Causes in Biology

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This paper has been written in cooperation with Neil Broom over the past several years, inspired by one small part of John Morton's 1972 book 'Man, Science and God'[1].

The four categories of cause, identified by Aristotle and little challenged for 2.3 millennia, have rarely been taught to science students. Two of the four are simply ignored today by the leading proponents of scientism such as Richard Dawkins, Lewis Wolpert, and Steven Weinberg. We suggest that Professor Morton's 1972 exposition of the 4 causes offers neglected potential to improve science and Christianity, *e.g.* by clarifying that murky, confused scene the theology of evolution.

The 'enlightenment' assumption that science can, and soon will, give an essentially complete description[2] and explanation of the physical (including biological) world had become widely influential, though little discussed, when we were science students. Since then, the limits of science and its proper interactions with other domains of knowledge have continued to be widely ignored. And even within science, little attention is directed to the question of what the word 'explanation' means.

Scientism is thus crudely asserted by mere implication, but not discussed. Scientism--faith in science as the "only" way of knowledge--has been in the ascendant for most of the time since the early 18th c. and has lately dominated scientific education by default. It is this last-mentioned aspect to which we most strenuously object. To neglect all mention of final cause is not good education (nor good philosophy); but to do so without any discussion is downright crude if not dishonest.

The term 'evolution' means the appearance of new life-forms--new species and bigger categories genus, family, order, class, phylum, kingdom--over time[3]. The idea that no new species have been created since the 6th day tends toward deism, which we reject in

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1 John Morton 'Man, Science and God' pp13-17 Auckland & London: Collins 1972

2 *e.g.* Descartes to Mersenne 1632 "I expect soon to be able to calculate the position of every star"

3 L Margulis & K V Schwartz 'Five Kingdoms' Freeman 1998

favour of theism. We believe God created the universe out of nothing but did not then cast it adrift like some wound-up clockwork toy; He also has sustained it from moment to moment over 10^{10}y. Christians concentrate on the spiritual sustenance from God through prayer, sacraments, etc., but have accorded less attention to God's maintenance of the Garden for us to live in as His stewards while praising Him (that is what we are here for). One among the several senses in which John Morton's life has been dedicated & productive is his tireless advocacy that we conserve this, the only biosphere we know of, which God not only created & sustains but also lived in briefly as a man to inaugurate the Kingdom of God on Earth. The failure of modern man to conserve ecosystems remains one of the most distressing aspects of modern life, but somewhat less so for Mort's staunch advocacy of applied ecology.

Our care, or neglect, of the biosphere will depend on what we believe about how and why it came to be. What can be discerned about the process by which its creation has occurred over time? Fig. 1 shows its time-frame and main catastrophic ice-ages (which appear to have been usually followed by surges of new life-forms). Fig. 2 summarises the main facts of evolution as known from the fossil record[4].

Science has inferred from a large body of observations that life appeared on our planet as blue-green algae 3×10^9 year BC, complex animals 1×10^9y, mammals 2×10^8y, and man somewhere in the region 10^6 -10^5 y BC. Evolution has certainly occurred, in the sense that new life-forms have appeared (mostly in bursts) over billions of years. However, evidence for descent from one to another is much sparser than is often assumed, and is difficult to come by. Many links are missing from the fossil record found to date.

This proliferation of increasingly complex life-forms over time requires explanation - ascription of causes--beyond what has become standard evolution theory *viz*. random mutation, natural selection, genetics, and population dynamics--the four lines of scientific thinking which have been synthesised into neo-Darwinism. Dogged refusal to discuss is a main mark of ideologies as distinct from schools of thought. We fear that neo-Darwinism has degenerated to such an unfortunate dogmatic or ideological status. In our opinion, evolution theory deserves better.

We are here concerned with the causes of evolution. The evasion of final cause in biology is one explanation (in an age of trendy materialism) of the recent popularity of Richard Dawkins as a vigorous advocate of scientism. Broom has outlined[5] objections to Dawkins's approach.

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[4] (compiled in collaboration with Mr Art Haughey and Assoc. Prof. Jack Grant-Mackie)

[5] N D Broom *Ecologist 28* (1) 23-28 (1998); much more detail in *idem* 'How Blind is The Watchmaker?' Aldershot: Ashgate 1998; revised ppbk edn. Downers Grove: IVP 2001

Gradualism remains a dominant principle in orthodox Darwinism, although hardly a dominant characteristic of the actual record of evolution, which is mainly discontinuities or saltations.

