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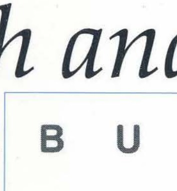
Faith and Thought

BULLETIN



THE VICTORIA INSTITUTE

or Philosophical Society of Great Britain
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Editorial

As promised in the last Bulletin, we have continued the Index for the early issues of the Transactions of the Victoria Institute, hoping that this might be of interest to some of our readers. Other, shorter indexes will be published in due course.

It was mentioned in our last issue that some of Robert Clark's writings would be published in the future, and this issue contains one of these, written somewhere between 1932 and 1940. It is apparently part of a larger manuscript, and the editor is very grateful to David Burgess for working through Robert Clark's writings and selecting interesting items. Any comments from readers would be welcomed.

Finally, attention is drawn to the essay competition - it is not too late to enter! The topic is of great relevance for all of us.

Annual General Meeting 2000

The Annual General Meeting of the Victoria Institute was held on Monday 15th May at Dr. Williams's Library, 14 Gordon Square, London WC1 at 5 p.m., with Terence Mitchell, Chairman of Council, presiding. The minutes of the 1999 AGM were accepted. (Published in *Faith & Thought* Bulletin No. 26 of October 1999). Election of Officers: The President, Professor D.J.E. Ingram, CBE, and the Vice-Presidents, Professors D.J. Wiseman, OBE, Malcolm A. Jeeves, CBE, and Sir Robert Boyd, CBE, were elected for a further term of office, as also were the two members of Council, Dr. John P. Kane and Professor D.C. Lainé, together with a new member of Council, Professor C.J, Humphreys. All elected members of Council are Trustees of the Institute, which is a registered charity. Accounts: The Secretary presented Provisional Accounts of year ended 31st December 1999. These were accepted subject to Examination.

Copies of the Trustees' Annual Report and Accounts are available from the Secretary. The Provisional figures for the year, as above, showed increased subscriptions, donations and investment income, compared with 1998 and an additional investment in the Prize Essay Trust Fund arising from unclaimed prize monies, which it is anticipated will assist in offering higher value prizes in future competitons. A significant but unusual item was the facility afforded by the Institute to the author of *The First Hundred Years of the Victoria Institute*, (F&T. 94[3]) Mr. Timothy C.F. Stunt, in receiving and passing on to the publisher of his research, a charitable grant of £3,000.

Immediately following the AGM, Rev. Michael J. Collis took the Chair and introduced Professor C.A. Russell, Emeritus and Visiting Research Professor at the Open University, who delivered a lecture under the title, *'Where Science and History Meet - Fresh Challenges to Christian Belief?'* It is planned to include the text of this lecture in the next number of the Bulletin.

Victoria Institute Millennium Essay Competition

A Prize of £500

is offered for the best essay dealing with

CHRISTIAN IMPLICATIONS OF THE HUMAN GENOME PROJECT

Closing date 30 April 2001

Competition Conditions:

1. The Council of the Victoria Institute will own the copyright of the essay, though the author will normally be permitted to embody it in a later, more comprehensive work.

2. It should not exceed 7000 words, excluding documentation, typewritten, with double spacing and 2cm margins.

3. It should be submitted to the Institute's office in Welling, accompanied by a brief synopsis of 200 words setting out which parts are claimed to be original, along with a sealed envelope with a motto outside, and the author's name inside.
4. Entries will be professionally refereed and if the referees consider the prize should be divided between two authors, the Council's decision will be final.
5. If no submissions are deemed worthy the Institute reserves the right to withold the prize and to publicise another competition thereafter.
6. Submission of an entry will indicate candidates' assent to all these conditions.

- *The successful author's name will be publicised as soon as possible after the closing date.*

What is Man?

Two recent television series could have been of interest to Christians, as they helped to confirm the Biblical view of Man.

The Channel 4 series 'Secrets of the Stone Age' gave persuasive evidence that Stone Age people were not club wielding, animal skin clad brutes, but highly civilised folk, who wove cloth, mass produced beads for decoration, and made wooden spears as aerodynamically balanced as modern javelins. What is more, 'Neanderthal Man' was as civilised, and interbred with them, and so was not, biologically, a distinct species. Most interesting was the argument that cave paintings were for a religious purpose, as, clearly, were careful burials with tools for the afterlife.

