic arrangement within the cell is quite complex and delicate. The method by which genes act shows that no gene, in reality, acts alone; but rather, each gene must depend upon each other gene in order that the individual organism might be complete. There is, therefore, a genetic balance for each species which is quite delicate.[144] Any large changes which are made in the genetic composition of the individuals of the species generally results in the reduction of the viability or fertility of that individual as has been previously mentioned.

This does not mean that there is not a variation within this balance, but it does mean that this variation must not be very great or the balance will be sufficiently upset to act to the detriment of the individuals involved.

Likewise, it does not mean that there can be only one genetic balance for a given type of life. There are, for instance, several

different species of Drosophila (fruit flies). Each of these is different from the other, and yet, there is a very great similarity between them. Each of them has a different combination of many of the same basic characteristics, i.e., a different genetic balance.

The function of this balance is to maintain the norm or optimum conditions for the species as a whole by eliminating those individuals which "upset" the balance.

Natural Selection. Most famous of the natural processes, due to the publicity given it by Charles Darwin and his followers, is this principle of natural selection. By this is meant the interacting forces of nature which allow for the survival of only the fittest individuals.

Even a casual glance at the evidence convinces one of the validity of the principle; but, when dealing with the subject of evolution, it must be remembered that natural selection is not creative.

> Selection, in short, has been proved to be merely selective, not creative, and here Darwin's theory, like Lamarck's is wanting in one of its essentials. It accounts for change, but only within the existing range of heredity variation, and without supporting facts to account for the appearance of the new hereditary characteristics it is inadequate.[145]

Natural selection uses the first principle mentioned, random mating, as its field of operation; and the second principle, genetic balance, as its criteria of operation.

Through the continual mixing of genes and the struggle for survival, the various combinations are evaluated and the less advantageous, while not eliminated, are prevented from becoming too numerous in the population. Improvement, as such, is very limited, within

the very nature of the cases: "as a group deploys, the kind and degree of improvement possible to it becomes progressively restricted with the passage of time."[146]

One very powerful application of the principle of natural selection takes place when there is an extreme change in environment for a group of individuals to which they must adjust or suffer extinction. Since, at this time, there is a change in environment, there must likewise be a change in the genetic balance. There will likely be, existing in the population in greater or lesser degree, some mutation or combination of mutations which will have a selective advantage in this new environment.

Goldschmidt illustrates this principle with his studies of Lymantria monacha, the nun moth.[147] In the last fifty years there has been an increase in wing coloration throughout the species which apparently has no selective value. Further examination, however, revealed that the coloration accompanied an alteration in the physiological organization of the moth which allowed it to survive when its food supply was contaminated due, ultimately, to the increase in industrialization in the areas where it lived.

The correct mutation was present, and with the alteration in environment, the genetic balance had to alter in order to maintain the species. Natural selection provided the process by which this could be accomplished.

Species Isolation.[148] This, too, is an important process in the maintenance of stability within the natural populations. It is accomplished by several methods depending upon the species of animal or plant involved; of these many methods, however, there are four

basic ones which include nearly all of the specific examples.[149]

A. Genetic Method. The genetic method of hybrid sterility has already been referred to in the discussion on the mechanics of inheritance. When there is a different number of chromosomes in the two species of plants or animals which are attempting to form a hybrid, the resulting hybrid, if the parents are sufficiently similar, may live but its genetic constitution is unable to act correctly to form reproductive cells; and it therefore is sterile. Occasionally hybrids of this type have produced offspring, but in so doing their reproductive cells have acted as one of the parental species and not as a hybrid. There is one other exception to this rule, but that was touched upon in chapter five.

Another instance of genetic sterility will be noted where the chromosome number is the same but the chromosome organization and configuration is so different that the chromosomes cannot pair off in the new species causing the hybrid to again be unable to produce reproductive cells. There are other instances where the chromosomes themselves are so unlike that the developmental process in the fertilized egg (if it can properly be called that) does not have the necessary genes to begin or continue.

B. Mechanical Method. In order for fertilization to take place the sperm from the male must be enabled to reach the egg of the female. In most instances cross fertilization between species is mechanically impossible because of the construction and orientation of the sex organs themselves. This is the case among many species, even among several of the species of Drosophila which appear to be very similar.[150] Many of the larger animals belonging to differ-

ent types; for example, cats and dogs; are also prevented from forming hybrids for this reason in addition to some of the others.

