Design and Purpose

CREATION VS. EVOLUTION

A shattering critique of the PBS/NOVA television series 'Evolution'
By *Answers in Genesis*

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Information: A modern scientific design argument

by Russell Grigg

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All the design in living things is encoded in a sort of recipe book with lots of *information*. Information describes the *complexity* of a sequence — it does *not* depend on the matter of the sequence. It could be a sequence of ink molecules on paper (book) — however the information is not contained in the molecules of ink but in the *patterns*. Information can also be stored as sound wave patterns (e.g. speech), but again the information is not the sound waves themselves; electrical impulses (telephone); magnetic patterns (computer hard drive).

The anti-theistic physicist Paul Davies admits: 'There is no law of physics able to create information from nothing'. Information scientist Werner Gitt has demonstrated that the laws of nature pertaining to information show that, in all known cases, information requires an intelligent message sender,[1] a conclusion rejected by Davies on purely philosphical (religious) grounds. Thus a modern version of the design argument involves detecting high information content. In fact, this is exactly what the SETI project is all about — the Search for ExtraTerrestrial Intelligence involves trying to detect a high-information radio signal, which they would regard as proof of an intelligent message sender, even if we had no idea of the nature of the sender.

In living things, information is all stored in patterns of DNA, which encode the instructions to make proteins, the building blocks for all the machinery of life. There are four types of DNA 'letters' called *nucleotides*, and 20 types of protein 'letters' called *amino acids*. A group (codon) of 3 DNA 'letters' codes for one protein 'letter'. The information is not contained in the chemistry of the 'letters' themselves, but in their *sequence*. DNA is by far the most compact information storage/retrieval system known.

Now consider if we had to write the information of living things in book form. Dawkins admits, '[T]here is enough information capacity in a single human cell to store the *Encyclopaedia Britannica*, all 30 volumes of it, three or four times over'.[2] Even the simplest living organism has 482 protein-coding genes of 580,000 'letters'.[3]

Let's suppose we had the technology to go the other way, and store books' information in DNA — this would be the ideal computer technology. The amount of information that could be stored in a pinhead's volume of DNA is equivalent to a pile of paperback books 500 times as tall as the distance from Earth to the moon, each with a different, yet specific content.[4] Putting it another way, a pinhead of DNA would have a billion times more information capacity than a 4 gigabyte hard drive.

Just as letters of the alphabet will not write the *Annals* of Ennius by themselves, the DNA letters will not form meaningful sequences on their own. And just as the *Annals* would be meaningless to a person who didn't understand the language, the DNA 'letter' arrangements would be meaningless without the 'language' of the DNA code.

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Dazzling design in miniature

by Prof. Werner Gitt

First published in:
***Creation* 20(1):6**
December 1997–February 1998

THE cells of the human body can produce at least 100,000 different types of proteins, all with a unique function. The information to make each of these complicated molecular machines is stored on the well-known molecule, DNA.

We think that we have done very well with human technology, packing information very densely on to computer hard drives, chips and CD-ROM disks. However, these all store information on the surface, whereas DNA stores it in three dimensions. It is by far the densest information storage mechanism known in the universe.

Let's look at the amount of information that could be contained in a pinhead volume of DNA. If all this information were written into paperback books, it would make a pile of such books 500 times higher than from here to the moon! The design of such an incredible system of information storage indicates a vastly intelligent Designer.

In addition, there is the information itself, which is stored on DNA, and transmitted from generation to generation of living things. There are no laws of science that support the idea that life, with all its information, could have come from non-living chemicals. On the contrary, we know from the laws of science, particularly in my own area of expertise, that messages (such as those that we find in all living things) always point back to an intelligent message sender. When we look at living things in the light of DNA, Genesis creation makes real sense of the scientific evidence.

ADDENDUM TO *CREATION* MAGAZINE ARTICLE: CALCULATIONS BY DR GITT

The greatest known density of information is that in the DNA of living cells. The diameter of this chemical storage medium is d = 2 nm, and the spiral increment of the helix is 3.4 nm (1 nm = 10^{-9} m = 10^{-6} mm). The volume of this cylinder is $V = h \times d^2 \times \pi/4$:

$V = 3.4 \times 10^{-6}$ mm $\times (2 \times 10^{-6}$ mm$)^2 \ \pi/4 = 10.68 \times 10^{-18}$ mm^3 per winding.

