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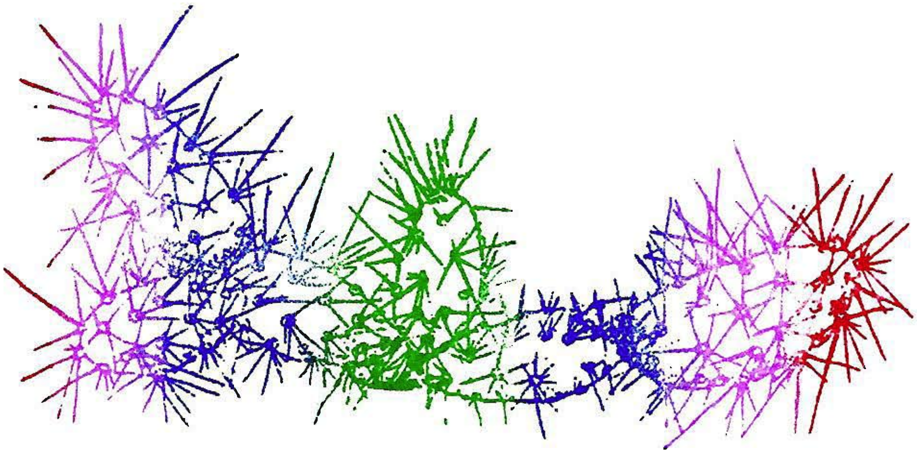

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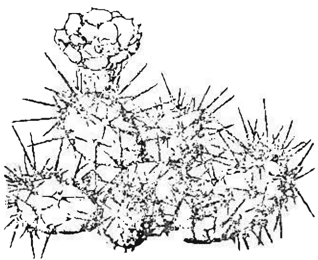
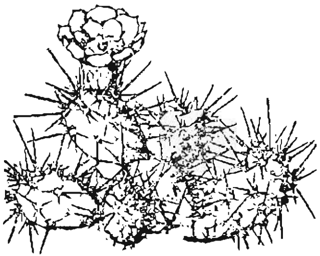




ALIENS AND OTHER EARTH LIFE FORMS
by Dale Speirs

The Shape Of Things To Come.

Review of **The Science Of Aliens** by Clifford Pickover [3]. Not fact but not fiction either; this book is in the realm in between where everything begins with the question "What if ... ". Pickover discusses how aliens from other worlds might look, a useful guide for world builders such as science fiction or alternative history writers.

His methodology is to compare hypothetical aliens with the ones on our planet, all the other species we share Earth with. As Pickover writes: " *... the most exotic journey would not be to see a thousand different worlds, but to see a single world through the eyes of a thousand different aliens.*". We have difficulty understanding the thought processes of a dog or a gorilla. What could be more alien than the Burgess Shale fossils, species so bizarre that even figuring out which is the front end of the animal is a challenge.

First Contact is the beginning point. We have already sent out our first signals to the stars, all the television and radio broadcasts since the 1920s. It is assumed that the first alien signals we receive will be purposeful mathematical equations, but they could just as easily be sending us their entertainment, their version of "I Love Lucy" or "Hockey Night In Canada". The greatest danger of First Contact is that the wrong sub-group on either side might make the contact. Pickover remarks that: "*We also arbitrarily equate advanced technology with advanced social development.*".

But all of that commentary is only by way of introduction to the main part of the book, on how aliens would evolve on a myriad of worlds and how their behaviour would be a function of that evolution. Pickover works from first principles to predict how natural selection would produce aliens. He discusses ecological classes (herbivores, carnivores), manipulative appendages (hands, tentacles), and sensory organs (eyes, nostrils).