C. Social Method. When there is a lack of mutual attraction between the sexes, across specific lines, there is a very effective barrier to the prevention of hybrid formation. Some species which can actually form semi-fertile hybrids are separated in this way to such an extent that such hybrids never do occur in nature and would be so discriminated against, if they did occur, that they would not be able to establish themselves.[151]

Mating habits, controlled by instincts, form a large part of this method. Each species has a particular mating habit involving actions (dances, motions, etc.) or appearance (the tail of the peacock, coloration in flies, etc.). Even with a single species the mating habits are a large factor in heredity. An example is given of experimentation in the white eyed mutation in Drosophila melanogaster: when the carriers of the white eyed genes were put into a population bottle of their own species, the gene soon disappeared because both white eyed females and normal females discriminated against the white eyed males and refused to mate with them.[152]

D. Chemical Method. Some very recent research in the genus Drosophila has revealed that there is an important chemical and physiological reaction involved in fertilization which further prevents inter-specific mating. When a male of another species attempts to fertilize the female, there is an internal physiological reaction which renders useless the sperm of the male through chemical action. This same reaction also prevents the female from being remated for a considerable period of time.[153]

Whether or not this same type of reaction takes place in other groups of species has not yet been determined, but that it is a definite possibility will readily be acknowledged.

E. Summary of Methods of Species Isolation. These various methods of separating the various species, even those that appear to be closely related, seem to indicate the rarity of the occurrence of hybrids which are the least bit fertile. Though the illustrations given were all from animals, the same type of separation methods holds true with the various plant forms.

This species isolation provides for a stability of the species unaffected by inroads made by other neighboring species which might upset the genetic balance of the first species. This allows each species to make its own adjustment to geographical and ecological peculiarities.

Summary of the Processes of Stability. Thomas Henry Huxley, the great champion of the evolutionary cause, called scientific attention to what he called "persistent types". In 1862 he wrote:

> In view of the immense diversity of known animal and vegetable forms, and the enormous length of time indicated by the accumulation of fossiliferous strata, the only circumstances to be wondered at is not that the changes of life have been so great, but that they have been so small.[154]

Again in 1870 he wrote:

> ...so long ago as the Miocene epoch, every important group in every important Order of Mammalia was already represented...the significance of persistent types, and the small amount of change which has taken place even in those forms which can be shown to have been modified, becomes greater and greater in my eyes the longer I occupy myself with the biology of the past.[155]

These conclusions are agreed to by the leading biologists of today, whether they happen to believe in organic evolution or not. Both the genetic evidences of the present and the historical evidences of the past bear evident witness that stability is a major characteristic of life as it is now known.

The Balance Between Stability and Change

Both of these principles are observable within the field of life, therefore they must be reconciled. It cannot be said that all life is operating upon the basis of unchanging stability; neither can it be said that all life is operating upon the basis of continual development; both principles are in balance within the framework of the organic universe.

The Hereditary Balance. As has been implied before, all life seems to progress around a norm. There is a basic core or standard within each type of life around which changes are made and variations exist but to which each type of life, by nature, is inclined to revert.

The various processes of change make adaptation possible when it is necessary, but it also remains reversible when the environment will allow it to return. The processes of change are not limitless. If the change in the environment is too extreme, the species may not have the inherent mechanism to cope with it and will become extinct, at least in that geographical area affected.

It is in the nature of the hereditary mechanism itself that there will be both a norm for each type of life and a limit to the changes that are possible in each kind of life. Beyond these limits

change does not go. In the norm there is an amazing stability.

Environmental Balance of Nature. As was discussed in the previous sections, genetic balance is linked with the environment and is influenced by it. When the environment changes, the genetic balance of the organism likewise changes.

A part of the environment of any particular species is every other species with which it comes in contact. A thorough examination of the interrelation between the various types of life shows that there is a balance there, also. The various types of life balance one another by what is commonly called the "balance of nature."

The study of this balance, which has been neglected during the last several decades, due to the fascination with the study of evolution, has been forced to return for very practical reasons. Man, in his control over nature, often brings a reaction upon himself because he does not consider this balance in his attempts to bring control within his hands.

The alfalfa caterpillar provides an example of this interaction and balance.[156] It was first discovered in California in 1850 where it lived on scattered legumes. It was limited to the Western States and its population was not very dense. During the next several decades alfalfa became a favorite hay crop in the same area and the caterpillar began to multiply, increase its population density and also its geographic spread, until now it covers nearly the entire United States of America. This was aided by the fact that alfalfa, as a hay crop, is cut several times a year; hence instead of the few generations possible upon the natural legumes the butterflies were able to move from field to field and always find a field which was

in the proper stage of growth for egg laying (eggs are laid on the very young shoots only, and the larval stage is completed before it is time to cut the alfalfa).