There are 10 chemical letters (nucleotides) in each winding of the double spiral (= 0.34×10^{-9} m/letter), giving a statistical information density of:

$r = 10$ letters/$(10.68 \times 10^{-18}$ mm$^3) = 0.94 \times 10^{18}$ letters per mm^3.

This packing density is so inconceivably great that we need illustrative comparisons.

First: What is the amount of information contained in a pinhead of DNA? How many paperback books can be stored in this volume?

Example: The paperback *Did God Use Evolution?* has the following dates:

Thickness = 12 mm, 160 pages, L_B = 250,000 letters/book

Volume of a pinhead of 2 mm diameter (r = 1 mm):

$V_p = 4/3\ \pi r^3 = 4.19\ mm^3$

How many letters can be stored in the volume of 1 pinhead?

$L_p = V_p \times \rho = 4.19\ mm^3 \times (0.94 \times 1018\ letters/mm^3) = 3.94 \times 10^{18}$ letters

How many books can be stored in the volume of 1 pinhead?

$n = L_p/L_B = 3.94 \times 10^{18}$ letters /(250,000 letters/book) = 15.76×10^{12} books

What is the height of the pile of books?

$h = 15.76 \times 10^{12}$ books x 12 mm/book = 189.1×10^{12} mm = 189.1×10^{6} km

Distance to the moon M = 384,000 km

How many times the distance to the moon is this?

$m = h/M = 189.1 \times 10^{6}$ km /384,000 km = 492.5 times

Secondly: The human genome has 3×10^9 letters (nucleotides). In body cells there are 6×10^9 letters.

The length of the genome L_G is given by

$L_G = (0.34 \times 10^{-9}$ m/letter) x 3×10^9 letters = 1.02 m

The volume of the human genome V_G is

$V_G = L_G/\rho = 3 \times 10^9$ letters/$(0.94 \times 10^{18}$ letters/$mm^3) = 3.19 \times 10^{-9}\ mm^3$

Volume of a pinhead of 2 mm diameter: $V = 4/3\ \pi r^3 = 4.19\ mm^3$

How many human genomes could be contained in 1 pinhead?

$k = 4.19\ mm^3 / (3.19 \times 10^{-9}\ mm^3) = 1.313 \times 10^9$ times

These are the genomes of more than thousand million people or one fifth of the population of the world.

Thirdly: A huge storage density is achieved, manifold greater than can be attained by the modern computers. To grasp the storage density of this material, we can imagine taking the material from the head of a pin with a diameter of 2 mm and stretching it out into a wire, which has the same diameter as a DNA molecule. How long would this wire be?

Diameter of the DNA molecule d = 2 nm = 2×10^{-6} mm (radius r = 10^{-6} mm)

Cross-section A of the DNA molecule:

$A = r^2\pi = (1\ nm)^2\pi = (10^{-6}\ mm)^2\pi = 3.14 \times 10^{-12}\ mm^2$

Length of the wire L_W = Volume of the pinhead V_p / Cross-section A

$L_W = V_p/A = 4.19\ mm^3 / (3.14 \times 10^{-12}\ mm^2) = 1.33 \times 10^{12}$ mm = 1.33×10^{6} km

Length of the equator = 40,000 km

k = 1.334 x 10^6 km/ 40,000 km = 33.3 times

If we are stretching out the material of a pinhead into a wire with the same thin diameter as a DNA molecule it would have a length more than 30 times around the equator.

These comparisons illustrate in a breath-taking way the brilliant storage concepts we are dealing with here, as well as the economic use of material and miniaturisation. The highest known (statistical) information density is obtained in living cells, exceeding by far the best achievements of highly integrated storage densities in computer systems.

Blown away by design

by Michael Denton

First published in:
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Dr Michael Denton, M.D., Ph.D. is a molecular biologist at the University of Otago, New Zealand. He is not a Biblical creationist. However, his book *Evolution: A Theory in Crisis* has exposed thousands to the overwhelming scientific problems of Darwinian belief. Though he now describes himself as an 'evolutionist', he is more open-minded than most. He thinks that the design of living things probably implies creative intelligence. He has always been, and still is, adamant that Darwinism 'does not give a credible and comprehensive explanation of how the pattern of life on Earth emerged'.

