4-15-1941

Genesis, Genetics, and Evolution

John William Klotz
Concordia Seminary, St. Louis, ir_Klotzj@csl.edu

GENESIS, GENETICS, AND EVOLUTION

A Thesis presented to the

Faculty of Concordia Theological Seminary

in partial fulfillment of the
requirements for the degree of

Bachelor of Divinity

by

John William Klotz, A. B., M. S.

Concordia Seminary
April 15, 1941

Approved by

TABLE OF CONTENTS

List of Figures

List of Tables

FOREWORD

The author wishes to thank Mr. W. Bernard Schuldt who prepared the illustrations for this thesis. To Dr. Theo. Graebner the author is grateful for his continued encouragement and for his advice and assistance in working out this thesis. Acknowledgement is also made to the University of Pittsburgh, Washington University, and Concordia Seminary for the use of library facilities.

PREFACE

This paper is concerned with the evolutionary theory. It attempts to study the theory both in the light of the Word of God and of the latest scientific evidence, particularly that in the field of genetics.

It is not the object of this paper to disprove the evolutionary hypothesis. The problem in itself is too big. Dr. Goldschmidt says in his most recent book: "No individual can claim such a mastery of all facts pertaining to evolution to enable him to present such a discussion (a discussion of the facts, theories, and laws of evolution)".[1] No one man in his lifetime can possibly become acquainted with all the phases of biological and allied branches of science which bear on it. He can understand and evaluate the argument for evolution only in his particular field. In other fields he must take the word of those who have made a special study of that field. But he cannot become acquainted first hand with the evidence in all fields.

It is just here that the difficulty arises. Living organisms are not divided into special departments. Physiology cannot be studied apart from genetics; anatomy cannot be studied apart from embryology; taxonomy cannot be studied apart from morphology. Unfortunately this is attempted all too often, and the result is a large number of unscientific statements.

---

1) Goldschmidt, Richard <u>The Material Basis of Evolution</u>, p. 3

Most of this paper will be concerned with genetics. That is my particular field. I believe that it is the most important field so far as evolution is concerned because it is through inheritance and through variation in the usual manner of inheritance that evolution must take place.

It will be argued that I approach the whole subject with a theological bias. I do not deny that. I cannot avoid doing that because I believe that where God has spoken we have the truth. I believe that He has spoken so far as evolution is concerned and that for that reason the matter is closed. But I also find much support for my refusal to believe the evolutionary explanation of the origin of the present biological world in biology itself. These evidences I shall discuss in my paper.

In approaching the problem of evolution as Christians, our first question must be: "What does Scripture say on the subject?". We do not have to look far for the answer, for in the very first chapter of Genesis, where the account of the creation of the world and man is given us, we find ten statements that the various plants and animals were created "after their kind". This same expression occurs elsewhere in Scripture twenty-one times.

Now what does this phrase: "after their kind" mean? Theistic evolutionists who are interested in keeping God in their theory insist that this word מִין does not mean species, but that it has a wider meaning in Scripture. That we must admit. In Buhl's edition of the celebrated Gesenius <u>Handwoerterbuch</u> its meaning is given as "Art, Stück, Variation, Artverschiedenheit, und dann coll. die einzelnen Varietaeten einer Gattung". 1)

There is much controversy over the etymology of the word. Some believe it to be derived from the root מון which does not occur in the Old Testament Scriptures. In Arabic one of the corresponding roots means "to tell lies". In Ethiopian the word means to "be wily", "be cunning". In Hebrew the term probably meant "to wear an appearance", "pretend". Hence the noun derived from this verb acquired the meaning "kind", "species". It is

1) Gesenius, W. <u>Handwoerterbuch über das Alte Testament</u>, ed. Buhl, Leipzig, 1910, p. 415

interesting to note that there is a similar relation in English between the noun "species" and the adjective "specious" in English.

A better derivation would take the word from מִין. This derivation is preferred by Buhl. Th. Noeldeke in the Zeitschrift der Deutschen Morgenlaendischen Gesellschaft (37, 532) and Dillmann derive it from the Arabic word for fear, cut, divide. This root does not occur in Old Testament Hebrew, but does occur in New Hebrew. In Yiddish it is used to refer to the different sects such as the Jewish-Christians. A similar christo-palestinian root means "nation".

This derivation is upheld by de Lagarde in his Uebersicht ueber die im Aramaic uebliche Bildung der Nomina (1889, 183f); by Schwally (Idioticon des christlichen palaestinischen Aramaic, 1893, 50); by Schulthess (Lexicon Syropalaestinum, 1903); by Littmann (Zeitschrift fuer Assyrologie, 12, 200; 14,89); by Koenig (Historich-kritisches Lehrgebaeude der Hebraischen Sprache, 2, 59f); by Fr. Delitzsch (Prolegomena eines neuen hebraischen aramaischen Woerterbuchs zum Alten Testament); by Haupt (Journal of the American Oriental Society, 25, 71).[1]

Closely related to this word is the word תְּמוּנָה which means "appearance", "likeness". It is often used for the likeness to God, Num. 12, 8 and Ps. 17, 15.

The various translations do not give us much help in determining the exact meaning of the word. In general the Septuagint translates the word מִין with the word γένος. But the

1) Buhl, loc. cit.

term γένος is even wider than the Hebrew מִין. In the New Testament γένος is translated variously as "diversity" (I Cor. 12, 28); "generation" (I Pet. 2, 9); "kind" (Matt. 13,47); "kindred" (Acts 4,6); "countryman" (II Cor. 11,26); "nation" (Mark 7,26); "offspring" (Acts 17,28); "one's country" (Acts 4, 36); "stock" (Acts 13,26); and "born at" or "born in" (Acts 18, 2.29).

Similarly the Vulgate does not shed much light on the exact meaning of the term מִין. Jerome translates it both as genus and as species. The two terms are used by him interchangeably, for in Gen. 1, 12 he translates מִין once as genus and the second time as species.

What then does the word mean? First of all, it does not mean "species"in the present restricted taxonomic sense of the word. That concept did not exist at the time of the Hebrews. But the term "species" approaches very close to its meaning. The term "kind" as we find it in our English Bible is also very good. A brief scientific definition would be this: When Moses said that the plants and animals were to reproduce after their kind, he meant that offspring were to have chromatin material the same or very similar to that of their parents.

Commentators and others who discuss this term are not entirely in agreement, but by and large they agree with the position cited above. We shall look into the statements of the a number of them. These are quoted not as authorities on the subject, but simply to show the different viewpoints which they hold.

Our Lutheran dogmaticians have very little to say on the subject because the subject was not in controversy at the time when they wrote. Yet there are numerous indications in their writings that they took a creation according to species for granted. Speaking of the creation of poisonous creatures, Calov says: "Omnes sane species herbarum et arborum initio conditae, sed quia omnia valde bona creata venenum et malitia non prima creatione sed a peccato merito deducitur".[1] Osiander in Thesis XIX of his Collegium Theologicum writes:"Forma creationis est productio specierum ad voluntatem creantis perfecte congruentium". In Thesis XXXIII he writes: "Plantae ipso actu (the creative act of the third day), hoc die, secundum exteriorem formam sunt productae". [2]

Finally we quote from Baier who writes:"Ut autem perennare posset mundus produxit Deus corpora simplicia quidem ea conditione ut nunquam penitus corrumpantur, mixtis vero, quae vitam corruptioi obnoxiam habent vim generandi aut multiplicandi se communicavit ad conservationem speciei unde et cuiusque speciei animantis duo utriusque sexus individua simul produxit".[3]

The commentators are almost unanimous in telling us that this term מין must refer to species as we know them today. Luther lived long before the days of Darwin and the evolutionary controversy. He knew nothing at all of modern taxonomy with its classification into genera and species. For that reason he can scarcely be accused of reading something into the

---

1) Calov, Abraham Biblia Testamenti Veteris et Novi Illustrata p. 228
2) Osiander, John Collegium Theologicam, p. 55ff
3) Baier, J. Compendium Theologiae, vol.II, p. 22

text, of approaching it with a theological bias. Yet Luther very clearly identifies the term מין with the term "species" as we understand it today. He says: "The fact that every plant arises from a plant like it according to regular laws is a clear sign that creation did not take place by chance, but according to the plan and foresight of God. From wheat there arises nothing but wheat: from barley nothing but barley: from rye nothing but rye: and so forth. Each species retains for all time its fixed order, way, and peculiarities." 1)

Another commentator, Schmidt, who lived long before the outbreak of the Darwinian controversy comes to the same conclusion. Writing in 1697 he says in commenting on Gen. 1,11: "Hoc est, Et lignum fructum faciens; faciens autem, non omne fructum unius speciei tantum, sed quodque juxta propriam speciem suam". 2)

Most modern commentators are agreed that the term as it is used in Genesis refers to the creation of species as we know them today. That is true not only of Fundamentalists, but also of some of the more Modernistic commentaries. For even though the Modernists may deny the authority and inspiration of Genesis, they will not, if they are Semitic scholars of any standing, deny its plain statements.

The Pulpit Commentary, a conservative commentary on the whole Bible, says on Gen. 1,11: "The phrase 'after his kind' appended to the second and third (herb and fruit tree) seems to indicate

---

1) Luther, Martin <u>Sämmtliche Schriften</u>, vol. I, p. 44
2) Schmidt, Sebastian <u>Genesis</u>, p. 10

that the different species of plants were already fixed. The modern dogma of the origin of species by development would thus be declared to be unbiblical as it has not yet been proved to be scientific. The utmost that can be claimed as established is that 'species' qua species have the power of variation along the line of certain characteristics belonging to themselves, but not that any absolutely new species has ever been developed with power indefinitely to multiply its kind". On verse 21 of the chapter the author says: "The generic terms are thus seen to include many distinct orders and species created each after its kind". 1)

An American Commentary on the Old Testament, a Baptist commentary, says on Gen. 1, 11: "After its kind: that is, after its species. This phrase conveys the important truth that these species do not run into each other. Apart from the divine word, there was nothing in matter itself nor in any of its possible combinations or adjustments that could produce life either vegetable or animal.......We have here an instance of the natural originating in the supernatural and then following established law in its established order.

"In this assertion of the distinctiveness of species and the production of each as a distinct part of the creative plan, revelation tallies perfectly with the conclusions of natural science which leads us to believe that each species as observed

---

1) Spense, Canon, ed. The Pulpit Commentary, Genesis, p.18

by us is permanently reproductive, variable within narrow limits, and incapable of permanent intermixture with other species; and though hypotheses of modification by descent and of the production of new species by such modification may be formed, they are not in accordance with experience and are still among the unproved speculations which haunt the outskirts of true science (Dawson)". [1)]

Adam Clarke, in his commentary on Genesis, says on Gen. 1, 11: "Everything both in the animal and vegetable world was made so according to its kind both in genus and species as to produce its own kind through endless generations. Thus the several races of animals and plants have been kept distinct from the foundation of the world to the present day. This is a proof that all future generations of plants and animals have been seminally included in those which God formed in the beginning". [2)]

Jamieson, Fausset, and Brown, in their Critical Commentary, say on the same verse: "After his kind (למינו) - after its species. It was applied to the herb noticed previously as it is mentioned afterwards in connection with the lower animals as well as man; and it is particularly worthy of notice that this mark of distinction is made and repeated in all the successive parts of the narrative relating to the creation of organic life, thereby clearly announcing it to be a universal

---

1) An American Commentary on the Old Testament: Genesis, p. 47
2) Clarke, Adam The Holy Bible with a Commentary, vol. I, p.36

law, established both in the vegetable and animal world that distinctions of species entered into the original plan of the Creator". 1)

Driver, the well-known critic, is forced by his scholarship to say: "After its kind: rather after its kinds (the word being collective) i.e. according to its various species: so vv. 12,24,25. The addition calls attention to the number and variety of the different species included under each head". 2)

Delitzsch, the well-known Hebrew scholar, says: "...but certainly a reference to the fruit tree .... is intended, the fruit of the fruit tree is determined according to species". 3)

Gunkel, another well-known critic, says on this verse:"Der Verfasser will deutlich machen, dass Gott es ist, der die Klassen festgesetzt und so die Ordnung der Welt selber bestimmt hat: Die Klassen sind ewig". 4)

Otto Procksch, in his commentary on Genesis, writes on this same verse, Gen. 1,11: "Die beiden genera der Flora entfalten sich in den species. Die einzelnen species sind also von Anfang an vorhanden". 5)

Peake, too, in his commentary on Genesis, agrees with the

---

1) Jamieson, et al. Critical Commentary, vol. I, p. 6
2) Driver, S.R. The Book of Genesis, p. 9
3) Delitzsch, Franz A New Commentary on Genesis, p. 89
4) Gunkel, Herman Handkommentar zum Alten Testament, Genesis, p. 95
5) Procksch, Otto Die Genesis p. 429

authorities whom we have quoted before. He says: "Each genus remains fixed and reproduces 'after its kinds', i.e. the various species embraced in it".[1]

Of course not all commentators agree that there is a reference to the creation according to species here. Some have their own peculiar exegesis of this verse. Among these is Matthew Henry who lived and wrote before the days of Darwin and the evolutionary controversy. He believes that these words are a general reference to the fact that God created all kinds of plants and animals and not a necessary reference to the fact that plants and animals were created according to species.

We would expect that some critics would be so biased in their approach to Scripture and so "modern" in their thinking that they would refuse to admit these words to be a reference to species. We are not surprised then when Skinner, the well-known critic, who edited the first volume of the International Critical Commentary, writes: "The etymology (of מין) is uncertain. If connected with תמונה (form, likeness) the meaning would be form (Lat. species); but in usage it seems to mean simply 'kind', the singular suffix here being distributive 'according to its several kinds'. In Syriac the corresponding word denotes family or tribe".[2]

Keil, the well-known Hebrew scholar, has a similar inter-

---

1) Peake, Arthur S. A Commentary on the Bible, p. 137
2) Driver, Samuel et al. ed. The International Critical Commentary, p. 24

pretation. He says on Gen. 1,11; "למינו besagt, dass die Kräuter und Bäume nach ihren mannigfaltigen Arten aus der Erde aufgingen und mit der Kraft, Samen und Frucht zu bringen, zugleich die Fähigkeit, sich in ihren Arten fortzupflanzen und zu vermehren, empfingen". While Keil lays the chief stress on the creation of a large number of different kinds of plants and animals, he does add that they reproduce according to their kind.[1)]

Finally we shall quote from one more critic, the Rev. F. Ramsey who says: "<u>Kinds of</u> - the meaning is not <u>according to type</u> (as the A.V. 'after....kind' suggests) but in <u>variety</u>. Verse 11 says that God made all varieties or kinds of herbs and trees: v. 21 that He made all sorts of water animals and air animals: and v. 25 that He made all kinds of land animals".[2)]

While we must admit then that we cannot say definitely that the word as it is used in Genesis means "species", we are safe in saying that most commentators have understood it in this way. This moreover would seem to be the natural way of understanding these statements when we approach them with an unprejudiced mind. The very fact that the word is repeated again and again would indicate that it has some real significance. It would almost seem as if the inspired writer had anticipated the controversies which would arise and in order to emphasize the fact that God did create the plants and animals according to their species, he repeats this term over and over

---

1) Keil, Carl <u>Biblischer Commentar über die Bücher Moses</u>, vol.I p. 17
2) Ramsay, F. <u>An Interpretation of Genesis</u>, p. 17

again. It is interesting to note that this phrase "after his kind" is not used in the case of the creation of man thereby indicating the gulf that exists between man and the highest animals.

Actually the concept "species" did not exist at the time the book of Genesis was written. That concept has arisen only with modern taxonomy since the days of Linnaeus. The people of Moses' time did not classify plants and animals into genera and species as we do today. There was no term for "species": Moses could not have written that God created plants and animals according to their species unless he had used a term utterly foreign to the people to the people of his time and to the peoples of the 33 centuries following him.