The natural enemies of the caterpillar include beetles, dragonflies, viruses and parasitic wasps. These attack the insect at various stages in its development. Because of the cultivation of alfalfa which has increased the food supply for the caterpillar, it has been found necessary, in order to maintain a balance and make a profit from the hay crop, to import one or more of these enemies of the alfalfa caterpillar, thus keeping the caterpillar damage under control.

Then again, if one of these predator insects or viruses should get out of hand and begin to attack other species which were valuable to man, it would take some additional ingenuity and research for man to find some type of predator to prey upon them in order to keep them in balance.

Another example of the loss of balance through human intervention is the rabbit population in Australia which was begun when a well-meaning person imported a few for pets. They soon took over the country forcing farmers and livestock to fight for their living. The rabbit had been imported without the natural balancing organisms with which they are generally associated. When the Myxomatosis germ was imported in 1950 and given its start in the rabbit population of the continent, things came back within control.[157]

Aside from these examples, the principle of the balance of nature is another example of the balance between stability and change.

> The relative numbers of the various kinds of plants and animals in the simplest natural

> community fluctuate constantly in accord with a complex web of interactions that ties them together. Under normal conditions the system as a whole tends to be self-regulating. Such factors as parasites, predators, disease, food supply and the competition for shelter keep any organism from upsetting the balance. If man is to make a move that will shift the balance in his favor, he must understand all the ramifications of the system.[158]

These interactions aid in maintaining the stability of environment which provides the stability in the genetic balance of the various species. And yet, within this stability there is, as was mentioned in the above quotation, constant change and fluctuation. Man often upsets the balance, and it takes time before it is able to return to its original norm or seek out a new norm, but the stability is but little changed.

The Purposes for the Balance between Change and Stability

This section is based upon an important assumption; the existence of a theistic God. If there is such a God, then it is reasonable to believe that there is reason in the organization of this organic universe. It is this reasonableness which was sought for within the framework of the previous presentations and conclusions.

Practical Purposes. A universe organized upon the principle of rigid stability alone could not contain life. One of the requirements by which man determines the existence of life is the concept of growth, and growth is change. Change is an essential part of life; complex living things develop from a simple living cell, living things are able to take nonliving matter and, by internal processes change them into living matter; rigidity would mean death in the uni-

verse; it had to have the principle of change.

On the other hand, a universe based upon change without stability would be completely unpredictable, mental operations would be essentially impossible for there would be very little consistency in nature and natural laws. If change is the basic criteria of the universe, where is science? If change is the basic criteria of the universe, then organization is impossible; organisms and matter would not remain within the organization but would be continually wandering off and man would never be able to obtain even the least amount of control over any part of the universe.

From the absurdity of these two extremes may be seen the purposes in the balance between change and stability. Change is necessary for flexibility and adaptability, for growth to be permitted and development to be possible and for life to be able to exist. Stability is necessary in order for there to be the possibility of predicting results from actions and, thus, the possibility of controlling portions of the universe.

Returning from the philosophical to the biological, it is readily seen that since there are bound to be occasional changes in the environment of life, it is necessary that there be flexibility in that life that it might be able to adapt itself to the new environment and thus perpetuate itself. Were it not for adaptability, with each change in the environment another species would pass out of existence, and soon there would be practically no life left on this earth at all. Within this adaptability there is the norm, and around adaptability there are the limits, in order that the various types of life might maintain their own places and not encroach on the territories

of the other types of life. Thus, this balance between stability and change within living things is very practical.

Divine Purposes. God, being the type of God that He is, works with design, plan and law. He has prepared a universe which is operative under these three principles without the necessity of continual repair work being done. It is consistent with divine economy for Him to devise life which has sufficient flexibility to maintain itself indefinitely, without divine intervention, and which has sufficient stability to be under orderly control and within balance.

This is the type of God that the Scriptures reveal; it is also the type of God that the natural universe reveals; a God of wisdom, justice and power.

CHAPTER V

SPECIAL CASES OF HEREDITARY TENDENCIES EXAMINED IN MODERN GENETICS

Introduction

There are two special cases of hereditary changes which are vital to this subject and deserve more lengthy discussion than would be practical within the framework of the preceeding chapter, though they could easily fit within its framework as far as the subjects are concerned. Their importance is due to recent research and theories concerning them, which have arisen. One is a revival of an old theory, and the other is the recognition of a special method of species formation.