Dr Denton agrees that natural (as well as artificial) selection is capable of generating some change in living things. But he says it is 'completely incapable of accounting for the broad picture, the complex adaptations required by the tree of life'.

The two most serious objections he has are as follows:

First, the nature of mutation (accidental changes in the genetic material of living things). He says that the 'essential bedrock of Darwinism' is the belief that 'all the organisms which have existed throughout history were generated by the accumulation of entirely undirected mutations'. In his professional opinion, 'that is an entirely unsubstantiated belief for which there is not the slightest evidence whatsoever'.

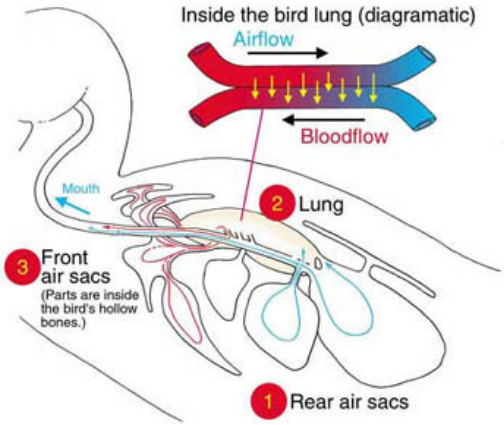
The second problem he sees is that there is 'a huge number of highly complex systems in nature which cannot be plausibly accounted for in terms of a gradual build-up of small random mutations'.

Indeed, he says, 'in many cases there does not exist in the biological literature even an attempt to explain how these things have come about'. A classic example, he says, is the lung of the bird, which is 'unique in being a circulatory lung rather than a bellows lung [see box]. I think it doesn't require a great deal of profound knowledge of biology to see that for an organ which is so central to the physiology of any higher organism, its drastic modification in that way by a series of small events is almost inconceivable. This is something we can't throw under the carpet again because, basically, as Darwin said, if any organ can be shown to be incapable of being achieved gradually in little steps, his theory would be totally overthrown.

'The fact is that, in common-sense terms, if you have no axe to grind, there are a vast number of such cases in nature.' Michael Denton, a recognised academic in his field, says that the claim that Darwinian gradualism 'can generate the sorts of complex systems we see throughout the biosphere is not only unsubstantiated, but in many cases it is actually beyond the realm of common sense that such things would ever happen'.

THE AMAZING BIRD LUNG

(see diagram on next page)



As a bird breathes, air moves into its rear air sacs (1). These then expel the air into the lung (2) and the air flows *through* the lung into the front air sacs (3). The air is expelled by the front air sacs as the bird breathes out. The lung does not expand and contract as does a reptile's or mammal's. The blood which picks up oxygen from the lung flows in the opposite direction to the air so that blood with the lowest oxygen (blue in the diagram always means lower oxygen, red means high oxygen) is exposed to air with the lowest oxygen. The blood with the highest oxygen is exposed to air with an even higher oxygen concentration. This ensures that, in every region of the circulation, the concentration of oxygen in the air is more than that of the blood with which it is in contact. This maximises the efficiency of oxygen transfer from the air to the blood. This is known as *counter-current* exchange. Such very efficient lungs help birds to handle the energy demands of flight, especially at high altitudes.[1]

REPTILE LUNG

The reptile lung, like ours, has an in-out bellows-like arrangement and does not have the counter-current circulation system.

For a reptile lung to change into a bird lung by small steps, while remaining functional throughout and providing a greater advantage at each step, defies imagination, according to Dr Michael Denton, an open-minded evolutionist.

The quotations in this article were extracted (with permission) from a video interview available on cassette (NTSC) from Access Research Network, PO Box 38069, Colorado Springs CO 80937-8069, USA. It was then re-checked with Dr Denton to ensure it fairly represented his current views.

NOTE

1. Actually, bats do very well with the 'bellows' type of lung. This makes the selectionist argument for the origin of birds' lungs (i.e. that they 'needed' them) even more difficult to sustain.