We stress and deplore the fact that Dawkins attributes to molecules (DNA) the property of intentionality, even creativity in design - properties which, we suggest, cannot belong to molecules.

If evolution is so unplanned & meaningless as Dawkins claims, why does he never avoid goal-laden accounts of the process? *Can* evolution actually *be* described in purpose-free language? If not, that fact might suggest that evolution theory should include rather than ignore the concept of final cause.

That Dawkins could be so popular illustrates the need to clarify **explanation** and **cause**. What is to be explained in biology, and what will count as a thorough explanation *i.e.* a full attribution of causes?

In order to promote consideration of causes in biology, we go back to William Paley's 1802 scenario of finding, during a stroll on a heath, a watch. Paley argued that the evident order of this mechanism would rightly force the finder who studied it to infer the existence of a purposive design, and therefore a purposeful designer. (This reasoning would seem especially warranted if the watch was running when found.) He then argued that the living mechanisms of nature - the complex machinery so evident in biology - must similarly be inferred to have been designed. We believe this argument has been unreasonably neglected and certainly not refuted. Megatime is no substitute for purpose in the creation of coordinated working ecological order.

In the course of advocating revival of Paley's argument, we attempt to bring up to date the definitions of causes.

A scholar of Greek philosophy discussing Aristotle's four causes remarked[6]:-

> The aim of wisdom, he says, is to arrive at knowledge of causes and principles. A 'cause' gives the answer to the question 'Why?'. Generally speaking, the cause of anything is the coming to be of a particular form in the appropriate matter: 'matter' and 'form' are then 'causes' of a thing's existence. But for a complete account of the reason why anything comes to be what it is, a further analysis of form is required, and the original two causes become four.

Aristotle's original statement (in his *Metaphysics*) is translated in Flew's textbook[7]:-

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[6] M E J Taylor 'Greek Philosophy - an introduction' pp120-121 London: Humphrey Milford, Oxford University Press 1924

[7] A Flew 'Introduction to Western Philosophy' p159 London: Thames & Hudson 1989

Cause means:

(1) that from which, as its constitutive material, something comes, *e.g.* the bronze of the statue . . . ;

(2) the form or pattern, that is, the account of the-what-is-to-be . . . ;

(3) the source of the first beginning of change or rest, *e.g.* the man who resolves is a cause, . . . ; and

(4) the end, that for the sake of which, *e.g.* as health is of walking around. ('Why is he walking around?', we say; 'In order to be healthy', and having said this we think we have given the cause.) . . .

These are just about all the senses of the word cause, and since the term is multiply ambiguous there are regularly several causes of the same thing; for instance, the making of a statue and the bronze are causes of the statue . . . They are not, however, causes in the same sense, since the one is material and the other efficient.

Flew comments that in ordinary English the word 'cause' would, by someone quite untouched by Aristotelian influences, be applied only to the Efficient and Final causes (not, we may note, the pair favoured by the scientism that I'm criticising).

Two or three of the labels which have so long been standard are less than self-explanatory, or are even confusing--notably 'efficient'--but it is probably too late to change them.

The difference between #2 and #4, which have been termed respectively Formal and Efficient, is not--in these, Aristotle's original definitions--very clear, but it might be fair to define efficient cause as a process leading to a specific new state; and the concept of purpose is clearly discernible in Aristotle's original wording.

Before the more recent decline in philosophy of science, Professor Morton, using science as Aristotle of course could not, clarified the 4 categories of cause in his 1972 'claret cameo'[1], which we here paraphrase.

What are the causes of my bottle of claret?

The **material** cause includes the grape juice and the yeast, materials transformed by the efficient cause into this peculiar substance claret. The **efficient** cause, as in Aristotle's prototypical example 'the making of a statue', is the action of the yeast on the grape sugars and some minor components, a

process resulting in aqueous ethanol and some minor chemicals characteristic of claret.

But my bottle of claret has also a **final** cause: a person (named Babich) exerted his will to organise suitable vessels & conditions for the substances which are the material cause, and planned a sequence of operations for the purpose of making claret by maximising the likelihood that the efficient cause for claret would operate *i.e.* the particular biochemical action of the yeast on the grape juice leading to claret.

Aristotle's **formal** cause is the 'claret idea' in Babich's mind.