Shortly thereafter, the BBC produced 'Ape Man', whose very title was an inauspicious start, as was the tendency of the first programme to speak of 'creatures' rather than 'people' painting in caves. Yet, here again, those painting caves 25,000 years ago were shown to be as human as we are in their religiosity.

However, we may have come into being the evidence surely confirms the Biblical picture that Man is distinct from all other creatures, because created in the image of God, to have fellowship with him. Even false, shamanistic beliefs bear indirect testimony that 'God has set eternity in the hearts of men' (Eccl. 3:11).

R.H. Allaway.

Evolution and the Laws of Thermodynamics (abridged)

R.E.D. Clark

When it is said that a number of bodies possess order, it is meant that they are related in their positions in some definite manner. Similarly, the amount of disorder represents the amount of random orientation which is present in a system.

This may be illustrated in the case of heat by considering a crystal lattice. Here, the individual ions in the lattice are vibrating independently and this vibration increases with the temperature, until it eventually causes the entire lattice to collapse (the melting point). In the crystal there is order to the extent that the average positions of the ions in the lattice may be represented as a regular framework, but there is no ordered relation between the individual movements of the ions of the lattice. On reducing the temperature to absolute zero, the vibrations in a crystal die out and so the system now has no disorder. This result, that the entropy (disorder) of a crystalline substance vanishes at absolute zero, is often referred to as the Third Law of Thermodynamics.

When we come to deal with large-scale objects, exactly the same principles hold. We may, for example, have a row of trees in which all are in a straight line and there is an equal distance between each pair, in which case they are highly ordered. Now the problem we have to discuss is whether ordered systems can occur spontaneously in nature, or whether it is necessary to postulate a mind which created the order.

It will be well, first, to be clear about the nature of order when dealing with far more complicated systems than the above examples afford. Order is simply the absence of random orientation and in the case, say, of an animal, we know that the various parts of the animal are not arranged at random, if for no other reason, because there is the same ratio between the distances of the different parts of one animal and the analogous parts of a different animal of the same species; for by definition an arrangement cannot be random if the exactly the same arrangement is frequently found elsewhere. The actual existence of order is quite independent of whether that order means anything purposive in the world, or whether we are able to find equations which will represent it: it is simply with the existence of order as such that we are dealing.

A little consideration will shew that we commonly distinguish between two different types of order in the world. In one of these experience has taught us to argue back to a mind responsible for it, but in the other we usually reach no such conclusion.

For instance, in the case of trees, most people would not hesitate to argue that they were planted with the deliberate aim of producing the order observed. However, if an aqueous suspension of gamboge be examined, it is found that the particles often collect together in straight lines. In like manner, precipitates are often found to collect in ordered, periodic functions, and the fact that optically active compounds occur in nature shews that individual molecules are ordered in a certain way. In none of these cases, however, does it appear that the observed order is directly due to any sorting principal or mind. In the same manner we should not deduce that mind was responsible for the order associated with the molecules in a crystal, or the order which results when we shake a quantity of needles in a bottle and find that they mainly collect in bundles instead of being distributed at random with respect to one another.

It follows, then, that we are accustomed to distinguish between two kinds of order - one of which is often produced by a sorting principle or mind (hereafter called ***mind-order***) and another kind which involves the operation of ordinary known laws. This latter type is due to the operation of a universal physical law, The First Law of Thermodynamics, which states that in reaching an equilibrium a system tends to reach that state where its potential energy is at a minimum. If this state happens to represent some kind of physical order, then ordering will occur in the process, and this order we shall subsequently refer to as ***thermodynamic order***. On this basis we can explain why it is that particles of gamboge collect in straight lines. The 'stickiness' of the particles holds them together, and their charge mutually repels them, so that they take up a position such that each one becomes as far apart from the rest as it possibly can, a condition fulfilled in the straight line. In like manner the molecules in a crystal lattice are so arranged that the structure is associated with the minimum energy, and in cases where a given kind of molecule is capable of building lattices in two or more ways (polymorphism), one of these states is stable while the others are unstable and can be converted into it.