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Great gecko glue?

by Jonathan Sarfati

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It's quite a sight to see geckos, small tropical lizards, running up and down walls and across ceilings, without any trouble. But what makes their feet stick? Several plausible ideas have been disproved:

- **Suction?** Suction caps work because air pressure on one side is no longer counterbalanced if there is a vacuum on the other. Because normal air pressure is 100 kPa (kilopascals), or 14 pounds per square inch, suction can be very effective. But geckos' feet can stick in a vacuum where there is no air pressure, so suction cannot be the reason.

- **Electrostatic attraction?** This is the attraction between electrically charged objects, for example a plastic comb rubbed with cloth can pick up small pieces of paper. But when researchers zapped the surrounding air with X-rays to form charged molecules (ions), which would cause any charge to leak away, the feet still stuck.

- **Ordinary glue?** There are no skin glands to produce any.

- **Friction?** Keratin, the protein in skin, is too slippery.

- **Interlocking between rough surfaces?** Geckos can even stick to polished glass.

The best explanation seems to be that the geckos' feet can exploit the weak short-range bonds between molecules.[1] That is, they stick via *van der Waals forces*.[2] But for such weak forces to work, there must be an enormous intimate contact area between foot and surface, so that enough individual weak forces can add up to a very strong force.

Under an electron microscope, researchers have found that the feet have very fine hairs (*setae*), about 1/10th of a millimetre long and packed 5,000 per square mm (three million per square inch). In turn, the end of each seta has about 400–1,000 branches ending in a spatula-like structure about 0.2–0.5 µm (microns—less than 1/50,000th inch) long. These *spatulae* can provide the necessary contact area. [Ed. note: the original Creation magazine published some fascinating photographs, thanks to one-off permission from the head gecko researcher, Dr Kellar Autumn. Those photos and more can be seen on his website: http://www.lclark.edu/~autumn/private/u38j47a0t/images.html]

With special instruments,[3] a team of biologists and engineers from several American universities analysed a seta from the foot of a Tokay gecko (*Gekko gecko*). The foot pad has an area of about 100 mm^2 (0.16 sq. inch) and can produce 10 newtons of adhesive force (enough to support two pounds). But they showed that an individual seta had an attractive force 10 times stronger than expected. In fact, one seta is strong enough to support an ant's weight, while a million could support a small child. So the gecko has plenty of attractive force to spare. This means it can handle the rough, irregular surfaces of its natural habitat.

Actually, the attractive force is far greater when the seta is gently pressed into the surface and then pulled along. The force also changes with the angle at which the hair is attached to the surface, so that

the seta can detach at about 30°. These elaborate properties are exploited by the gecko's 'unusually complex behaviour'[1] of uncurling its toes when attaching, and unpeeling while detaching. This all means that the gecko can not only stick properly with each step, but also avoid getting stuck, all without using much energy.

Another amazing feature is that the gecko's feet are self-cleaning—unlike sticky tape, to which dirt easily sticks, rendering it useless. The researchers are still trying to find out how geckos manage that.

One evolutionist said: 'It's great to look at how evolution has solved mechanical problems'.[4] But he never said *how* evolution, via chance mutations and natural selection, could have produced the complex foot structure as well as the movement pattern needed to use the structure properly. For example, there was no explanation of how half-formed setae and spatulae and an imperfect movement would benefit the animal and thus be selected for. This seems more like blind faith for people who have ruled out a Designer by decree.

But is this legitimate? The researchers commented that designing such a structure is 'beyond the limits of human technology',[1] especially finding a material that can be split so finely 1,000 times. If the structure is 'beyond the limits of human technology', then it's reasonable to believe that it was designed by One whose intelligence is beyond our own.

They also pointed out that the 'natural technology of gecko foot hairs can provide biological inspiration for future design of a remarkably effective adhesive'.[1] In fact, giving robots sticky feet and getting them to walk the way geckos do (with the uncurling/unpeeling action) has made 'champion climbers' out of two robots.[5] Dr Autumn also commented: 'Geckos can do things that we just can't do with current robotics and adhesive technology.'[6]

So not only can we not design anything as complex as the gecko's foot, human designers are learning new things from it. This speaks of a Master Designer of the foot, who programmed the complex 'recipe' for the foot, as well as the movement patterns, into the gecko's DNA.

