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Readings on Evolution

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READINGS ON EVOLUTION

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By

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CHARLES DARWIN'S AUTOBIOGRAPHY

One of the most remarkable success stories in science is that of a naturalist who got off to a bad start in life. Charles Darwin was born in Shrewsbury, England, on February 12, 1809. He was a puny child, a sickly youth, a poor student, and in his early years appeared to be a misfit in a family of robust, energetic, intellectual people. His father once said to him, "You care for nothing but shooting, dogs, and rat-catching, and you will be a disgrace to yourself and all your family." The only qualities which during his school years promised well for the future were that he had strong and diversified tastes, much zeal for whatever interested him, and a keen pleasure in understanding any complex subject or thing. He had an inquiring mind, a curiosity about natural things, and a dedication to test and to prove scientifically what he believed.

As a boy Charles had collected shells, rocks, and fossils. At Cambridge, through the efforts of a professor of botany he became seriously interested in accumulating all sorts of specimens from nature. He showed such aptitude for cataloguing and recording what he found that it was not surprising that he was recommended as a naturalist to a British expedition of exploration on <u>The Beagle</u>.

After returning from the expedition, Darwin lived in London while he worked on the material gathered during the voyage. Shortly afterward he married Susan Wedgwood, a cousin, and they moved to an elegant country estate in Kent. Because they were both wealthy, Charles could spend his life working on his concept of the logical, evolutionary development of the living world. During the remainder of his life. Darwin was almost constantly ill. He developed a routine of working very hard for so long as his constitution allowed, then taking a brief holiday rest, then plunging again into work. During this time he published Zoology of the Voyage of the Beagle, Origin of Species, Descent of Man, for which he is mostly known, as well as numerous other works.

VOYAGE OF THE BEAGLE

by Charles Darwin

When H.M.S. Beagle slipped from her moorings in Davenport harbour on December 27, 1831, the events which were to end in the writing of Origin of Species were being set in motion. The trip of exploration to strange areas of the world made Charles Darwin, the ship's naturalist, physically sick both from anticipation and fear. He was excited by the prospect of studying plants, mammals, and birds in distant lands. It scared him to go because he was afraid of the water and knew he was subject to seasickness. In spite of his fears he set sail for a voyage that lasted nearly five years.

For his work as naturalist, Darwin was assigned as office and shop a space in the chartroom so narrow that he was forced to develop habits of order. The Beagle sailed to Cape Verde Islands, the coasts of South America, the Galapagos Islands, Tahiti, New Zealand, Australia, Tasmania, Mauritius, Ascension the Azores, and many other Pacific islands, and then home around the Cape of Good Hope. Everywhere the ship anchored, Darwin went ashore to study the plant and animal life. Not only did he collect specimens, note habits, chart distributions, and write accurate descriptions, but he also searched into the reason of things.

THE ORIGIN OF SPECIES

by Charles Darwin

When on board H.M.S. Beagle as naturalist, Charles Darwin was much struck with certain facts in the distribution of the organic beings inhabiting South America, and in the geological relations of the present to the past inhabitants of that continent. Thus was laid the first stage in the preparation of The Origin of Species. The second stage lay in London with the discovery of the law of Natural Selection in 1838 when Darwin realized that for the creation of new domestic breeds two factors were necessary: first there was a breeder or selector--and the breeder existed in Nature--and secondly the animals experimented on must have in them a tendency to vary in a desired direction. The third stage was that of accumulating masses of evidence; this lasted until 1854, when the preparation of The Origin of Species entered its fourth stage. Darwin was now committed to setting in systematic order the immense amount of evidence he had accumulated--all of it bearing upon the problem of transmutation or evolution of every from of life. On November 24, 1859, the book was published and thus ended the fifth stage; its preparation lasted, from beginning to end, a period of forty years. The first edition (1200 copies) of this book sold out on the day of publication.

The first four chapters of The Origin of Species explain the operations of artificial selection by man, and of natural selection occasioned by the struggle for existence. Chapter five presents the laws of variation and causes of modification other than natural selection. Chapters six through ten expose fully the difficulties in believing in evolution and natural selection. The closing three chapters marshal the evidence for evolution.

Darwin's concept of evolution for which he produced irrefutable evidence was: 1) Animals reproduce in much greater numbers than can possibly be supported by the environment in which they live, and more than is necessary to maintain the species. 2) As a result great numbers of individuals within each species must be destroyed. Therefore, there must be a struggle for existence and a survival of the fittest, not only among the animals of a single species but also between the many different species. 3) Animals of the same species vary in their structure; variations of structure within the same species must be inherited. Only in this way can the best structures be passed on from one generation to another. 4) During the struggle for existence, natural selection will act so that the best animals within a species will survive. By inheriting the best characteristics, surviving individuals within a species will gradually become better adapted to their

environment. This evolution within the species will in time change and give rise to a new species. Variations occur slowly but continuously.

The Origin of Species is still the book which contains the most complete demonstration that the law of evolution is true. Darwin brought forward such an immense array of facts in his book and set them down in such a logical sequence that his argument proved irresistible.