The improvement is that the example of efficient cause in Morton's claret cameo makes clearer in terms of chemistry (as the pre-science Aristotle could not) the concept of a process for a purpose. We propose, as a clarification for the age of science, to define the efficient cause of X as a process of change involving matter &/or energy leading characteristically to X.

What then can be said to explain--ascribe the causes of--an organism? The blueprints encoded in DNA are material causes, and operate as parts of efficient causes through the several types of RNA and the many enzymes essential for synthesis of proteins & other biochemicals; but DNA is certainly not a final cause. As Professor Morton has recently put it, DNA is not the kind of thing that can cause other things, as if paints could leap from tubes to create a Turner, or vibrations & percussions form themselves into a work of Mozart. A person implementing a plan - a final cause, like Aristotle's prototypical 'the man who resolves'--is the only way such things can come to be.

If science consists of discovering materials and forms (*e.g.* species of organism) and elucidating qualitatively & quantitatively the processes - including energy conversions - which result in new physical situations, then material and efficient causes are the only causes science can study.

But we have found no reason to say that no final cause operates in biology. The neo-Darwinist approach simply *assumes* that efficient causes (with of course the material causes needed for them to operate) suffice to explain evolution. Emergent properties are assumed to be entailed in the impersonal laws of nature, to whatever arbitrary extent may seem desirable in the attempt to evade final cause.

The main exception is obviously technology - and more widely, all human acts to modify the physical world. The only type of final cause - person acting to cause a change - is, in this 'Enlightenment' approach, human will. Thus ‘who designed this

watch?' is an allowed question, but 'who designed this frog?' not[8]. This assumption - an implied denial, rather than any reasoning - appears not to have been subjected to much scrutiny.

One point not at issue is that **emergent properties** are real & important. As matter takes more complex forms, new properties emerge which are absent in the simpler forms. To take an extremely simple example, the molecular substance H_2 (ordinary hydrogen) has more types of properties than does atomic hydrogen H, and science (mainly quantum mechanics) has gone some way toward explaining those emergent properties (*e.g.* vibrations & rotations seen by infra-red & Raman spectroscopy; nuclear magnetic resonance spectra; etc). But a phenomenon such as the emergence of the first seed-plant (a sequoia, 3×10^8y BC), with no known 'proto-sequoia' precursor, represents a scale & co-ordination of emergence requiring more detailed explanation. Science should continue to discover efficient causes in biology, but the working assumption that there are no final causes should not be viewed as a theological fact.

Perhaps the most advanced non-theological attempt to do justice to causes in biology is Waddington's concept, developed further by Sheldrake, of morphogenic fields. Sheldrake's ideas offer a main bridgehead for the re-connecting of science and religion; since we believe this to be a principal task facing today's world, we sketch Sheldrake's two key concepts here.

It is important to distinguish morphogenic[9] fields, the basic contribution of Sheldrake, from his secondary, far less supported, concept 'morphic resonance' which involves changes in the fields.

Sheldrake's concept **morphogenic field**, directly traceable to Waddington's concept 'chreode'[10], reminds us that the set of blueprints in DNA, a set specifying primary structures (*i.e.* sequences) for two great classes of macromolecules - nucleic acids and proteins - is not sufficient to specify life. Those linear listings may be necessary, but are not sufficient; the central biological problems of development and of adaptation have not been illuminated by hypothetical models, let alone facts, for how DNA sequences might co-ordinate these processes. The forming of an organism in development requires specifications for when, and where and how fast, to build from each respective DNA blueprint. Can, as a matter of logic, such a development plan be discovered by 'The Human Genome Project', which is only DNA sequencing? The

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[8] (but note that a person who tries to patent a transgenic organism is claiming to be a final cause)

[9] It is possible to imagine reasons why Sheldrake normally inserts another syllable: morphogenetic.

[10] C H Waddington 'Towards a Theoretical Biology' 2 vols Edinburgh Univ. Press 1969

chreode into which a fertilised frog egg grows, to become a frog rather than a dog, is a set of co-ordinating instructions which science has scarcely if at all begun to glimpse, and arguably cannot. It is, according to Sheldrake, a morphogenic field - a formative influence which pre-exists outside the physical universe. Sheldrake also ascribes reparative growth to morphogenic fields, *e.g.* regrowth of limbs by some animals after amputation. These fields seem to us wholly consistent with theism. We postulate that morphogenic fields are a means of God's action in biology - a means of creating, maintaining, & modifying species.