The Lamarckian Theory

Historical Recapitulation. Jean Baptiste Pierre Antoine de Monet, Chevalier de Lamarck (1744-1829), a French zoologist of a generation before Darwin, developed his theory of the inheritance of acquired characteristics in order to answer the problem of the development of species. He published his theory in 1809 under the title of *Philosophie Zoologique*.

> What qualities the organism has, it has because it needs them and because they are purposive; for the form is not immediately referable to the circumstances in which it finds itself. That is the beginning and end of the theory, and the rest is only the vague and hesitating attempt to show how the need can bring about the new structure. That this is Lamarck's central thought appears from his

> summary of the theory, which includes his two well known laws. He says: "in order to see the true order of things one must recognize:---
>
> "(1) That every change which is at all considerable and continuously maintained in the circumstances of each race of animals, affects in it a real change in their need.
>
> "(2) That every change in the need of animals necessitates other actions on their part for the satisfaction of the new needs, and in consequence, other habits.
>
> "(3) That since every new need requires new actions to satisfy it, it demands of the animal which experiences it the more frequent use of such a part as was formerly less used, so that it becomes considerably developed and enlarged; or the use of new parts which insensibly arise in the organism from the needs, by the efforts of its inner feeling, as I shall presently show from known facts." (Vol. I p. 234)[159]

With the advent of the science of genetics and its more complete understanding, the theory of Lamarck fell into disrepute. Julian Huxley concludes that natural selection is not just <u>an</u> effective agency of evolution, but that it is <u>the</u> effective agency of evolution and, therefore, that Lamarckianism is of absolutely no importance. In spite of the violent attacks upon this theory, however, it has never completely died out in biological thinking.[160]

<u>The Present Form of the Theory</u>. The contemporary teaching of the Lamarckian theory of inheritance is, to a large extent, centered around the Russian biologist, Lysenko.

> In 1948 a conference was held in Moscow at which the views of Lysenko were expounded more fully than hitherto. From the verbatim report it appears that he and his school accept the role of the chromosomes in the transmission of hereditary characters, but do not accept what they call the Weismann theory of an independent hereditary substance. They believe that the chromosomes are not the only particles of a living body which are concerned in heredity, and that under certain condi-

> tions the heredity of an organism can be altered by alteration in its environment.[161]

Their work has been politically sponsored by the Russian government, and most of it has concerned plants of economic importance.

The most recent development in Lysenkoism is of a partially political nature. Quite recently he has been denounced by the Soviet Academy of Science as a "scientific monopolist," who has failed "to make theoretical contributions of practical value". As the reporter has stated: "This is a serious indictment, because Lysenko's strength lay in the supposed practical achievement of his system."[162] The denunciation, however, was of Lysenko himself, not of the Michurinist theory upon which his work was based.

In the United States some recent work has been reported by C. H. Waddington in which he attempts to reorganize the Lamarckian theory in the light of the known facts of genetic inheritance. In his discussion he points out the difficulty of several features of Darwinianism and a few cases which are hard to account for, scientifically, except by some form of Lamarckianism.[163] His conclusions involve a principle which he has christened "genetic assimilation of an acquired character." This he defines:

> ...the genetic constitution becomes so ready to make this particular response (after generations of individuals acquiring this characteristic)--is set on such a delicate hair trigger to do so--that finally the response occurs on its own without requiring the environment to touch it off.[164]

Another concept which is occasionally brought forward in the same research is the thought that due to some genetic characteristic, some individuals are more adaptable than other individuals. Some in-

terpret this as providing a means, in conjunction with the above method, by which adaptability, and therefore adaptation, may be inherited.

<u>Limitations of the Theory</u>. The recent disrepute of Lysenko, in Russia, gives almost undeniable proof that much of his supposed evidence, upon which his work was based, was more apparent than real. Since his evidence has not been made available for public examination but remains behind the "iron curtain", it is difficult to examine the theory itself.

Even more recent information from the Soviet Academy of Sciences reports that a geneticist, N. V. Turbin, in discussing Lysenko's work claims that the evidence was "clearly falsified".

