

ORIGIN OF LIFE: TERRESTRIAL OR COSMIC?

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Of the unsolved questions that have intrigued mankind one of the foremost has been how life originated on our planet, Earth. Was it the work of an external agency, an all powerful God? Or did it arise as a consequence of the actions of natural processes on the earth itself? The latter view is favoured by most scientists.

But not surprisingly in this age of science fiction, of UFO's and anticipated visitors from outer space a third view has captured the imagination of the mass media. This is the view proposed by Arrhenius in 1907 that has recently been extended by Fred Hoyle and Chandra Wickremasinghe, that life travelled to our earth from outer space not once, but almost continuously.

With their hypothesis they claim not only to have solved the riddle of the origin of life on earth, but also to have explained the processes of evolution itself and the occurrence of epidemics of disease. This has to be the work of genius and is an achievement that should make us Sri Lankans, very proud-if it is indeed true. We are sure that these two eminent professors would be the first to accept that a theory with such momentous implications should stand the test of the most searching scientific investigation, questioning and criticism.

It is in this spirit that an attempt is being made in this article to properly pose some pertinent questions and doubts that were unfortunately rather brusquely brushed aside without proper answers when they were first raised by us during the much publicised inaugural seminar of the Institute of Fundamental Studies held at the B.M.I.C.H. in December 1982.

First, let us see what it is that they are seeking to debunk and discard through their theory. It is a whole body of scientific knowledge and concepts that has been painstakingly built up over the years and that has stood the test of time and rigorous scientific verification, and which has provided logical answers to major questions and permitted the advance of mankind.

Once the idea of spontaneous generation of mice, maggots and microbes had been laid to rest by the simple, but elegant and brilliant experiments of

Redi, Spallanzani and Pasteur, the infinite regress of chick and egg led to the obvious conclusion that some primordial organism had produced the myriad living organisms we see today by an elaborate evolutionary process. This view is strongly backed by the fact that all life is composed of the same or very similar organic chemical molecules like DNA, RNA, proteins, sugars and fats and also by the fact that they have similar metabolic processes going on inside them. These processes and the bodily structures show an increase in complexity from lowly organisms to the higher animals and plants. This ordered progression is also seen in the palaeontological evidence where the layers of the earth's crust show fossils of simpler animals deeper down while the more advanced forms are found only in the upper layers. Therefore, life must have had an origin at a single point of time in a primordial organism in the distant past and then evolved very gradually to give all the present day organisms. The ideas about organic evolution have come from very early Greek, if not earlier, times but got scientific credibility only with the Theory of Evolution through Natural Selection as advanced by Darwin and Wallace in 1858.

The scientific theory of the origin of life is about sixty years old. The most logical, scientific and satisfying theory of the origin of life on the earth was put forward by the Russian biologist A.I. Oparin in 1924. Independent of him, the British mathematician turned experimental biochemist, J. B. S. Haldane, came to a similar conclusion a little later. Both Oparin and Haldane contended that through a long process of *chemical evolution* life came into being *on this earth itself* through random stochastic processes. The origin of the earth is now accepted as being about 4.6 billion years ago, and life originated perhaps about 2 to 3 billion years ago.

Miller's Experiments

The first attempts to experimentally prove that the complex organic chemical molecules like proteins, carbohydrates, fats, RNA and DNA can be synthesized from simpler chemicals were carried out by Stanley Miller in the United States in 1952 under the supervision of Urey. He exposed a mixture of simple chemicals like hydrogen, ammonia and methane to electric discharges inside a flask and detected the presence of a few simple amino acids in the flask. Amino acids are the basic building blocks of proteins. This work has since then been repeated with the advanced technology available today and extended by Oro, Florkin, Carl Sagan and our own Cyril Ponnampereuma, who successfully produced more complex molecules like dinucleotides, Ribose sugars and ATP molecules in the laboratory from simpler substances like methane and formaldehyde under the influence of ultraviolet light over only a few months of experimentation. (Ultraviolet light was used in these experiments because it is fairly well established that the early

atmosphere of the earth was devoid of oxygen and the protective ozone layers which thereby permitted such activity). In this manner a considerable body of evidence has been gathered in support of an *abiogenic origin of life* on the earth itself.

