Chapter One Patterns of Change

A Paradox: The mammal specie which has the most capable adults, is the mammal specie which has the most helpless babies.

Evolution is another paradox. A mixture of ancient and modern, fact and fiction, which purports to explain the past and predict the future.

Yet, in an ever changing universe, as the past becomes the future, the totality of previous environments becomes an amorphous mosaic -- to mock and mystify the present.

The comprehensive nature of evolution requires the acceptance that all past events and relationships were part of one totality. This creates mystery and frustration for the scientist, but it also provides a marvellous discipline.

In this regard, any theory which seeks to describe the evolutionary process of any aspect of the Universe, must fit the facts -- totally. If it fits some facts, but not all - then it's wrong. This is the joy of evolution, as a scientific discipline, for it means that false hypotheses can be quickly tested and eliminated.

Evolutionary theory should be based upon facts. However, in terms of Philosophy, no factual concept can be proved absolutely. In this context, facts are phenomena which can only be measured in relation to other facts. As a result, if the datum facts are false, all facts which relate to them will be equally false.

Scientific Facts

Scientists accept this philosophic position. In practice, evolutionary theory is based upon scientific facts. These facts are phenomena which scientists have measured, tested and defined according to internationally agreed verification procedures. Such facts are accepted as true facts - until proved false.

An example may illustrate the nature of scientific facts.

In 1911, a physicist named Einstein predicted that a ray of light, which grazed the Sun, would be bent by gravity through 0.83 seconds of arc. In 1917, he revised this figure, and predicted a deflection of 1.7 seconds of arc. This prediction was duly confirmed by an astronomer named Eddington, in 1919. (See Chapter 11 post).

This discovery creates a potential problem for scientists who are researching into the evolution of the stars and galaxies. This is because over 99% of all the stars in the detectable Universe, are partially or totally obscured from the Earth, by the 1% of the stars which lie directly between them and the Earth. As a result, most of the light from most of the stars in the Universe, is bent by stellar gravity.
This means that the observed position of the stars is not the true position, and nobody can be sure whether a distant star's light has been bent upwards, downwards or side wards. However, scientists can get round this problem by referring to the isotropic nature of the Universe, which allows them to assume that all such errors are self-compensating.

This is the nature of evolutionary facts. Scientists have to deal with past events, where time and distance make truly accurate assessment relatively impossible.

Human evolution involved genetic, sociological, psychological, cultural and technological relationships. To put these in perspective, a knowledge of the current scientific conventions on Universal Evolution, and Ecology is desirable. The former concerns time and distance, while the latter involves current interrelationships.

The remainder of this chapter will relate the basic elements of Universal Evolution, while Chapter Two relates the essence of Ecological Evolution.

Evolution of the Universe

The mainstream scientific convention on the creation of the Universe centres on the Big Bang theory. This evolutionary theory is based relativity theory, coupled with facts determined by Astronomers and Particle-physicists. It holds that the Universe was originally concentrated into a small primeval particle, which exploded about 18 billion years ago. Most of the basic elements of the Universe were created within the first few seconds following this explosion.

In the first hundredth of a second of universal existence, the temperature was a 100 billion degrees Kelvin, and primitive particles were expanding into an enormous fireball.These particles comprised electrons, positrons, photons, neutrinos and antineutrinos. The density of the fireball, at this point of tine, was about 4 billion times that of water.

After about one tenth of a second, the temperature had dropped to 30 billion degrees, and the density of the fireball was 380,000 times that of water,

By the time the Universe was 14.5 seconds old, the electrons and positrons were in the process of destroying each other; and the nuclei of deuterium (heavy hydrogen), were beginning to form. At this point, the temperature had dropped to 3 billion degrees.

When the Universe was three minutes old, tritium and helium nuclei started to form as the temperature dropped to a billion degrees.

About 700,000 years later, the Universe had become sufficiently cool for stable atoms to form. These comprised mainly hydrogen and helium, which began to form stars and galaxies.

The Pattern of Change

Although this theory is very dependent upon certain frames of reference, and interpretations of data, the pattern of change should be noted. Thus, the interaction and relationship of time and distance; heat and pressure and variation and extinction, are at the centre of most evolutionary changes. They will be perceived throughout this book.