> The whole theory of the formation of species through environmental change, Turbin concluded, is "unsubstantial and essentially mistaken".[165]

Passing from Lysenko to the American adaptations of the Lamarckian theory, it is interesting to note that in the experimentation, mentioned above, by Waddington, the experimenter admitted that the conclusions could point to the appearance of a characteristic of low penetrance (one which is present genetically but does not appear unless the environment stimulates its appearance), which is the product of multiple genes; and so by forcing the appearance of the character in each generation by environment, he was able to breed up the race genetically and overcome the lack of penetrance.

> Actually the assumption that mutations take place is unnecessary; we may more plausibly assume that the genes on which the assimilated character depends were present in the original population, though scattered in it.

> If this is the case, the process of genetic assimilation can go only as far as the genes contained in the initial population will permit.[166]

Thus, there is a limit, just as in Mendelian heredity, to the amount of advance which can be accomplished, even through selective breeding.

Argument. There is no evidence of the inheritance of any characteristics which are acquired in any way during the life of an individual or a series of individuals. All of the experimentation which has been done has pointed, rather, to the limitations of adaptation within the framework of the genetic inheritance.

True, there are some problems, which are not answered by the Darwinian theory of evolution, which would be answered by Lamarckianism if it were true. The problem of the ostrich is a case in point:

> The bird sits on rather peculiar parts of its anatomy: the two load bearing points are at the front of the breast and near the tail. At these two places the ostrich has large, thick callosities....(and) They appear on the chick while it is still in the egg, before it has sat on anything....Can we really be satisfied with a theory which suggests that, purely by chance, a hereditary change has turned up which produces callosities in just the right places, and that the sitting habit of the ostrich had nothing to do with it?[167]

It must be remembered, however, that the two alternatives mentioned above are not the only alternatives which are available in the solution of the problem. The concept of a special creation by a God, who was aware of the method which the bird would use to sit, is also a possibility.

Polyploidal Developments

Definitions. The number of chromosomes in the sperm or egg of a given species is known as the haploid number of that species. The body cells of that same species will have just twice the haploid number of chromosomes or a diploid number for that species. If an individual plant or animal should have more than two haploid sets of chromosomes, it is known as a polyploid (triploid, tetraploid, pentaploid, etc.).

If a particular individual of some species should, through some freak occurrence, have its chromosomes doubled, it would be known as an autopolyploid. If a hybrid between two species should have its chromosomes doubled, it would be known as an allopolyploid.

Autopolyploids. Autotriploids can arise in several ways, but usually they occur when either the egg or the sperm in a particular fertilization has had its chromosomes doubled; thus the fertilized egg will contain three complete haploid complements of chromosomes.[168] This state is highly unstable, when it comes to sexual reproduction, since reproductive cells with a haploid number are usually more fertile than cells with the diploid number; the triploid species, thus, would tend to revert back to the normal number of chromosomes as represented by the parent species.

Triploids do occur in nature, however, although it is more common in plants where vegetative reproduction is more common. Triploids are occasionally huskier and more vigorous than the corresponding diploids, but their general appearance is very similar to the parent species, except for the occasionally larger size of organs and over-all

body size. In this way new species which are only partly fertile, when crossed with the parent species, have occasionally been originated in nature.

The things which have been concluded concerning the autotriploids also hold true for the other autopolyploids. They are generally of reduced fertility even though the individuals themselves appear to be huskier and more vigorous. They are noted, in most cases, for their instability, although vegetatively they do breed true and have proved themselves to be of economic value. Polyploid animals are almost nonexistent.[169]

Another unexpected characteristic of the polyploid is their genetic rigidity.[170] Ordinary diploid plants have only two homologous genes for the various characteristics; therefore, there are frequent variations in the individuals, as has been pointed out in the previous chapter, and they are quite adaptable. On the other hand, polyploids have three, four or more homologous genes and therefore, the existence of only one dominant gene may often mask the effects of, say, three recessive genes. Therefore, it is very seldom that the characteristic of that recessive gene will ever show itself. There will be almost no variation in a polyploid species. Of course, those species which are so infertile that they do most, if not all, of their reproduction vegetatively will have no variation whatsoever. Those types of species are not adaptable and therefore are only advantageous in a limited environment which will not be subject to extreme change.

This occurrence of doubling of chromosomes within a cell, upon which the polyploidy depends, does not occur frequently in nature. There are a number of chemical agents which will induce doubling in-

cluding chloral hydrate, sulfanilamide, colchicine and others.[171] Colchicine is the most frequently used. Various other freak occurrences can cause this condition without the application of the chemicals, and this is undoubtedly how the occurrences take place in natural populations. Agriculturalists have frequently used the chemicals in order to originate new fruit and vegetable crops. The new species, which are thus formed, are true species but are subject to the limitations mentioned above and are not as effective, in most natural conditions, as are the parent diploid species.