Panspermia

As opposed to this theory the cosmic origin of life was first proposed by the Swedish chemist Svante Arrhenius in 1907 in the form of his *Panspermia* theory. He advocated the idea that sperms or spores (Hoyle and Wickremasinghe's bacteria) came from outer space (and as suggested by Lord Kelvin were driven by the pressure of light) and seeded the earth with life. The leading biologists of that time, in particular Donan in 1929, severely criticized this view, pointing out that life cannot be supported and multiplied in space due to the inhospitable and rigorous conditions existing out there and that in any case the question of how life began was pushed out into a realm outside the ken of man, and beyond experimental verification. This latter point, he stressed, made the panspermia theory most illogical, unscientific and dubious.

Bacteria in Space

Hoyle and Wickremasinghe have not only resuscitated this almost dead theory, but they have extended it also to explain the processes of organic evolution by hypothesising that microbes visit the earth even now producing new mutations and they use the sudden appearances of epidemics of disease as proof in support of this notion. They base their arguments in support of a cosmic origin of life on this earth and a cosmic control of evolution, on three main points. The first, is based on two experimental findings quoted by them which they interpret to mean that there is life, at least in the form of bacteria, in interstellar dust. The second, is the outbreak of occasional epidemics of human diseases almost simultaneously, at different places on the earth, which they say go to prove that pathogens come from outer space. The third, is a purely theoretical deduction that statistical chance alone is not sufficient for chemical evolution to have produced complex protein molecules from amino acids in a matter of 700 million years which they believe was the time available for such an occurrence. We shall take each "point" and try to find out whether such arguments are plausible and valid.

Case against bacteria

Their idea of bacteria in outer space comes from infra-red and UV analyses of the proportions of elements present in interstellar dust. The absorption spectra curve for interstellar dust which they produce as evidence appears to tally closely with the curve obtained from similar analyses of bacteria on earth (even from the Kelani Ganga)—and they claim with no other system.

We find it difficult to accept this concept for the following reasons. First, we are not told how many times this has been corroborated by reputed astrophysicists. Before accepting such an hypothesis corroborative evidence is absolutely essential as it is imperative to repeatedly check results before other theories are debunked. Second, there can be errors of estimation and interpretation particularly because controlled experiments cannot be carried out on bacteria supposed to live billions of miles away to verify such observations. Third, it is possible that various chemicals in the correct proportions can give infra-red and UV absorption spectra curves similar to that of bacteria. We admit that if it were so it would be a remarkable coincidence—but yet it may well be so. It would be more remarkable to have live bacteria there!

Epidemics

It is as proof of mutational changes being produced by microbes from space, (and not due to random mutations as given in accepted theories of evolution) that Hoyle and Wickramasinghe propose the hypothesis of viruses from outer space causing epidemics of human disease.

Epidemics have been proved repeatedly to be due to the spread of infective agents like bacteria and viruses from person to person, either directly or indirectly (through food, water or a vector like a mosquito). This has been confirmed not only by observation and controlled experimentation but also by stopping the spread of epidemics by interfering with the mode of transmission. That is, by treating water supplies, eliminating mosquito vectors, etc. It is true as pointed out by Hoyle and Wickramasinghe there are a few instances that have not been adequately accounted for, such as the introduction of infections to some isolated communities, but these may be far more easily explained as being due to natural causes like air currents, infected water supplies, or undetected person to person transmission than being the result of a voyage of billions of miles from outer space of bacteria or viruses of dubious origin.