Evolution of Galaxies

After the primary evolution of the early Universe, the simplest free atoms, namely: hydrogen, helium and tritium, started to form stars and galaxies.

There are many different types of galaxies, and most of them are themselves part of huge, spherical clusters of galaxies. The individual galaxies are generally either spherical, ellipsoid or disc-shaped.

The mainstream conventions on the evolution of the common disc galaxies, like our own Milky Way galaxy, theorise that the galaxies originally formed into a spherical shell. This galactic shell of stars formed on the outer surface of the galactic cloud , because the outer periphery was cooler than the more central parts of the proto-galaxy.

It is unlikely that the proto-galactic cloud was a perfect sphere at its birth, although gravitational pressure would tend to encourage spherical development. The influence of gravity upon the shape of the galactic cloud, would tend to lead to a concentration of stars at the spheric anomalies. This could result in the formation of globular clusters.

The stars and globular clusters of stars, which formed at that time, are classified by Astronomers as Population II stars. These stars are considered to be much older than the Population I stars, which are found in the main disc of the galaxy. In time, the more massive of these older, Population II stars, exploded to form novas, or supernovas. At least half of the matter produced by these stellar explosions would be ejected into the galactic cloud.

A characteristic of the Population II stars is the production of relatively heavy elements, which are produced by the rapid rate of nuclear reactions within the stellar cores. As a result, the galactic cloud would accumulate relatively large quantities of the heavier elements. This explains why the more recently formed Population I stars, feature a much higher heavy element content than their older predecessors.

The isotropic nature of the Universe applies to the distribution of matter, as well as its dynamic movement. Thus, although the general movement of galaxies is away from the site of the Big Bang, individual stars within the galaxies, can move in any direction.

The initiation of such stellar movement may have been the impact of gravitational pressure on the non-spheroid anomalies of the proto-galactic clouds.

In this regard, where the distribution of the stars within a galaxy was even, the dynamic movement of the stars would be isotropic. As a result, the galaxy would remain spherical.

However, where the distribution of the stars was irregular, the dynamic movement of the stars within the galaxy, would vary according to their distribution and mass. In this context, if there was a preponderance of stars moving in any particular direction, this could lead to the creation of galactic spin along the plane of that direction. This could create a disc-type of galaxy.

Galactic evolution shows the element of chance in the determination of long term developments. It also illustrates how anomalies, within an isotropic environment, can lead to the development of long term structural changes. In this regard, it should be noted how the pattern of change is reinforced and maintained, by early evolutionary developments.

Stars are classified by Astronomers and Astrophysicists according to their luminosity and colour, on the Hertzbrung-Russell diagram. In this context, the brightest stars are perceived of as blue/white in colour. They are relatively massive, young stars, which eventually explode - as novas, or supernovas. The next brightest stars are the yellow/white stars of the main sequence, like our Sun.

The third brightest of the white coloured stars are known as White Dwarfs. These are the nearly extinct remains of yellow/white stars. The other stars appear red in colour, and comprise either Red Giants, or Red Dwarfs. The former are main sequence stars, prior to becoming White Dwarfs; while the latter are main sequence stars of low luminosity.

Evolution of Stars

Stars are created within a cloud of gas and dust, known as a nebula. As nebulae are too opaque to be examined by optical telescopes stellar formation cannot be visually observed. However, nebulae are transparent to millimetre and infrared waves. Therefore Astrophysicists, equipped with proper receiving aerials, can gather all the data they need to determine the basic processes involved in stellar evolution.

The current mainstream conventions on stellar formation, have been generated mainly through the use of sophisticated computer programmes and processors. According to these studies, the most idealised model - which involves a perfectly spherical, proto-stellar cloud, would develop in the manner described below.

Initially, as part of a nebula gas and dust cloud, the proto-stellar cloud would be transparent to light, and would be heated by the light of neighbouring stars. In addition, any dust in the cloud, would reflect any infrared light which penetrated the cloud.