Allopolyploids. Allopolyploids present a bit different problem. As has been mentioned in the previous chapter, while hybrids are generally sterile, or nearly so, and therefore ineffective in the origination of any new species, if the hybrid were to be treated with colchicine and its chromosomes were to be doubled, it would become fertile and reproductive. This process was used by several experimenters in the last few years to produce new hybrid species.

Ledyard Stebbins, in an article which he titles Cataclysmic Evolution, reports of the work of several experimenters in this type of development.[172] A new species of chrysanthemum was produced which shared the characteristics of both its parents. Various species of tobacco have been checked and a few seem to have originated that way. A European moss and an English grass have also been produced by this method.[173] These are definitely true species according to the biological definition of that term.

> Not only have many new autopolyploid and allopolyploid species and varieties been experimentally produced, but there is much evidence that they occur in nature, thus providing a

potent factor in evolution. Only a few cases of new forms arising in nature through autopolyploidy have been substantiated, but many cases of natural allopolyploidy are known. Such forms have been recorded among the chestnuts, grasses, irises, roses and others.[174]

Limitations.

> Some authorities estimate that a third or more of the species of angiosperms are polyploids. And polyploidy is common, although not everywhere found, in the rest of the plant kingdom....To leap immediately to judgment of the importance of polyploidy in evolution may lead to precarious conclusions, however. Autoploidy as such adds no new genes to the chromosome complex. The phenotypic effects (physical expression) of autoploidy are frequently seen largely as exaggerations of characteristics already present in the diploid. Only seldom do significantly divergent characters appear. Allopolyploids are sometimes strikingly different from any of their progenitor types; but also they may be nearly indistinguishable from one of the parental species, and they are most often intermediates. Stebbins has expressed the view that allopolyploidy "has probably involved chiefly the production of new combinations of characters, rather than the origin of the characters themselves."[175]

Thus, the most important limitation of the polyploid process is its lack of ability to bring about anything new. Polyploid roses are still roses; polyploid mosses are still mosses; and polyploid apples remain apples. Each kind retains its own nature with only the exaggeration of some characteristic or group of characteristics. Even in the case of allopolyploidy nothing new is added; there is only the origination of a fertile hybrid species. It should be recalled here that not all species can form hybrids. The formation of hybrids, even sterile hybrids, is a very limited process and takes place only within narrow bounds of biological classification. When one of these

hybrids becomes fertile, even though that fertility is limited, no new "kind" of life has been begun in the broad sense of that term. The adaptability of the new species is also very low, it will be recalled from the above discussion. The genetic inheritance is very limited and the possibility of variety within the new species is limited by that limitation and by the nature of the polyploid as discussed above.

The experiments of Karpechenko in crossing the cabbage with the radish have not been mentioned above because later attempts to verify the experiments have been unsuccessful.[176] The verification attempt discovered that the new plants were so nearly sterile and so unstable that it was impossible to establish a population of the new species. If a particular species is not able to establish a population, it is hardly worthy of the name of species.

Argument. While this process of species production is fraught with difficulties and great limitations, there is evidence that some origination of previously non-existent species has taken place in nature by such a process. Some of these new species, autopolyploid and allopolyploid, are self-propagating in natural habitats.

It is admitted, however, that no advanced characteristics which have selective advantage have entered the biological field by this process and thus, as the quotation above points out, it is not likely a major factor in evolution, but only a factor in diversification.[177]

These new species are noted for their rigidity rather than their adaptability, hence, would not be desirable stepping-stones in the process of evolution.

Summary

These two special cases, like the general cases mentioned in chapter four, provide no basis for the operation of organic evolution as commonly presented.

The available evidence shows that Lamarckianism still has no valid grounds in the field of genetics and that the reported examples of the inheritance of acquired characteristics may be explained, just as easily, by natural selection and other admittedly valid hereditary procedures.

Polyploidy can lay just claim to the origination of new species. The writer is forced, from the evidence, however, to maintain that no new kinds have been originated by this method. No major changes are made from the parent species except in exaggeration of characteristics, and the resulting species are notably unsuited to evolutionary purposes because of their tendency to revert to the parent species and also because of their rigidity or lack of adaptability.