Finally we must remark that the term"species" is an arbitrary designation. As we shall have occasion to state in another connection, nature itself is not classified: it is man who classifies nature. The term "species" is a taxonomic term, and like other terms, it describes nature as man sees it, not as it actually is.

Actually no competent biologist today even attempts to define species. Dobzhansky says in his latest book:" Of late the futility of attempts to find a universally valid criterion for distinguishing species has come to be fairly generally if reluctantly recognized. This diffidence has prompted an affable systematist to propose something like the following definition of a species: 'a species is what a competent systematist considers to be a species'".[1)]

It might be well to add a word here with regard to our own position over against defining a species. And that is this. If competent systematists cannot agree on a definition of a species, certainly we ought not try to propound a definition. For if we accept the most widely accepted definition of a species, viz., a group of animals or plants capable of fertile interbreeding indefinitely, I think we will have to admit that new species in this sense of the word have appeared.

I do not believe that the account in Genesis requires us to accept this definition of a species. Moreover I do not believe that all forms which are today classified as distinct species have existed as such since the Creation. For instance, there are several species of Drosophila which have evidently originated from a common ancestor. They exhibit parallel mutations: that is, the different species show the same mutations. Moreover in those forms which can be crossed, a study of their chromosomes in synapsis shows that for the most part the chromosomes are alike. Here and there in sections of the individual chromosomes translocations and inversions have evidently occurred. This would indicate, at least to my mind, that these species have come from a common ancestor.

I do not however believe that all forms today have originated from a single common ancestor or that they have originated from a relatively few common ancestors. That, I believe,

---

1) Dobzhansky, Th. <u>Genetics and the Origin of the Species</u>, p. 310

would be contrary to the account of Genesis and also contrary to the facts of science. The scientific evidence on the matter I shall present in these next pages.

Genetics is concerned with the study of inheritance, the study of the way in which the various characters in plants and animals are handed down from parent to offspring. It is axiomatic that like begets like, and yet every thinking man realizes that there are certain differences between the parent and the offspring. Genetics is concerned with both problems: why the offspring resembles the parent, and why it differs from the parent.

Since each individual originates from a single fertilized cell (or in the case of parthenogenetic reproduction from a single unfertilized cell) it is evident that all hereditary characters must be determined in this single cell. The mechanism by which this takes place is to be found in the nucleus of the cell. The actual determiners of heredity seem to be the genes which are carried on the chromosomes. A gene has never been seen even with the most powerful microscope, but they are postulated as being minute bodies located on the chromosomes.

The theory of the gene was first promulgated by Morgan, Bridges, and their associates early in this century. Their work was concerned chiefly with a small Mediterranean fruit fly, Drosophila melanogaster. They believed that the genes were arranged in linear order on the chromosomes. Because of this linear arrangement it is possible to map the chromosomes and to say at exactly which point the gene for a certain character is located. The map of Drosophila is fairly complete and its accuracy has been confirmed by cytological studies.

Each gene probably determines several characters, but it is named according to the chief character which it determines. Obviously it is possible to study only those body characters which are external. No doubt the internal anatomy and physiology are determined in the same way as the external features are determined, but it is impossible to study them at present. It is estimated that Drosophila has between 3,000 and 5,000 genes, although estimates run as high as 28,000. Of these only about 600 are known. The reason for this is two-fold: it is impossible to analyze internal characters as we mentioned above; and the fact that genes are discovered only when two genes at the same locus produce different effects. Genetics is based upon a study of these differences. Were all plants and animals alike, the study of inheritance would be impossible.

Now how do these genes operate? It is conceived that they are arranged along a chromosome in a line. All the chromosomes, except the sex chromosome s in one sex, are paired. The genes on the chromosomes and the chromosomes themselves line up against one another very much in the fashion illustrated in Figure I. 1)

---

1) I personally do not believe that this is the correct picture of the mechanism of inheritance. I am inclined to agree with Goldschmidt that there is no such thing as a gene. However since the Morgan-Bridges scheme is still dominant in Genetics, I am presenting it here.

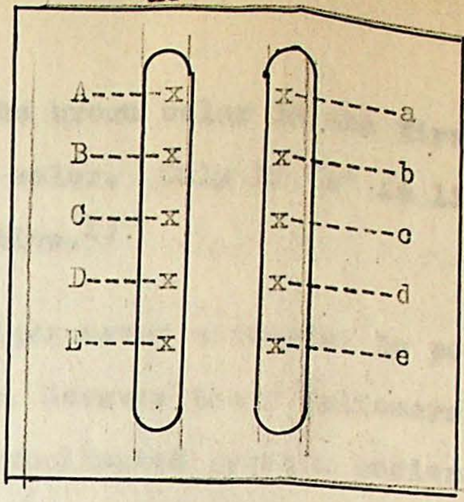

Figure I: Illustrating the chromosomes according to the Morgan-Bridges scheme.

Thus A is opposite a, B is opposite b, C is opposite c, and so on.

We said before that the genes are discovered only whenttwo of them have different effects. It has been found that in most cases one gene appears to be more powerful than the other, and thus is able to cause its effect to appear when matched with its companion gene, known as its allelomorph or allel. This gene is known as the dominant gene and is always designated with a capital letter. Its allel is known as the recessive gene and is designated with the corresponding small letter. Thus in human eye color brown is dominant over blue.[1] The brown factor or the gene causing brown color may be designated with the letter "B" and the blue factor ornthe gene causing the blue color may be designated with the letter "b". Thus if "B" is lined up opposite "B", the eyes are brown: if "B" is lined up opposite "b", the eyes are also brown because"B" is dominant over "b". This color cannot be dis-

1) Actually there are a number of factors involved in human eye color, and this scheme does not always hold. However as a general statement, this scheme fits the case.

tinguished from the brown color in the first case. Apparently it is the same color. Only if "b" is lined up opposite "b" is the color blue.[1)]

Morgan and Bridges never attempted to postulate the exact nature of the gene. However their followers did postulate that they were highly complicated protein bodies. And it follows from the theory of the gene as it was promulgated by Morgan and Bridges that the gene is some sort of a separate entity, protein or otherwise, located upon the chromosome which bears it. Indeed some geneticists believe that the tiny bumps which appear on the giant salivary chromosomes of Drosophila are the genes. However Goldschmidt has recently thrown a monkey wrench into the theory and has done it so effectively that at least in my opinion the entire theory of the gene will have to be discarded or at best revised. In one of his recent books, after discussing the nature of the gene, he says:" The preceding sentences bring us now to the point where we have to ask ourselves whether or not the theory of the gene as the hereditary unit of actual separate existence is still tenable. The facts regarding the position effects[2)] which we have mentioned

---

1) See Figure III, p. 22
2) Position effects are those effects which it has been discovered certain "genës" have depending upon their location in the chromosome. For instance it has been discovered that if a certain gene is translocated onto a chromosome other than that one on which it is usually located, it has an entirely different effect. This should not occur if the Morgan Bridges theory is correct.

have led to a situation where gene-like effects are attributed to contiguity between different points in a region of the chromosome assumed to represent different genes and the so-called inert material.[1] The theory of the gene has certainly to be stretched considerably to allow a description of such facts in terms of genes. Is there no alternative? It seems that these facts and a number of others point to a theory of the germ plasm in which the individual genes will no longer exist".[2] Goldschmidt has not yet definitely formulated his theory, but points to a theory according to which the entire chromosome will be regarded more or less as a long organic chain molecule. A certain arrangement of this chain at a certain point means the development of one character and a different arrangement of the chain means the development of another character. Allelomorphs then would be due to different stereoisomeres.

In his latest book he says of his new theory:" Let us compare the chromosome to a very long chain molecule of a protein. The linear pattern of the chromosome is then the typical pattern of the different amino-acid residues. Let us assume that this chain molecule acts as an autocatalytic proteinase (an assumption required for any model of the germ plasm). As it is known that each protein (and therefore probably each proteinase) is characterized by the length of the chain, the type of amino-acid residues, and the

1) That portion of the chromosome on which no genes have been discovered.
2) Goldschmidt, Richard Physiological Genetics, p.309

specific order or pattern or rhythm of the repetition of these residues along the chain, innumerable types of protein may be obtained by permutation of these three variables, without any change within the individual residues, the loci of the chain; still more may be obtained if different polypeptids are united end to end in a superchain. The mechanics of the possible changes from one type of protein to another by a pattern change involving the three variables may be described in terms equivalent to the words breakage, inversion, translocation, deletion, rearrangement. A series of steps will probably be needed to transform one stable pattern into another though the details can hardly be understood yet. As soon as this transformation is completed, a new protein, proteinase , chemical system has been achieved. It is possible and conceivable that within one such long chain, small local pattern changes (stereoisomerisms) occur which do not change in a general way the cataclytic activities of the whole though they impair it. ......A similar condition applied to small parts of a chain molecule would be a perfect model for mutations if mutations were actually with position effects as we claim". 1)

Recent physiological investigation has tended to favor this theory of Goldschmidt. Nucleic acid seems to be one of the constituent components of the chromosomes. From the structural formula given below we can see that such a

---

1) Goldschmidt, Richard The Material Basis of Evolution, p. 248

theory is at least possible (Figure II).

But even though the theory of Morgan and Bidges may be wrong the data and facts which they have presented are correct. We are able to study the results of the action of the genes even though we are not able to understand their constitution. The results of gene action were studied

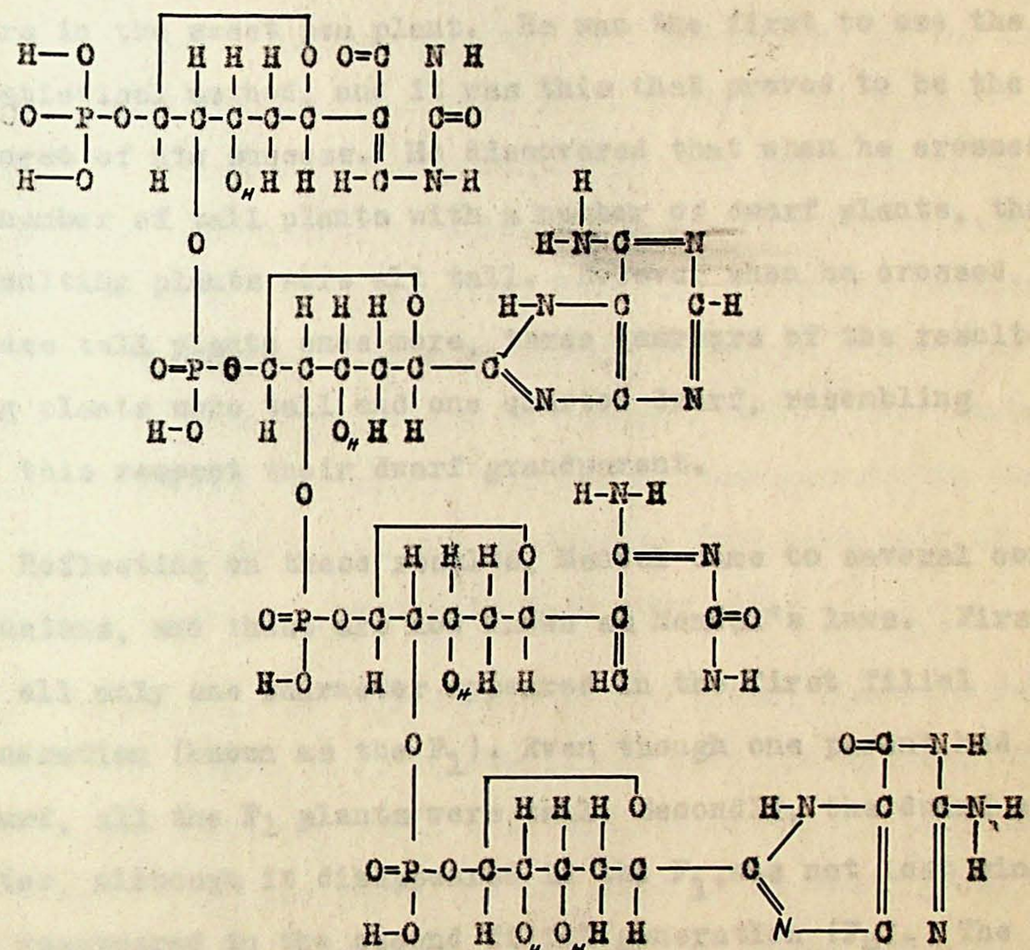

Figure II: The Probable Chemical Structure of Nucleic Acid

by the earliest geneticists. The first of these was Mendel, who might well be known as the father of genetics. Mendel was an Austrian monk who entered the Augustinian

Monastery at Brünn, Austria, at the age of 21. There in the monastery garden he conducted his famous experiments with sweet.peas. He published the results of his work in 1856, but his famous paper lay unappreciated until the turn of the century when it was discovered simultaneously by three independent scientists, De Vries, Correns, and Tschermak.

Mendel was interested in studying inheritance of characters in the sweet pea plant. He was the first to use the statistical method, and it was this that proved to be the secret of his success. He discovered that when he crossed a number of tall plants with a number of dwarf plants, the resulting plants were all tall. However when he crossed these tall plants once more, three quarters of the resulting plants were tall and one quarter dwarf, resembling in this respect their dwarf grandparent.

Reflecting on these results, Mendel came to several conclusions, and these are now known as Mendel's laws. First of all only one character appeared in the first filial generation (known as the F_1). Even though one parent had been dwarf, all the F_1 plants were tall. Secondly, the dwarf character, although it disappeared in the F_1, was not lost since it reappeared in the second filial generation (F_2). The tall character Mendel called the dominant, and the dwarf character he called the recessive. One further point seemed clear. If the factors are supposed to occur in pairs in each individual, some method must exist which keeps the factors in pairs from generation to generation. Mendel assumed that only one of the two factors of each pair gets into each germ cell. Today studies of the process of meiosis have confirmed this. Cells, we know, reproduce themselves ordinarily by the process of mitosis. Each chromosome splits in two, so that each of the daughter cells have the same number of chromosomes. But through the wise providence of the Creator germ cells do not reproduce in this way: otherwise the number of chromosomes would double in each generation. Instead through the process of meiosis the number of chromosomes is halved in the germ cells. Thus the offspring receives half the species number of chromosomes from its father and half from its mother. We remarked before that chromosomes are paired, except for the sex chromosomes in one sex. In meiosis then one chromosome from each pair of chromosomes is placed into each germ cell.

Now let us see how these laws of Mendel operate. The tall pea plant would be designated with the letters "TT" and the dwarf pea plant with the letters "tt". Such plants where both genes are alike are said to be homozygous. After meiosis takes place, only one of these factors is in the germ cell. These two cells unite to form the F_1 plant which is designated by the letters "Tt". It is said to be phenotypically tall (tall according to its appearance) but genotypically (according to the character of its genes) to contain also the recessive dwarf factor. Figure III illustrates what happens in both the F_1 and the F_2. Note that in the F_2 four possible combinations of genes are to be had.

```
                TT  x  tt
Meiosis         T      t                  F1
                    Tt (tall)

          Tt  x Tt    Tt  x  Tt    Tt  x  Tt   Tt x Tt
Meiosis   T     T     T      t     t      T    t    t
             TT (tall)    Tt (tall)    Tt (tall)  tt (dwarf)

1.  BB x bb    2.  BB x BB    3.  BB x Bb    BB x Bb
    B    b         B    B         B    B     B    b
      Bb             BB             BB         Bb
   (brown)        (brown)        (brown)     (brown)

4.  Bb x Bb        Bb x Bb        Bb x Bb    Bb x Bb
    B    B         B    b         b    B     b    b
      BB             Bb             Bb         bb
   (brown)        (brown)        (brown)     (blue)

5.  bb x bb
    b    b
      bb
    (blue)
```

Figure III: How Mendel's Laws work. In the first series we have a cross between a tall pea plant and a dwarf pea plant. In the second case we have the possibilities with human eye color (See note on p. 15). #1 illustrates the possibilities when a man homozygous for brown marries a blue eyed woman: #2 illustrates what happens when both parents are homozygous for brown: #3 illustrates what happens when one parent is homozygous for brown and the other heterozygous: #4 illustrates what happens when both parents are heterozygous: and #5 illustrates what happens when both parents are blue eyed. This diagram covers all possibilities and with it it is possible to trace through several generations.