The details would vary between ecosystems, but aliens would probably evolve tube digestion since flow processing is more efficient than batch processing. Centralized nervous systems will produce brains, for contrary to what Internet fanatics will tell you, a central system is more efficient when economics is considered (which, as any stock broker can advise, is not the case with the Internet). Intestines and brains inevitably lead to bilateral symmetry. Sense organs will be concentrated near the mouth to examine food. The brain need not be near the sensors, nor is the humanoid shape inevitable. Intelligence is <u>not</u> selected for by evolution since there is no relation between the success of a species and its intellect. (Insert obvious joke about humans here.)

The book compares alien traits with Earth critter senses, and extrapolates how body development would affect behaviour. On a cloud-shrouded planet where vision is useless, for example, scent would be a means of communication. Pickover then takes this as an example and compares it to Earth moths which communicate by pheromones. From there the next step is to consider how a scent-communicating species would develop their society. Their mathematics, for example, would probably use fuzzy logic, as the aliens would think in terms of continua, not abrupt edges or integers as a vision-based species such as humans do.

In the next section, Pickover considers the environments that aliens could live in, and again makes the comparison with Earth habitats. Not standard habitats like forests, meadows, or the first 100 metres of ocean, but the habitats we have that are as bizarre as anything an SF writer could think up.

Hydrothermal vent organisms gathered around deep sea magma tubes live at 400°C (water does not boil because of the pressure). Existing more than two kilometres below the surface, worms, fish, and other species live directly or indirectly off chemotrophic bacteria that get their energy from sulphides and heavy metals. Elsewhere in the deeps, worms live 6.5 km below, tolerating 650 Gs of pressure in their methyl hydrate habitats.

South African gold mines 3.5 km deep have bacteria living in the ore. It is estimated that the biomass of microbes living in the bedrock of the Earth far below the surface is the same or greater than that on the surface. Life is slower paced due to energy constraints, with bacteria cell division perhaps once a year or once a century.

Not just microbes down below. Cave dwellers living in perpetual dark are not rare. With no light for photosynthesis, the sulphide bacteria are the basis of the food chain that supports insects, crustaceans, and fish with no eyes. Animals trapped in caves evolve new eyeless species for that habitat, feeling their way around with whiskers or antennae. Pickover discusses Movile Cave in Romania, known to have been sealed for 5 million years before accidental discovery in 1996, and supporting 30 species unknown elsewhere, fully adapted to perpetual dark. He asks: "*If humans were placed in an environment like Movile Cave, with sufficient oxygen leaking into the cave via minute cracks, what kinds of creatures would we evolve into in the next 5 million years? Would our eyes fade away? Would our fingertips become extrasensitive?*"

Cold is another habitat for alien life, both here and off-planet. Antarctic fish survive with glycopeptide antifreeze in their blood. Plants in the Arctic survive -80°C by dehydrating to prevent ice crystals from rupturing cells. Red snow and green ice are tinted by algae.

Out in space, brown dwarfs, halfway between stars and planets, could support life since they generate non-fusion heat internally. Cosmology has always depressed me because entropy makes all life apparently futile. Pickover considers alien life when the universe is 10^{100} years old. By then all the stars are long burned out and gone, matter has evaporated, and the universe is a diffuse ocean of electrons. Aliens living as electrical organisms would be very slow thinking by our standards due to the low energy level, but fast enough to the Diffuse Ones when time is of no consequence.

Pickover discusses panspermia, natural or directed, the idea that Earth may have been seeded with life from space. 10,000 tons of cometary dust fall into Earth each year, most of it organics and complex molecules. Fred Hoyle and others consider the possibility of that dust being cosmic seeds. Might there be some alien pathogens in the dust as well? Pickover doubts it, because alien pathogens would not be specific to our species.

Panspermia raises the question of the origin of life on Earth. Experiments reproducing early Earth conditions demonstrate that the precursors of proteins and RNA are easily synthesized by natural reactions, perhaps supplement by alien panspermia. The big argument among those experimenters is which self-replicating molecule came first, the RNA or the protein.

The ease with which amino acids can be produced from basic chemicals using simulated early atmospheres suggests that life is easy to produce in the galaxy. There is one question to delight nitpickers though. What is life? Self-replicating molecules? Cells, however primitive?