By far the commonest kind of order which exists in nature is of this thermodynamic type, that is to say, it is a pure 'accident' associated with systems which have arrived at their stable states and the existence of this order does not necessarily imply any new principle or mind to explain it. It follows that, as defined above, a thermodynamic order becomes a mind-order when the environment is so altered that it no longer represents a minimum potential state. A mind-order does not therefore *necessarily* imply mind unless it is a mind-order at the time of formation. The point is important for an understanding of what follows.

If now we exclude the possibility of the direct action of mind in nature, it follows that thermodynamic ordering is the only kind of ordering process which can take place between physical objects, and it is easily proved that if another kind of order were shewn to result directly, the first law of thermodynamics would be contravened, and perpetual motion machines could be constructed. Therefore, we may produce a desired order either by a sorting method which involves mental activity, or such an order may result when things are arranged - accidentally or designedly - so that the order desired represents a minimum potential state; there can be no other method of production. In the latter case of thermodynamic ordering, we cannot, of course, definitely exclude the mental process unless we are sure that the arrangement which caused the mechanical sorting process was itself undesigned.

Having now discussed how order may be produced, we shall examine the problem which meets us in nature. From an observed order, how can we determine what method was used in its production?[1] Now, if we had any reason to be sure that the environment in which the observed order existed had not been altered since that order was produced, the obvious crucial experiment would be to alter the order in some way and observe whether there were any factors which tended to reproduce the original state.

In practice, however, such an experiment would be vitiated by at least two factors. In the first place, one form of order invariably co-exists with a large number of other orders, whereas for our experiment we should require it to be isolated, since from mechanical analogies the imposition of ordered and unordered systems upon an original ordered one would create a potential gradient in the latter, even if it did not exist in it originally. And in the second place, the fact that chemical reactions take place in living matter shews that the environment *is* continually altering. It appears, in fact, that there is no obvious way of tackling the complexities of nature by direct experimental methods, and we shall have to examine the possible properties of ordered systems in order to go further.

Life shews the phenomenon of self-propagation; that is to say, individuals are able to produce more indivduals or the same kind. Is it possible, then, to imagine any way in which an ordered system can propagate itself? By applying the first law of thermodynamics once again, we can see that self-propagation is only mechanistically possible when the matter which is in the vicinity of the given system happens to attain a minimum potential by taking the form of the original system.

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1 For example, the dextro- and laevo- forms of an optically active compound are associated with equal potential energies but when a molecule contains several asymmetric carbon atoms, then the two possible ways of creating a new one are not associated with equal energy changes. This phenomenon is known asymmetric induction. It can be explained on purely mechanical grounds.

In the simplest possible case, that of the crystal, the nucleus merely acts as a catalyst, causing the environment to take up this condition, but in the complex cases of living matter, chemical changes are constantly taking place and altering environments, so that mechanistic reproduction occurs only when the living system temporarily causes its food environment to take up a singular form as a minimum potential state; however, the subsequent changes alter the environment and appear to leave the new system in an unstable state (mind-order), for on death decomposition rapidly ensues in it. Except for this later removal of the necessary environment, it appears possible to regard reproduction as analogous to crystal growth. Now the possibility of reproduction of this kind depends upon the presence of the right kind of environment. For instance, in the simplest case known to us, that of the crystal, the initial crystal must be placed in a solution of the same substance - or of substances which would easily yield it chemically - and the solution must furthermore be slightly supersaturated and within certain temperature limits. The more complex the order the crystal represents, the more carefully the conditions must be defined; unless it is a very simple structure, anything beyond a slight supersaturation will result in an amorphous precipitation, even if crystal nuclei are present in abundance.

By making the conditions more exacting, it is possible to imagine a much more complex system reproducing itself; for example it would probably be possible to construct a mechanism which would cause a given photographic print to turn out exactly similar prints of its own accord, but the environment - the necessary machinery, photographic paper, etc. - needs to be far more complicated the more complex the object to be reproduced.

It seems then at first sight, that such reproduction of an order already existing could take place without any direct operation of mind; on the other hand, a purely mechanistic reproduction of this kind cannot exclude mind, for a mechanism capable of building its environment into repeats of itself needs to be so highly specialised that planning may be needed to explain its existence in the first place. Now, this initial formation must be due to either a direct creation - that is, to the direct working of mind - or the gradual evolution[2] resulting from mechanisms propagating more complex ones.