We said before that the study of genetics was possible only because of a difference in genes found at the same locus in the chromosome. The question now arises how these differences and changes arise. I have no doubt that some of them were present at the Creation. But it is true that many have appeared since that time and are still appearing today. These changes are known as mutations.

Mutations may take place in somatic tissue, that is, in body tissue outside the germ cells. Such a mutation occurs when a tree is discovered with one branch having double leaves. We are not concerned with these since they do not affect the germ cells and are therefore not transmitted.

More important are those mutations which occur in the germ cells. These may be of two types, either dominant or recessive. For our purposes in this paper, the following facts should be noted:

1. Most genes are exceedingly stable. The natural mutation rate is very low.
2. Different genes have different rates of mutation. Some mutate very rarely:others under certain circumstances are high as 100%.
3. Mutations may occur at any point in the life history of the organism, though they seem to occur most frequently just before or during the process of meiosis.
4. The rate of mutation in various genes may vary in different tissues or at different stages of devel-

opment of the organism.

5. A mutation is usually regarded as a change in a gene, not the loss of a gene. Some changes which were at first regarded as mutations, as the Bar-eyed character in Drosophila, have been found to be due to the deletion of a portion of the chromosome, but this is not truly a mutation. It is also believed that many "lethal" mutations are actually a loss of chromosomal material.

6. More than one change may occur in a given gene, producing multiple allelomorphs, which usually affect the same character in differing degrees. Thus instead of having only two characters as we have for height in the sweet pea, we have four characters for coat color in rabbits, all of which are determined by allelomorphic genes at the same locus. This is true for coat color in most animals.

7. The direction of mutation is however "preferential", occuring more often in some directions than in others. In other words, mutation does not occur by chance, but it is under the direction of some guiding force which we may well identify with God.

8. The mutability and preferential direction may themselves be changed through mutation.

9. According to the Bridges-Morgan theory, mutations

appear to be chemical changes. According to the theory which Goldschmidt seems to favor, they would be changes in the arrangement of the "G" chain, and two different genes at the same locus would merely be isomeres.

10. Mutations are usually harmful to the organism. This is undoubtedly, so far as we are concerned in this paper, the most important point with regard to mutations. We will have occasion to return to this point again.
11. Mutations are usually recessive to the wild type. This is related to the point above, since, as we shall see, almost all recessive mutations are now regarded as at least semi-lethal.
12. Mutations with slight effects are much more common than those with marked effects.
13. Mutations with no visible effects are most common of all. This is in line with the fact that many mutations affact internal anatomy and physiology, and no technique has thus far been developed to study these.
14. Radiation may greatly increase the natural mutation rate. This is one of the chief evidences for evolution, and we shall have occasion to discuss it further later. [1]

---

1) For Goldschmidt's views on the whole subject of mutations, see p. 16ff.

Frequently there are discovered exceptions to the Mendelian principles which can be explained only by assuming that one of the factors in a homozygous state causes the death of the zygote. As stated above, when we cross two heterozygotes, we expect to get a ratio of three dominants to one recessive. But when Landauer and Dunn[1)] crossed two creeper chickens, they discovered a two to one ratio instead of the expected three to one ratio. Seven-hundred-seventy-five creeper fowls resulted and 338 normal fowls. Now it is known that creeper, a breed in which the wings and legs are considerably shortened giving the chickens a squatty appearance, is a dominant character. From thesebdata and other data which confirmed these results, they postulated the theory that whenever the factor"creeper" is homozygous, it results in the death of the zygote. Thus "CC" dies, "Cc" is a creeper chicken, and "cc" is a normal chicken. What happens when twa creeper fowls are interbred is shown in Figure IV.

Other lethals that are recessive are more difficult to discover, but techniques have been developed for the study of them, particularly in Drosophila. This method, discovered by Muller, is known as the ClB method. In the X chromosome (the sex chromosome) of Drosophila the following three factors appear. "C" represents a dominant factor which prevents all crossing over in this pair of chromosomes: "c"

---

1) Landauer, W., and Dunn, L.C. Journal of Genetics, 23 (1930), p. 397

is the absence of this factor. "L" represents a normal factor for viability: "l" is its allelmorph, known to be lethal, since all flies of the formula "ll" of "lY" ("Y" representing the male equivalent of the female "X" chromosome which is not homologous and carries very few genes) die. "B" is a dominant

Cc x Cc	Cc x Cc	Cc x Cc	Cc x Cc
C C	C c	c C	c c
CC	Cc	Cc	cc
Dies	Creeper	Creeper	Normal

Figure IV: Illustrating a cross between two creeper fowls

factor for bar eye, while b is its wild type allelomorph producing normal eye.

Muller produced a stock in which the females were heterozygous for these three factors, having ClB on one chromosome and cLb on the other. These could live because the lethal "l" was covered by its normal dominant allelomorph. Such females were mated to (cLb) (Y) males. Of the female offspring, the bar eyed flies would carry ClB on one chromosome (from the mother) and cLb (from the father) on the other.

These bar eyed flies were then bred to normal males (cLb) (Y) and the offspring examined. Naturally half the males died because of the lethal recessive received from the original female parent. The other half of the males receive their chromosome from the original male parent. If a recessive lethal has occurred there, these flies will also die, since they receive the lethal with no normal allelomorph to cover it up. Hence large numbers of flies could be examined for lethal mutations simply by looking for cultures where there were no males. When such a culture is found, it is because of a lethal produced in the X-chromosome of the male. The chart in Figure V shows how this method works.

Other investigators have developed similar methods with similar results. What we are most concerned with here are

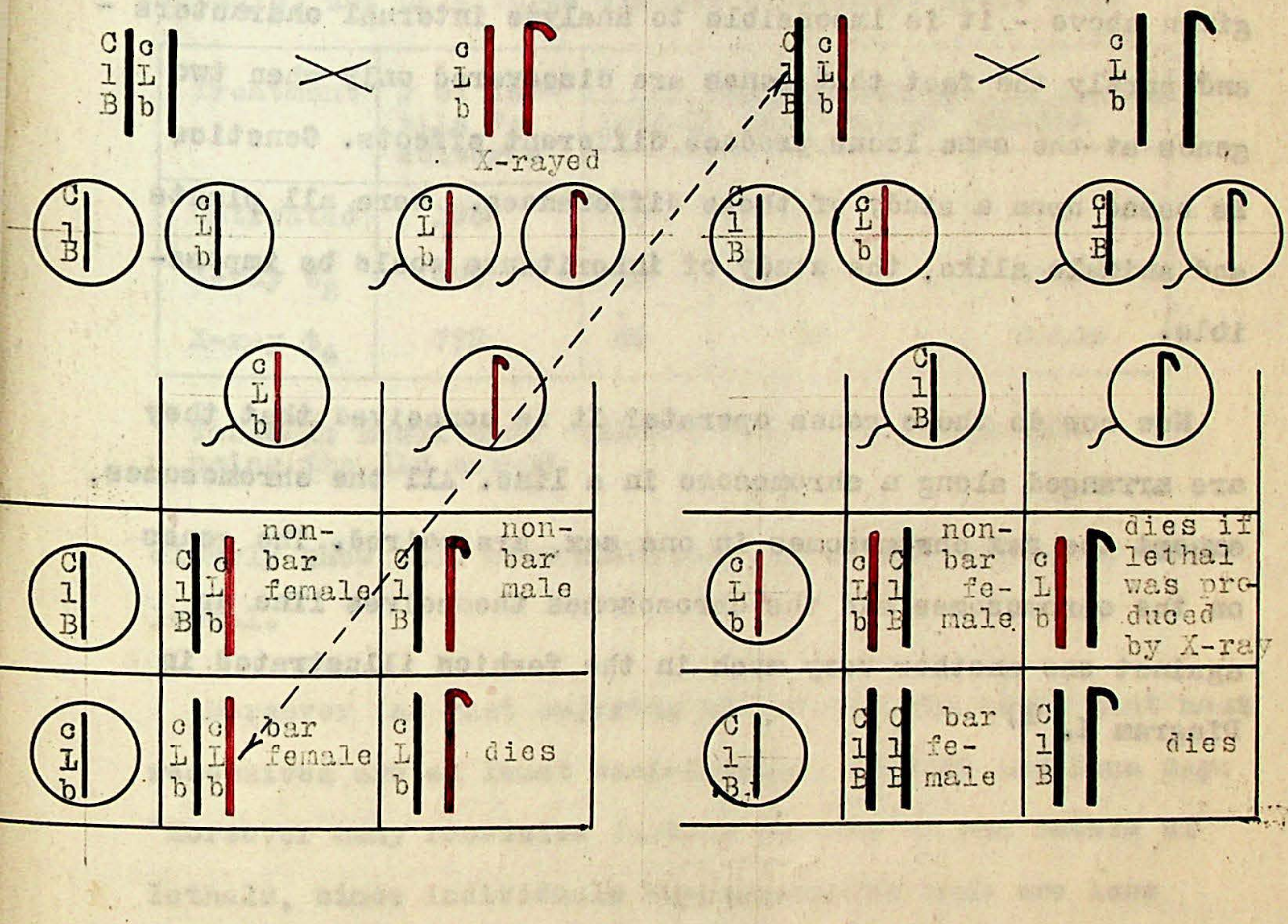

Figure V: The Muller ClB method for detecting lethals.

these results. Table I gives the results of Muller's work. [1] It might be said by way of explanation that Muller was studying the production of mutations by X-radiation.

We are not interested in the difference between the radiated and non-radiated flies, but we are interested in the fact that in the first group, the radiated group, there were 49 lethals and four semi-lethals for the one visible mutation. In the second group there were 89 lethals, 12 semi-lethals, and only three visible mutations. These data

Treatment	# of fertile F_2 cultures	New mutations		
		lethal	semi-lethal	viable
Untreated	198	0	0	0
X-ray t_2	676	49	4	1plus
X-ray t_4	772	89	12	3plus

Table I: Results of Muller's work with Drosophila using the ClB method

clearly show that most mutations are either lethal or semi-lethal.

Moreover the vast majority of geneticists admit that most recessives are at least semi-lethals. Sinnott and Dunn say: "Moreover many recessive factors partake of the nature of lethals, since individuals homozygous for them are less viable than the 'normal' or wild type". [2] This was very evident in the work which I personally carried on last

1) Muller, H. J. Radiation and Genetics, American Naturalist, vol. 64
2) Sinnott, E., and Dunn, L.C. Principles of Genetics, p. 114

year. If viability and fertility were normal, the two classes + (the designation for the wild type, made up almost exclusively of dominants) and "ab" should have had the same number in them, but they did not. (See Table II). This effect was brought about by only two recessive genes. The rest of the genes, of which there are no doubt several thousands, are, we assume, dominant or at least the very same genes that + has. These results are not isolated. So far as I know, most inves-

Cross a-b	F_1 virgin females	F_2 males				
		+	a	b	ab	Total
vl-ho	vl/ho	89	480	784	24	1377
vl-sb	vl/sb	428	263	343	225	1259
vl-le	vl/le	303	417	500	157	1377
vl-bl	vl/bl	375	464	383	133	1355

Table II: Results of crosses with veinless in Habrobracon juglandis.1)

tigators who have worked on the problem have had the same results. In Table III, I shall present the data from one other investigation which is typical of the results generally achieved. Clearly these results show that, at least with Habrobracon juglandis, recessive mutations are definitely semi-lethal.

Mendel worked with seven different sets of characters in the sweet pea, and on those results published his paper. By some stroke of luck, comparable to the stoke of luck Morgan and Bridges had in picking on Drosophila melanogaster

---

1) Klotz, John <u>Linkage Tests of Veinless, a Wing Factor in Habrobracon juglandis</u>, Thesis, M.S., University of Pittsburgh, 1940, p.18

for their material, each of the pairs of characters which he picked were located on different chromosomes. Had he picked two pairs of characters located on the same chromosome, his results would have been very confusing to him. We know now that such factors do exist, for there are thousands of genes and only a relatively few chromosomes. Since genes do not separate in meiosis, but chromosomes do, we would expect two genes that are on the same chromosome to remain together and

Cross a-b	F_1 virgin females	F_2 males				
		+	a	b	ab	total
Y-sw	Y/sw	261	23	293	30	608
Y-sb	Y/sb	193	50	124	92	457
Y-fo	Y/fo	263	37	147	33	480
Y-rd	Y~~X~~/rd	218	23	174	18	433
Y-cd	Y/cd	243	30	140	33	436
Y-to	Y/to	48	16	10	8	72
Y-Eh	Y/Eh	165	13	96	11	285

Table III: Results of crosses with yellow in Habrobracon juglandis.[1]

and not to separate in a random assortment.

We find just such exceptions to the law of random assortment: we find cases where pairs of factors do not assort at random, but tend to stick together in the way in which they enter the cross. The first of these was discovered in sweet peas by Bateson and Punnett in 1906. We call such factors

1) Catizone, Olga <u>The Linkage Relations of Yellow, an Antennal Factor in Habrobracon Juglandis</u>, Thesis, M.S., University of Pittsburgh, 1938, p. 23

linked factors, and we explain linkage by assuming that the pairs of factors concerned are carried on the same pair of chromosomes.

Two such linked factors are black body and long wings in Drosophila, and their allelomorphs, grey body and vestigial wings. When these two are crossed, all the offspring have grey bodies and long wings, since these are the two dominants. These grey-bodied, long-winged flies are now back-crossed with the double recessive, black-bodied, vestigial-winged flies. Ordinarily we should expect a 1:1:1:1 ratio (See Figure VI) Actually we find very few black-bodied, vestigial winged flies or grey-bodied, long-winged flies.

In other words, the factors have appeared in the same

BbVv x bbvv	BbVv x bbvv	BbVv x bbvv	BbVv x bbvv
B V b v	B v b v	bV b v	B v b v
BbVv	Bbvv	bbVv	bbvv
Black body	Black body	Grey body	Grey body
Vestigial wings	Long wings	Vestigial wings	Long wings

Figure VI: Expected results from a cross between a heterozygous Black-bodied, vestigial winged fly, and a grey bodied, long winged fly.

way that they entered into the cross throughbtheir grandparents. It is therefore assumed that the two factors are linked, and that the genes which bring them about are located on the same chromosome. To indicate this they are not written BBvv and bbVV, but (Bv) (Bv) and (bV) (bV). (See Figure VII).

