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Review: Prof. Stuart Burgess and Dominic Statham, *Inspiration by Creation: How Engineers Are Copying God's Creation*, Creation Book Publishers, Atlanta, GA, 2018

Pages: 121

They Are Without Excuse

Professor Stuart Burgess is an accomplished engineer and creationist who shows in this book how inferior his complex designs are, compared to the grandeur of what has been created.

The four-bar satellite arm mechanism, mechanical dragonfly, and fish-jaw hand inventions all point to a superior sophistication and technology ("supreme design") in the real thing, and in so doing should convince any rational person of God's existence:

"For 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:"
Roman 1.20, Authorized Version

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Preface (pp. 7-10)

Ancient Egyptians modelled their columns on palm trees, and medieval architecture was based on natural curves.

"Supreme design" means exceptional fitness.

I) The Design Argument (pp. 11-26)

The Big Bang theory requires both large and small stars.

The simplest organism requires over 350 genes, which is a *tacit admission of irreducible complexity and the phenotypic level.*

Professor Harold Morowitz estimated the chance of life spontaneously forming was 1 in $10^{40,000}$.

Professor Theodosius Dobzhansky said, "Prebiological natural selection is a contradiction in terms."

The central rotor of the ATP synthase engine spins at over 9,000 rpm.

A kinesin transport machine is 70 X 10^{-9}m long, travels at over 2,000km hr^{-1} (100 steps per second), and has a power-to-weight ratio 15 times a gasoline engine.

Gas turbine engines replaced piston ones because they had a much higher power-to-weight ratio.

Transistors replaced thermionic valves in digital computers.

Engineers often achieve good design by *brainstorming.*

William Paley (1743-1805) published his book in 1802, twenty-three years *after* David Hume's book (which supposedly refuted it!)

II) Why Engineers Need Inspiration (pp. 27-34)

Thomas Newcomen designed the first steam engine in 1712.

Nikolaus Otto designed the first combustion engine in the 1860s.

"Engineer" is derived from the Latin "ingenium"

Satellite solar panels must be folded and stored for launch, then unfolded once in orbit.

Professor Burgess' double-action worn gearbox was critical for the £1.4b Envisat mission.

The conceptual design process involves: (i) studying the competition; (ii) reverse engineering; (iii) brainstorming; (iv) structured questioning; (v) inversion [co-option]; (vi) freehand sketching; (vii) first principles studying; (viii) functional decomposition [divide and conquer]; (ix) bioinspiration.

III) Important Examples of Bioinspired Design (pp. 35-44)

The first aeroplane had to have a lightweight structure, aerodynamic wings, a powerful and lightweight engine, and control flaps for landing. Prior to 1899, engineers did not understand the need for control flaps and thought navigation could be achieved by the pilot shifting his body weight.

Bird tail feathers provide them with a stabilising force.

"Velcro" is a French comportment of *velours* (velvet) and *crochet* (hook) and was discovered in 1948.

Man-made materials develop small cracks after repeated loading. So far, polymers have been designed with self-contained glue capsules that activate if a crack occurs. One complex alternative would be to have an interconnected tubular vascular network.

The skin's blood vessel network permeates every section of skin so as to be in a position to repair damage at any location.

Shark skin remains very clean and was the bioinspiration for "Sharklet" plastic which has a microscopic diamond pattern that prevents biofilm accretion.

Biofouling of hulls reduces shipping efficiency by fifteen percent. Shark skin does not suffer the same problem because it generated microvortices and turbulences with motion.

The Bombardier Beetle sprays out a irritant p-benzoquinone in a high-frequency pulse or mini explosions. Biomimetics 3000 have developed a uMist spray based on the beetle's delivery mechanism.

<u>IV) A Dragonfly-Inspired Air Vehicle (pp. 45-56)</u>

There is a pressing need for small air vehicles about fifteen centimetres in length for surveillance and urban warfare.

Insect flapping involves more twisting than in birds. Their wingtips create circular leading edge air vortices.

Copying two pairs of wings in the dragonfly was considered too much of a challenge. Their wings flap forty times per second and have two twisting actions at the end of the upstroke and down strokes. The total flap angle is 80^o and the twist is 40^o.

