Some Ancient-Greek Ideas on Evolution

David Bardell

THE theory of evolution explains the development of organisms from ancestral types over a long period of time. For most students the theory had its origin in the last century. This is a reflection of coverage of the topic in textbooks; in which, quite correctly, the work of Charles Darwin and Alfred Russel Wallace is emphasized. Contrary to much popular belief, Darwin and Wallace did not bring into existence the idea of biological evolution. Textbooks generally point out this fact and note that earlier in the 19th century Lamarck had strongly advocated evolution of organisms. The mechanism of evolution propounded by Lamarck was quickly recognized as being unlikely, whereas that put forth by Darwin and Wallace was plausible. In addition, Darwin and Wallace presented much more evidence to support their explanation of evolution than Lamarck did. Consequently, Darwin and Wallace are considered to be the founders of the modern theory of evolution. Furthermore, although other explanations of the mechanism of evolution have since been proposed; that of Darwin and Wallace, based on natural selection of variants of a species, has best stood the test of time.

Actually the concept of evolution goes back to before the 19th century. For example, in the 18th century Erasmus Darwin, the grandfather of Charles Darwin, wrote that he did not believe that species of animals living on Earth at that time had remained unchanged since the time of their creation. He argued that species would change over long stretches of time. His views on the subject were published in his *Zoonomia, or the Laws of Organic Life.*

There is enormous diversity in the biological and nonbiological world. Be that as it may, all things, whether living or nonliving, are made up of the same chemical elements. The theory of chemical evolution was proposed in the 1920s by a Russian biochemist named Oparin and by Haldane, a British biologist. According to their theory, life developed from nonliving sources by a series of spontaneous chemical reactions in the atmosphere and oceans early in the Earth's history. These reactions do not occur under chemical and physical conditions found on Earth today, but it was postulated that they could have done so under the kinds of conditions that existed on Earth billions of years ago. Two American scientists, Miller and Urey, provided the first experimental evidence in support of chemical evolution. In 1953, they subjected certain chemical elements and simple inorganic compounds that existed in great abundance on the primitive Earth to energy from simulated lightning, and found that amino acids and some other organic compounds were formed. Subsequently, other investigators confirmed and expanded these studies. Among the others is Melvin Calvin, best known for his Nobel prize-winning research on photosynthesis, but who has also made major contributions to chemical evolution.

All known human cultures, primitive as well as advanced, have developed explanations for the origin of the world, human beings and other organisms. Virtually all of the explanations are based on supernatural phenomena. This reflects the great difficulty posed by trying to explain a natural origin for the Earth and its numerous forms of life.

Like other cultures, the ancient Greeks gave their attention to the origin of the world and life. It was generally believed that supernatural beings created everything that existed. For example, Prometheus created man from clay. Then Prometheus stole fire from heaven and gave it to man to make life easier for him. Zeus, the supreme god, punished Prometheus for giving man fire. Since fire would greatly benefit man, Zeus counterbalanced it by bringing about the creation of woman to trouble man (Harvey 1966). The foregoing notwithstanding, some ancient Greeks tried to explain the origin of human beings and other forms of life as a consequence of natural happenings.

Although he had no concept of chemical elements as we know them today, Thales (ca. 640–546 B.C.) proposed that all things, living as well as nonliving, were ultimately made up of just one basic substance. The writings of Thales have not survived, but it is known from Aristotle that Thales believed water was the fundamental building block of matter (Aristotle 4th century B.C.). There was a reason for that belief, since Thales knew that water could exist in more than one form. For example, when heated, liquid water changes into steam, the gaseous form of water. Concerning organisms and the basic substance, water was known to be essential for all forms of life, a good reason to believe that it was the elemental substance of living things. Thales asserted that water was not

David Bardell is Professor of Biology at Kean College of New Jersey, Union, NJ 07083-9982.

only the basic substance out of which everything was made, but also into which everything decayed, and so became available for reuse. Thus, the basic substance was neither created nor destroyed, but used over and over again, just as we now know is the case with the chemical elements.

Others thought along similar lines to Thales. Anaximenes (6th century B.C.) thought that air was the elemental material out of which all things are made (Aristotle 4th century B.C.). By either condensation or rarefaction, air gave rise to other forms of matter. For example, water appears when air is condensed. Anaximenes believed that different degrees of condensation or rarefaction of air produced the different kinds of matter that existed in the living and nonliving world.

Empedocles (ca. 492 – ca. 432 B.C.), unlike Thales and Anaximenes, thought there was more than one elemental material. He believed that the world was composed of four basic substances: water, air, earth and fire (Aristotle 4th century B.C.). He was of the opinion that these four substances combined in various proportions to make up all the things that existed in the world. Existing things, in turn decayed, whereupon the four basic substances separated and could then recombine to make up other objects. According to Empedocles, two natural forces brought about interactions between the elemental substances, a force of attraction and another of repulsion.