If you have alien life, then sex rears its ugly head, as some married writer once wrote. Sex is required for maintenance of genetic variability, to protect against sudden environmental changes. Alien sex can't be anymore bizarre than Earth sex. Here we have hermaphrodites, gender-changing fish and birds, numerous parthenogenetic animals and plants, microbes with up to 10 genders, homosexuality and cross-species copulation (numerous animals).

Humour is harder to deal with due to cultural taboos on both sides. Aliens watching our television programmes might think that insults and physical assaults are normal social procedure. This is a subset of a greater problem in dealing with aliens, that of communication. Technical communication will be easier than the cultural side of things. Mathematical messages are universal, but if an alien species discovered the Voyager space probes, what would they make of the silhouette of two humans on the plaque the probes carry? Pickover also suggests that coded messages might be emplaced into DNA, but this seems too much of a stretch. No one would expect to read the value of pi in a tarier genome; much too subtle.

Science fiction writers have often considered communication problems in their stories. One of the best is Stanislaw Lem's novel SOLARIS, about scientists trying to communicate with a sentient ocean and failing because the ocean has no referents to the humans and cannot respond meaningfully.

In the 1970s the Soviets suggested transmitting the mathematical formula $10^2 + 11^2 + 12^2 = 13^2 + 14^2$ because both sides of the equation produce the number 365, which is the number of days in an Earth year. Pickover considers this to be too arbitrary, something the aliens would not be expected to guess from an interstellar distance. He suggests instead the single most unitary equation in mathematics, $1 + e^{i*pi} = 0$. This equation unites the binary integers 1 and 0, the transcendental numbers e and pi, and i (the square root of -1). The difficulty with this formula is that it is not as easy to transmit transcendental numbers into space as would be with integers.

We have enough trouble translating some Earth languages such as Etruscan; can we do it with alien languages? Probably yes, as there would be a better chance if the aliens are still active and responding to us. They would be trying to help us decode them and there would be a flow of fresh texts to work on, as opposed to fragments of long-dead Earth languages which have had no native speakers for millennia. Pickover provides examples of possible messages we might receive from the stars, and what ones we have sent into space. There will be a strong reliance on binary communication and mathematical formulae, since immediate transmissions in a language would be incomprehensible.

Would robot emissaries be used for First Contact? They might be sent out by aliens in roughly the same form as the alien's physiognomy, so as to judge the response of the receiving species. Monoliths? Long transit times in space would require robot probes to be heavily armoured and radiation proof for physical survival, self-repairing, and use light for energy. Robot probes would be lurkers, listening for radio transmissions as proof of civilization, then reporting back to the aliens rather than making direct contact.

Interstellar travel will be very difficult. Faster-than-light travel is wishful thinking, a useful plot device for writers to move their characters around in a hurry but no more than over-optimistic thinking out loud by physicists. Cryonics, hibernation, and generation ships can bridge the interstellar gaps but require extreme reliability.

Pickover scorns alien abductions. Reports of greys (whatever happened to the little green men?) owe more to temporal lobe epilepsy and other psychological malfunctions.

Pickover sums up with a comment on the scarcity of sentient life. Life is almost a certainty elsewhere in the universe, given the ability of it to survive extreme environments on Earth, but the odds of spacefaring life are vanishingly small.

The Shape Of Other Things To Come.

Pickover set the scene in this series of reviews, and so now I move to the next scene, no less than 50 million years into the future. Dougal Dixon's speculative fact book **After Man: A Zoology Of**

The Future [4] considered what would happen in the long view if the human race were to vanish. Firstly though, he starts off with factual summaries of what we know about evolution and ecology (two sides of the same coin) and plate tectonics.