CHAPTER VI

SUMMARY AND CONCLUSIONS

Introduction

The science of genetics has been determined to be a valid and authoritative science in the examination of the problem of evolution. The conclusions of scientists, working in this field, have been evaluated above in the light of both the objective evidences which they present and the subjective philosophical problems. These evaluations and conclusions have been summarized very briefly below and a short resolution of the problem given. This has been done to bring the answer to the problem proposed in chapter one more clearly into focus.

The Conclusions of Genetics

Microevolution. Microevolution is a term coined by Goldschmidt who defines it thus:

> Microevolution within the species proceeds by accumulation of micromutations (genetic mutations) and occupation of the available ecological niches by the preadapted mutants. Microevolution, especially geographic variation, adapts the species to the different conditions existing in the available range of distribution.[178]

This type of evolution is apparent from the evidence which is available. It does not go beyond the bounds of species; therefore, it is completely within the Scriptural statement concerning inheritance as given in chapter one.

Origin of Species. The origin of species is a problem present-

ed by Darwin and is the title of his best known work. Though science does not bear out all of the theories presented in his work, most of his principles have been determined to be valid ones, and science has determined the origin of many species.

As has been discussed in prior chapters, there are several methods and instances by which new species can be originated. One of these is by polyploidy. These species are noted for their rigidity, rather than adaptability, and their reduced sexual fertility as well as their increased vigor and size over the parent species (the diploid species). This type of species origination is fairly common among plants but completely unproved among animals.

Another possible method for the origination of species is the isolation of chromosomal translocations to such an extent that the two branches of a species become sexually isolated and, therefore, distinct species. It is very uncommon, but it has been observed among both plants and animals, but seldom among the higher animals.

This must be noted concerning both of these principles: that the new species which were originated remained very similar to the parent species. In the case of translocations, the differences are occasionally indistinguishable except by attempted hybridization. Polyploid species are generally distinguishable from the parent species, but they are so similar that their parentage is very obvious. They do not depart far from the parent species and do not depart at all from the family or order of species.

<u>The Limits of Evolution</u>.[179] The theory of organic evolution, as usually presented, meets many unbridged gaps in its processes. This was shown in the preceeding discussion. In some cases these gaps

divide off one species from all other species; however, in most cases the gaps fall around the next larger biological classifications: families and orders. Dr. Mixter, on the basis of paleontology, places the gaps around the orders and between man and the primates.[180] The genetic evidences show that it would be difficult to make the groups that large, but further evidence may alter that situation.

Summary of Genetic Evidence. There is a true type of evolution, which is evident today throughout the field of biology. This evolution is effective in the origination of new species and in new adaptations and population groups of existing species. These new species and adaptations, however, are not greatly removed from the parent species and distinct lines of demarcation are noted which limit the evolutionary processes, if they can be called by that title.

The Scriptures and Inheritance

On the basis of the above summary of the genetic evidence it is readily understood that the Scriptural term "kind" should not be translated by the biological term "species". The species are not absolutely immutable as some theologians have stated. The Scriptures do not require such a translation, but, as pointed out in chapter one, very easily permit the translation of "kind" to mean a larger but definitely limited group. This is in agreement with the conclusions of genetics. The statement made in chapter one, that living things are to "reproduce after their kind in a relatively stable pattern of descent,"[181] is an accurate statement of the conclusions of genetics and of the Scriptures.

A Resolution of the Problem

The so-called conflict between science and the Scriptures is rather a conflict between scientists and Bible interpreters; it is not a conflict between the evidences of science and the statements of the Scriptures.

The thing which scientists must do in maintaining the resolution of this problem is to beware of extrapolation of the evidence and laws. This is a principle of both science and philosophy and it must be remembered in every circumstance.

The thing which theologians and exegetes must do, in maintaining the resolution of this problem, is to refrain from demanding a more rigid interpretation of the Scriptures than the Scriptures themselves would indicate is necessary. Such a demand is unwise and uncalled for, both from the standpoint of science and of the Scriptures.

> We must not affirm more than we aught, lest we be called upon to prove more than we are able.[182]

This advice is applicable for all participants in arguments among scientists, historians, exegetes or theologians.

FOOTNOTES

1. Arthur W. Lindsey, *Principles of Organic Evolution* (St. Louis, The C. V. Mosby Company, 1952), p. 44.

2. J. T. Patterson & W. S. Stone, *Evolution in the Genus Drosophila* (New York, The MacMillan Co., 1952), p. 52.

3. *Ibid*.

