Tree of life in evolution: a discussion

Introduction

The tree of life in science describes the relationships of all life on Earth in an evolutionary context. Charles Darwin talks about envisioning evolution ; however, the book’s sole illustration is of a branched diagram that is very tree-like. The evolutionary relationships of the tree of life were refined using genetic data by the great American microbiologist Carl Woese, the discoverer of the domain Archaea and a pioneer in genetic methods in evolutionary biology.

Homology and homoplasy are two aspects of evolution. Homology is the concept where two similar structures have the same functions and they are derived through descent from a common ancestor. The two other external factors affecting genetic variation Vertically generated and horizontally acquired variation.

Vertically generated and horizontally acquired variation

Vertically generated and horizontally acquired variation are the yin and the yang of the evolutionary process. They are very important to make evolution possible. Each of them is different in evolutionary impact. Vertically generated variation is highly restricted in character, it amounts to variations on a lineage’s existing cellular themes. Whereas for horizontal transfer, it can call on the diversity of the entire biosphere and systems that have evolved under all manner of conditions, in a great variety of different cellular environments. Thus, horizontally derived variation is the major evolutionary source of true innovation in novel enzymatic pathways and novel membrane transporter.

Vertically generated variation is not very easy to manage and use. Vertically generated variation hold the key to the evolution of biological complexity and specificity.

The essence of vertically generated variation on a lineage's existing themes is the principal way in which biological specificity and cellular integration evolve. A horizontal acquisition of true novelty and a predominantly vertical generation of complexity and functional differentiation, and integration are the two forces whose interchange propels the evolution of the cell. Although horizontal transfer and vertical inheritance generally have very different evolutionary consequences, there are conditions important in the present context under which their effects copy one another, like two peas in a pod.

Horizontal gene transfer is any process which an organism incorporates genetic material from another organism without being the offspring of that organism. By comparing with vertical transfer, it occurs when an organism receives genetic material from its ancestor like its evolved parent. Most scientists have focused on vertical transfer, but there is a awareness that horizontal gene transfer is a highly significant phenomenon, and amongst single-celled organisms are the dominant form of genetic transfer. Artificial horizontal gene transfer is a form of genetic engineering.

The Cambrian explosion

The Cambrian explosion or radiation was the seemingly rapid appearance of most major groups of complex animals around 530 million years ago, as evidenced by the fossil record. This was accompanied by a major diversification of other organisms, including animals, phytoplankton, and calcimicrobes. Before about 580 million years ago, most organisms were simple, composed of individual cells occasionally organized into colonies. Over the following 70 or 80 million years the rate of evolution accelerated by an order of magnitude in terms of the extinction and origination rate of species and the diversity of life began to resemble today.

The Cambrian explosion has generated extensive scientific debate. The seemingly rapid appearance of fossils in the Primordial Strata was noted as early as the mid 19th century, and Charles Darwin saw it as one of the main objections that could be made against his theory of evolution by natural selection.

The long-running puzzlement about the appearance of the Cambrian fauna, seemingly abruptly and from nowhere, centers on three key points: whether there really was a mass diversification of complex organisms over a relatively short period of time during the early Cambrian; what might have caused such rapid evolution; and what it would imply about the origin and evolution of animals. Interpretation is difficult due to a limited supply of evidence, based mainly on an incomplete fossil record and chemical signatures left in Cambrian rocks.

The Cambrian explosion can be viewed as two waves of metazoan expansion into empty niches. Firstly, a co-evolutionary rise in diversity as animals explored niches on the Ediacaran sea floor, followed by a second expansion in the early Cambrian as they became established in the water column. The rate of diversification seen in the Cambrian phase of the explosion is unparalleled among marine animals: it affected all metazoan clades of which

Cambrian fossils have been found. Later radiations, such as those of fish in the Silurian and Devonian periods, involved fewer taxa, mainly with very similar body plans. Although the recovery from the Permian-Triassic extinction started with about as few animal species as the Cambrian explosion, the recovery produced far fewer significantly new types of animals.

Whatever triggered the early Cambrian diversification opened up an exceptionally wide range of previously-unavailable ecological niches. When these were all occupied, there was little room for such wide-ranging diversifications to occur again, because there was strong competition in all niches and incumbents usually had the advantage. If there had continued to be a wide range of empty niches, clades would be able to continue diversifying and become disparate enough for us to recognise them as different phyla when niches are filled, lineages will continue to resemble one another long after they diverge, as there is limited opportunity for them to change their life-styles and forms.