Sheldrake points out that the 'behaviour' of a TV set - the showing of homunculi on the screen - might well provoke one who had never seen such a thing to seek within the set those homunculi; but the search would reveal only components arranged to resonate with an electromagnetic field.

It may perhaps be not too loose to suggest that morphogenic fields are a means for God's formal causes (*e.g*. the 'frog plan') to get implemented in the physical world. I would like to suggest further that our formal causes (*e.g*. Babich's 'claret idea') get implemented as efficient causes by means which are essentially unknown but which may be some variety or analogue of morphogenic fields. How spirit moves matter is a question regarding not only divine action but also our immediate physiology.

The concept of morphogenic fields has stood for decades as the only serious idea on offer for biologists who ask what is, so to speak, immediately behind the biological phenomena of metabolic maps, nucleic acid sequences, neuron pulses, muscle contractions, etc. Today many if not most scientists assume that nothing behind the superficial is needed - having never heard of half of Aristotle's 4 categories of cause. This is the stance of such main proponents of scientism as Dawkins. We believe Sheldrake has made good progress on integration of all 4 causes toward a more comprehensive theory of biology.

A decade after his original formulation of his secondary concept, **morphic resonance**, the empirical evidence for it summarised in Sheldrake's most recent book on his theory[11] was still slight. The concept, evidently difficult to demonstrate, is that a given efficient cause becomes more likely to happen after it has occurred once, *e.g.* crystallisation of a novel organic chemical, because the earlier occurrences modify the relevant morphogenic field. The dearth of evidence does not prove that morphic resonance is unreal; it may just be inconveniently rare for controlled, systematically

[11] R Sheldrake 'The Rebirth of Nature' pp88-90 Century 1990

repeatable observation. The Flynn effect[12] - the startling improvement in IQ test performances over a few decades - may well be an example of morphic resonance.

This postulated change-mechanism is to the fields themselves roughly as mutation is to routine accurate heredity. In each process the secondary phenomenon is much less readily observed even if provoked (*e.g.* by an artificial mutagen, in the case of mutations) let alone at minimal rates (*e.g.* caused by natural radiation or minimal irreducible error rates in DNA replication).

Sheldrake assumes, for simplicity, that morphogenic fields are not attenuated in time or space. This does seem a convenient provisional axiom, but refinements will presumably follow. As for numbers, the exposure[13] of the 'hundredth monkey' myth as wishful thinking still leaves almost all relevant possibilities open. The power of groupthink, let alone prayer, is difficult to assess scientifically - but not therefore unreal.

Our main contention is that evolution cannot be explained by only material and efficient causes. They are necessary but not sufficient for the task. The chemical materials are necessary, as are the elaboratings of metabolic pathways within organisms and ecochemical cycles amongst them. But the patterns of evolution cannot have been produced by the mere outworkings of the laws of physics & chemistry. Ecological order, the grandest mechanism, implies design and therefore final cause. Consciousness is if anything even more glaringly not explained by mere efficient causes in biochemistry & biophysics[14].

We therefore return to Morton's exposition of the Four Causes: if the final cause - the person Babich - is required to explain the bottle of claret, mustn't we conclude that the living world is caused (in mysterious ways) by God's creative actions according to His plan? The efficient causes of organisms, seen in the record of evolution, require for explanation *the* final cause - God - working out his formal causes. (I recommend here, in passing, reflection on 'the Alpha and the Omega'; *e.g.* in The Millennium will formal cause have merged with efficient cause?)

I now proceed to interpret my original discipline, Biochemistry, on the understanding I just outlined.

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[12] J R Flynn, Massive IQ gains in 14 nations: what IQ tests really measure *Psych. Bull. 101* 171-191 1980

[13] Markus Possel & Ron Amundson 'Senior Researcher Comments on the Hundredth Monkey Phenomenon in Japan', *Skeptical Inquirer*, May/June 1996.

[14] I remark here that Heisenberg uncertainty is very unpromising as a source of free will, much as random mutation is a most unpromising source of order in ecology.

A scientist contemplating any living organism can ask three types of question which may be vernacularly put:-

What's In There?

What's It Doing In There?

How Does It Know What to Do In There?

These three questions - historically, tackled in that order (with overlaps in time) - correspond respectively to Aristotle's material, efficient, and final causes.

1 'What's In There?'