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2 Throughout this paper Evolution is used in a restricted sense, of the production of a more ordered mechanism from a simpler one. If, say, a particular arrangement of cells became more prominent (large in number or size) in the offspring, this would not be evolution according to this definition. Evolution occurs in the above restricted sense only when the arrangement appears for the first time.

The problem to be faced, then, is whether it is possible for a given form of order to use its environment to build up its own order with another order superimposed, and without the direct action of any kind of sorting principle.

Once again, the new form of order can only be built up if it corresponds to a minimum energy state of the food, etc. which forms the environment. Now the outer surroundings of food, light, temperature etc. may or may not have anything to do with the new order to be superimposed. Let us suppose, to begin with, that they have nothing to do with it, in which case they may be considered constant and the mechanism itself altering in such a way that it frequently produces a more complex mechanism than its own, as minimum potential states.

We may consider identical stages of the reproductive process in two successive generations, of which the latter is more complex than the former. Since these two cases both correspond to minimum potential states, the problem is how the individuals of the successive generations manage to alter their reproductive mechanisms to obtain this result. Either the order which results from evolution is due to chance or it is not, and if not, it must have existed elsewhere before, either in the original species (in which case evolution did not occur in the sense that the word is here used), or in its environment of food, etc. We shall examine the possibilities considering that of chance first.

As we have pointed out, there is a strong argument from analogy for supposing that, with so complex a system as is present in even the lower forms of life, the conditions for its propagating at all will be extremely critical. If we are to invoke chance changes for making a new type of order, in addition to the original order, into a minimum potential state, we must clearly invoke the chance changes for the whole system. In other words, the more complex the system gets, the higher the chance that existing orders will break down, and the lower the chance that a random change in the system will show itself by producing a new order, without change in the others. There would seem to be no escape from this, unless we assume that, when once a new order does come to exist, there is an uncanny power which prevents any random changes in such a direction as to remove it.

There is a very close analogy with ordinary human experience. If, on shuffling some playing cards, we remove two in a given order, a further shuffle is not likely to produce the original two, with another predetermined one, in the right order, but will usually break up the order with which we started. This is simply an example of a universal law of nature, of which the Second Law of Thermodynamics is a particular case, namely that when things are left to chance, disorder increases, while any local decreases will be so far offset by the increases that they need not be considered.[3] It is clear that living matter is composed of such huge numbers of molecules, and even cells, that meaninglessly large figures will represent the chances against an increase in disorder.

A study of freaks in nature shews that they conform with those conclusions. In such cases it is observed that an existing order may be lost, as for example in colour blindness or the loss of a limb; or, on the other hand, an existing order may occur more often than in the ususal case, as for example when two heads or six fingers on the hands are present. There would appear to be no evidence that a new order is ever produced in such cases. Freak snakes may produce two heads, but never does a stray leg appear.

This is as we should expect, for the reduplication of an existing order, two heads instead of one for instance, offers no fundamental difficulty, but there is theoretically a vast difference between the first formation of an order, and its reproduction when one is formed.

To simplify the problem we have, in the above, assumed that the surroundings of food, temperature, light etc. are irrelevant. Will the difficulty be avoided if we allow that such factors are involved in the process? It appears not, for if outward circumstances are themselves to be controlled by chance, there is still every reason to doubt why they should increase the ordering. Alternation of light and darkness, summer and winter etc. are, of course, capable of producing their own periodic order in matter - for example, in the rings seen in the cross-section of a tree - but to imagine that outward circumstances are frequently going to alter in such a manner as to create new order and not destroy the old, is to postulate that there is an evolution in the order of the outward circumstances themselves, which leaves the problem where we started. There seems no particular reason for pushing the difficulty back, for on general grounds it seems inconceivable that constantly increasing external orders do exist, and that even if they did they would benefit most species, instead of ordering one and destroying the rest. In any case, if chance is to be invoked, variations on such a scale will be immeasurably less probable than they would be in the quantities of matter in living material.

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3 In the production of thermodynamic order, ordering of one kind takes place at the expense of ordering of another, but no-one doubts that, as a whole, order decreases in the process. The difficulty of expressing this in a lucid form is due to the fact that it is not easy to relate different kinds of order precisely. The important point is that ordering cannot occur mechanically unless another kind of disorder can be created simultaneously. The direct production of mind-order entropy cannot be simultaneously created, but whether another static disorder can be created will be discussed later.