With those basics laid out for the reader, he turns to maps of the Earth as it will exist 50 megayears from now. (And doesn't Y2K look rather silly in that timeframe?) Continental drift has plowed Australia into Southeast Asia, and rifted East Africa away from the main continent, making it an nearby island much like Madagascar. North America and South America are separated by water again, as they were in the past. The Bering Strait has closed up solidly, joining North America to Siberia.

Dixon then looks at how evolution will produce new families and orders of animals. He considers that domesticated animals will have died out after humans because they were too dependent on us. I am prepared to believe that livestock would revert to wild types but find it difficult to think they would die out without us. After all, cattle roam the rangeland of the Canadian prairies without too much trouble; there are herds in southern Alberta and Saskatchewan that go weeks without the rancher checking up on them. Goats are unkillable in mountain country as a species, and cats and dogs even today live as feral animals in urban areas.

However, for the purpose of the book, we grant him the extinction of our livestock, from the same cause, perhaps, that wiped out humanity. This allows other species to repopulate vacant niches. Dixon believes that deer will not survive deforestation, although I can assure him that in Alberta urban white-tailed and mule deers are thriving. Granting him that one as well, allows him to let rabbits refill forest niches left vacant by deers. This produces rabbucks, evolved from the pest animals of today into the same size and general body shape as deer, but rabbit heads and feet.

The artwork for this book is, I must now mention, excellent. Dixon's new species are brought to life realistically and well defined in the details by the artists.

The other species likely to thrive after we have departed this vale of tears is the rat. In the next 50 megayears their incisors are modified into canines, and the animals become dog-sized predators. In the tundra, they take over the niche of polar bears, becoming the saber-toothed bardelots.

Dixon extrapolates numerous speculative lines of evolution, too many to mention all. Examples are antelopes that elaborate their horns into battering rams, perching geese with opposable toes, and squirrels with quilled tails that they can wrap themselves in for protection against predators. The vortex and the porpin evolve from penguins to take over the vacant niches of whales and porpoises. Penguins the size of whales? Dixon makes it work, though, with no more speculative liberties than what SF readers accept for faster-than-light starships.

I particularly like his extrapolation of beaver evolution. The tail and hind legs gradually fuse into a single flat pad, which improves swimming ability. It also helps beavers shimmy short distances up trees for that extra nibble.

Everything that Dixon extrapolates is reasonably logical, given what we know of natural selection. The species are alien but of Earth. The Earth itself has become alien from continental drift. We need not look to the stars for beings not as we know life.

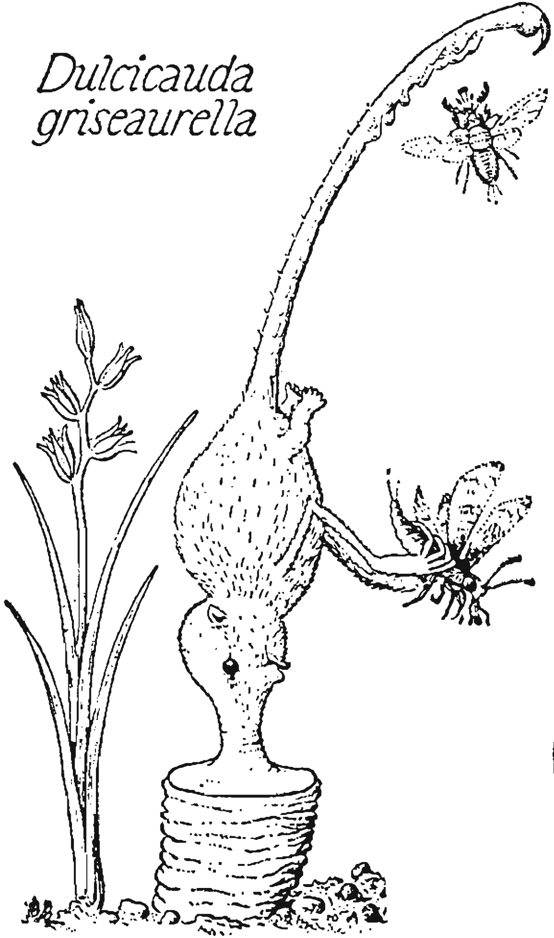
The Shape Of Things We Just Missed.