The list of biochemicals, the material constituents of organisms, includes many minerals in various chemical states, but most famously compounds of the element carbon.

Scientists call compounds of carbon 'organic', and the branch of chemistry analysing & synthesising carbon compounds is called organic chemistry. Millions of organic compounds are theoretically possible, and about one million are known, most of them not believed to occur naturally. No other element than carbon exhibits anything like this complexity in its chemistry. Vague talk of alternative biochemistry based on silicon is low-grade science fiction. Biochemistry is aqueous organic chemistry.

Until the early 19th c. - well into the age of 'Enlightenment' - chemists generally accepted that, while organic compounds such as indigo were susceptible of analysis to discover their molecular structures, artificial synthesis of an organic compound was subject to a subtle quasi-religious aura of impossibility or, at least, peculiar extreme difficulties. By the first artificial test-tube synthesis of an organic compound Wöhler in 1828 broke down the mystique. He made urea, an organic compound having a simple 8-atom molecule, identical to the main nitrogenous organic component of the urine from many types of animal. Synthetic organic chemistry then flourished magnificently, earning many Nobel prizes; and today even modified genes get synthesised in the lab (but only with the crucial selective catalyses of enzymes biosynthesised by, and then separated from, living organisms).

There certainly are further biochemicals to be discovered, but by the early 20th c. the catalogue was beginning - rather like pieces of a jigsaw puzzle - to make enough sense to allow asking the next question.

2 'What's It Doing In There?'

Some sketchy list of biochemicals having been compiled in the heroic age of 'natural product' organic chemistry, it became practicable to begin the search for metabolic pathways - the network of chemical reactions which build up (anabolism) and break down (catabolism) biochemicals within living cells.

Another category of what's 'doing' in living organisms is electrical processes, notably in nerves. These are conventionally assumed to be reducible to biochemistry. Genes are assumed to encode the full instructions for macromolecules, importantly proteins but also nucleic acids (RNA & DNA), and bioelectricity is assumed to be caused by the cooperating behaviour of some of these macromolecules along with lipids (fatty compounds) and some carbohydrates, in membranes. Similarly analysed are other transductions *e.g.* of chemical energy to mechanical energy in muscles. The discipline of physiology deals with these electrical and mechanical aspects of life, but the assumption is prevalent that those phenomena can be reduced to biochemistry.

By the mid-1960s J D Watson could advance (in the first edition of his textbook *Molecular Biology of the Gene*) some loose arguments that perhaps one-third of the metabolic pathways were known, for one species - a favourite subject of biochemists, the paradigmatic simple single-celled bacterium *Escherichia coli*. A vague feeling of quasi-completeness set in, at least for this and a few other relatively well-studied microbes. No longer did many biochemistry laboratories pursue discovery of further metabolic pathways; biochemists pressed on to the third category of biochemical question.

3 'How Does It Know What to Do In There?'

It is all very well to have a reasonably coherent picture of metabolic pathways - some idea of 'what's doing in there' - but how is this complex co-ordinated system unfolded as a frog zygote develops into a frog rather than a dog? This, the problem of development, had stimulated classical biologists to remarkable discoveries in embryology. The pattern of an organism's development as simply displayed within that species' life cycle had been investigated in some detail in a wide range of species. Restorative potentials were explored after various experimental ablations of anatomical or chemical parts. Patterns of biochemical coordination in time & space were explored in molecular detail, *e.g.* the biosynthesis of chlorophyll as a plant first meets light, or the biosynthesis of haemoglobin in mammalian cells specialised to produce this iron complex.

Development has been theorised as the successive expression of genes. The standard model has depicted the gene - in a cell nucleus or mitochondrion or chloroplast or plasmid or virus - as a stretch of DNA (or in some viruses RNA) constituting the linearly-encoded specifications to guide the synthesis of corresponding RNA, translated in most cases into corresponding protein molecules. Since the thousands of enzymes acting to catalyse their respective reactions within the metabolic pathways[15] are proteins, the general model emerges that development is largely a matter of synthesising, at suitable places & times, the appropriate amounts of the proteins - more generally, the macromolecules - which function in timely coordination to cause the dynamic network of chemical, electrical & mechanical processes occurring in living organisms.

Our first question asked for a static list. The second question was in essence dynamical - what *processes* occur in life? The third question not only asks about changing rates of biochemical reactions but also leads us to distinguish the different kinds of causes operating in biology.