However, when gravity compressed the proto-stellar cloud, it would become opaque to light, and thus lose this source of heat. Eventually, gravity also overcame the thermally produced internal pressure, and the proto-stellar cloud contracted.

The infrared radiation produced by the reflecting dust within the cloud, slowed the rate of contraction, but eventually the proto-stellar cloud was compressed to such a degree that it also became opaque to infrared radiation.

The consequent reduction in thermal pressure led to the collapse of the proto-stellar cloud, as gravity compressed it still further. Eventually, the heat generated by gravitational compression was sufficient to overcome the pressure of gravity, and the contraction temporarily ceased.

This resulted in a region known as the first core, which measured about 930 million miles in diameter. At this point, the temperature was about 100 degrees Kelvin, (i.e. well below the freezing point of water).

The remaining matter outside this first core, continued the process, under the influence of gravity, and added to the first core. However, the latter's size remained the same, although its temperature and density, rose and fell with each inflow of new matter from outside the core.

Eventually, the temperature of the first core rose to a about 2,000 degrees Kelvin, and at this point the diatomic hydrogen atoms disassociated into single atoms of hydrogen.

In this context, because hydrogen absorbs energy as it disassociates, the temperature of the core dropped, and gravity began to compress the core still further. The second dynamic collapse continued until the temperature reached about 100,000 degrees Kelvin. At this point, the thermal pressure was once again able to equalise the pressure of gravity.

This second core initially only contained a small fraction of the proto-stellar cloud, and was only a few times the size of the Sun. The remainder of the cloud continued to fall inwards under gravitational pressure, and entered the second core.

When the second core was largely complete, the remaining proto-stellar cloud collapsed around it -- and the proto-star entered the main sequence of stellar evolution.

In this idealised model, the process of collapse takes about 100,000 years.

Most proto-stellar clouds would have some element of initial spin, and most would be asymmetric - in terms of the distribution of matter within the cloud. These influences change the resultant development of the first and second core stages of proto-stellar evolution. The influence of spin causes a cloud to flatten out, and produce a doughnut-shaped first core. This may evolve into two second cores, producing the binary star systems which are typical of the majority of stars in the Universe.

Asymmetric influences, coupled with spin, may similarly produce binary stars; or may produce several stars from one single proto-stellar cloud. However, if an asymmetric cloud spins very slowly, the second core will become elongated, but will not divide. The result will be a single star with a spiral disc of stellar material surrounding the star. This could have been the process which led to our own Sun, and its planetary system.

Most stars, are about the size of the Sun. When they have converted their hydrogen atoms into helium, their thermonuclear energy is reduced, with the result that gravity causes the helium to collapse inwards.

This gravitational pressure leads to an increase in temperature, which results in more hydrogen burning in the outer shell of the star. This causes the shell to expand, resulting in a star known as a Red Giant. The star's heat gradually dissipates into space, whereupon the pressure of gravity causes another collapse. This results in a star known as a White Dwarf

Very large stars, about ten times the size of the Sun, go through the same stages. However, because of their larger mass, their temperature is higher, and the rate of hydrogen depletion is quicker. They too become Red Giants, but because they are so massive the hydrogen shell is large enough to cause a secondary collapse.

This leads to the conversion of helium into carbon. This process continues with the successive development of heavier atoms, until the reactions cease with the formation of iron.

Iron fusion reactions take energy in, instead of giving it out, and this results in a drop of thermal pressure, which leads to gravitational collapse. The result, is either a nova or a supernova, depending upon the mass of the star. The remaining core may become a pulsar.

The Pattern of Change

Stellar evolution, demonstrates the powerful interplay of thermal and gravitational pressures, coupled with the energy variations which come from atomic fusion, and disassociation. Pressure, collapse, stasis, reversals and oscillation are all part of the process of stellar evolution; and all are important elements in the pattern of change.

Evolution of Planets

The Cold Gas Disc Theory, which comprises the present scientific convention on the formation of the Sun's planetary system, dovetails fairly neatly into the conventions on stellar evolution. Both imply that the planets would form from the residue of the proto-stellar cloud. However, according to the disc theory, the proto-planets were originally formed from a series of rings, which developed around the newly formed Sun.