Not all of the ancient Greek philosophers and scientists sought to explain the world in known entities such as water, air, earth and fire. Democritus (ca. 460 – ca. 370 B.C.) asserted that the world consisted of atoms and void, the latter being the space between atoms that were not in contact with other atoms (Kerferd 1971). He argued that atoms were invisible, also that they were indivisible and could neither be created nor destroyed. There was more than one kind of atom, and they differed from one another in shape and size. The numerous different things in the world, living or otherwise, were the result of different combinations of atoms. It was Democritus who coined the name *atom*, which is still used in modern science for the basic unit of the chemical elements.

Another philosopher and scientist, Anaximander (ca. 611 – ca. 547 B.C.), a younger contemporary of Thales, also sought the basis of the world in a fundamental substance other than substances recognized at that time (Harvey 1966). He called the unrecognizable substance *indefinite*, since it was not a definite material like Thales' water. He believed the world was formed from a mist of indefinite. The indefinite at the center of the mist solidified, thus giving rise to the physical structure of the world. With respect to evolution, Anaximander went further than other scholars of the time. He did not just argue that living and nonliving things were ultimately composed of the same basic substance, but also argued that life had arisen from the nonliving world. He believed that living creatures had originally been generated in primeval mud by the heat of the sun.

This idea of the origin of life should not be confused with the now disproven concept of spontaneous generation, by which living things are always arising from lifeless materials; for example, fishes from mud at the bottom of rivers and maggots from decomposing meat. Anaximander spoke of the origin of life in primeval mud, or mud of the earliest ages, and not mud of his own time. In this argument by Anaximander one can see a rudimentary form of the theory of chemical evolution proposed 2500 years later by Oparin and Haldane.

Anaximander also gave his attention to the origin of human beings. He believed they had their origin in fish (Anaximander 6th century B.C.). Although his belief that human beings came directly from fish in human form is far from what is now known about this subject; the origin of human beings can be traced back via mammals to reptiles, then from reptiles to amphibians, and from amphibians to fishes.

Empedocles is another person who considered the origin and evolution of organisms. He thought that

parts of organisms came into existence first. Then individual parts, like eyes and limbs, came together to form complete organisms. The concept also explained why there is diversity among organisms. Since mingling of parts was by chance, and not in an orderly manner, the coming together of parts in different ways produced different organisms. Although Empedocles' ideas appear to be of a vivid imagination, and are perhaps no more credible than the reasons asserted for creation of life by supernatural means, he put forth an interesting argument (Empedocles 5th century B.C.), that was commented on by Aristotle:

> *And so with all other organs that seem to embody a purpose. In cases where a coincidence brought about such a combination as might have been arranged on purpose, the creatures, it is urged, having been suitably formed by the operation of chance, survived; otherwise they perished, and still perish.*

This argument is suggestive of natural selection, the mechanism of evolution whereby nature selects for survival those organisms that are best fitted to their environment. According to Empedocles, creatures that happened to be compounded in a suitable way would survive, whereas those unfortunate in the way they were made would perish. The survivors, which owe their existence to nothing more than chance because of their ability to survive, look as if they were made on purpose rather than by a haphazard course of events. One of the claims still being made for supernatural creation of life is that since organisms fit so well into their environment, they must have been created on purpose.

Aristotle (384–322 B.C.), as noted above, discussed the ideas of Empedocles, and more than 2000 years later Charles Darwin commented on some of this discussion to support his theory of evolution by natural selection. Darwin's *The Origin of Species* starts with a chapter titled, "An Historical Sketch of the Progress of Opinion on the Origin of Species, Previously to the Publication of the First Edition of this Work."

Speaking of Aristotle's remarks on an idea of Empedocles, Darwin said:

> *We here see the principle of natural selection shadowed forth, but how little Aristotle fully comprehended the principle, is shown by his remarks on the formation of the teeth* (Darwin 1859).

Unlike Darwin, Aristotle opposed the ideas of Empedocles. With respect to the above quotation, Aristotle could not accept that incisors, which are shaped for cutting, and molars, which are shaped for grinding, owed their characteristics to chance. He believed the different kinds of teeth had been purposefully shaped in order to fulfill their different functions.

Although the ideas of the ancient Greek philosophers and scientists discussed herein may appear naive and sometimes fanciful, especially in view of modern knowledge, these scholars showed remarkable wisdom in seeking natural causes rather than accepting well-entrenched beliefs in a supernatural origin for the world and its life-forms. In doing so, they had no antecedent knowledge to draw on, and thus took the first steps in developing the subject of evolution.

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