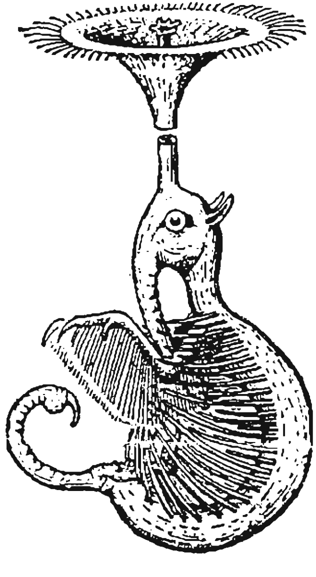
Review of **The Snouters: Form And Life Of The Rhinogrades** by Harald Stumpke [5]. This is a amiable parody of scientific monographs, written in the exact same style, but which also serves to explain speciation in a painless manner.

The book is science fiction posing as fact, an account of the mammalian order Rhinogradentia, commonly known as snouters. This bizarre offshoot of some ancestral insectivorous shrew was endemic to the South Pacific island of Hy-yi-yi. The island, its fauna, and its human native population were unknown until 1941 when it was accidently discovered. The native tribe was wiped out because the discoverer had a head cold at the time he landed and they had no resistence to the common cold virus. Studies on the snouters were carried out but before the research could be concluded the island was destroyed by hydrogen bomb tests.

The rhinogrades were the only mammals in Hy-yi-yi, and with no significant predation on them soon spread into a multiplicity of ecological niches. Stumpke uses the snouters as an example of functional selection, and follows on with learned discussions of their taxonomy and nomenclature, just like the real thing: " ... *whereas Stulten favors placing Mammontops in the immediate vicinity of the tetrarrhines, in that he lays more weight on the nasal structure than on the number of snouts, Bromeante de Burlas holds the opinion that the number of snouts deserves the greater systematic consideration, while the degrees of nasal differentiation is to be regarded as due merely to convergence.*" [page 76].

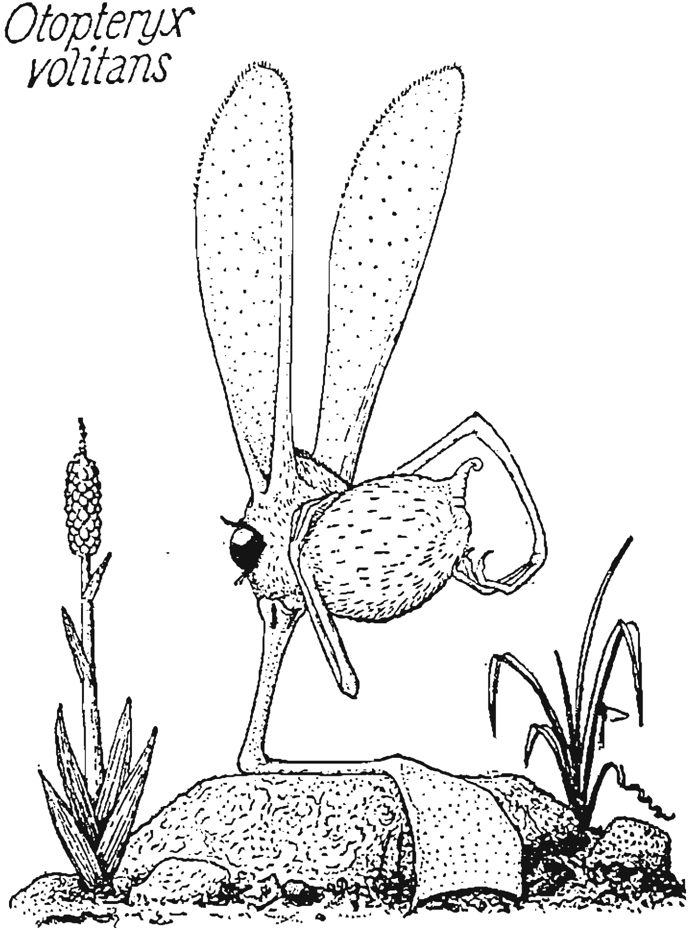
The form closest to the ancestral root of snouters was *Archirrhinos*, which still walked on all fours. It was an insectivore, and after catching its prey, such as a cockroach, would roll forward and balance on its snout, thereby allowing it to use all four limbs in eating the insect.