If to explain a bottle of claret requires a final cause, how can a frog be assumed not to have been designed?

Biochemistry & physiology fall entirely within the categories of material and efficient causes. Regarding ontogeny, and perhaps even more strongly regarding phylogeny, such explanations - no matter how complete in themselves - should not be deemed to constitute between them total explanation in biology.

The assumption to omit final cause in biological theory has been little discussed. This assumption is a most important aspect of the popular attitude **scientific atheism**. But is it better than mere question-begging? I conspue its furtive role as an unstated axiom of many modern scientists. It is usually just a thinly-disguised assertion of atheism.

Here is the comment of a prominent (USA) intellectual regarding our basic argument.

> My hunch is that complexity among organisms will gradually become understandable within a broadly Darwinian framework, just as Dawkins has proposed. It's always a mistake, I believe, to take the still-unsolved puzzles of the natural world as evidence that they require a creator; this has been disproved at every juncture, and I'm pretty sure the process of secularizing nature's mysteries will continue.

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15 'Biochemical Pathways' wall-chart Mannheim: Boehringer Chemicals semi-annual

But do the laws of chemistry show much sign of explaining why the frog appeared in evolution? Is there even a glimpse of neo-Darwinian explanation why the type of algae known as diatoms do not appear in the fossil record until so recently as ca.150M year ago whereas the first algae were ca.3600M year ago? Can neo-Darwinism get far at all in explaining even simple organs in anatomy, let alone ecological behaviour such as migrations of eels or godwits? Sheldrake has argued that the popularisation of neo-Darwinist theory has amounted to little better than the issuing of an endless series of promissory notes. The actual achievements of scientific atheism in explaining life remain extremely slender.

It is not just that scientific atheism has made slower progress than it had hoped - though this sluggishness might be widely admitted. The inadequacy of explanation is not merely quantitative. The more important point is the qualitative distinction: no amount of explanation in the categories of material & efficient causes can suffice to explain life.

Biochemistry & physiology are rightly pursued on the working hypothesis that their discoveries will establish more & more facts in the categories of material & efficient causes; but non-existence of final cause is a working assumption for the purposes of scientific method, rather than a general philosophical axiom let alone a fact of biology.

Absence of final cause has been a most regrettable - crippling, I would argue - assumption in much recent philosophy of science, and in the actual teaching of science to students. This error has been an unadmitted ideological projection onto nature, much like the 'red in tooth & claw' canard - the idea that competition rather than co-operation is the main characteristic of ecosystems - which has been (as Goldsmith has argued in his magnum opus 'The Way') projected onto biology from the ideology known as economics.

I think what has essentially been going on since Darwin and Wallace presented their main idea is misuse of that idea as a weapon for atheists to club religion. The pretence that science can supplant religion, rather than cooperating with it, has been far too influential and should be promptly abandoned. The status of scientist confers no special authority in theology or even epistemology. Omitting half of the 4 causes is an axiom acquiring no valid augmentation of authority from Dawkins, Weinberg, Hawking, or any other scientist.

The end of 'creationism'

Morton brought up to date the 4 causes. We can now see that evolution, as a material process, is an array of efficient causes which cannot bear directly on the question of final causes (though it does give hints, explored in natural theology).

To admit evolution as a fact is not at all to deny creation but only to say that it has been more or less continuous. For a theist, as opposed to a deist, the concept of God's constant creative participation in the world is essential; the idea that novel species ceased to be created after the 6th day is more in the nature of deism and can hardly be claimed to give God more credit or respect.

The big bang and the subsequent workings of the laws of physics & chemistry - a dazzling set of efficient causes of the world we now live in - hardly begin to explain **why** organisms came into existence, or why they so marvellously cooperate in ecosystems.

The real issue is not the mischievous waste of time misleadingly called "creation science" which diverts thought into the phoney dispute 'evolution *v.* creation'[16]. The real issue is realistic explanation *v.* invalid neglect of final cause.

Dr Don Nield: Again I have no question but a comment. I think Drs Broom & Mann should perhaps be a little more careful in their terminology in talking about neo-Darwinism. Both speakers introduced the idea quite correctly - it is just the combination of genetics, especially as developed 1920-50, with the natural selection proposed by Darwin. But in fact many of those who developed neo-Darwinism were Christians. Shouldn't we distinguish neo-Darwinism from Dawkinsism?