It is to be noted that there are a few of the type flies, and a few of the double recessives. Actually 42% of the flies have black bodies and long wings, 42% have grey bodies and vestigial wings, 8% have grey bodies and long wings, and 8% have black bodies and vestigial wings. How is this to be explained? If the genes are linked, how is it possible for type and the double recessive to appear? This introduces us to the phenomenon of crossing over, which is one of the most important concepts in modern genetics. It is based on the cytological events in the process of meiosis. In reality the process of meiosis is not so simple as it was outlined earlier in this paper. It is really a very complicated process. What actually occurs is that each chromosome divides in two so that in the place of each pair of chromosomes there are now four known as a tetrad. These are distributed in a series of steps until each of four cells has one of the chromosomes. In these processes the chromosomes come to lie very close to one another, and from time to time exchange homologous parts. Thus it is possible for genes to cross over from one chromosome to another (See Figure VIII).

```
(Bv)(bV) x (bv)(bv)         (Bv)(bV) x (bv)(bv)
(Bv)       (bv)                  (bV)     (bv)
    (Bv)(bv)                       (bV)(bv)
 Black body                    Grey body
 Long wings                    Vestigial wings
```

Figure VII: Inheritance of linked characters

Because of this phenomenon of crossing over, it is possible to map the chromosome and determine at least relatively where on a chromosome certain genes are located. It is postulated that if certain genes are very close together, they will be separated very seldom in the process of crossing over, while if they are distant from one another, they will tend to be separated up to 50% of the time. Map distances are calculated after mathematical corrections have been made according to the number of crossovers in the total number of flies. Thus in the Drosophila case above, the

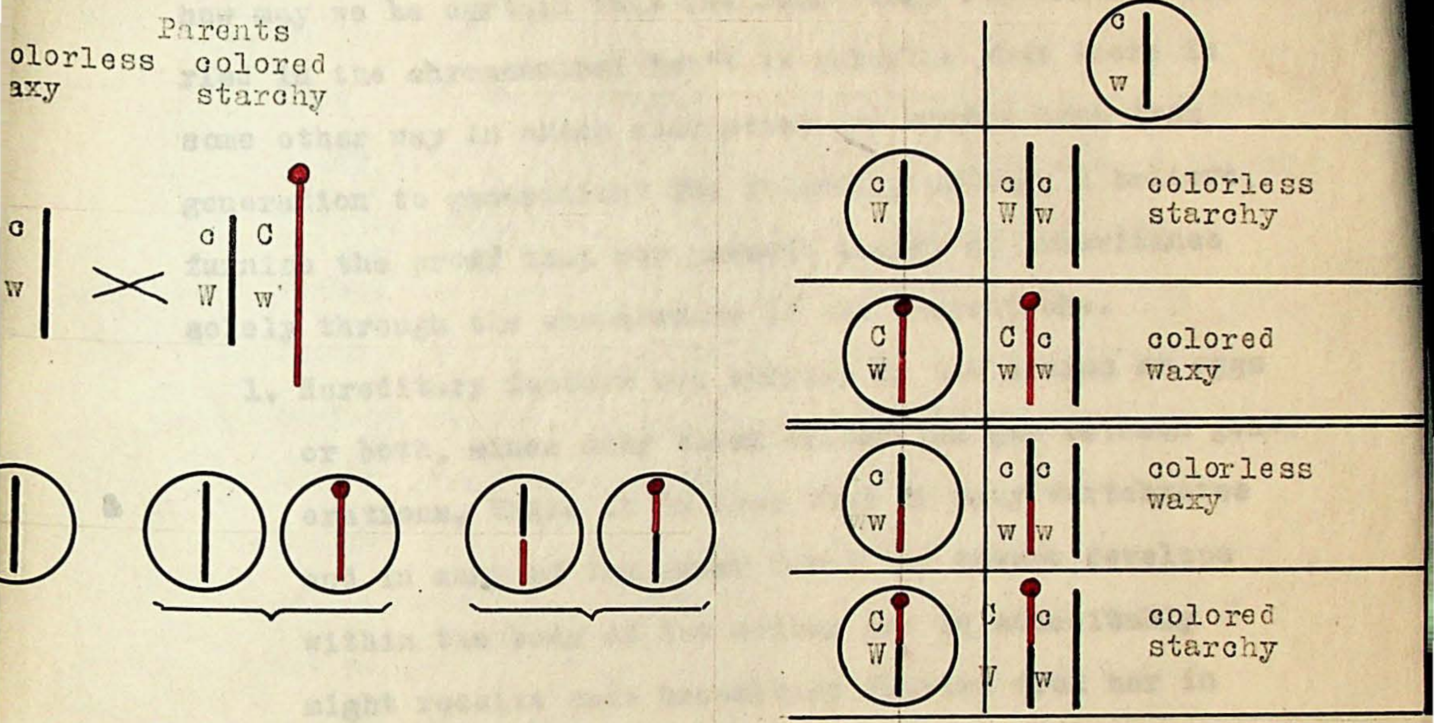

Figure VIII: Diagramatic Illustration of the Cytological evidence for crossing over.

total number of crossovers constituted about 16% of the total. After corrections have been made, it is discovered that they are separated 18.5 units on Chromosome II. That these distances are relatively correct has been confirmed by cytological evidence. They are not absolutely correct, because there are inert regions on the chromosome, regions which do not contain any mutant genes. Maps have been prepared for Drosophila melanogaster and for maize. At present a map of Habrobracon juglandis is in the process of preparation.

Finally in any study of genetics, the question arises: how may we be certain that the hereditary factors are carried in the chromosomes? Isn't it possible that there is some other way in which characters are handed down from generation to generation? The following points, I believe, furnish the proof that our present theory of inheritance solely through the chromosomes is the correct one.

1. Hereditary factors are carried in the sperms or eggs or both, since only these bridge the gap between generations. While it is true that in many vertebrates and in many of the lower forms the embryo develops within the body of the mother and so conceivably might receive some hereditary factors from her in another way, it is also true that in other forms the sperms and eggs are shed into the water from the parents and that the principles of heredity appear to be the same for all species.
2. Within the species, the sperm and the egg (with certain exceptions such as sex-linked factors and aberrations) contribute equally to the inheritance of specific factors. Reciprocal crosses, i.e., AB x ab and ab x AB give identical F_1's.

3. Although the egg has a relatively large amount of cytoplasm in relation to the nucleus, the sperm is practically all nucleus. Moreover in fertilization whatever cytoplasm the sperm has is left outside the egg and only the nuclei unite in actual fertilization. Thus only the nucleus appears to be essential in the transmission of hereditary factors.
4. Of the nuclear contents, only the chromatin material appears to be accurately divided at mitosis and segregated during meiosis. Moreover the chromatin is formed into chromosomes with a constant and characteristic number and appearance for each species.
5. There are striking parallels between the behavior of factors as seen in the results of breeding and the behavior of chromosomes as seen under the microscope. Factors occur in pairs in the cells of the individual: so do chromosomes. Certain factors behave as if only one member of a pair were present in one sex: only one member of one pair of chromosomes is present in the corresponding sex. The number of linkage groups is as a rule definite and constant for any species: so is the number of chromosomes, and in those species which have been carefully studied the number of chromosomes is the same as the number of linkage groups.

One of the most distressing exceptions to this theory was the behavior of plastids in plants. It was discovered that they did not behave in the way that they should have if they were inherited through the chromosomes. Thorough investigation of the problem seems to indicate that the plastids are a mechanism all by themselves. They are not governed by the chromosomes, but seem to reproduce by mitosis from the parent plastids themselves.

From time to time there have been other phenomena reported which at first glance seemed to indicate that inheritance is governed at least to some extent by the cytoplasm. While geneticists have not been able to answer all these cases satisfactorily, there is at present no indication that there is any such thing as inheritance through the cytoplasm. Goldschmidt discusses all these so-called cases of cytoplasmic inheritance and says: "Thus we conclude that the cytoplasm is mainly the substratum for genic action in which all those decisive processes take place which constitute development and which are steered by the genes. The specificity of the cytoplasm is therefore one of the prerequisites of orderly development, and this is tacitly assumed when the action of the genes is being discussed. Thus far however no fact is known which would force us to assume that specific hereditary traits exist that are transmitted through the cytoplasm and are individually caused by a genic property of the cytoplasm. The plastids of plants are probably a third independent constituent of the cell in regard to heredity". [1]

---

1) Goldschmidt, Richard <u>Physiological Genetics</u>, p. 280

We turn now to a consideration of the relation of genetics to evolution. It is generally admitted that the mechanism for evolution must be sought in genetics: indeed enthusiastic evolutionists proclaim genetics to be "a laboratory experiment in evolution". Shull says: "The easiest way to bring about modification of a species with a high degree of stability of each new state would be to introduce the changes into the hereditary units; and there seems to be little doubt that this is actually what has happened. The physical basis of evolution is thus identical with the physical basis of heredity". [1] Sinnott and Dunn say:"The importance of a knowledge of inheritance for the development of evolutionary theory was recognized when the young science of genetics (sometimes known as experimental evolution) was established. ...In recent years however a more complete understanding of their own problems has made it possible for geneticists to make substantial contributions to a knowledge of the mechanism of evolution, especially as to two of its problems. These are first the origin and nature of inherited variations and second the processes by which these variations give rise to segregated groups of individuals, the new racesm species, and higher taxonomic categories". [2]

First of all, what theory of evolution are we dealing with? It is well known that almost every evolutionist has his own particular theory or at least modification of the theory of

1) Shull, A. Evolution, p. 68
2) Sinnott, E., and Dunn, L.C. Op. Cit. p. 345

evolution. But by and large the prevailing theory today, the theory which permeates all other theories, is a Neo-Darwinism. Darwinism is not dead, not by a long shot. Darwinism today is still very much alive. The concept of a survival of the fittest and the survival value of certain characters still prevails among scientists today. Likewise most scientists today believe that evolution has come about through the cumulative effect of many small changes. Indeed Lamarckism is not yet dead in scientific circles today: it has only been placed on the shelf. No scientist holds to Lamarckism today because the inheritance of acquired characteristics was effectively disproven by Weismann, who cut off the tails of 19 generations of rats without noting any effect and then gave up in disgust.

Modern genetics today is unanimous in denying the possibility of an inheritance of somatic changes. Shull says: "No satisfactory evidence that a soma may impress its characteristics, or any characteristics, upon the germ cells within it has ever been obtained".[1] And Goldschmidt speaks of the "well known fact that heritable effects of the environment with a purposive response of the germ plasm to environment have never been proven and are considered as actually impossible on the basis of our present genetic knowledge". [2] But Lamarckism is such a satisfying theory, a theory which explains so many things, a theory which would solve almost every evolutionary difficulty, that

1) Shull, A. Op. Cit. p. 102
2) Goldschmidt, R. Material Basis, p. 102

the moment there was discovered the slightest evidence for the inheritance of acquired characteristics, Lamarckism would spring forth full grown once more.

Now how do geneticists believe evolution to have taken place? There are three methods which are postulated. First of all, it is believed that evolution takes place through recombination of genes. In other words, new forms develop through new combinations of genes already present in the chromosomes of the parents. Shull says: "A clear notion of the relation of heredity to this long range evolution may be had by laying emphasis on the phenomena of widespread occurrence, and upon the more specialized ones only when they may serve an evolutionary end with relative promptness. In front rank among these phenomenam as a continuing source of change is the rearrangement of the genes". 1)

There is much to be said for this idea. The variety that is possible is infinite. With only four pairs of genes, thirty-six combinations are possible. Now most organisms possess several thousand genes. Assuming this number to be 6,000 (3,000 pairs) and assuming that only 1% of these 3,000 loci in the chromosomes are occupied by more than one kind of gene, and that the number of kinds of genes at one locus is not in any case more than two, the number of possible combinations of genes in the species would still amount to the staggering total of 3^{30} or over 200,000 billions. Or

---

1) Shull, Op. Cit. p. 78

suppose an organism possesses only 1000 genes, each capable of producing ten allelomorphs. Then the possible gene combinations that may be formed are 10^{1000}. Shull remarks: "It is obvious that such a situation offers abundant material for evolution". [1)]

A second way in which evolution is postulated as having taken place is through chromosomal aberrations. By this is meant some change in whole chromosomes which does not affect the genes (although according to Goldschmidt any reaggangement of chromatin material would necessarily involve a change in the genes as well). Chromosomal changes are of several kinds. Occasionally several chromosomes are added or subtracted: the number of chromosomes may be doubled or halved. Fragments of chromosomes may be added or subtracted. Portions of the chromosome may be inverted or translocated. It is interessing to note that De Vries' famous theory was based on such chromosomal aberzations. Although he coined the term "mutation", he never saw what we regard as a mutation today. Oenothera, the evening primrose, the plant with which he worked, is a plant that is noted for the number of chromosome changes which are responsible for the different varieties.

All of these changes in the chromosomes have visible effects, and this is regarded as one of the chief methods by which evolution takes place. Of this method Shull says: While much of what is known regarding genetic change through

1) Shull, Op. Cit. p. 81

chromosome fragmentation has been discovered in the vinegar fly Drosophila, enough of it has been confirmed in other species to suggest that it may be a fairly general process. If successful evolution can be derived from it, therefore, it is legitimate to speculate upon its possibilities in any or all of the higher animals or plants."[1] The "if" is the most important word in the whole section. It is to be noted that Goldschmidt's new theory of evolution which we shall discuss in connection with the criticism of this method of evolution fits into this category.

The third method of evolution is through mutation which we have discussed above. It is assumed that if mutat ions can create new varieties of the same species, eventually they ought to create new species as well. This is perhaps the most important method so far as genetic evolutionists are concerned. It is discussed at length by Shull and by Sinnott and Dunn. For that reason we shall have to consider this method at length in our paper.

Since the time of Darwin evolutionists have been attacked because they have been unable to point to any actual cases in the laboratory or in the field where a new species has developed. It must of course be said that it is not exactly a fair demand that cases of evolution in the field be presented. That is **almost** impossible. But we do have a right to expect to see evolution take place in the laboratory.

---

1) Shull, Op. Cit. p. 95f

Of late there has been much rejoicing among evolutionists on this score, because there have been developed in the laboratory several plants which apparently are new species. And so most biologists today rejoice that their much pampered theory has at last been vindicated and that at last there is scientific evidence for it.

We shall analyze three of these alleged instances of the production of new species. With few exceptions, so far as I know, they are all the result of a doubling or halving of the number of chromosomes in a species or of the addition or subtraction of a single chromosome from the species number.

One of these exceptions wasamade in 1928 by Karpechenko between a radish and a cabbage. The radish used was Raphanus saturis (2n - the normal number of chromosomes - equals 18) and the cabbage was Brassica oleraceae (2n=18). Thus both plants had a chromosome number of 18. The F_1 hybrids had 18 chromosomes, nine from the radish and nine from the cabbage. Nearly all of these hybrids were sterile, but under favorable conditions some F_1 plants produced a few seeds. Some of the F_2 plants resembled the hybrid: others were intermediate between it and the radish parent. Those which resembled the F_1 hybrid were found to have 36 chromosomes, the sum of the chromosome numbers of the two parent species. They were thus tetraploid hybrids and proved not only to unite certain characters from both parents, but to be fully fertile and to breed true to the hybrid and tetraploid characters.

A study of the meiotic divisions of the F_1 hybrid showed that pairing of the radish and cabbage chromosomes did not occur, and the 18 univalents were generally distributed at random to the gametes, each of which received from 6 to 12 chromosomes and were not functional. Occasionally in pollen mother cells, the first meiotic division was abnormal resulting in nuclei with all 18 chromosomes so that a few pollen grains formed from these contained 9nradish and 9 cabbage chromosomes.