4. Quoted in Lindsey, *op. cit*., p. 42.

5. Quoted in *Ibid*.

6. Genesis 1:11-12, 20-25 A.S.V.

7. Bernard Ramm, *The Christian View of Science and Scriptures* (Michigan, Eerdmans Publishing Company, 1954), p. 66.

8. *Ibid*., p. 67.

9. William J. Tinkle and Walter E. Lammerts, "Biology and Creation," *Modern Science and Christian Faith*, ed. by American Scientific Affiliation (Wheaton, Illinois, Van Kampen Press, 1950), p. 63.

10. Julian Huxley, *Evolution in Action* (New York, Harper and Brothers, 1953), p. 2.

11. *Ibid*., p. 6f.

12. Ramm, *op. cit*., p. 263ff.

13. Mark 4:1-8 A.S.V.

14. Matthew 21:18-22 A.S.V.

15. Warren Weaver, "Fundamental Questions in Science," *Scientific American*, September, 1953, vol. 189, no. 3, p. 51.

16. Harry W. Hepner, *Psychology Applied to Life and Work* (New York, Prentice-Hall, Inc., 1941), p. 36f.

17. Lindsey, *op. cit*., p. 13.

18. Robert Patterson, *The Errors of Evolution* (Boston, H. L. Hastings, 1889), p. 215.

19. For more complete discussion see the following paper: A. Delbert Rice, "Secular Educational Philosophy and the Church," unpublished paper prepared for Western Evangelical Seminary, November, 1951.

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182. Oral quotation from Dr. Kenneth P. Wesche, Western Evangelical Seminary.

GLOSSARY

Agnosticism -- the belief that man cannot know spiritual truths; such as whether or not there is a God.

Allelle -- one of a pair (or more) of genes which affect the same character.

Atheism -- the belief that there is no God.

Chromosome -- a sub-microscopic, rod-like unit within the nucleus of a living cell which acts as carrier of inheritance units, genes. See page 52.

Cytoplasm -- all of the content of a living cell not included in the nucleus.

Deism -- the belief that there is a God, but that God is not concerned or active with the universe at the present time. Deism usually admits the agency of God in the original creation.

Differentiation -- the process in the development of an embryo by which cells are developed for different specialized functions.

Diploid -- the normal number of chromosomes in the body cells of a given species. See page 87.

Dominance -- the action of one gene which acts to eliminate or completely mask its allelle.

Ecology -- the mutual relations between an organism and its environment; climatic, chemical and biological.

Extrapolation -- the process of extending the conclusions of a given set of data beyond the limits of that data. See page 45.

Gene -- a hypothetical entity, regarded as a small part of a chromosome which is concerned with the transmission and development of hereditary characters. See page 54.

Genotype -- the genetic constitution of an individual. The genes which it posesses.

Haploid -- one half the diploid number for a given species. The number of chromosomes in the sperm or egg. See page 87.

Heterozygous -- an individual having unlike alleles for a given character, i.e., two different genes for the same characteristic.

Homologous -- comparable positions upon two chromosomes or comparable chromosomes.

Homozygous -- an individual having identical alleles for a given character.

Interpolation -- the process of extending the conclusions of a given set of data within the limits of that data. See page 45.

Macroevolution -- the process of organic evolution across all geological time. See page 7.

Materialism -- the belief that reality is composed only of matter and the forces inherent in matter. That the spiritual is not real.

Microevolution -- the processes of organic evolution which are observable within the limits of human history. See page 93 .

Natural Selection -- the process of eliminating the weaker individuals (and hence the genotypes which caused them) by natural forces permitting survival of only the fittest individuals.

Nucleus -- a nearly spherical unit within the cell containing chromosomes.

Phenotype -- the appearance of an individual. The genetic expression within the individual--opposed to genotype.

Phylogenetic -- having to do with the race history and relationships of an organism.

Plasmagene -- inheritance determiners located in the cytoplasm.

Polyploids -- individuals or races having more than a diploid number of chromosomes in the body cells. See page 87.

Primates -- the order of mammals containing apes, lemurs, and monkeys. Many also include man.

Recessive characteristics -- characteristics which are masked in the presence of a dominant characteristic. The expression of a recessive gene. Recognizable only when homozygous.

Skepticism -- the belief that changeless truth cannot be known.

Species -- a biological population with a definite genetic identity. See page 2.

Taxonomy -- the science of plant and animal classification which depends primarily upon descriptive biology, i.e., the physical character and visible homologies.

Theism -- the belief in the existence of a God who has created and is presently active and concerned with the universe.

Viable -- capable of living, or growing.

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