MENDELISM AND EVOLUTION

E. B. Ford

The particulate theory of evolution, known as Mendelism, is dependent on segregation, independent assortment, linkage, crossing over, and mutation. The mature germ cells, which fuse at fertilization to form the zygote, contain one member of each chromosome pair, due to a process called meiosis in which they conjugate, separate, and pass at random to opposite poles during cell division. Independent assortment has to do with the fact that two contrasted characters behave independently of each other when inherited together. Each chromosome contains many factors that will be inherited together; this is known as linkage. Linkage, however, is not always complete, for an exchange of genes may occur during the prophase of the first meiotic division. This is known as crossing-over. Mutation is the inception of a heritable variation.

A given gene will always have the same effect in the same environment. But because genes interact with the environment, the same genetic factor does not always have the same effect.

There are two distinct effects of evolution. First, that an inherited character conferring any advantage on the individual wil tend to spread through the species, since the individuals which possess it will be favoured by selection.

Secondly, that the effects of a gene, if advantageous, may be intensified owing to the tendency for those individuals to be preserved. The establishment of a harmoniously balanced gene complex, as well as the preservation or rejection of individual genes, must be regarded as a fundamental duty of evolution.

ORGANIC EVOLUTION AND THE BIBLE

Eldon J. Gardner

Organic evolution is the aspect of the broad subject that deals with changes among living organisms, both plants and animals. Charles Darwin and Alfred Russel Wallace in 1858 were the first clearly to describe the process as descent from a common ancestor with modification. The most tangible evidence for evolution has come from paleontology; fossil remains provide a pattern of the history of animals and plants on the earth.

The ultimate origin of life has been postulated to be nucleic acids, amino acids, and acetic acid; these compounds are essential to living systems, and it is possible that they represent the basic requirements for life processes. An energy source would be required to bring chemicals together and form the compounds necessary for living systems. Lightening, known to have occurred in the early stages of the earth's history, could represent that required energy source.

The position taken in this book is that the Bible is a book of religion and not a book of science. It was written long before anyone knew anything about modern science. The Bible was written by many different authors, each telling his own story and reflecting the cultural background available to

him. Scientific accomplishments, on the other hand, are based on an objective method for seeking truth. Science deals with phenomena that can be studied by the physical senses, particularly the sense of sight. These methods have proved the origin of life but have not thus far yielded any evidence concerning a creator. Science can neither prove that there is a creator nor prove that there is not a creator.

EVOLUTION

Jay M. Savage

Evolution is a vast and complex subject touching on every phase of biology, from biochemistry and cell physiology to systematics and ecology. No serious biologist today doubts the fact of evolution, the development of an entity in the course of time through a gradual sequence of changes from a simple to a complex state.

The first clear recognition and demonstration of the fact of evolution was made by Jean Baptiste Lamarck. His theory held that new structures appear because of an "inner want" of the organism and these structures are acquired in response to need and are then inherited by later generations. Darwin provided the key to evolution and persuaded the world to accept the fact of evolution. On the Origin of Species includes three aspects: the recognition of evolution as a fact; the presentation of data demonstrating the fact; and the development of a theory of how evolution took place. Research during the last thirty years by Sewall Wright has demonstrated that evolutionary forces act not on individuals but on populations.

Evolution at its simplest involves relatively minor changes in the gene pool of a particular population from one generation to the next; this is known as sequental evolution.

A second major pattern of evolution usually is the result of forces operating over a longer period of time, or divergent evolution. The elemental forces of evolution are: 1) mutation, 2) natural selection, and 3) genetic drift, or fluctuations of alleles or gene combinations. The end product of evolutionary change is establishment of organisms that function more efficiently in a certain environmental situation.

While races and species retain basic genetic characteristics that make interbreeding possible, species are generally isolated. Some species are incapable of genetic exchange because of spatial separation. Genetic isolation is illustrated in ecological, ethological, morphological, physiological, and cytological barriers.

Among the most controversial aspects of Charles Darwin's ideas on evolution was his recognition that man appeared to have evolved from other animals. The principal progress in human evolution during the last 500,000 years has been in the development of a larger and more efficient brain, the expansion of tool production and design to complex levels, and the awareneww and control by man of the environment. Correlated with the large brain size of man are his ability to reason, his fine memory, and his use of language. Apparently, bipedalism freed the hands so that tool use and construction became evolutionary possibilities in the remote ancestors of man. Of great importance with the physical changes in the history of the human

race are the changes accomplished through our cultural evolution. Our principal problem for the future is in learning to control not the environment but ourselves.

POPULATION, EVOLUTION, AND BIRTH CONTROL

Edited by Garrett Hardin

Population. More than a century and a half ago, Thomas Malthus published his essay on population, unleashing a storm of controversy which has continued unabated to this day. Malthus proposed a cybernetic scheme of population: from the vitality of nature comes the ever-present threat of population increase, but this is opposed by the limitations set by the environment. Forethought, planning, and charity are self-defeating in such a system. Malthus asserted that suffering was inevitable, simply because population had the capability of increasing more rapidly than the means of subsistence.