Since the F_2 tetraploids had 36 chromosomes, it is probable that these arose through the union of such exceptional F_1 gametes so that the tetraploid would have 18 radish and 18 cabbage chromosomes. Meiosis in the tetraploid was regular and normal: 18 pairs of chromosomes were formed. Undoubtedly the 9 cabbage chromosomes paired with their nine cabbage homologues, and the nine radish chromosomes with their homologues from the same parent species. The gametes of the tetraploid thus each transmitted nine cabbage and nine radish chromosomes and perpetuated a new set of characters in a fertile intergeneric hybrid breeding true to its own type and infertile with both parents. 1)

A very interesting experiment was recently performed by Müntzing in which he synthesized a new species from its

---

1) Sinnott and Dunn, Op. Cit., p. 323

putative parents. He used Galeopsis pubescens as the female parent and Galeopsis speciosa as the male parent. In both n=8. The F_1 hybrid was highly sterile: its anthers contained only 8.9% to 22.3% of visibly good pollen., and few good ovules were produced. In the F_2 generation a single plant was found that proved to be a triploid (2n=24). This triploid plant was back-crossed to a pure pubescens. A single seed resulted from the back-cross. It gave rise to a plant which proved to be a tetraploid (2n=32). This tetraploid was fertile and became the progenitor of a strain which has been named "artificial Tetrahit". This artifical Tetrahit is like the real Galeopsis tetrahit in possessing 32 chromosomes in somatic cells and 16 bivalents at meiosis. The meiotic divisions are with few exceptions normal. A cross between the artificial and the natural tetrahit gives normally developed offspring which are externally similar to either parent. The fertility is complete in some individuals, while others are partially sterile (partial sterility has been observed in some lines of the pure Galeopsis tetrahit).[1]

It is postulated that this is the way in which the species Galeopsis tetrahit originated. It is believed that in some way the two parent species interbred, and the result was the species which we now know as Galeopsis tetrahit. Dobzhansky says:"Although the origin of the natural Galeopsis tetrahit from a cross between pubescens and speciosa is very probable, it remains unknown when and where the event took place".[2]

---

1) Müntzing, A. <u>Outlines to a genetic monograph of the genus Galeopsis</u> and <u>Cytogenetic investigations on synthetic Galeopsis tetrahit</u>. <u>Hereditas</u>:13:185-341 and 16:105-154
2) <u>Dobzhansky, Op. Cit. p. 209</u>

Far more common than such interspecific and intergeneric crosses is the production of tetraploid plants from diploid plants of the same species. A number of these have been developed that are sterile with the original parent plant. Among these is a tetraploid tomato which has been developed by Lindstrom. This tetraploid tomato is cross-sterile with the diploid species. It was produced asexually by decapitating young heterozygous pimpinellifollium plants and allowing a callus to form on the cut stem. Nuclear or chromosomal doubling took place in a few of the cells of the callus from which adventitious tetraploid sprouts arose. Only thee of the 100 tested sprouts proved to be tetraploid. From one of these larger sprouts three generations were bred. These proved to be completely cross-sterile with the parental species. [1)]

If we accept the generally accepted definition of a species, then, these are new species, for they are sterile with their parents and reproduce after their kind. But let us remember that "species" is only a definition and a concept that man himself has set up. It is axiomatic that man classifies nature although nature itself is unclassified. The same hold true so far as definitions are concerned. Nature does not fit into man's definitions, but man makes his definitions to conform to what he observes in nature. [2)]

---

1) Lindstrom, E. W. <u>A Fertile Tetraploid Tomato</u>, Journ. Hered. 23(1932): <u>115</u>

2) On this whole subject, see the previous discussion on p. 11

Concerning our whole system of taxonomy and classification, Dobzhansky says: "Since the time of Darwin and his immediate followers, the term 'natural classification' has meant in biology one based on the hypothetical common descent of organisms. The forms united together in a species, genus, class, or phylum were supposed to have descended from a single common ancestor or from a group of very similar ancestors. The lines of separation between the systematic categories were, hence, adjusted, at least in theory, not so much to the discontinuities in the observed variations as to the branching of real or assumed phylogenetic trees. And yet the classification has continued to be based chiefly on morphological studies of the existing organisms rather than on the phylogenetic series of fossils. The logical difficulty thus incurred is circumvented with the aid of a hypothesis according to which the similarity between organisms is a function of their descent. In other words it is believed that one may safely base the classification on studies of the structures and functions of the organisms existing at our time level, in the assurance that if such studies are made complete enough, a picture of the phylogeny will emerge automatically. This comfortably complacent theory has received some rude shocks from certain paleontological data that cast a grave doubt on the proposition that similarity is always a function of descent. Now if similar organisms may, however rarely, develop from dissimilar ancestors, a phylogenetic classification must sometimes unite dissimilar and separate similar forms. The resulting system will be at least in some of its parts neither natural in the sense defined above nor convenient for practical purposes". [1]

Assuming, however, that these are new species, they are still no proof or even evidence for evolution, because they contribute nothing new. Their characters are the same characters which their parent plants had except that they are accentuated. No new character which did not exist before is brought into the world by them. For that reason they do not contradict the rule laid down in Genesis that all plants and animals are to reproduce after their kind. The two parent plants did reproduce after their kind: their offspring were nothing new.

Moreover the means by which these plants were produced were extremely artificial. It is inconceivable that any of these three phenomena should have occurred out in nature. Under ordinary circumstances it is impossible for a cabbage to be fertilized by radish pollen, or vice versa. Lindstrom's tomato was not only a freak, but it was a pathological freak as well. The fact that chromosomal doubling took place is evidence of a pathological condition in the plant.

The fact that so few of the new species were produced at first is also striking. Müntzing tells us that under the most favorable conditions only 23.3% of the pollen

---

1) Dobzhansky, Op. Cit. p. 304f

was good, and that there were only a few good ovules. Moreover only a single seed resulted from the second cross. Karpechenko tells us that under favorable conditions some of the F_1 plants produced a few seeds, and he admits that these were the result of an abnormal meiotic division. Lindstrom reports that of 100 sprouts tested, only three proved to be tetraploid. His work was confined entirely to one of these three tetraploid sprouts.

To be sure, it cannot be denied that Galeopsis tetrahit may have arisen from Galeopsis pubescens and Galeopsis speciosa in a manner similar to that demonstrated by Müntzing. But it is extremely doubtful if it could have arisen in the exact manner postulated by Müntzing. For these reasons I can scarcely regard these instances and other instances like them as evidence of the production of new species or as proofs for the fact that evolution take place. None of them furnish us with even an approximation of the manner in which a general evolution of all species could have taken place.

Let me conclude this section with several quotations which have to do with this subject. Of the possibility of discovering a new species in the field, Willis says: "The chance of seeing such a mutation occur is practically nil".[1] With regard to the production of new species by doubling of the chromosome number such as we have in Lindstrom's tomato, Goldschmidt says:"In animals true poly-

---

1) Willis, J.C. The Origin of the Species by Large rather than by Gradual Change and by Guppy's method of Differentiation. Ann. Bot. 37:605-628. Quoted by Goldschmidt Material Basis, p. 211

ploidy by doubling of the chromosome set is either not found or is of limited significance.......Since it seems that comparable features (features comparable to polyploidy in plants) are absent, or at least unimportant in animals, the process of polyploidy cannot be regarded as a general evolutionary principle."[1]

We shall now look more closely at the three manners which have been postulated as the manners in which evolution takes place. It is well to note in the first place that for the first and last, recombinations and mutations, there is not even the slightest evidence for the development of new species. For the second, chromosomal aberrations, there is some alleged evidence, but this can hardly be accepted as any proof for the truth of the evolutionary hypothesis. Most important however is the fact that there are a number of bars to evolution taking place in any of these ways. These bars we shall now discuss.

Turning first to the theory of evolution through recombination of genes, let us look more critically at it. In the first place, nothing new is contributed by gene recombinations. The gene material is already there. The new characters which appear either already existed in one of the varieties of the species or they existed in a recessive state, covered by dominants. In gene recombinations there is no change, nothing new , no addition to the

1) Goldschmidt, <u>Material Basis</u>, p. 237.240

qualities and character which already exist.

Moreover there are definite restrictions upon the freedom of assortment. Recombination of genes is almost impossible in cases of vegetative reproduction. By vegetative is meant reproduction by roots, cuttings, bulbs, and the like. Most of the botanical freaks of Luther Burbank can be reproduced only in this way. That is also true of some of our vegetables. In these plants there is no meiosis and hence no possibility of genes crossing over and recombining.

Similarly there is a definite restriction placed upon recombinations of genes in those plants, such as beans and wheat, in which self fertilization is the rule. Instead of getting recombinations of genes, there is steady progress toward a homozygous individual. Recombination is definitely restricted to those genes which are already in the plant. It is impossible for other genes not already in the stock to be introduced.

Some plants, moreover, reproduce parthenogenetically. In various forms of the hymenoptera, parthenogenesis may be practiced either in the absence of a sperm or at the will of the female. In these cases the result is the same as in self-fertilizing plants. Gene recombination is limited to those genes already present in the parent organism. The introduction of new genes from other individuals of the same species is either impossible or restricted.

Another restriction on the freedom of assortment of genes is the failure of certain linkages in the chromosome to break. Thus in the small chromosome pair of Drosophila containing only a few mutant genes, crossing over is practically non-existent. Undoubtedly this is due to the small size of the chromosome. In comparison with others it is truly a dwarf. Because of its smallness, it is physically impossible for it to twist around its homologue in the same way that the larger chromosomes do this. This is probably true not only in the IV Chromosome of Drosophila, but also in all chromosomes of all species that are as small as it.

Finally in the male of Drosophila crossing over is practically non-existent. Why this is is not yet known. No one has accounted for this phenomenon up to the present time. This very definitely limits the freedom of assortment of genes in these cases. Drosophila is the only case in which this has been shown to be true, but there is not any reason to doubt that this phenomenon exists in other animals. The only reason that other cases have not been discovered yet is that other forms have not yet been so thoroughly studied.

To be sure this argument against the freedom of assortment must not be pressed too far. It is sufficient to recognize that it exists. Probably there is considerable freedom of assortment among genes. The important criticism of the theory is the one first mentioned: the fact that recombinations contribute nothing new, but simply reassort characters already present.

The second way in which it is postulated that evolution may take place is through chromosomal aberrations. This implies some peculiarity in the chromosomes. In some cases a single chromosome is added or deleted. In others a complete set of chromosomes is added. In still others, a chromosome is inverted, and in others a piece of the chromosome is translocated or added or deleted. We have discussed the evidence for the production of new species through chromosomal aberrations above and have seen that they are no evidences for evolution.

Moreover, if we follow the theory of Bridges and Morgan, we can apply the same criticism to this phenomenon as we did to the phenomenon of recombination of genes: no new contributions are made. It is simply a rearrangement or addition of genes that are already present. No new factors are developed and no new genes contributed. However there are a number of discrepancies in the Morgan-Bridges theory which incline us toward one that at least resembles in general what Goldschmidt postulates. In that case translocations and inversions, deletions and additions would be significant and would contribute new factors. We shall discuss Goldschmidt's theory in a section at the end of this paper. It is to be noted, however, that the above mentioned instances of the production of new species do not fall into this category, since they are due to the addition of whole sets of chromosomes.

But there are other objections to this theory. In the first place most of the abnormalities are definitely harmful to the individual. Shull says: "At their best such abnormal forms produce but few functional germ cells; at their worst the chromosome combination proves fatal to the individual that possesses it". [1] Sinnott and Dunn say: "Although deficiencies and duplications produce the most marked character changes, they generally reduce viability to such an extent that they would soon be eliminated in nature. They probably do not provide an important source of continuing viability found in nature". [2]

That has been shown particularly in Drosophila. It has often been said that in picking Drosophila Morgan and Bridges had a piece of luck almost as great as Mendel had in picking the sweet pea characters that he did. One of the reasons for this statement is the discovery of giant cells in the salivary glands of these flies. They are truly tremendous not only in comparison with the cells of other parts of Drosophila, but also in comparison with other animal and plant cells. Because of their size it is possible to study the chromosomes under a high powered microscope and thus observe cytologically various genetic

1) Shull, Op. Cit. p. 93
2) Sinnott and Dunn, Op. Cit. p. 335f

effects. Thus it has been possible to study the addition and subtraction of chromosomes and correlate this with the cytology of the animal. Normal flies have a pair of sex chromosomes (in the female, two "X" chromosomes: in the male one "X" chromosome and one "Y" chromosome which is not homologous to the "X" chromosome, but is largely inert), two pairs of large chromosomes, and a pair of small chromosomes, four pairs in all. It has been discovered that this number may be doubled so that instead of a 2n fly, we have a 4n fly. Such a fly is a normal female. Similarly the number may be halved so that we have an n fly, also normal. Such a 2n fly may be crossed with a 4n fly. The resulting 3n fly is also a normal female.

But if this ratio is upset, the individual suffers. A fly with a normal pair of sex chromosomes and three each of the autosomes (3n-1) is an intersex, sterile, and showing the characteristics of both sexes. On the other hand, a fly with three sex chromosomes and a pair each of the autosomes (2n plus 1) is a sterile superfemale. All the female characters are accentuated, but the fly cannot reproduce. The same is true of males. A fly with an X chromosome, a Y chromosome, and three each of the autosomes is a sterile male with all the male characters accentuated. It is clear then that a radical rearrangement of the chromosomes results in harm to the individual. Either it is completely lethal or the individual is sterile.

The deletion of a portion of a chromosome is usually fatal if it becomes homozygous. Of this Snyder says: "If the missing piece is not too extensive the individuals lacking it may live, especially in a heterozygous state. Rarely can an individual exist with a similar part missing from both chromosomes of the pair".[1)]

Thus we see that chromosomal aberrations are usually injurious to the animal or plant affected, and for that reason can hardly be the source of the new species which evolution is hunting.

We turn now to what is probably the most significant argument for evolution so far as genetics is concerned. That is the argument from mutations. It is reasoned that if mutations can cause changes in the species, and thus bring about varieties of the same species, they can also cause changes that are large enough to bring about new species. We have discussed mutations above and have outlined the argument from mutations there.

How do mutations occur? Here evolutionists and geneticists cannot answer. In nature they occur at random: their occurrence cannot be predicted. In the laboratory time is too precious to wait for their occurrence in the natural course of events, and so the rate of mutation is speeded up by ultra-violet radiation, X-radia-

---

1) Snyder, L. <u>The Principles of Heredity</u>, p. 175

tion, and other forms of radiation. Radiation has been responsible for the discovery of most of the mutants in Habrobracon as well as in Drosophila.

The question arises as to whether or not radiation of some sort is the cause of mutations in nature, and the best answer at present seems to be: No. We all know that there is a small amount of radiation on the earth at all times. The chief source of such radiation is the cosmic rays which strike the earth continuously. Shortly after it was discovered that mutations could be produced by radiation, it was postulated that this was the ultimate cause of all mutation. Babcock and Collins made tests in a railway tunnel [1] and Hanson and Heys made tests in a carnotite mine.[2] In both these places radiation is greater than on the open surface of the earth. In both of these tests flies reared amid the greater radiation yielded more lethal mutations than those reared on the open surface of the earth, However the differences were not large, and statistical calculations throw doubt on the validity of any conclusion that mey be drawn from these data.

Today there is serios doubt as to whether radiation could be the cause of mutations in nature. Shull says: "Some further doubt is thrown on radiation as the cause of natural mutations by the large number of these which

1) Babcock, E., and Collins, J. Does Natural Ionizing Radiation Control Rate of Mutation? p. 6230628
2) Hanson, F., and Heys, F. A possible Relation Between Natural Radiation and Gene Mutations, p. 43f

have occurred. It has been shown that the number of lethal mutations produced by X-rays is roughly proportional to the amount of radiant energy used (See Table I, p. 29). Muller has used this relation to calculate how much radiation there would have to be to have produced the many mutations that have arisen in Drosophila in the last twenty odd years, and finds that the radiation actually in existence is less than a thousandth of the required amount. He has considered the possibility that radiant material may be concentrated near the germ celss in the flies, but this has seemed unlikely and some experiments by Spencer in which another species of Drosophila was reared on a food culture mixed with ground carnotite yielded no mutations. The cause of natural mutations is therefore much in doubt".1)

On this same subject Dobzhansky says:" Mutation producing agents other than short wave radiations are in all probability present in nature. This is a field which has been extensively explored at present and where discoveries are likely at any time. But for the moment, one is forced to admit that no securely established conclusions have emerged". 2)

We have mentioned before some of the other difficulties. The fact that most mutations are lethal or semilethal cannot be overemphasized. Then too almost all muta-

1)Shull, Op. Cit. p. 106f
2)Dobzhansky, Op. Cit. p. 31

tions are recessive. Moreover those dominants which occur are almost all lethal when homozygous. No doubt some of these are deficiencies, the deficiency removing a gene which prevented the development of the particular character involved. Curly wing and star eye are dominant mutations in Drosophila which are lethal in a homozygous condition. Notch wing is one of these dominants, lethal when homozygous, that has definitely been proven to be due to a deficiency.