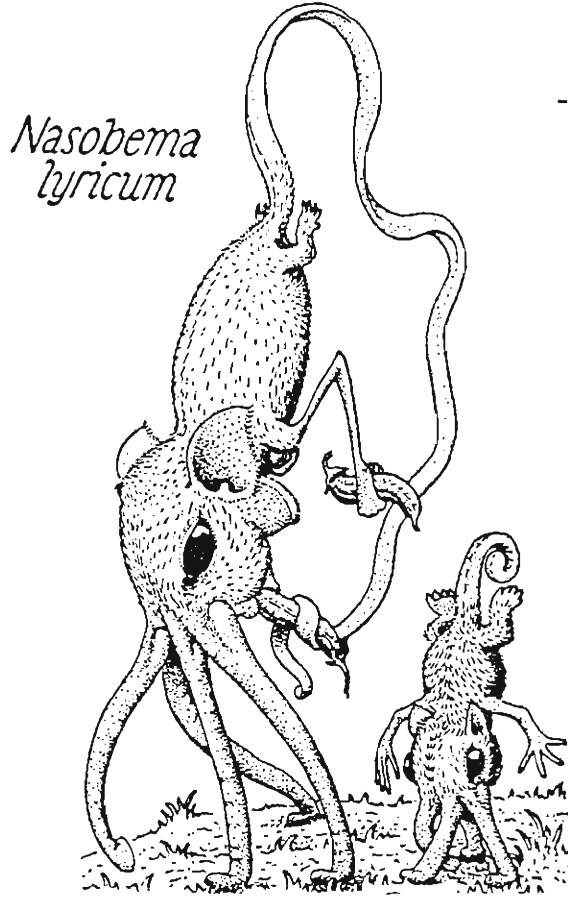




Rhinostentor submersus

Figure 1 to 3: From Stumpke [5]. Forms of snouters.





Figures 4 and 5: From Stumpke [5]. Different species of snouters.

From there, all manner of divergences evolved, such as the headstander *Dulcicauda*, aquatic forms such as the plankton feeder *Rhinostentor*, burrowers, and reduced parasitic forms.

There were snout leapers such as *Otopteryx*, which answered the question of what a kangaroo would look like if it hopped on its nose. There were flower mimics, whose heads or nostrils resemble flowers, enabling the snouters to snatch insects that try to pollinate them. There were the polyrrhines, which had multiple noses used for walking.

The snouters demonstrate how evolution could produce alien life forms on Earth, given the opportunity to fill vacant niches.

The Shape Of Things That Were.

Review of **The Crucible Of Creation** by Simon Conway Morris [6]. The Burgess Shale fauna demonstrate how evolution did in fact produce alien life forms on Earth. This fauna is 520 megayears old, from the Middle Cambrian of British Columbia. The site is popular with palaeontologists not only because of the high-quality fossils that record an unsuspected view of palaeoecology but because it is on the upper slope of Mount Stephen and offers a spectacular view of the Rockies and their turquoise lakes (not the standard blue of ordinary lakes, but an opaque turquoise from the finely-powdered glacial meltwater sediments).

Morris starts from first principles, with an overview of solar system history and evolutionary philosophy, sometimes but only rarely drifting into jargon. The Burgess fossils are not simply considered in isolation but in the context of debates with Stephen Gould and Richard Dawkins on how evolution works. Dawkins adheres to the primacy of the gene, the selfish DNA, while Gould, using the Burgess fossils as an example, considers how random chance outweighs adaptation.