'For the unseen things of Him from the creation of the world are clearly seen, being realized by the things that are made, even His eternal power and Godhead, so that they are without excuse' (Romans 1:20).

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Lobster eyes—brilliant geometric design
Lobster eyes, X-ray telescopes, and microchips

by Jonathan Sarfati

First published in:
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The eye of a lobster (and some other 10-legged crustaceans[1] including shrimps and prawns) shows a remarkable geometry not found elsewhere in nature—it has tiny facets that are perfectly *square*, so it 'looks like perfect graph paper.'[2] This is needed, because the eye focuses light by *reflection*, unlike most other eyes that focus by *refraction* (bending of light) by a lens. The graph paper appearance is caused by the ends of many tiny square tubes on a spherical surface. The sides of the tubes are very flat and shiny mirrors, and their precise geometrical arrangement means that parallel light rays are all reflected to a focus [3,4] (see diagram, left). The square arrangement is crucial, because only with the reflectors at right angles can it form an image from light rays from any direction.[4] Also, only if the tubes are about twice as long as they are wide can they reflect most light rays off *exactly two* mirrors.[4]

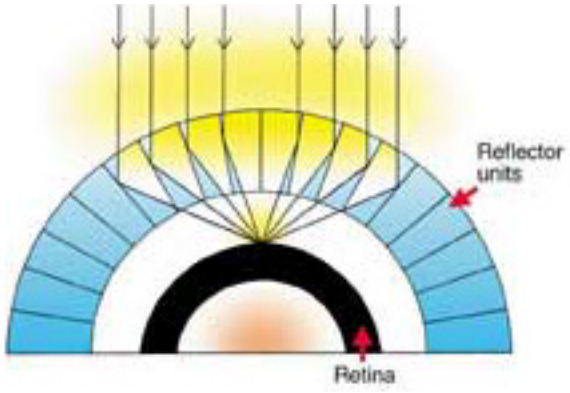

Diagram showing how the lobster eye focuses light. Adapted from Denton, Ref. 5.

Concentrating light from a relatively wide area is useful when it's quite dark, but in bright light the lobster's eye moves opaque pigment to block all light rays to the retina other than those parallel to the tubes.[5]

'LOBSTER EYE' FOCUSES OUTER SPACE X-RAYS

Not only does the lobster eye have all the earmarks of being designed by a master designer, it has also inspired human designers. Astronomers had wanted a telescope that could focus X-rays from certain heavenly bodies, but there was no practical lens that would focus X-rays. An ordinary concave mirror wouldn't work, because X-rays would just go through—they reflect only at glancing angles. But Roger Angel of the University of Arizona pointed out that this problem 'might be overcome by copying the design of crustacean eyes.'[6,7] *The Lobster Eye*, launched by a satellite, should enable astronomers 'to observe a quarter of the sky at any one time'.[6] An elaborate process produces a 5 by 5 cm (2 by 2 inches) array of tiny (10–200 microns (μm)[8] across) square, hollow tubes made of X-ray-reflecting lead glass, about 0.5–1.0 mm deep, then heated and curved into part of a sphere, just like the lobster eye. A hundred of these would be grouped into modules, and 20 modules fitted to the telescope.

'REVERSE' LOBSTER EYE DESIGNS FINE MICROCHIPS

The lobster eye design could also help in making computer chips with electronic components

hundreds of times smaller than is possible today. Chips are made with photolithography, where a beam of parallel light shines through a stencil-like mask onto a semiconducting material, and changes it so that acid will not etch the part exposed. Then acid etches the rest away, leaving the desired

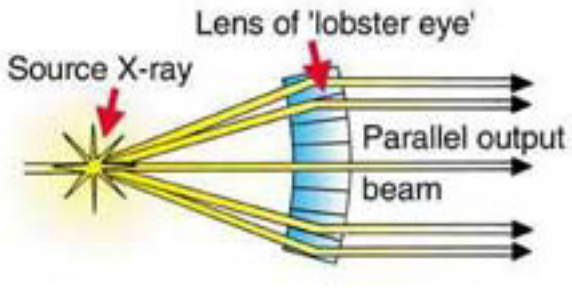

Diagram showing how a lobster eye lens working in reverse generates a parallel X-ray beam. Adapted from Chown, Ref. 9.