One of the biggest difficulties that genetic evolutionists face today is the difficulty of explaining the origin of dominance. How does it happen that certain characters are dominant over their allelomorphs? No one has even a theory to explain this. There is no known genetic or physiological reason why certain genes are dominant over others. Here the geneticist must throw up his hands and say:"I don't know". Almost every factor in the wild type is now known to be dominant, and in his present state of ignorance the geneticist knows only the answer of the theologian to this problem: it must have been made that way by a higher power.

Of the possibility of evolution through mutations, Goldschmidt says: "So-called gene mutations and recombination within an interbreeding population may lead to a kaleidoscopic diversification within the species, which may find expression in the production of subspecific categories, if selection, adaptation, isolation, migration, etc., work to separate some of the recombination groups, ...But all this happens within an identical general genetical pattern, which may also be called a single reation system. The change from species to species is not a change involving more and more additional atomistic changes, but a complete change of the primary pattern or reaction system into a new one, which afterwards may again produce intraspecific variation by micromutation. One might call this different type of genetic change a systematic mutation, though this does not have to occur in one step as we have seen". [1]

Earlier in the same book he says: "Subspecies are actually therefore neither incipient species nor models for the origin of species. They are more or less diversified blind alleys within the species. The decisive step in evolution, the first step toward macroevolution, the step from one species to another, requires another evolutionary method than that of sheer accumulation of micromutations." [2]

There are other problems which arise in connection with mutations. There is first of all the problem of the direction of mutation. If mutation occurred by chance, we

1) Goldschmidt, Material Basis, p.205
2) Ibid. p. 183

should expect them to occur in all directions. There should be no particular direction discernible in which mutations were occurring. But this is not true. Mutations do not occur at random. Shull says:"There are many things, however, which indicate that in the dealing our of mutations the cards are stacked. The available evidence goes to show that there are numerous restrictions upon the process of modification, so that the wheel of change, like the wheel of fortune in a well-managed casino, betrays a strong tendency to stop at certain points. To assume under these circumstances that every conceivable type of mutation not only may but will occur is like supposing that a tetrahedon will rest stably in twenty, or a hundred, or indefinitely numerous positions. Moreover a casual glance at the mutations which have occurred abundantly in certain organisms suggests they are limited in their nature. For example the eye color of the fly Drosophila has mutated many times. Were the direction of these mutations subject to no control, all colors of the spectrum should be equally likely to occur. While many shades of red have resulted from these modifications, there has been no blue or green. In view of the frequency of mutation of eye color, one is led to suspect that blues and greens are absent because Drosophila is incapable of mutating in that way." 1)

1) Shull, Op. Cit. p. 123

Shull then proceeds to tell us that the reason why the gene cannot mutate in all directions is probably to be found in the high specificity of the protein which constitutes the gene. But if this protein is so highly specific that it cannot give rise to certain eye colors, how is it going to give rise to characters which will set off the individual as an entirely new species?

Another fact that makes us doubt that mutations are the cause of evolution is the fact that there are often reverse mutations to type. At first it was not believed that this was possible, but it is now known to be a fact. Evolution however will not advance by taking a step forward and then retracing that step again, nor will it advance very rapidly by taking two steps forward and then one backward. Such returns to a former condition have occurred in a number of genes. Thus the eosin eye of Drosophila originated as a mutation from the white eye, and later a repetition of eosin came from the wild type red. Now from the eosin stocks there have arisen both white and wild type mutants, both returns to the original and reversals of the earlier mutation. It is a known fact that in Drosophila virilis, a certain miniature winged type mutates to the wild type with great frequency, about 5% in each generation. Such reverse mutations would certainly tend to slow down evolution tremendously.

Much has been made of the phenomenon of parallel mutations. It has been discovered that mutations in Drosophila melanogaster and Drosophila simulans are very much alike. In fact it almost seems as if the mutations are identical. Similar comparisons have been made in mammals between the guinea pig and the Peruvian cavy. But this is not necessarily an evidence for evolution. As we saw earlier, our thesis does not require us to maintain that such closely related forms had two distinct ancestors.

One of the favorite modifications of the Darwinian system is the doctrine of orthogenesis, a concessionnto theistic evolutionists. It is assumed that evolution is following not a random path, but a path toward a goal that has been set for it by some higher power. It might be assumed that the evidence for directional mutation cited above supports the theory of orthogenesis. Such is not the case. Mutations, particularly in Drosophila, have not been directional in the orthogenetic sense of the word. It is possible to arrange the various shades of eye color, for example, in a series of mutants grading from red to white. But unfortunately this did not occur. As a matter of fact the first mutation from the wild type deep red was white, and the intermediate colors were distributed irregularly from time to time. Moreover instead of one mutant giving rise to another, all these mutations came directly from the wild type except for eosin which arose first from white.

Another very significant fact about mutations is that they are never related in any way to the environment. Shull says: "Of the hundreds of mutations which have been discovered in various plants and animals, not one has shown any indication that its nature was environmentally determined......In particular, mutations were never obviously adaptive: mutant organisms were not, so far as could be seen, better fitted for the environment than were the types from which they sprang".[1] This is very significant, since it is a cardinal principle that characters must have a survival value and that evolution takes place by the development of characters which fit the individual to cope better with his environment.

The number of individuals displaying a certain character depends upon the number of genes for that character in the population. If there are only a few genes for a certain character in existence, it is likely to occur very seldom in the population, or if it is a recessive gene, it will be swamped out by the dominants. Actually however a stable gene ratio is reached in a population after a short time. What this ratio will be depends upon the viability and fertility of the characters involved. Suppose two kinds of genes are involved, "A" and "a". Let the number of gene "A" equal p and the number of gene "a" equal q. Then

1) Shull, Op. Cit. p. 132

p plus q = 1. If all the individuals in an indefinitely large population, freely interbreeding, reproduce at the same rate and all types survive to the same degree, and if there is no linkage and no overlapping of generations, the next generation will consist of p^2 individuals of the composition AA, pq individuals whose genes are Aa, and q^2 individuals that are aa. In the next generation under similar conditions the three combinations should occur in the same ratio, and so on indefinitely. Thus a stable gene ratio is established.

Actually this very seldom occurs. In the first place, recessive genes are almost always of a lower fertility and viability rate than their dominant allelomorph. Then too mutations may affect these fertility and viability rates and thus change the gene ratio. Finally mutations which introduce new genes affect the gene ratio.

The chances of a single mutated gene surviving are very small. Suppose the population is constant at about a million individuals. The individual containing this mutated gene is only one individual in this million. This number, let us assume, is reduced to ten thousand before maturity and the survivors are determined by pure chance. This reduces the probability of survival of this gene to 1 in 100. If the individual escapes this elimination and mates, and the pair produce 200 offspring equally with all other pairs so as to yield once more a million young individuals, one hundred of these individuals will contain the mutant gene. Now the situation of the new gene with respect to its survival is improved, since even with a 90% reduction of the population before maturity, it is likely to survive.

Table IV, which I have taken from Dobzhansky who in turn took it from Fisher, presents the matter from a slightly different viewpoint. This means that finally if there is no survival value all of 10,000 original mutations will become extinct. If these mutations have

Generation	Probability of extinction		Probability of survival	
	No advantage	1% advantage	No advantage	1% advantage
1	0.3,679	0.3,642	0.6,321	0.6,358
3	0.6,259	0.6,197	0.3,741	0.3,803
7	0.7,905	0.7,825	0.2,095	0.2,175
15	0.8,873	0.8,783	0.1,127	0.1,217
31	0.9,411	0.9,313	0.0,589	0.0,687
63	0.9,698	0.9,591	0.0,302	0.0,409
127	0.9,847	0.9,729	0.0,153	0.0,271
Limit	1.0,000	0.9,803	0.0,000	0.0,197

Table IV: Survival of mutations (After Fisher, The Genetic Theory of Natural Selection, Clarendon, Oxford, 1930) 1)

a 1% survival value, 197 of them will survive. What is meant by a 1% survival value I do not know. But it is

1) Dobzhansky, Op. Cit. p. 130

interesting to note that even in spite of this survival value most of the mutations will be lost.

As we can see, then, the chances of survival of a mutant gene are really very slim. Indeed its only hope of survival lies in the repeated production of it by independent mutation. While it is true that the same mutation has been observed to occur several times, most mutations occur only once and would therefore in the ordinary course of events probably be lost.

Population also plays a very important part in determining the character of the individuals. It has been discovered that sharp reduction of the population entails the fixation (homozygous condition) and loss of genes. In small populations inbreeding is very common and quite close. In such a small group there is consequently little variation and little chance for selection, which is one of the things on which evolution is postulated. Since most mutations are harmful, it is likely that a harmful mutation would be most likely to occur. This would be seized upon in a small population, would get into a homozygous state, and thus bring on the degeneration and extination of the group. On the other hand, if the population is very large all gene frequencies reach an equilibrium appropriate to the conditions prevailing and there cane be little evolution. Only a population of intermediate size is at all favorable to evolution.

It is one of the postulates of the theory of natural selection that one factor that has a survival value is protective resemblance. Thus if an animal evolves a color that resembles its environment, it is less likely to be eaten by its enemies. This fact that it is able to escape being eaten is said to have a survival value, and this, it is claimed, is one step in evolution. Thus it is said that fish which are dark colored above and light colored on their underside have taken advantage of this protective resemblance. To an enemy that is below them they blend in with the lighter water above them, and to an enemy above, they blend in with the dark color of the deep water below them. Lizards are often mottled, and this is said to be a protective resemblance to their background. Andssowwe could cite literally thousands of examples of what is called protective resemblance.

Let us stop to analyze this argument. In the first place, it tacitly assumes that protective resemblance takes place in response to an environmental stimulis. The animal finds it to its advantage to resemble its environment, and through this wish manages to acquire a color that resembles its environment. No one holds such an idea of genetic mutation in response to the desire of the individual today.

Even assuming that this protective resemblance has been acquired by the organism through some chance mutation, it is generally acknowledged today that protective resemblance plays little part in the struggle for existence. McAtee after years of study of the stomach contents of North American birds came to the conclusion that protection is largely a myth. [1] He gives the number of individuals of various supposedly protected and unprotected groups which were eaten and draws the inference that all kinds are devoured about in proportion to the available numbers. It is possible to select some "protectively colored" families which were eaten less often than their number would seem to warrent, but at the same time there are other "protected" families which are eaten more often than their number would warrent. Shull says:"On the whole the results of stomach examinations are not impressive as evidence of such protection". [2]

It is also true that judgment as to whether a family is protectively colored is in a way highly subjective. By that I mean that we are judging protective coloration according to human standards. And it has become apparent in recent years that not all animals see as we do. It is a well known fact that ants are blind to red light, but that they do see ultra-violet light. It has been clearly shown that other insects are also sensitive to ultra-violet light. Thus

1) McAtee, W. Warning Colors and Mimicry, Quarterly Review of Biology, vol. 8 (2) 1933, p. 209-213 and Effectiveness in Nature of so-called Protective Adaptations, Smithsonian Institute Miscellaneous Collection, vol. 85 (7) 1932
2) Shull, Op. Cit. p. 168

an animal which we term inconspicuous could certainly not safely be regarded as protected from attack by a predacious insect.

Another factor that must be considered is the size of the object relative to the observer and the latter's field of vision. Thus a mottled lizard lying among the rocks is a very small object in a very large object as viewed by man, but to its enemy it may be a relatively large part of a small landscape.

For these reasons the argument for evolution from protective resemblance can scarcely have any meaning. Even Shull admits: "The notion has been overworked,....applied uncritically, and ....some, perhaps many, of the supposed instances of evolution guided by and leading to inconspicuousness probably are not such". 1)

Another very much overworked theory which was once thought to contribute to the problem of evolution is the theory of sexual selection. Today this has been abandoned by most biologists. It was mentioned already by Darwin. He believed that the species was originally dull in both sexes, but that individual males mutated (although he did not use this term) to somewhat brighter colors which aided them in winning the females. By repetition of such mutations and selection it was generally believed that all of the males would eventually

1) Shull, Op. Cit. p. 174

become brightly colored. This was extended not only to coloration but to any quality which might be attractive to the female such as the "horns" of the staghorn and other beetles, and the mane of the male lion. Darwin himself extended this theory to include also the weapons such as spurs, antlers, horns, and teeth, by which the males fight for the possession of the female.

Again this implies mutation in a direction desired by the individual and is open to objection for that reason. We cited the evidence before which showed that mutations in Drosophila were in no way adaptive.

There are other objections against this theory. Mayer clearly showed that odor was the guiding factor in mating in the Promethea moth. When the antennae of the males were covered with shellac, the males were prevented from finding the females. When some females were cut in two, the abdomen in one part and the wings, thorax, and head in the other part, the males came to the abdomen and not to the head and wings. When females were put in closed glass jars, the males did not find them even though they were in plain sight. Finally Mayer cut off the wings of some of the females and glued the wings of males to the stumps. Males mated with male-appearing females as frequently as with others. This experiment not only showed that sexual selection played little part in the mating process, but also that the female, who, it is postulated makes the choice, played only a passive role in the whole process.[1]

This theory also ascribes an esthetic sense to the female, which it is doubtful that she possesses. Likewise it has been discovered that sime brilliantly colored males do not display their charms by any special courtship behavior, and special coloration is therefore useless. Finally it is also true that in the case of the salamander, where the sperm is not introduced directly into the female by the male, there is no guarantee that the female mates with the male who has courted her. Most evolutionists therefore admit that this argument has been very much overstressed in years gone by.

Just the opposite of protective coloration is the phenomenon known as "warning coloration". Here animals do not attempt to blend in with their background, but they are actually so highly colored that they actually attract attention. Most of these animals, according to Poulton who is the chief advocate of this theory, are unpalatable, dangerous, or in some way protected by spines, hairs, or hardness. It pays such an animal to advertise this fact. Quick recognition of such an obnoxious species by a predatory animal saves its members many experimental or ignorant attacks. The ancestors of these brightly colored species must have originally been dull colored and have reached the present condition step by step through an accumulation of bright mutations, each of which has been recognized by the predator. Such warning coloration is to be found among bees, wasps, skunks, coral fish, all of which are objection-

1) Mayer, A. <u>On the Mating Instinct in Moths</u>, <u>Psyche</u> vol. 9 (1900):p. 15-20

able for some reason or another. The Gila monster, the only poisonous lizard,is also said to be warningly colored.

This theory is again open to the objection that it cannot be demonstated that mutations are in any way adaptive. But there are still other objections which we may offer. There are some brightly colored species whose color cannot in any way be considered as giving warning. Certain annelid worms which have been said to be warningly colored live in tubes, and in that way they have no chance to display their colors. The walking stick has an acrid taste, but it is so dull and stick-like that it is universally classified among the protectively colored animals. The Endomychidae, a family of beetles, are highly colored, but they are seldom seen, since they live in fungi. Furthermore, if the first mutations were recognized by predacious animals, further mutations would have no additional survival value. Indeed if these animals were recognized as undersirable in their original state, there would be no reason for their becoming colored at all.

Likewise there is serious doubt as to whether these warning colorations actually serve their purpose. Turning once more to McAtee's studies, we find some remarkable facts. The cinch bug, supposedly warningly colored, was eaten by 29 species of birds, three of which, in single individual birds, ate more than 100 cinch bugs at a single meal. Either the cinch bug is not disagreeable or the birds do not learn. Seventy-seven blister beetles, also said to be warningly colored, were eaten by a single kingbird in one meal. We could cite still other instances, but these will suffice to show that the theory simply falls to pieces when it is put to the test.

Because of this, other theories, such as that of immunity coloration, have taken its place. This theory has as little basis in fact as does the theory of warning coloration, and for that reason has few supporters today.

Today conspicuous color in animals is accounted for by most evolutionists on the principle of mimicry. The original proposal of mimicry, that of Bates, postulated that an edible species mimics an inedible one. A difficulty arose when it was discovered that different species of the same subfamily often resembled one another. It is generally held that all families of one sub-family are either edible or inedible. This meant that one distasteful species was mimicking another distasteful species, and this would hardly fit into the general idea. Mueller came to the rescue by suggesting that two distasteful species might economize by offering to predatory animals only one sign of distastefulness instead of two. Predators would have to learn from experience that animals having a brilliant color were not good to eat. In this process a certain number of individuals would be destroyed. If this loss could be divided between two species, it would be an advantage.