It is widely recognised that chance variation cannot be invoked to explain evolution in biology any more than in the case of energy. Evolutionists cannot avoid the difficulty by pointing out that in fact retrogression is commoner than evolution, in the higher forms of life, for it is clear that, according to physical principles, retrogression ought to become so extremely common, even in unimaginably low forms of life, that evolution to higher forces would be statistically impossible.

There is one other way in which it is suggested that the new order for evolution is obtained. We know that it is possible to take slightly ordered energy and at the expense of disordering it further we can obtain a small portion more highly organised than before - there being still, of course, a loss of order in the entire process. It is suggested that the same thing may be true of living species. Since mammals, for example, feed upon animal or vegetable systems which are themselves ordered, and thereby destroy the order of the latter, is it not possible that the higher forms of life are thus obtaining a highly specialised order in small quantity by destroying a large amount of order in the lower forms of life?

This is really the only thinkable mechanism which can now be suggested, and at first sight it seems quite plausible. We can imagine that the lower orders were in turn made in the same way, until we arrive at the lowest of all, which were purely thermodynamic orders whose environment had altered after their formation, to make them function subsequently as mind-orders. In some form or other this seems to be the view accepted by most biologists at the present time, though lucid expresions of it are rare. A little consideration, however, will shew that it is merely another ingenious device for making a perpetual motion machine!

We may perhaps put the case best by asking what is going to decide whether a newly-formed order is going to make sense if it is obtained from other lower orders in this way. For instance, why should the new order help to make useful organisms, instead of merely arranging molecules in circles? We can see why it is that order comes out of disorder in the case of entropy: it is because it is already there. Suppose we have a hot gas in a cylinder. It consists of molecules moving in every direction. When the piston, forming one end of the cylinder, moves outwards, we are utilising the components in that direction of the motions of the molecules. In other words, the very high order (with no disorder) of the work done is due to the fact that the piston utilised those molecules which happened to have the order (direction of motion) we wanted. There was no question of making an order which was not present before.We are then able to utilise the forces due to the impingement of the more ordered molecules on the piston, which duly move in the same direction. Since the remaining molecules remain as such, the energy is a whole more ordered than the overall energies of the ordered and disordered molecules.

In similar manner we can imagine a large number of stationary obects placed between two straight lines on a frictionless plane. It would be possible, without doing work, to remove all those which were not within a given distance of one of the lines; we should now have a row of objects much more highly ordered than the original collection taken as a whole. But no new order would have been introduced by the process: indeed it would not have been possible to create a new kind of order in the process. For instance, from the large number of slightly disordered original objects, we cannot have some of them placed in a circular formation at the expense of disordering the rest. Every method we can devise of so placing them involves the order which we desire to impress upon some of them.

It is, then, a fundamental result that although we can obtain a small system having more order from a large one having less, this cannot be done unless we are content with the same kind of order that was originally there, and when we actually want ordered systems we are always obliged to use our minds, or where possible the thermodynamic method of getting it. Thus, if we want a straight line, we stretch a string, which takes up the desired configuration in accordance with the first law of thermodynamics.

Now, in nature it is quite clear that the higher forms of life contain kinds of order which are not present in the lower forms. For instance, we may take almost any part of the body which is not represented in simple plants and, according to the above principle, it will be impossible, by producing disorder in the plants, to produce the order we are considering in the mammal.

We may summarise our conclusions in this way:

If we are allowed to assume that a given species represents (when it is formed) a purely *thermodynamic order*, then if any evolution of the species occurs, the new form must be represented by the original thermodynamic order, with a *mind-order* superimposed *at the time of formation*, for if the new order is a thermodynamic order, it must have been represented in the original species, and no evolution could have taken place.

Since there is no method of producing such a mind-order which does not involve the possibility of perpetual motion, it appears on purely physical grounds that evolution (in the sense defined) cannot occur, though retrogression would often be expected. Further, if we are right in considering that there is no fundamental difficulty about the propagation of existing types of order, then there is no reason to doubt that very considerable changes in species can occur through either a given kind of order enlarging or diminishing itself, perhaps under the influence of changed climatic or other external conditions, or through interbreeding. In other words, it would be impossible for all living species on earth to be derived from a common stock, although there is no physical objection to the view that all species could be derived from perhaps up to only several hundred original species.