pattern. However, there is a limit to how small the pattern can be, because light bends around edges (diffraction), thus spoiling the pattern. Shorter wavelengths mean less diffraction, and use of ultraviolet light has resulted in components only 0.18 µm across. X-rays would be ideal because of their tiny wavelength, but it has been expensive to produce a parallel beam. This is solved by a device like the *Lobster Eye* telescope—but running in reverse, as it were (see diagram above) X-rays are produced by a laser zapping a small point of metal and heating it to about 1 million °C (almost 2 million °F)—this spot is strategically located at the focus of the 'lobster eye', and a parallel beam emerges from the 'eye'.[9]

LOBSTER EYES: CHANCE OR DESIGN?

Despite the enormous human ingenuity behind these artificial 'lobster eyes', evolutionists refuse to acknowledge a designer for the real thing, which must also be able to repair itself and be connected to a data processor (brain) as well! A designer violates the self-serving 'rules of the game' decreed by materialists (cf. Romans 1:18 ff.).[10]

Instead, they generally believe that this eye evolved from a refracting compound eye with round or hexagonal (six-sided) tubes, as other crustaceans have. Claimed supporting evidence is that the free-swimming lobster larva has a refractive eye, which is transformed into the reflective eye of the adult. However, this is just a variant of the thoroughly discredited embryonic recapitulation theory, which was supported by forged drawings.[11] Lobsters clearly already have in place the genetic 'programming' for the transformation—this does not explain how this information arose in the first place! Neo-Darwinist theory requires:

1. A pathway of many tiny steps, with each new change caused by genetic copying mistakes (mutations).

2. Each step must have an advantage over the previous one, so its possessor will leave more offspring (natural selection).

The lobster eye seems to illustrate 'irreducible complexity'.[12] That is, unless all the right parts were in the right arrangement, all at once, light rays would not focus. Further, the mirror arrangement produces an upright image, while a lens produces an *inverted* one, so the brain would also need to be reprogrammed to interpret this major change. Hypothetical intermediate steps between a refractive and reflective eye, e.g. a halfway stage between a hexagonal and square tube, or between a mirror and a lens, would produce a much worse image.[5] An organism with such an eye for life would have a serious disadvantage, so natural selection would work *against* such intermediates. And even a fully formed reflective eye (mathematically impossible to produce in a single step) seems to have little or no selective advantage over the refractive eye, since crabs—which have roughly the same lifestyle in a similar environment—manage fine with refractive eyes. So if even a fully formed reflective eye has

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little advantage, how much less could natural selection work on hypothetical intermediates, which must have been even less advantageous?[13]

CONCLUSION

The lobster eye exhibits amazing design, and has even inspired human designers to copy it for advanced technological applications. This eye, like many other features in living organisms, defies all plausible attempts to explain it without a Designer.

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Trilobite Technology

by Charles Stammers

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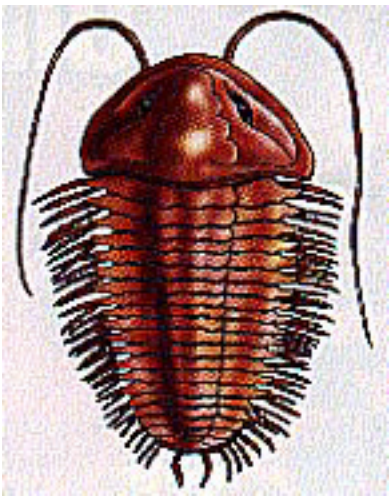
TRILOBITES, DESCRIBED BY Stephen Jay Gould as 'everyone's favourite invertebrate fossil', are a class of marine arthropods which are often well preserved and of striking appearance.[1,2] They are believed to be extinct.



They are mostly between 10 and 50 mm long (3/8 to two inches) although a few species attained a length of 750mm (2 1/2 feet). Trilobites are characterized by a ridged carapace, or shell, made of chitin, divided into three lobes which give the class its name.While most trilobites had eyes, a number had none. A common form of trilobite eye consisted of an array of rods known as *ommatidia*, each of which pointed in a slightly different direction. The array was protected by a transparent-membrane, or cornea. Such eyes are also found in insects and crustaceans.However, within the family Phacopidae, there were trilobites with an eye of a fundamentally different nature, the *aggregate* or *schizochroal* eye.