Under gravitational pressure, the gas and dust coalesced to form the planets, and their moons. Although none of the planets was massive enough to develop thermonuclear reactions they all would have undergone a degree of internal heating, which would result in the heavier elements sinking into the core of each planet. The current theory suggests that the Sun's solar wind would tend to evaporate the lighter elements on the surface of those planets which were closest to the Sun. As a result, the terrestrial planets of Mercury, Venus, Earth and Mars, are much more dense than the outer planets.

The planets are considered composite in nature - made up of aggregates of smaller bodies. In this regard, some of the lighter elements which were formed upon the surfaces of the internalised aggregates would be buried within the main body of the resultant planet. This material would be gradually transferred, by internal convection currents, to the outer surfaces of the planet to form volcanoes etc.

The long term evolution of the planets and their moons, would be dependent upon their mass, and surface-to-volume ratios; and their distance from the Sun. In this context, a relatively high mass-to-volume ratio would imply a substantial magnetic field, which could have a proportionate influence on the growth of a planetary atmosphere.

The Pattern of Change

In the context of general evolution, the development of the planets introduces greater complexity - with surface-to-volume ratios, aggregates, and convection currents. But the pattern of change is maintained and reinforced.

Thus: gravity, pressure, heat, dynamics, variation and stasis.

Evolution of the Biosphere

The mainstream scientific conventions, on the Earth's biospheric evolution, start with its formation as a planet: in accordance with the Cold Gas Disc Theory.

This convention holds that the Earth was initially heated by gravitational pressure, and the resultant degassing of the lighter elements produced a relatively heavy atmosphere consisting of water vapour mixed with ammonia, methane, and carbon monoxide.

As the Earth was reduced in volume, due to gravitational pressure, its surface solidified to form oceanic, and continental crusts. These combined with the upper part of the mantle to form the lithosphere, which is generally composed of crystallised rock. The solid lithosphere floats upon a semisolid layer called the asthenosphere, which moves slowly around under the influence of convection currents caused by the dissipation of heat from the Earth's interior.

As the asthenosphere is only semisolid, it can move in a gradual, elastic manner. By contrast, the solid lithosphere can move only by shearing its crystalline formations of rock. This results in earthquakes and volcanic eruptions.

The continental crust lies on a series of independent continental plates, which may divide or combine, depending on the movements of the asthenosphere below. When they divide, a oceanic crust is formed, as molten lava comes up from the base of the lithosphere to fill the gap created by the divide.

When the plates collide, they may either cause surface folding - as in the case of the Himalayas, or they may overlap to produce an oceanic trench, coupled with surface folding on the overlapping plate.

The development of the Earth's magnetic field, which is due to the iron core of the planet, provided an important shield against the solar wind produced by the Sun. In addition, it acted as a barrier to prevent the total dissipation of the Earth's atmosphere. As a result, the upper regions of the atmosphere have shielded the surface of the Earth from the ultraviolet rays, cosmic rays and meteorites, which could otherwise have destroyed the biosphere.

Another vital element in the development of the biosphere, has been the carbon-carbon cycle, which has stabilised the Earth's atmospheric conditions, in terms of both temperature and gaseous composition.

It can be perceived that a combination of a great many factors have provided the basis for the development of life on Earth.

Early Life

One of the early life forms was anaerobic bacteria, which consumed methane gas and produced oxygen as a waste product. Over billions of years, these creatures interacted with the atomic and chemical agents of evolution creating an environment which was suitable for the establishment of plant life.

The plants developed the ability to convert the Sun's light into chemical energy which could be stored as starch, or sugar. This created the environment required for the evolution of relatively large terrestrial animals.

As the evolutionary process continued, it became more and more complex. This was due to structural and chemical variations involved in the developing life forms. In addition, plant and animal interrelationships created an enormous range of organic and behavioural variables.

However, the basic universal forces shaped and developed the evolution of life in a similar way to the evolution of the planets, stars and galaxies.

The Pattern of Change

In this regard, the most important elements of the pattern of change, namely: gravity, pressure, heat, surface-to-volume ratios, variation and extinction, are clearly discernible in all aspects of evolution.