Some of these epidemics are due to viruses that undergo frequent genetic change. For example, in the case of influenza, minor changes (*antigenic drifts*) are associated with smaller epidemics and major changes (*antigenic shifts*) with larger epidemics. On the basis of existing genetic theory, this has been most satisfactorily explained to be due to the known processes of mutation and recombination and the rapid transfer of plasmids among bacteria. But Hoyle and Wickramasinghe seem to think that these frequent genetic changes and the almost simultaneous appearance of a disease at more than one place is evidence of the frequent introduction of viruses from outer space. It seems strange that new sub-types of influenza virus could come each year from outer space, but not other epidemic viruses like smallpox,

or Japanese encephalitis, of each of which only one type is found. It also seems very strange indeed that the smallpox virus has stopped coming since the completion of the WHO Smallpox Eradication Programme of selective immunization in 1978.

Incidentally, most of the diseases that Hoyle and Wickramasinghe refer to are caused by *viruses* and not by the *bacteria* they believe are there in intergalactic space. There are problems associated with *viruses* living in space. Because, although viruses can survive by themselves, for purposes of multiplication they must get inside the *living* cells of other higher organisms, where they parasitically commission the cellular machinery of such cells to make copies of themselves. Furthermore, viruses are very specific as to what cell they will infect and multiply in. For instance, *bacterial viruses do not infect human cells*. So the viruses that visit us from intergalactic space and infect man must live and multiply in a variety of specialized cells in outer space. That is indeed a very difficult conclusion to accept. Unless of course, we accept the blind belief that all these cells are out there in the form of a super-organism—God! But it is difficult to imagine an omnipotent God being infected by viruses!

Question of Probabilities

The idea of Hoyle and Wickramasinghe of the improbability of various amino acids joining up at random to form complex proteins as found even in a simple bacterium does not appear to be valid. Chemical evolutionists contend that these may have gradually built up over long periods of time with the incessant action of radiations and electric discharges on a primeval sea. The probability of obtaining 2000 proteins each with the correct arrangement of about 1000 amino acids to produce proteins by random permutations alone of the known 20 amino acids would be a mind boggling one in $10^{40,000}$ as they contend. We could admit this, however, only if the two thousand proteins with 1000 amino acids each were to be built at one moment of time. There would have been billions and billions of amino acids, nucleotides etc. formed which could arrange and rearrange very many times in a matter of minutes, or even seconds, sometimes preserving certain combinations to which others could be added on. These could increase in complexity to produce the first molecules that could replicate and then give rise to life. These processes went on for over a billion years or even for the lesser period of 700 million years that Hoyle and Wickramasinghe accept based on electron microscopic preparations of meteorites by Phlog, which is a long time indeed when expressed in minutes, leave alone seconds! These first forms of replicating molecules need not necessarily be the complex bacteria—nor even the simpler viruses. They may well have been very much simpler conglomerates of organic molecules concentrated as froth and held loosely together

bound to soil particles on the shores by electrostatic or surface tension forces. Once the ability to replicate developed, information storage and transfer could become possible. With this ability to conserve information the speed of formation of macromolecules could have been increased tremendously due to short-cuts in the synthesis of macro molecules, thus overcoming the barriers of improbability.

Hoyle and Wickramasinghe have also used another argument about improbabilities with regard to shifts of alleles in populations to state that evolutionary changes cannot take place on the accepted theories of mutation production and Natural Selection, and instead an intervention of cosmic bacteria are invoked by them to produce such evolutionary changes. The same reasoning as given above by us could be used to refute their arguments. The recycling of atoms (matter) on the earth through billions and billions and billions of individual molecules and organisms existing for brief periods of time (when compared with the geological and evolutionary time scales) could transmit recurrently mutated information to produce gradual evolutionary changes. At certain times cosmic phenomena (like sun spot activity, increased cosmic ray intensities and magnetic reversals) would have increased mutation rates and thereby accelerated evolutionary changes to produce major evolutionary jumps ("punctuated evolution" of Gould) within a relatively short span of time. The gamblers ruin paradox works for a small population of numbers—but where astronomical numbers are involved the frequency of alleles can see-saw over long periods of time. It has to be borne in mind that genes mutate from one allele to another constantly and extinction of alleles will not take place, but only alterations in the frequencies of alleles are possible under the influence of Natural Selection or of Random Genetic Drift.