Trilobites are mostly found in Cambrian rock,[3] which evolutionists claim was laid down hundreds of millions of years ago. Most people mistakenly think that these were much simpler creatures than today's. This is actually not true. The aggregate eye, for example, reveals remarkably precise design. The details in the technical section below show us that this trilobite eye, far from being 'primitive', was constructed on the basis of precise optical engineering principles which people only discovered a few centuries ago.

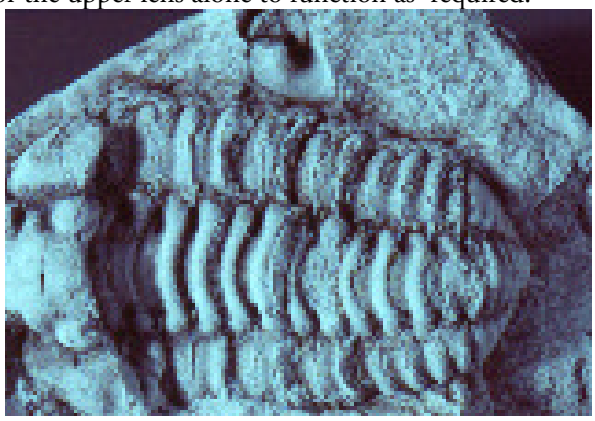
It is pointless to talk of 'natural selection acting over millions of years' as the cause of this brilliant design. There is no record of indifferently designed lower lenses. More importantly, there is no need for the trilobite to have had a perfect eye, or even any eye at all. Many had no sight, but there is no evidence that they coped any less well.

Evolutionists claim that 'design' in nature is only in response to need. However, from a creation perspective, design in organisms, though certainly related to functional need, also glorifies God and testifies to Him. Romans 1:20 reminds us that 'the invisible things of him from the creation of the world are clearly seen, being understood by the things that are made, even *his eternal power and Godhead; so that they are without excuse.'*

TECHNICALLY SPEAKING … THE AGGREGATE EYE OF THE PHACOPID TRILOBITE

The aggregate eye has a lens which consists of two parts. The upper lens is of oriented calcite (refractive index n = 1.66) and the lower of chitin (refractive index n = 1.53). The shape of the common boundary is described by a fourth-order equation.

Professor Levi-Setti, an authority on trilobites, states that with a calcite lens immersed in water (as would be the case for trilobites) it is impossible for the upper lens alone to function as required.[4]



The lower lens is shaped to correct the ray pattern emerging from the calcite lens and to focus all rays on a common point.

A similarly shaped boundary for a glass lens in air was deduced by both Descartes[5] and Huygens.[6]

In regard to the trilobite lens, Levi-Setti states[1]

'There is in fact only one choice of indices for which the lens brings an incident parallel beam to a focus. This involves the upper lens being made of calcite (n = 1.66) and the intralensar bowl being made of chitin (n = 1.53).'

Dr Levi-Setti concluded:

'Trilobites had solved a very elegant physical problem and apparently knew about Fermat's principle, Abbé's sine law, Snell's laws of refraction and the optics of birefringent crystals …'.[7]

CHARLES STAMMERS, B.Sc.(Hons.), Ph.D. (Mech. Eng).

Dr Stammers was converted from atheism whilst a post-graduate student. Since 1973 Charles has lectured in Mech. Engineering, University of Bath. With 52 publications in the field of engineering, he says he knows design when he sees it.

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Design in Living Organisms: Motors

by Jonathan Sarfati

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In our everyday experience, we can usually tell whether something has been designed. The main evidence is high *information content*. The information content of any arrangement is the size, in bits, of the shortest algorithm required to generate that arrangement. This means that repetitive structures, like crystals, have a low information content, because all that it needed is to specify a few positions, then the instructions 'more of the same'. The difference between a crystal and an enzyme or DNA is like the difference between a book containing nothing but ABCD repeated and a book of Shakespeare.

On a practical level, the information specifies the many parts needed to make machines work. Often, the removal of one part can disrupt the whole machine. Biochemist Michael Behe, in his book *Darwin's Black Box*, calls this irreducible complexity.[1] He gives the example of a very simple machine: a mousetrap. This would not work without a platform, holding bar, spring, hammer and catch, all in the right place. The thrust of Behe's book is that many structures in living organisms show irreducible complexity, far in excess of a mousetrap or indeed any man-made machine.