The ancestors of the mimic were supposed to have been dull colored. Gradually one of the dull ancestors acquired a certain amount of color. This color was transmitted to later generations and in time the amount of color increased. According to this theory, the resembling forms must occupy the same area. In the case of Batesain mimicry, which still has a host of supporters, there must be a difference in liability to attack, one being more protected than the other by its own qualities. The model must be more numerous in individuals than is the mimic. The mimic must have a distinctively different color or pattern from its near relatives. Finally the mimicry affects only the external characters.

This theory too is open to a number of objections. First of all, as we have said in the cases of the preceding theories, there is no evidence of mutation in response to an environmental need. Moreover in many cases there is no real knowledge that one of the species involved is protected by a disagreeable or dangerous quality. In other cases it is difficult to say from which enemies the animal is to be protected. If an animal has more th n one set of enemies, it is doubtful whether mimicry would be of the same value with all of them. We know that some animals are practically color-blind: to these brilliant colors would mean nothing. Other animals see different portions of the spectrum than those which we see. It must be admitted that the whole theory is based upon human reactions and observations.

In some cases there is doubt as to whether the resemblance is sufficient to deceive. In many cases living specimens are different from museum specimens, and it is on museum specimens that the theory is built.

Poulton describes the capture of a clearwing moth, which is supposed to be the mimic of a hornet, by a lizard which at the first trial kept away from the "stinging" end. Soon it discovered, however, that the moth was harmless and the very next time that a clearwing was offered, it recognized its nature and ate it without caution. If a single experience is all that is necessary to see through the deception, the mimicry cannot be very valuable.

Aside from birds, it is generally admitted that lizards and monkeys are the chief enemies of butterflies. Experiments by Manders have shown that lizards eat the supposedly evil tasting butterflies as readily as the palátable ones, and it would seem from the work of Poulton that ordinary deceptions of mimicry are no match for the powers of perception.

According to this theory the resemblance must have arisen by small steps under selection. At the early stages of the process, the difference between the mimic and the model were very great: yet the resemblance, slight as it was, fooled the predator. Later predatory animals are supposed to have been deceived only by those individuals most like the model - otherwise further resemblance would have had no survival value - and to have devoured all those less similar to it. In other words, the predator's powers of discrimination improved enormously as the individuals mutated toward their model. Even Shull realizes that this is one of the weaknesses of the theory and says: "It would be one of the marvels of evolution if the improvement in discrimination required should have been timed to coincide so completely with the development of some mimic". 1)

There are still other objections. First of all, mimicry involves warning coloration. There is no proof that such a phenomenon exists. Moreover sometimes the mimic is more abundant than its model. Occasionally too the mimic and the so-called model do not occupy the same region. It has been discovered that in one case one of the species of the pair is in South America and the other in Africa.

To sum up then, all four theories ‑ the theory of protective resemblance, the theory of sexual selection, the theory of warning coloration, and the theory of mimicry - are open to many of the same objections. They are all highly subjective. They assume that animals see just as we do, while as a matter of fact we know that they do not. Under ultra-violet light, wing patterns appear very much different from the manner in which they appear under natural light. For that reason to some animals some mimics do not resemble their models in any way. Moreover these theories also assume that an animal has the same taste reactions as we humans do, for it assumes that insects which have a disagreeable taste according to human standards also

---

1) Shull, Op. Cit. p. 188

have a disagreeable taste so far as the predators are concerned. We know that this is not true from the examples of the lizards cited above which devoured both palatable and unpalatable insects without any differentiation.

On this whole subject Dobzhansky says: "...the process of development of protective and warning characteristics has not been observed in a species either in the laboratory or in nature. The concealing and mimetic resemblances that we record in nature are the end products of the historic processes that have taken place and it only remains for us to infer whether their origin through natural selection is or is not probable." 1)

Another factor in evolution about which we hear a great deal is geographic isolation. It is believed that isolation of groups of individuals from one another has played an important part in the origin of species. Thus it is assumed that two groups of the same species are isolated from one another by some water barrier. Different mutations arise in the two different groups and in the course of time these two groups would become so different that they would constitute two different species. There are of course barriers other than water barriers: distance itself is a barrier.

It is generally admitted however that most species are not

---

1) Dobzhansky, Op. Cit. p. 163

completely isolated from related species. Though they do not occupy the same region, they are nevertheless not very far apart. This theory would require that related groups be incapable of interbreeding with fertility, for if the two groups interbreed, they are no longer isolated. Early proponents of this theory assumed that a gradual accumulation of different mutations would bring this about. On this point Shull says: "There is little in the ordinary facts of genetics to support the view that accumulation of differences of the kinds by which species are recognized and distinguished from one another leads to sterility.... How these single step causes of intersterility could arise any better in separated groups than in freely interbreeding populations is not clear".[1] Goldschmidt says: "The origin of species is not to be conceived of as occurring via geographic races or the members of a rassenkreis (racial circle)".[2] Even Dobzhansky says on this point:" Isolation is a conservative factor that slows down the evolutionary process....Too early an isolation of the favorable gene combinations formed in the process of race differentation would mean too extreme a specialization of the organism to the environmental conditions that may be only temporary. The end result may be extinction.........Isolation is necessary, but it must not come too early." [3]

Moreover it must always be kept in mind that mutations

1) Shull, Op. Cit. p. 230
2) Goldschmidt, Material Basis, p. 168
3) Dobzhansky, Op. Cit. p. 229

have never produced a new species. In all of the work done with Drosophila, no form that would conform to our idea of species has arisen. It is generally admitted therefore that this idea of geographical isolation has been overworked by evolutionists.

Another tremendous problem so far as evolution isnconcerned is the problem of early evolution after the beginning of life. No reputable biologist today attempts to account for the origin of life. Evolutionists prefer to leave that problem to the philosopher and to start out with life already existing. It is assumed, howevery that the first life was very minute. Whether it was cellular or not is difficult to say. However many evolutionists point to the filterable viruses which we know today as akin to the earliest forms of life. Very little is known of these forms at present. But here a difficultympresents itself. All known filterable viruses today live within other organisms, and it is impossible that the early forms of life should have done that.

Most evolutionists postulate the beginning of life in a single form, yes, in a single individual. But here too there is a diffulty. If there was only one form and it reproduced without any limits, it would soon outstip its food supply. One biologist has said:"If the earliest plants had been able to reproduce themselves unchecked, they would soon have exhausted all the food substances and would themselves have vanished. So it is probably that together with the earliest plants there appeared other organisms to feed upon them, and that these in turn were kept in check by still other forms of life.....Animal life could not have persisted on the earth had not the animals at their first appearance assumed a number of different and diverse forms".[1]) Is there any reason then why we should not assume that God created all of the species at one time?

There is another difficulty in explaining how single celled organisms became organisms made up of aggregates or colonies of cells and then changed into the metazoa, organisms made up of a large number of highly differentiated cells. Explanations for this change are purely speculative.

Finally there is no explanation for the change from the invertebrates to the vertebrates. The body plan of the vertebrates is exactly opposite that of the invertebrates (Figure IX). Invertebrates have a ventral central nervous system and a dorsal heart: vertebrates have a dorsal central nervous system and a ventral heart. This change can be accounted for only by some fantastic theory. Among those propounded has been the one according to which an invertebrate clung for millions of years to a rock facing upstream in a rapidly moving river. In the course of time the force of the current turned him inside out and he became a vertebrate. Needless to say such an explanation is impossible

---

1) Acta Biotheoretica, III, pt. 3, 1933, p. 185f

genetically. It has been demonstrated time after time that changes in response to the environment are not inherited. For this reason most evolutionists today postulate a separate beginning for vertebrates and invertebrates. Some scientists assume that vertebrate differentiation takes place at an early embryonic stage. They insist that the difference between the two must begin already in the gastrula stage of the embryo. This is of course true because at gastrulation the body plan is laid down. However they do not explain how this difference originated.

This whole system of building up new species by gradual change whether from invertebrate to vertebrate or from protozoa to metazoa is rejected by Goldschmidt in the very first pages of his book. Of this whole system to which he gives the name microevolution, he says: "This term has been used by Dobzhansky for evolutionary processes observable

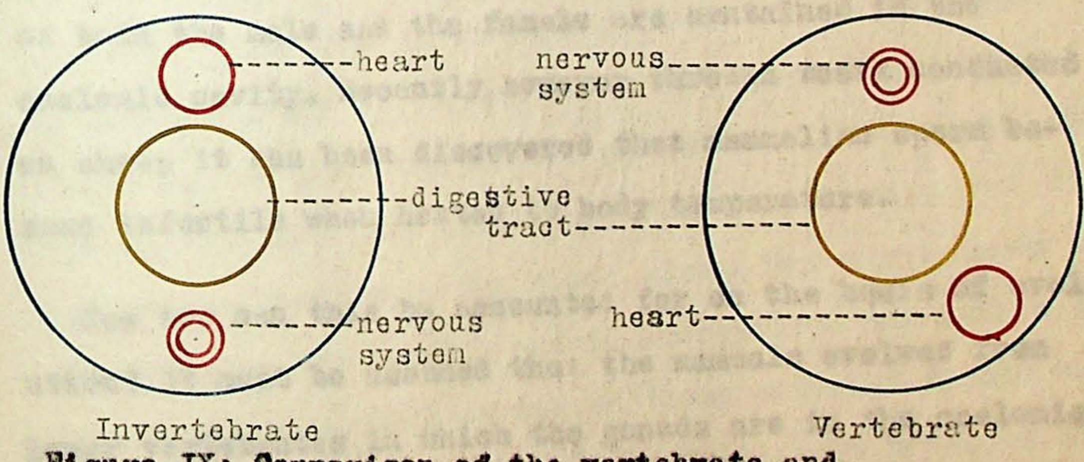

Figure IX: Comparison of the vertebrate and invertebrate body plan.

within the span of a human lifetime as opposed to macroevolution on a geological scale. It will be one of the major contentions of this booksto show that the facts of micro-evolution do not suffice for an understanding of macro-evolution. The latter term will be used here for the evolution of the good species and all higher taxonomic categories".[1)]

From a genetic viewpoint and from the viewpoint of evolution there are a number of characters which cannot be accounted for, characters which have not and cannot have arisen in the course of evolution. Some of these we discuss now in this paper.

One of the things that has puzzled anatomists for a number of years was the reason why the male gonads in mammals should be outside the body cavity. In all other animals, both vertebrates and invertebrates, the gonads of both the male and the female are contained in the coelomic cavity. Recently however through tests conducted on sheep it has been discovered that mammalian sperm become infertile when heated to body temperature.

Now how can this be accounted for on the basis of evolution? It must be assumed that the mammals evolved from lower vertebrates in which the gonads are in the coelomic cavity. It cannot be assumed that some vertebrates were evolved in which the sperm became infertile at body temperature: these animals could not have continued to propagate themselves. On the other hand it can scarcely be assumed that the first step in their evolution placed their gonads outside the body cavity: such an arrangement would have had a negative survival value, because outside the body cavity, the gonads are more liable to be injured. For that reason those animals in which this arrangement had developed would have died out because they would not have been so well equipped to survive as those in which the gonads were still within the body cavity.

Another very interesting thing which cannot be explained on an evolutionary principle is the development of blood groups in humans. When a foreign protein is injected into the blood stream of an animal, the cells of that animal produce a characteristic substance which reacts with the foreign protein and which is known as an anti-body. The foreign proten which causes the production of the anti-body is known as an antigen. One of the reactions which may take place when an antigen reacts with an anti-body is an agglutination of the cells. In the human blood stream there may be found two normal antigens and two normal anti-bodies. The antigens are to be found in the human red cells and the antibodies in the blood serum. For convenience the two antigens are named A and B. Landsteiner and others found that a person might have one of these antigens in his cells or he might have the other, or he might have both, or he might have neither. Whatever antigen a person has in his cells, the corresponding antibody is lacking in his serum. That is obvious, because the presence of both antigen and anti-body would lead to agglutination and death. When an antigen is not present in the cells, the corresponding anti-body is present. This fact is the basis for the present system of blood typing.

Now how can such a thing be explained on the basis of evolution? It is obvious that according to evolutionary theory at one time there must have been only one group. Let us assume that this group had either both antigens or both antibodies. The first change would have introduced one of the corresponding antigens or antibodies into the blood stream and death would have resulted. Or suppose that originally the blood stream contained neither antigen and neither antibody. The first step would have been the introduction of one of the antibodies or one of the antigens. But eventually the corresponding antigen or anti-body would have been introduced and death would have resulted to the individual. From a genetic standpoint it is almost inconceivable that both the blood cells and the blood serum should have changed at the same time to make the present arrangement possible. The odds against such a chance happening are almost overwhelming.

Modern investigations in physiology have disclosed complexities which make evolution impossible. Much of physiology today is concerned with hydrogen ion concentration, known as pH. It has been found that for all practical purposes hydrogen ion concentration of any liquid varies from one gram of hydrogen ions per liter to .00000000000001 grams per liter. The former is a strongly acid solution: the latter a strongly basic solution. All gradations between these two figures are to be found. A solution containing .0000001 grams of hydrogen ions per liter is neutral. In measuring hydrogen ion concentration, it has not been found convenient to deal with decimals because they are too complicated. Instead it is measured in terms of 10^{-n}. This "n" is then known as the pH of the solution. Thus a pH of 6.4 means a hydrogen ion concentration of $10^{-6.4}$. A pH of 7 is neutral.

In studying enzymatic action it has been found that pH plays a very important role. Each of the digestive enzymes has a particular pH at which it works best. This is known as its optimum. Indeed it is only within a certain range of pH that an enzyme shows its characteristic catalysis. The marvelous thing is that the pH of the various parts of the digestive system is not only within this range of activity, but it is actually equal to the optimum for that particular enzyme. Thus the pepsin of the gastric juice is active at a pH of between 1 and 3 with its optimum between 1.2 and 1.8. This means that to work most efficiently it must have an acid environment. This is exactly what it finds in the stomach: indeed the pH of the stomach is generally between 1.2 and 1.8. Similarly trypsin is active between pH 6.8 and pH 9.6while its optimum is at about 8.2. This is exactly what it finds in the pancreatic juice.

There are some cases in which the environment of an enzyme, while within the range of activity, is not always at the exact optimum pH. At first this seems somewhat disconcerting, but when we study these instances, we find that they are concerned with exactly those processes which need to be slowed down or speeded up at times. When it is necessary to speed these processes up, the pH approaches the optimum. On the other hadn when it is necessary to slow these processes down, the pH changes, moving toward those limits in which the enzyme is active.

It is almost impossible that this should have come about through evolution. Evolution assumes change from the simple to the complex. That would mean that at one time the pH of the whole digestive tract would have had to be the same. But this would have made it impossible for some of the enzymes to act. Pepsin cannot act in an alkaline environment, while pepsin cannot actiin a strongly acid environment. This then is certainly one of the processes which could not have evolved.

Another interesting thing in connection with enzymatic action is the fact that an enzyme shows its maximum effect at between 38° and 40° which is exactly body heat. Catalysis is a chemical process and is therefore subject to chemical laws. We would then expect that the higher the temperature, the more rapidly the enzyme would act. That, it has been discovered, is true. But an enzyme is also a highly unstable protein, extremely sensitive to temperature. A high temperature will cause an enzyme to disintegrate and thus to lose its effectiveness. For that reason up to a certain point increased temperature speeds up the chemical process, but above this temperature this effect is offset by the destruction of the enzyme through disintegration. In every case animal enzymes show their optimum effect at body temperature.