A similar view, based on the biological evidence, was given by Rendle Short (Trans. Vict. Inst., 1930). This would explain to some extent why so many species contain 'remnants' resembling parts of other species, but it is not maintained that the difficulty would thereby be completely solved. Nevertheless, it is one thing to admit difficulties and another to propound a theory which does not seem to be in accord with elementary principles.

It appears that it is not even open for someone to say that, although we cannot think of any mechanistic process for obtaining the new order for evolution, yet some such process *may* exist. For by examining the problem in the light of the principles of physics, we are able to say definitely what could *not* occur. Now, at its inception, the mind-order cannot be obtained except by mind, and since by definition mind is a sorting principle, it is useless to speculate on other, undiscovered factors which might have the effect of mind. In any case, if we postulate such a sorting process, we are, in effect, saying that the first law of thermodynamics was not true in biology; would this be more satisfying than invoking miracle?!

The situation seems to denand that we must believe either in the original creation of a fairly limited number of species, which have changed and multiplied since, or that evolution of all species took place from primitive forms of life through direct miracle. Our intuition seems to tell us that, if we must invoke miracle in order to explain a result, we had better choose the hypothesis which involves least of it. It may be, of course, that our intuition leads us astray here, but until there is very good evidence to the contrary, it would appear much easier to believe in the creation of a relatively few species (or even of many) than to suppose that a miracle occurs for each stage in the evolution of each species, and at each such stage a separate miracle for, at any rate, *some* of the individuals! The fact that in one case the miracles would be more sensational than in the other does not seem a very sound reason for preferring the latter!

It is, of course, just conceivable that biological evidence might one day force us to accept the view that all species were derived from primitive forms, but at present it seems much more reasonable to suppose that biology, being so extremely complex, it is more likely that some biologists have made a mistake in its interpretations than that a direct application of elementary and well-established physical principles should lead us astray.

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Book Reviews

P.D. Ward and D. Brownlee

Rare Earth: Why Complex Life is Uncommon in the Universe

New York, NY: Copernicus, 2000. 333 pp. hb. £17.50.
ISBN 0-387-98701-0

Reviewed by Ernest Lucas.

It is arguable that the search for extra-terrestrial intelligent life has become the modern form of the medieval quest for the Holy Grail. It seems to have become a form of religious commitment for some people, including some scientists. In the mid-1970s Frank Drake and Carl Sagan, using what has become known as the Drake Equation, estimated that a million civilisations of intelligent creatures might exist in our galaxy alone. That estimate has been widely accepted, but rests on assumptions that are rarely examined critically, partly because of a lack of sufficient reliable information.

The authors of this book are both Professors at the University of Washington, Seattle. Ward is a geologist and Brownlee an astronomer. They are convinced that there is now enough evidence to challenge the conclusion reached by Sagan. Their thesis is that microbial life may well be very common in the universe, but that *complex* life - animals and higher life - is probably extremely rare.

Until the 1970s it was believed that no life of any sort could live at temperatures above 60°. However, in the early 1970s microbes were found living in hot springs at temperatures up to 100°C. These 'thermophilic' microbes are now known to be only one example of a range of 'extremophiles' - microbes capable of living in various kinds of extreme conditions. These extreme conditions include: sub-zero temperatures in icebergs, around deep-sea volcanic vents where temperatures exceed 80°C and there is no light, deep in rocks where the pressure is high and there is no organic material. Assuming that life can come into being by a natural process, Ward and Brownlee argue that these extremophiles are prime candidates for the kind of life that was the first to arise on Earth, when the conditions were much less hospitable to life than they are now. On this basis they conclude that microbial life could well have come into being on many other planets in the universe.

However, they go on to argue that the conditions needed for complex life to arise from microbial life by a process of evolution are very stringent, and rarely to be found. Here are just a few of the constraints they point out.

1. Life will only arise and continue to evolve on a rocky planet in orbit around a stable star that is large enough to burn for long enough to give sufficient time for evolution to occur. Ward and Brownlee estimate that only about 2-5% of stars meet these requirements.

2. Many stars exist in large clusters or are members of a multiple star system. It is very unlikely that a stable planetary system could form in such situations because of the disturbing effect of the gravitational pull of the various stars on the planets.

