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Developmental Paleontology and the Reception of Darwinism

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Description

Evidence that organisms are related by common descent with modification has been obtained by paleontology, comparative anatomy, biogeography, embryology, biochemistry, molecular genetics, and other biological disciplines. The idea first emerged from observations of systematic changes in the succession of fossil remains found in a sequence of layered rocks. Such layers have a cumulative thickness of tens of kilometers that represent at least 3.5 billion years of geological time. The general sequence of fossils from bottom upward in layered rocks had been recognized before Darwin proposed that the succession of biological forms strongly implied evolution.

The farther back into the past one looked, the less the fossils resembled recent forms, the more the various lineages merged, and the broader the implications of a common ancestry. The mammalian ear and jaw offer an example in which paleontology and comparative anatomy combine to show common ancestry through transitional stages. The lower jaws of mammals contain only one bone, whereas those of reptiles have several. The other bones in the reptile jaw are homologous with bones now found in the mammalian ear. What function could these bones have had during intermediate stages? Paleontologists have discovered intermediate forms of mammal-like reptiles with a double jaw joint one composed of the bones that persist in mammalian jaws, the other consisting of bones that eventually became the hammer and anvil of the mammalian ear. Similar examples are numerous.

Cells and their Constituents

Biogeography also has contributed evidence for common descent. The diversity of life is stupendous. Approximately 250,000 species of living plants, 100,000 species of fungi, and 1.5 million species of animals and microorganisms have been described and named, and the census is far from complete. Some species, such as human beings and our companion the dog can live under a wide range of environmental conditions. Others are amazingly specialized. One species of the fungus laboulbenia grows exclusively on the rear portion of the covering wings of a single species of beetle found only in some cases of southern France. The larvae of the fly Drosophila carcinophila can develop only in specialized grooves beneath the flaps of the third pair of oral appendages of the land crab gecarcinus curricula, which is found only on certain Caribbean islands. Despite the basic biological, chemical, and physical similarities found in all living things, a diversity of life exists not only among and between species but also within every natural population. The phenomenon of diversity has had a long history of study because so many of the variations that exist in nature are visible to the eye. The fact that organisms changed during prehistoric times and that new variations are constantly evolving can be verified by paleontological records as well as by breeding experiments in the laboratory. Long after Darwin assumed that variations existed; Biologists discovered that they are caused by a change in the genetic material. That change can be a slight alteration in the sequence of the constituents of DNA (nucleotides), a larger change such as a structural alteration of a chromosome, or a complete change in the number of chromosomes. In any case, a change in the genetic material in the reproductive cells manifests itself as some kind of structural or chemical change in the offspring. The consequence of such a mutation depends upon the interaction of the mutant offspring with its environment.

It has been suggested that sexual reproduction became the dominant type of reproduction among organisms because of its inherent advantage of variability, which is the mechanism that enables a species to adjust to changing conditions. New variations are potentially present in genetic differences, but how preponderant a variation becomes in a gene pool depends upon the number of offspring the mutants or variants produce. It is possible for a genetic novelty to spread in time to all members of a population, especially if the novelty enhances the population's chances for survival in the environment in which it exists. Thus, when a species is introduced into a new habitat, it either adapts to the change by natural selection or by some other evolutionary mechanism or eventually dies off. Because each new habitat means new adaptations, habitat changes have been responsible for the millions of different kinds of species and for the heterogeneity within each species.

Biologists once depended on the light microscope to study the morphology of cells found in higher plants and

animals. The functioning of cells in unicellular and in multicellular organisms was then postulated from observation of the structure; the discovery of the chloroplasts in the cell, for example, led to the investigation of the process of photosynthesis. With the invention of the electron microscope, the fine organization of the plastids could be used for further quantitative studies of the different parts of that process.

Qualitative and Quantitative Analyses

Qualitative and quantitative analyses in biology make use of a variety of techniques and approaches to identify and estimate levels of nucleic acids, proteins, carbohydrates, and other chemical constituents of cells and tissues. Many such techniques make use of antibodies or probes that bind to specific molecules within cells and that are tagged with a chemical, commonly a fluorescent dye, a radioactive isotope, or a biological stain, thereby enabling or enhancing microscopic visualization or detection of the molecules of interest. Human biology is an interdisciplinary area of academic study that examines humans through the influences and interplay of many diverse fields such as genetics, evolution, physiology, anatomy, epidemiology, anthropology, ecology, nutrition, population genetics, and sociocultural influences. It is closely related to the biomedical sciences, biological anthropology and other biological fields tying in various aspects of human functionality. It wasn't until the 20th century when bio gerontologist, Raymond pearl, founder of the journal human biology, phrased the term human biology in a way to describe a separate subsection apart from biology.

It is also a portmanteau term that describes all biological aspects of the human body, typically using the human body as a type organism for mammalia, and in that context it is the basis for many undergraduate University degrees and modules.