I shall mention just one more physiological fact which to my mind cannot be accounted for on the basis of evolution. That is the phenomenon of buffer action. We mentioned above that the body maintains a pH which is equal to that of the optimum of the particular enzyme which is to work there. To maintain this pH constantly a mechanism is necessary, for the introduction of a solution differing in pH would change the pH of the environment. This is done by means of buffers. These are substances which give off (H•) ions or (OH) ions according to the acidity or alkalinity of the solution. Thus if an acid is introduced, the buffer gives off (OH) ions to counteract this. If a base is introduced, the buffer gives off (H•) ions. In this way the body is able to maintain a constant pH. The remarkable thing is that the two buffers to be found in the blood stream, NaH_2PO_4 and H_2CO_3, require larger amounts of alkali to effect a change in the $(H^{\cdot})$ of their solutions than any other of the weak acids save H_2S. In other words the buffer substances of the blood are among the very most effective that would be found. Could this be due to chance alone?

To show how importantt the environment is and how delicate a balance is necessary, let me quote one instance cited by Dobzhansky. He says: "Environment of the spermatozoa in the reproductive organs of the female of another species may be unsuitable for them and may cause their death or at least a loss of fertilizing ability. Spermatozoa of higher animals are known to be highly sensitive to any variation in the environment, particularly to those in osmotic pressure. The spermatozoa of a duck, a goose, and a cock has been injected in the genital ducts. After 22 to 25 hours the birds were dissected and large numbers of spermatozoa were found in the upper portions of the oviducts. But while those of the duck were alive and motile, a majority of the spermatozoa of the goose and cock were already dead (Serebrovsky 1935 Hybridization of Animals Biomedgiz, Moscow-Leningrad)". 1)

It might be well at this point to comment on Goldschmidt's latest theory, a theory which is based on changes in the chromosomes. Goldschmidt rejects absolutely the present

---

1) Dobzhansky, Op. Cit. p. 246

neo-Darwinian theory: in fact he believes that it hampers progress in evolutionary thought. Goldschmidt believes briefly that evolution has come about by translocations and inversions which result in the sudden establishment of new species. He carefully distinguishes between micro-evolution, or intraspecific variation, and macroevolution, interspecific variation. As is rather obvious, we are concerned only with his macroevolution, since we readily admit that microevolution in his sense is a commonly observed phenomenon.

Perhaps a quotation from his most recent book, The Material Basis of Evolution, best sums up his approach. There he says: "Species and the higher categories originiate in single macroevolutionary steps as completely new genetic systems. The genetical process which is involved consists of a repatterning of the chromosomes which results in a new genetic system. The theory of the genes and of the accumulation of micromutants by selection has been ruled out of this picture. This new genetic system, which may evolve by successive steps of repatterning until a threshold for changed action is reached, produces a change in development which is termed a systematic mutation. Thus selection is at once provided with the material needed for quick macroevolution. The facts of development, especially those furnished by experimental embryology, show that the potentialities, the mechanics of development, permit huge changes to take place in a single step. The facts of physiological genetics and their explanation in terms of coordinated rates of processes of differentiation furnish the insight into the possibilities of macroevolution by single steps. A considerable role is assigned to such genetic changes as affect early embryonic processes and automatically entail major deviations in the entire organization. The general picture of evolution resulting from such deliberations is in harmony with the facts of taxonomy, morphology, embryology, paleontology, and the new developments of genetics. The neo-Darwinian theory of the geneticists is no longer tenable". 1)

One of the contributions of Goldschmidt's theory is that it simplifies the theory of evolution considerably. This he mentions as a point in its favor. And yet in a way it is too simple. We know that life phenomena are infinitely more complicated than those of the inorganic world; we know that a synthesis of the organic compounds making up living materials will not result in a living organism. Goldschmidt realizes that his theory is subject to this criticism, and answers by saying that life must be based on simple processes; otherwise no organisms could exist. We would answer that organisms exist insspite of the complexity of their organisation because of the hand of God behind them, but Goldschmidt refuses to admit such vitalism.

Actually much of the theory is based on deductive reason-

---

1) Goldschmidt, Material Basis, p. 396ff

ing. There is no experimental proof for the theory: no new species has been observed to develop in the manner postulated by Goldschmidt. This he admits, for he says: "Unfortunately no experimental attack on this problem is at present apparent". [1] As a result there are numerous statements in his book such as: "Unbiased synthesis of existing facts seems to favor our solution"[2]; "We may consider these facts as, at present, barely hinting that macroevolutionary steps based upon a change in relative growth might be based genetically upon systematic mutation" [3]; "We can imagine that here a model for directed genetical change has been found, combined with the possibility of large steps, the systematic mutations. We shall not indulge in further premature speculations, but I think that we are justified in having at least intimated the interesting possibilites of further advance in this direction"[4] On the evolution of man, he follows Stockard and says:"An evolution from this hominid (Sinanthropus) to Homo sapiens may therefore be conceived of as having been perfected in a single genetic step, an event which is possible on the basis of endocrine control of growth and differentiation". [5] Yet he admits inthe next sentence that "this is certainly purely speculative".

Now what is the nature and basis for Goldschmidt's argu-

---

1) Goldschmidt, Material Basis, p. 334
2) Ibid. p. 334
3) Ibid. p. 321
4) Ibid. p. 323
5) Ibid. p. 283

mentation? He has a number of avenues of approach to the problem, but I think that one example will suffice to show the general line of argumentation which he employs. He takes the interesting example of the intersexes. Intersexes result from some disturbance in the balance of the chromosomes. In these, depending on the exact genetic balance, different degrees of intersexuality affecting both primary and secondary sexual characters may be achieved. For instance, in Lymantria dispar, the male normally has a single uncus which develops from paired primordia. However in one grade of intersex these paired primordia fail to fuse resulting in paired unci. It has been found that this same result can be achieved in males with a normal genetic balance by treating them with heat, X-ray, ultraviolet ray, etc. at a certain critical period in their embryological development. Moreover it has been found that there are certain relatives of the lymantriids which normally have paired unci. These facts, Goldschmidt reasons, give us a possible explanation of the way evolution may have taken place. Some factor which temporarily disturbed the genetic balance may have developed in Lymantria. This factor, by affecting the development at the critical period, caused the double unci. Later this disturbance became stabilized and we have a new species. [1]

While we are willing to admit that something like this

1) Goldschmidt, <u>Material Basis</u>, p. 302ff

might possibly occur, though the resulting form would not be a new "kind" in the sense of Genesis 1, it is hard to conceive of its rather frequent occurrence as Goldschmidt's theory would require. The theory, as we have noted before, lacks experimental proof. Then too most disturbances of this nature affect the viability of the individual. In fact such disturbances may be lethal. The intersexes referred to above are always sterile. Goldschmidt himself realizes that there is a difficulty here, for he says: "A repatterning of chromosomes - our systematic mutation - necessarily leads at first to non-viabile groups (homozygous translocations, deficiencies, etc.). The new pattern therefore cannot survive in the population except in the absence of selection pressure against the heterozygote and under proper conditions of interbreeding. But this applies only to some of the initial steps corresponding to the simple pattern changes by so-called chromosome mutation. The fact that, for example, in Drosophila miranda a chromosomal pattern perfectly different from that in pseudoobscura is viable in homozygous condition proves that at some point in the repatterning process the constitution of a new system, viable in homozygous state, must have been accomplished (of course, provided that one pattern is evolved from another one, which can hardly be doubted). It is not known at which point this decisive condition is reached".[1] Note that he assumes evolution as a fact and that he assumes something has happened - the change from

---

1) Goldschmidt, Material Basis, p. 206f

non-viable to viable - about which he has not even the slightest shred of evidence.

Another criticism that might be raised against the theory is that frequently inversions and translocations have no effect on the phenotype or outward appearance of the species. Goldschmidt himself admits this, for he says:"...the internal chromosomal pattern may slowly change in a series of steps without any visible effect on the phenotype and without any accumulation of so-called gene mutations, small or large".[1] If Goldschmidt's theory is true, we would expect every inversion and translocation to have its effect. If not everyone has an effect, what determines which one will have an effect and which ones will not?

Still another criticism, though not necessarily such a weighty one, is that Goldschmidt tries to correlate his theory with recapitulation, the theory of Haeckel, a theory which has been all but abandoned today.

In summary then, we may say of Goldschmidt's theory that we are willingtto admit that new taxonomic species may possibly evolve in the manner postulated by Goldschmidt, But these would not be different <u>kinds</u> of animals in the sense that the word is used in Genesis. Moreover his theory would hardly account for the evolution and origin of species as that phrase is used in scientific circles today.

---

1) Goldschmidt, <u>Material Basis</u>, p. 191

Actually however the problem of evolution is too big today either to prove or disprove. There is no conclusive evidence in favor of it today, nor, on the other hand, can we say that there is conclusive scientific evidence against it. There are many things in the biological world which evolution cannot account for. On the other hand there are many things today which in our present state of knowledge appear to us to point to evolution. Perhaps someday some scientific evidence will be discovered which will disprove the theory beyond a doubt. But that day is not here yet.

In this paper I have considered some of the scientific facts which I believe militate against the theory of evolution. All of these, however, are only supporting evidences in the Christian's judgment of the theory. He refuses to accept it, not because there is scientific evidence against it, but primarily because the Bible rejects it. When God has spoken, the matter is closed. And even if there are many things which he cannot understand and explain, still he accepts God's account of the origin of thins, confident that God and the Biblical account will ultimately be vindicated, if not by scientific evidence yet to be discovered, at least in the light of eternity.

In conclusion, let me show that scientists themselves realize that the problem is far from solved in a satisfactory manner by quoting once more from two of the world's leading geneticists, Goldschmidt and Dobzhansky. Goldschmidt says: "The statement of the problem already indicates that I cannot agree with the viewpoint of the textbooks that the problem of evolution has been solved as far as the genetic basis is concerned. This viewpoint considers it as granted that the process of mutation of the units of heredity, the genes, is the starting point for evolution, and that the accumulation of gene mutations, the isolation and selection of the new variants which afterwards continue to repeat the same process over again, account for all evolutionary diversifications. This viewpoint......must take it for granted that somehow new genes are formed, as it is hardly to be assumed that man and amoeba may be connected by mutations of the same genes, though the chromosomes of some Protozoa look uncomfortably like those of the higher animals. It must further be taken for granted that all possible differences, including the most complicated adaptations, have been built up by the accumulation of such mutations. We shall try to show that this viewpoint does not suffice to explain the facts.... At this point in our discussion I may challenge the adherents of the strictly Darwinian view, which we are discussing here, to try to explain the evolution of the following features by accumulation and selection of small mutants: hair in mammals, feathers in birds, segmentation of arthropods and vertebrates, the transformationof the gill arches in phylogeny including the aortic arches, muscles, nerves, etc.; further teeth, shells of mollusks, ectoskeletons, compound eyes, blood circulation, alternation of generations, statocysts, ambulacral system of echinoderms, pedicellaria of the same, cnidocysts, poison apparatus of snakes, whalebone, and finally, primary chemical differences like hemeglobin vs hemocyanin, etc". 1)

And Dobzhansky says: "The origin of hereditary variations is, however, only a part of the mechanism of evolution. If we possessed a complete knowledge of the physiological causes producing gene mutations and chromosomal changes, as well as a knowledge of the rates with which these changes arise, there would still remain much to be learned about evolution. These variations may be compared with building materials, but the presence of an unlimited supply of materials does not in itself give assurance that a building is going to be constructed. The impact of mutations tend to increase variability. Mutations and chromosomal changes are constantly arising at a finite rate, presumably in all organisms. But in nature we do not find a single greatly variable population of living beings which becomes more and more variable as time goes on: instead the organic world is segregated into more than a million separate species, each of which possesses its own limited supply of variability which it does not share with the others. A change of the species

1) Goldschmidt, Material Basis, p. 6

from one state to the other or a differentiation of a single variable population into separate ones, the origin of the species in the strict sense of the word, constitutes a problem which is logically distinct from that of the origin of hereditary variation." 1)

1) Dobzhansky, Op. Cit. p. 119

BIBLIOGRAPHY

1. Acta Biotheorética, III, part 3 (1930)

2. An American Commentary on the Old Testament, American Baptist Publication Society, Boston, c. 1908. The Book of Genesis

3. Babcock, E.B., and J.L. Collins Does Natural Ionizing Radiation Control Rate of Mutation? Proceedings of the National Academy of Science, vol. 15 (1929)

4. Baier, Compendium Theologiae Positiva, ed. Walther.

5. Calov, Abr. Biblia Testamenti Veteris et Novi Illustrata

6. Catizone, Olga The Linkage Relations of Yellow, an Antennal Factor in Habrobracon Juglandis, University of Pittsburgh, 1938

7. Clarke, Adam The Holy Bible with a Commentary, New York, Eaton and Mains, vol. 1

8. Delitzsch, Franz A New Commentary on Genesis, Edinburg, T. and T. Clark Co., 1899

9. Dobzhansky, Theodosius Genetics and the Origin of the Species, New York, Columbia U. Press, 1937

10. Driver, S. R. The Book of Genesis, Methuen and Co., London, 1920. 11th ed.

11. Driver, Samuel Rolles, et al. The International Critical Commentary, New York, Scribners, 1910 Genesis.

12. Gesenius, William Thesaurus Philiiogicus Criticus Linguae Hebraeae et Chaldaeae Veteris Testamenti, Leipzig, 1839

13. Gesenius, William A Hebrew and English Lexicon of the Old Testament, Francis Brown et al. eds., Boston, Houghton, 1907

14. Gesenius, William A Hebrew and English Lexicon of the Old Testament including the Biblical Chaldee, Edward Robinson, ed., Boston, Houghton, 1854

15. Goldschmidt, Richard The Material Basis of Evolution, New Haven, Yale Press, 1940

16. Goldschmidt, Richard Physiological Genetics, New York, McGraw-Hill, 1938

17. Gunkel, Hermann Handkommentar zum Alten Testament:Genesis Goettingen, Vandenhoeck and Rupprecht, 1902

18. Hanson, F.B., and Heys, Florence A Possible Relation between Natural Radiation and Gene Mutations:Science, 71, (1930)

19. Jamieson, Fausset, and Brown, Critical Commentary, vol. 1

20. Keil, Carl Friedrich Biblischer Commentar über die Bücher Moses, Leipzig, Dörffling and Franke, 1878

21. Klotz, John W. Linkage Tests with Veinless, a Wing Factor in Habrobracon Juglandis, University of Pittsburgh, 1940

22. Landauer, W., and Dunn, L.C. Journal of Genetics, 23 (1930)

23. Lindstrom, E. W. A FertilenTetraploid Tomato, Journal of Heredity, 23 (1932)

24. Luther,Mattin Sämmtliche Schriften, St. Louis, Concordia,vol. 1

25. McAtee, W. L. Effectiveness in Nature of the So-Called Protective Adaptations in the Animal Kingdom, Chiefly as Illustrated by the Food Habits of the Nearctic Birds, Smithsonian Institute Miscellaneous Collection, 1932

26. McAtee, W.L. Warning Colors and Mimicry, Quarterly Review of Biology, 8 (1933)

27. Mayer, A.G. On the Mating Instinct in Moths, Psyche, 9 (1900)

28. Muller, H.J. Radiation and Genetics, American Naturalist, 64

29. Osiander, John Adam, Collegium Theologicum Systematicum

30. Peake, Arthur A Commentary on the Bible, Nelson, New York, 1919

31. Procksch, Otto Die Genesis, Deichertsche, Leipzig, 1913

32. Ramsay, F. P. An Interpretation of Genesis, Neale, New York, 1911

33. Shull, A. Franklin Evolution, McGraw Hill, New York, 1936

34. Sinnott, Edmund,and Dunn, L.C. Principles of Genetics, McGraw Hill, New Y ork, 1939

35. Snyder, Laurence The Principles of Heredity, Heath, Boston, 1935

36. Schmidt, Sebastian <u>Genesis</u>, 1697

37. Spence, Canon, ed. <u>The Pulpit Commentary</u>, Funk, New York, vol. 1

Index