Life in outer space?

Anyway, let us give a general picture of what it is like to live out there in space. From all available *reliable* information, space has zero pressure, almost zero temperature and is full of cosmic radiations. Can such an inhospitable environment support life, leave alone help in the propagation of life? We simply cannot comprehend how life processes can withstand all these rigours. A few changes in pressure? Yes. A few changes in temperature? Yes. A few changes in radiation doses? Yes. But not the ability to withstand the *vast changes* in each of them, *nor the ability to withstand all of them together* by a *single* bacterial (or even viral) species. And more important, how are moisture and nutrients obtained for survival, growth and multiplication?

There is just one more point to consider before we conclude that it is not possible for life to exist in interstellar dust; if bacteria shower the earth

all the time (or at certain times) they must also gather on the surface of the moon. All tests carried out on moon dust by NASA has *not* shown any traces of organic chemicals so far.

The improbability of the occurrence of bacteria or viruses in space may well be 1 in $10^{80,000}$ which is a certain impossibility. The question also arises about the survival of these organisms in travelling through the dense atmosphere of the earth.

Some background Information

Both Hoyle and Wickramasinghe are good mathematicians (in their own right) who by training are specialized to have a set of assumptions on which to build up a beautiful, logical conclusion. However, they do not have experience in experimental research, and therefore we feel that they are somewhat out of depth especially with regard to Biology. Hoyle made brilliant theoretical deductions in the 1950's about the nuclear processes that go on in the Sun. Since then he has proposed a theory of the continuous creation of matter in space (the "steady state" theory of the Universe) which has been categorically *rejected* by astrophysicists. Now he turns to Biology with another "steady state" theory which boggles the imagination of down to earth biologists for the audacity and verve with which it is presented by him, leave alone the falsity of this dogma. A steady state theory of Evolution (a contradiction in terms) is incompatible with a non steady state Universe.

This emotional attitude of belligerence and arrogance arouses a suspicion that both may be really espousing the cause of the concept of a God and Creation. A concept that involves belief and hence emotion-and not cool-headed rational thinking that is truly scientific. Everyone is entitled to his beliefs. But scientific methods and scientific truths are as sacred and profane as are theological ones because they also have a very useful social function. If what they wanted to say was that God created all, then let them say so. They are entitled to their views and beliefs which we could then respect. They should not, however, try to give a threadbare scientific garb for their metaphysical concepts. For what in effect they say is that both matter and life have always co-existed because, they contend, life did not arise from matter. With an evolving Universe such a concept is untenable in the strictly scientific sense. Therefore, their theory is metaphysical, not scientific.

Their views have been severely criticized (and even ridiculed) in Britain and the US. Normally, when *Scientific* theories are proposed or those that have been accepted are demolished, then it is the *scientific community* itself which initially accepts the new theories and thereby discard older ones. Examples are the revolutionary theories advanced by Copernicus, Mendel

and Einstein. It is only later that the public gets to know about such theories. In the present instance Hoyle and Wickramasinghe have gone to the public before being accepted by the specialists by whom they are yet being severely criticized both at home and abroad. Pasteur went public and demolished earlier concepts—but he could do so because he repeatedly held demonstrations to prove his findings. Not so with Hoyle and Wickramasinghe. They seem to rush into print on the slightest pretext of getting “evidence” in support of their fixed hypothesis.

Our conclusion

The reason why we wrote this article was due to the more pressing and serious concern we feel that, perhaps unwittingly, they are *undermining the very basis of scientific enquiry and research in this Country* which is yet in the process of being formed, particularly due to the wide publicity they have sought and got for their dubious thesis. This would help those other unscientific (anti-scientific?) communities like astrologers, soothsayers and witch-doctors to ridicule science and have a rollicking time duping a gullible public. This, we feel is inimical to the progress and development of Sri Lanka. However, the fact that they have focussed attention on a very fundamental problem and given it wide publicity thereby creating an awareness (however erroneous) and an interest in these engrossing topics of the origin of life and evolution, is commendable.