3. For the same reason, the chance of a stable planetary system forming decreases the closer a star is to the centre of the galaxy, because the general density of the star population increases. Our Sun is about halfway between the centre of our galaxy and its outer edge. Another hazard for life on planets nearer to the galactic centre is that the chance of the planet being bathed by harmful radiation (gamma rays, X-rays, high energy particles of various kinds) produced by unstable stars as they collapse or explode would be much higher.

4. Although planets have now been observed around a dozen or so nearby stars, these are all 'gas giants', like Jupiter, most of which are in very elliptical orbits. Computer simulations show that in such a situation the perturbations caused by the large planet would 'evict' small planets like the Earth from the solar system. Only where the orbits of the large planets are nearly circular, as in our solar system, can the smaller planets remain in a stable orbit. The

observational evidence so far suggests that this is a rare situation.

5. Both the degree of tilt of the Earth's axis of rotation, and the fact that it has remained stable through most of the Earth's history, are important factors in the relative stability of its climate and the continued existence of oceans of liquid water. Rapid and extreme changes in climate, and the loss of the oceans, would have meant the end of complex life on Earth. The stability of the Earth's axis of rotation is due to the presence of an unusually large Moon.

6. Perhaps the most novel part of the author's argument is that plate tectonics may have played a crucial role in the evolution of life on Earth. This is because, by various mechanisms, it helps maintain an equitable temperature on Earth. The 'drift' of the continents also promotes both biological productivity and biological diversity. The Earth is the only planet in our solar system on which plate tectonics operates. It is not clear why this is so. It may be due to a combination of its compostion, size and the presence of a large Moon.

The only 'philosophical' conclusion that Ward and Brownlee draw from their discussion is, 'We are not the center of the Universe, and we never will be. But we are not so ordinary as Western science has made us out to be for two millennia. Our global inferiority complex may be unwarranted' (283). They go on to comment that if animal life is very rare in the universe then perhaps we ought to do more that we are to prevent species extinction. However, if our existence is simply a very rare cosmic accident, rather than a fairly common one, it is not clear what ground this is for either a superiority or an inferiority complex. The more relevant point is that in neither case is there any basis for a meaning or purpose to life. That being so, it is not clear why one should be too concerned about preserving it.

Ward and Brownlee write clearly and argue their case well. They present an important challenge to the long prevailing assumptions on the basis of which some scientists have interpreted the Drake Equation in a very positive way. What they show is that our solar system may be 'fine-tuned' for complex life. If that is so, we are left with the logical options of concluding either that our existence is a great cosmic accident or the outcome of a carefully designed process. On its own, science cannot resolve those options.

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Rachel R. Baum (Editor)
Funeral and Memorial Service Readings, Poems and Tributes.
Shelwing, Folkestone, CT20 2BH. 2000, 172 pp. HB £22.50.
ISBN 0-7864-0699-2 USA Publishers - McFarland.Co.Inc.

Reviewed by A.B. Robins

This book was originally published in the USA in 1999, and I received it for review this spring. It may seem a surprising inclusion within this journal, and I confess my interest, since taking funerals occasionally falls to my lot. Hence any compilation of suitable readings is to be welcomed. However, most of us are faced at some time with preparations for a funeral of someone we know and love, so in that spirit the review is offered.

How does the book measure up to expectations? It is well set-out, with eleven chapters dealing with tributes to mothers, fathers, children, friends etc. Moreover, the two indexes are to authors and to first lines, so it is easy to find what one may have vaguely remembered and wish to recall. There are two appendices. One of these gives a list of selected resources such as planning funerals, after-care, bereavement counselling and so on. The second apendix is devoted to a list of support agencies but these are entirely of American organisations, and less useful for other readers. A small, third, index gives a list of well-known people who have used particular tributes, for example readings given at Diana, Princess of Wales' funeral by her sisters.

Of the actual 'meat' of the book - this is very much a personal matter. Some poems are wonderful , others less so, but that is a matter of taste. Many, but by no means all, of the readings are Christian in spirit. There are none from other faiths. As the preface indicates 'people now have secular gatherings, or incorporate religious ceremony with secular practice'. So in that light must the book be judged. In any event, the right tribute for a particular occasion or person is a highly individual matter at a very traumatic moment. I think this book will be a good resource for anyone seeking guidance and help.

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