Mann: That's a fruitful suggestion - any contemptuous focussing on Dawkins is very welcome to me [laughter]. He's a disgrace to science [laughter]. I'm glad you can laugh at that - I can't. I'm worried when science is disgraced to the extent of his selling millions of books. There's something very wrong with the public status of science when that kind of rubbish can sell to that extent. Sheldrake, by contrast, is in a different class - he's getting down to business; he's acknowledging all 4 causes, whereas Dawkins (while of course not being so helpful as to say so) is flagging away 2

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[16] Robert Mann & Neil Broom'Creationism *v*. evolution **but not** creation *v*. evolution' *Stimulus 8* (2) 16 - 21 (2000)

of the 4 causes. It's a travesty - a shocking bout of slum-dwelling in the history of intellectual activity.

Q: In the new age of quantum technology, when we find that time itself is a variable, might we not find in the future when the blinkers are taken from our eyes, maybe the Six Day notion is still on because Time itself changes in length? We all know that the atomic clock that goes from here to the moon & back runs slower than the one that stays on Earth.

Mann: I don't think that will get you very far at all in explaining the difference between 6 days and 6 billion years. The apparent variation in time to which you allude is not really cogent to anything I've discussed today. And here let me mention that the Heisenberg Uncertainty Principle which is intimately tied up with the realm of thinking you've referred to shows very little promise indeed regarding any of the questions I've touched on. It's essentially blind; it gives no hint of final or formal cause; it's just a source of randomness, which is *not* what we need to explain evolution.

Finlay: I see efficient and material causes as being rightly the subject matter of science. Final and formal causes are personal categories and therefore cannot ever be suitable for scientific investigation.

Mann: Yes!

Finlay: So it's not that formal & final causes can ever be biology; but the question is whether we add by faith personal causes to our biology or do we dismiss personal causes from our biology. The biology itself is the same.

Mann: Yes I think that's a very reasonable approach. Of course, it's always tempting to say the province of religion doesn't overlap with the province of science and therefore they can't come into conflict (let alone war according to A. D. White). There is some truth in that line, but it won't quite do; they do in fact overlap, and indeed we *want* them to overlap. We want a new biology to stop being so fixated by materialism and to explore seriously, as Sheldrake has led us to do, how biology could at last get interested anew in how final and formal causes are to be understood as affecting life. I don't want any more materialistic biology; I've pointed to main thinkers who are giving us some leads for re-integrating strictly 'scientific' biology with a much wider view. I

commend especially Professor Morton's paper in the Festschrift which will give you more leadership than you've yet seen.

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1 John Morton *Man, Science and God* pp13, 16 Auckland & London: Collins 1972
2 *e.g.* Descartes to Mersenne 1632 "I expect soon to be able to calculate the position of every star"
3 L Margulis & K V Schwartz *Five Kingdoms* Freeman 1998
4 (compiled in collaboration with Mr Art Haughey and Assoc. Prof. Jack Grant-Mackie)
5 N D Broom *Ecologist 28* (1) 23-28 (1998); much more detail in *idem* 'How Blind is The Watchmaker?' Aldershot: Ashgate 1998; revised edn. 2001 Downers Grove: IVP
6 M E J Taylor *Greek Philosophy - an introduction* pp120-121 London: Humphrey Milford, Oxford University Press 1924
7 A Flew *Introduction to Western Philosophy* p159 London: Thames & Hudson 1989
8 (but note that a person who tries to patent a transgenic organism is claiming to be a final cause)
9 It is possible to imagine reasons why Sheldrake normally inserts another syllable to say 'morphogenetic'.
10 C H Waddington *Towards a Theoretical Biology* 2 vols Edinburgh Univ. Press 1969
11 R Sheldrake *The Rebirth of Nature* pp88-90 Century 1990
12 J R Flynn 'Massive IQ gains in 14 nations: what IQ tests really measure' *Psych. Bull. 101* 171-191 1980
13 M Possel & R Amundson 'Senior Researcher Comments on the Hundredth Monkey Phenomenon in Japan', *Skeptical Inquirer* May/June 1996
14 I remark here that Heisenberg uncertainty is very unpromising as a source of free will, much as random mutation is a most unpromising source of order in ecology.
15 'Biochemical Pathways' wall-chart Mannheim: Boehringer Chemicals semi-annual
16 Robert Mann & Neil Broom 'Creationism *v*. evolution **but not** creation *v*. evolution' *Stimulus 8* (2) 16-20 (2000)