MOTORS: A CASE STUDY

Motors are irreducibly complex, because they need many parts working together to function. For example, an electric motor needs a power source, fixed stator, movable rotor, and a commutator or slip rings.

The more parts needed for a machine, the harder it is to make it smaller. Miniaturisation is such a vital part of the computer industry, and the best human minds are constantly working at it. And though miniaturised motors would be very useful, e.g. for unblocking clogged arteries and blood cleaning, the number of parts makes it difficult to make them below a certain size. But ingenious scientists are making them smaller all the time.[2]

However the design in living organisms has far exceeded our most painstaking efforts. Bacteria propel themselves using *flagella*, filaments propelled by a true rotary motor. This motor is only the size of a virus, thus far smaller than anything man-made. Yet it can rotate at over 1000 times per second.[3]

But even this impressively tiny motor is not the tiniest in God's creation. In a paper published in March 1997, Hiroyuki Noji *et al.* directly observed the rotation of the enzyme *F_1-ATPase*, a subunit of a larger enzyme, *ATP synthase*.[4,5] This had been suggested as the mechanism for the enzyme's operation by Paul Boyer.[6] Structural determination by X-ray diffraction by a team led by John Walker had supported this theory.[7] A few months after Noji *et al* published their work, it was announced that Boyer and Walker had won a half share of the 1997 Nobel Prize for Chemistry for their discovery.[8]

The F_1-ATPase motor has nine components — five different proteins with the stoichiometry of $3\alpha{:}3\beta{:}1\gamma{:}1\delta{:}1\varepsilon$. In bovine mitochondria, they contain 510, 482, 272, 146 and 50 amino acids respectively, so M_r = 371,000. F_1-ATPase is a flattened sphere about 10 nm across by 8 nm high —

so tiny that 10^{17} would fill the volume of a pinhead. This has been shown to spin 'like a motor' to produce ATP, a chemical which is the 'energy currency' of life.[9] This motor produces an immense torque (turning force) for its size — in the experiment, it rotated a strand of another protein, *actin*, 100 times its own length. Also, when driving a heavy load, it probably changes to a lower gear, as any well-designed motor should.

ATP synthase also contains the membrane-embedded F_0 subunit functioning as a proton (hydrogen ion) channel. Protons flowing through F_0 provide the driving force of the F_1-ATPase motor. They turn a wheel-like structure as water turns a water wheel, but researchers are still trying to determine precisely how. This rotation changes the conformation of the three active sites on the enzyme. Then each in turn can attach ADP and inorganic phosphate to form ATP. Unlike most enzymes, where energy is needed to link the building blocks, ATP synthase uses energy to link them to the enzyme, and throw off the newly formed ATP molecules. Separating the ATP from the enzyme needs much energy.

ATP synthase is the central enzyme in energy conversion in mitochondria, chloroplasts and bacteria. Since energy is required for life, and all life uses ATP as its energy currency, life could not have evolved before this motor was fully functional. Natural selection by definition is differential reproduction, so requires self-reproducing entities to start with. So even if a series of gradual steps could be imagined up this peak of 'Mount Improbable', there would be no natural selection to enable that climb.

One of the *Nature* articles was appropriately entitled 'Real Engines of Creation'. Unfortunately, despite the evidence for exquisite design, many scientists (including the editor of *Nature*) still have a blind faith that mutations and natural selection could build such machines.

WOULD ANY EVIDENCE CONVINCE EVOLUTIONISTS?

The famous British evolutionist (and communist) J.B.S. Haldane claimed in 1949 that evolution could never produce 'various mechanisms, such as the wheel and magnet, which would be useless till fairly perfect.'[10] Therefore such machines in organisms would, in his opinion, prove evolution false. These molecular motors have indeed fulfilled one of Haldane's criteria. Also, turtles[11] and monarch butterflies[12] which use magnetic sensors for navigation fulfil Haldane's other criterion. I wonder whether Haldane would have had a change of heart if he had been alive to see these discoveries. Many evolutionists rule out intelligent design *a priori*, so the evidence, overwhelming as it is, would probably have no effect.

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