There is a similar one-time explosion in the evolution of land plants: after a cryptic history beginning about 450 million years ago, land plants underwent a uniquely rapid adaptive radiation during the Devonian period, about 400 million years ago.

Different Historical Fossil Records Of Plant And Animal Life

Plant life during the cambrian and ordovician which are the first two periods of the paleozoic era was confined to the water. Algae of immense size several hundred feet in length dominated the seas. Land plants came into existence in silurian time in the form of strange little vascular plants named the psilophytes. In the carboniferous period, imposing spore bearing trees lepidodendrids and calamites, and primitive naked seeded plants pteridosperms and cordaites reached their peak of development. The end of the paleozoic era marked the extinction of the majority of the luxuriant trees of the carboniferous coal swamps. The mesozoic era was the age of gymnosperms as evidenced by the abundance of cycads, ginkgoes and conifers. Flowering plants in the form of angiosperm rose to ascendancy toward the close of the mesozoic era and established themselves as the dominant plant group on the earth.

In animal life, many of the invertebrate groups were already highly diversified and abundant in the cambrian the first period of the paleozpic era 600 million years ago. The paleozoic era called the age of invertebrates with its multitude of nautiloids, eurtpterids and trilobites. Brachiopods with hinged valves were the commonest shellfish of the paleozoic seas. In the mesozic era, the air breathing insects and vertebrates in the shape of the widely distributed reptiles held the center of the stage. Birds and mammals became prominent in the cenozoic era and the human species arrived on the scene in the closing stages of this era.

Paleontologist study the fossil record based on boundaries between strata where one mix of fossils gives way to another. Transitional links are intermediate between major groups. Archeopteryx has features intermediate between primitive reptiles and birds. Eustheopteron is fish ancestral to amphibians. Seymoria is amphibian ancestral to reptiles. Therapsids are reptiles ancestral to mammals.

Data are understandable assuming humans and chimpanzees share a more recent commn ancestor than do humans and ducks or yeast. Biochemical evidence is generally consistent with anatomical similarity of organisms. Tortoises, lizards, sunflower trees and other unqiue plants and animals on the islands were similar to forms on the mainland of south american as they were descended from those organisms. The differences between each island group resulted from the inhabitants of each island having been isolated from each other and changing slowly and separately in response to the conditions on their own island.

Factors Affecting The Pace Of Species Evolution

The factors affecting species who had evolved significantly overtime while other species did not evolve as much are due to biological factors like point mutation and viruses infection where DNA is easily attacked and attracted by viruses. There are also one other important factor that support it. Natural selection, in the form of overproduction of offspring, constancy of numbers, struggle for existence where members of a species were constantly competing with each other in an effort to survive and only a few will live long enough to breed. There were also variation among the offspring, survival of the fittest where only the strongest will survive the tough condition. Like produce like and last but not least, the formation of new species where individuals lacking favourable characteristic are less likely to survive long enough to breed. The inheritance of one small variation will not by itself produce a new species. However, the development of a number of variations in a particular direction over many generation will gradually lead to the evolution of a new species.

Conclusion

The prokaryotes, the bacteria and archaea have the ability to transfer genetic information between unrelated organisms through Horizontal gene transfer (HGT). Recombination, gene loss, duplication, and gene creation are a few of the processes by which genes can be transferred within and between bacterial and archael species, causing variation that is not due to vertical transfer. There is emerging evidence of HGT occurring within the prokaryotes at the single and multicell level and the view is now emerging that the tree of life gives an incomplete picture of life's evolution. It was a useful tool in understanding the basic processes of evolution but cannot explain the full complexity of the situation.

Ultimately, i concluded that tree of life is correct and accurate to a certain extent but the informations obtained was not enough and completed.

REFERENCE

HTTP://shiva. msu. montana. edu/courses/mb437_537_2004_fall/docs/uprooting. pdf

HTTP://www. pnas. org/cgi/reprint/97/15/8392. pdf

Futuyma, D. J. (1998) Evolutionary Biology. 3rd edn. Sunderland, Massachusetts: Sinauer Assiociates, Inc.

Long, J. A. (1995) The Rise Of Fishes: 500 million years of evolution. Australia, Sydney: University of New South Wales Press.

Solomon, E. P, Berg, L. R & Martin D. W. (2002) Biology. 6th edn. Thomson Learning, Inc.