The author and team used two four-bar parallelogram mechanisms to create the twisting motion, with a 'phase-lag' between them. The physical equations to solve involved eight bar lengths and one phase angle.

The end product had a 150mm wingspan and weighed 10g. The linkage bars were under a millimetre in diameter and the wings were mylar with metal ribs and could only flap at seven beats per second [however, this could be pushed to 12Hz before the drive components would fail]. Assembly required precision tweezers and large magnifying glasses.

Dragonfly nypmhs live in the water for up to four years and after they change into flies live another two months.

The dragonfly wing is irreducibly complex as the four bars and joints must be in place simultaneously for flapping to work.

The teams Micro Air Vehicle (MAV) was 1,000 times heavier than the real thing!

V) A Knee-Inspired Robotic Joint (pp. 57-67)

Over seventy years, the human knee joint moves millions of times, utilising a 'condylar joint'. This is a rolling cam and linkage system or an "inverted parallelogram four-bar mechanism".

The femur condyles are covered in cartilage to ensure smooth functioning of the joint.

VI) A Fish-Jaw-Inspired Robotic Hand (pp. 68-79)

The WHO estimates 15m people suffer stroke each year and about a third die.

Each figure of the hand has a protective sheath which is diagonally oriented to maintain a constant tension. Finger tendons are also bifurcated for better joint movement.

Due to technical limitations, the team could not copy every joint of the human hand.

Four-bar mechanisms are very good at giving precise motions.

The Slingjaw Wrasse fish can extend its mouth up to 65% from its head up to 10gs acceleration. This value is proportional to the square root of the fish's length and any advantage disappears over 35cm.

VII) Examples of Outstanding Design in Nature (pp. 81-105)

The epidermis is multi-layered and only 0.1mm thick.

Combining toughness and sensitivity is very challenging.

Filaggrin binds keratin fibres together as mortar holds bricks together.

Melanocytes produce the light-sensitive chemical melanin.

Damaged foot nerves make people injury prone and cause ulceration.

Humans are better than machines at picking tomatoes since they don’t damage the fruit.

The adult heart pumps 7,000 litres of blood each day. It has two circuits, the pulmonary which transports carbon-dioxide rich blood to the lungs for exhalation and picks up oxygen by attaching the molecule to haemoglobin, and the systemic circuit which transports oxygen-rich blood to the body and de-oxygenated and carbon-dioxide-rich blood back to the heart.

The systemic circuit requires a higher pressure since the blood must travel to the whole body, not just the lungs, meaning the separation of the system into two is more efficient. Also, it is superior to a series design in case of damage.

Such a complex plumbing system cannot evolve by Darwinian natural selection and random mutation.

Fish only have a single circulatory system.

Engineers are taught not to design bottom-up since it is impossible to foresee any sub-system requirements.

The heart weighs only 300 grams and has two parts or pumps, a left and right. Each ventricle contracts after the atrium with a precise timing delay, beating 2.5B times over an 80-year lifespan.

Heart muscle cells contain many mitochondria.

A highly-trained athlete can pump thirty litres of blood a minute and long-term aerobic exercise can increase heart muscle mass by 40%.

The heart is covered by a sac called the pericardium, having fluid between them to reduce contraction friction. Because of this, man-made hearts only last three or four years, needing an external power supply. These also damage the blood as the generate an uneven flow.

Supposedly, the four-chambered heart evolved from the three-chambered amphibian, which in turn came from the two-chambered fish heart. However, this is impossible since the rewiring and plumbing changes would have to be simultaneous to avoid death.

Each adult has around five litres of blood which can transport nutrients, fight infections, transfer heat, and clot to aid in wound healing.

An adult has 25T red blood cells, 40B white blood cells and 1T platelets which all circulate in about a minute.

When blood system sphincters shut, blood flows through shunt vessels to conserve heat (which is why the hands and feet feel cold).

RBC production is controlled by a kidney hormone and the bone marrow, spleen, and lymph nodes.

Protein chaperonins reject parts which do not conform to their specification.

VIII) Objections to Design (pp. 106-119)

The human S-shaped spine is called “lordosis”.

The eagle’s eye is ‘backwardly designed, yet it is so good that it can spot a rabbit at over 3km!

IX) Design and the Designer (pp. 120-127)