Evolution. Prior to the publishing of Origin of the Species numerous men of science had written down their ideas and attitudes on evolution. Why these earlier revolutionary activities had so little lasting effect is a fascinating historical question. These earlier revolutionists helped sensitize the intellectual public to the issues of the coming controversy. Even though the idea of evolution was old before 1859, Charles Darwin is given the credit for the idea of natural selection. One objection to Darwin's ideas came from Adam Sedgwick. He held that species have been constant for thousands of years and time could never change them so long as the conditions remained

constant. Change the conditions, and the old species would disappear; new species might have room to come in and flourish--by creation. This is only a small part of the controversy over Darwinism that still rages strong today. One widely held misconception is that Darwinism and evolution are synonomous.

Birth Control. No longer under a taboo, the subject of birth control can at last be freely discussed and its implications discussed. In the United States the taboo was given legal sanction by Anthony Comstock, who headed the Society for the Suppression of Vice. As a result of his activities, Congress in 1873 passed the notorious "Comstock Law" which made it a criminal offense to import, mail, or transport in interstate commerce "any article of medicine for the prevention of conception or for causing abortion." Comstockery was brought to an end in the first half of the twentieth century. Better methods of birth control were developed, and knowledge of them was disseminated by a host of courageous workers, of whom the nurse Margaret Sanger in this country and the botanist Maru Stopes in England are the most noted. Norman E. Himes, in his book Medical History of Contraception (1936), clinches the point for birth control: "Men and women have always longed for both fertility and sterility, each at its appointed time and in its chosen circumstances. This has been a universal aim, whether people have always been conscious of it or not."

EARLY EVOLUTION OF LIFE

By Richard S. Young and Cyril Ponnamperuma

The 6th century B.C. Greek philosopher, Anaximander, taught that the first animals arose from sea slime, and men from the bellies of fish. In the 19th and 20th centuries philosophers and scientists, including Arrhenius, felt that life is eternal, and is transported in the from of living spores through space from planet to planet by means of pressure exerted on them by sunlight. When these spores land on a planet suitable for life, they grow and give rise to the entire living population of that planet. This concept, known as panspermia, merely suggests how life could have originated on any given planet, ignoring any discussion of the actual origin of life. Haeckel, in 1900, stated that "the chemical properties of carbon are the sole cause of living moment, and the simplest form of living protoplasm must arise from non-living nitrogenous carbon compounds by a process of spontaneous generation."

The elements probably arose from a primordial cloud of hydrogen gas. Tremendous amounts of energy became available through condensations of the cloud and a series of reactions generated the elements. This event probably took place about 20 billion years ago or more. About five billion years ago, when the solar system was being formed, the highly reactive

elements which occur in living organisms probably existed in their reduced forms; thus carbon was present in the form of methane, nitrogen as ammonia and oxygen as water.

The products of early chemical evolution required, and had, an environment conducive to the synthesis of complex organic molecules, ultimately giving rise to living-metabolizing units. These primitive cells gradually changed the environment and further biological evolution became necessary. Thus was set into being the line of changes which created the first form of life on earth, at least two billion years ago.

THE ORIGIN OF LIFE

By John Keosian

By the twentieth century, thinking on the origin of life had developed along several main approaches: 1) Vitalism attributes the distinctive properties characteristic of living things to a super-natural "life force." 2) Special creation is the literal interpretation of the biblical story. 3) Panspermia assumes the origin of life as eternal and universal. 4) Mechanism is based on the belief that the origin, activities, and properties of life derive from natural laws. 5) Materialism applies natural laws to the explanation of the origin of life.

The first comprehensive statement of the theory of the origin of life on the earth was made by Oparin in Russia in 1936. Oparin based his contentions on the then prevalent theory of the fiery origin of the planets. According to this theory a mass of the sun's atmosphere was torn away and condensed into a planet. Carbon and many of the metals have a high vaporization point and condensed as the gases cooled and "dropped" to the center of the mass, ultimately forming the core. From the outer layers of the mass the lighter gases--hydrogen, helium, nitrogen, oxygen, argon--escaped into space and formed the stratified atmosphere. Oparin assumed that the first organic compounds were hydrocarbons which were reduced states found in

the atmosphere.

The era in which organic compounds appeared must have extended from the origin of the earth some 4.5 billion years ago until life appeared about 2.5 billion years ago.

CONCLUSION

In reading these selections on evolution, I became aware of many misconceptions I had about the word evolution itself. I believe that too many people think evolution means that man is a direct descendent of the monkey, and nothing more. This is far from the truth. I also was not aware of the wide thinking on evolution that had taken place long before Darwin's time.

In scanning the library for books and periodicals on evolution, I became aware of the vast amount of literature on every possible aspect of biology. I have been challenged to keep up my outside reading. Two subjects I would like to find out more about are the philosophy of biology and Julian Huxley's view of evolution. I would like to suggest that a course in "Readings in Biological Sciences" be added to the biology curriculum, as I think it would help biology majors to know what is happening outside the world of the textbook. Also having to do reading on one's own is a good discipline.

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