The origin of life is surveyed by Morris, from its origin during the Precambrian of 4 to 3 gigayears ago. Eukaryotic life developed sometime 2.1 to 1 gigayears ago. Eukaryotes have cell nuclei, mitochondria (symbiont energy sources), and chloroplasts (in plants, where photosynthesis occurs). Prokaryotes, from which eukaryotes evolved, are the primitive stage, microbes without cell nuclei. We humans are eukaryotes, as indeed are all advanced plants and animals. Soft-bodied animals developed sometime after 600 megayears ago, and the development of skeletal characteristics mark the beginning of
the Cambrian era 550 megayears ago.

The first soft-bodied animals appeared approximately 620 to 550 megayears ago. They are known as the Ediacaran fauna, after the type locality in the Ediacara Hills of South Australia, but are now also known from Russia, Siberia, Newfoundland, and Namibia. These fossils set the stage for the Burgess fauna and are so strange that even today palaeontologists can't agree on what kingdom or phyla some of them belong to.

The Burgess Shale fauna were discovered as a result of extending fieldwork from other nearby sites that had been discovered in the 1880s by surveyors working on the transcontinental railroad through the British Columbia mountains. American geologist Charles Doolittle Walcott (Smithsonian Institution) discovered the Burgess Shale locality on August 31, 1909. His party was returning to base from fieldwork at another locality when his wife Helena's horse stumbled on a rock. Walcott noticed something unusual about the rock, split it open, and found numerous soft-bodied fossils. Since then numerous excavations have been carried out at the site by various palaeontologists. The site is now inside Yoho National Park and access is strictly controlled..

Simon Morris began his work on Burgess fossils with a bizarre worm-like critter he named *Hallucigenia*. He made a mistake in his initial report and depicted his specimen upside-down. Once corrected, it was still a bizarre critter, for there is still no agreement as to which end is the head and which the tail.

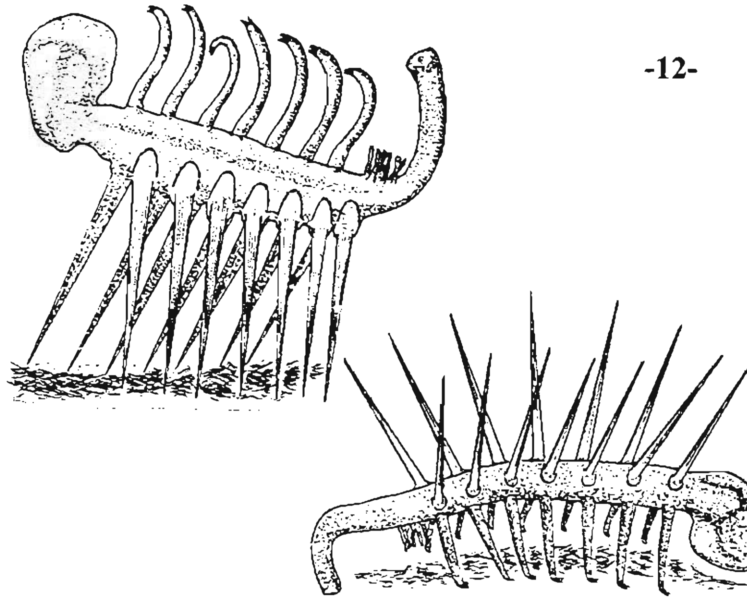


Figure 6: From Morris [6]. Top figure is incorrect upside-down version, bottom is corrected impression, but which is the head?

Anomalocaris was particularly vexing to the several palaeontologists who had a role in finally puzzling out its form. Various parts of the one-metre-long animal had been found scattered and described as different species. Its claws were thought to be a crustacean abdomen, and its circular mouth a compressed jellyfish.

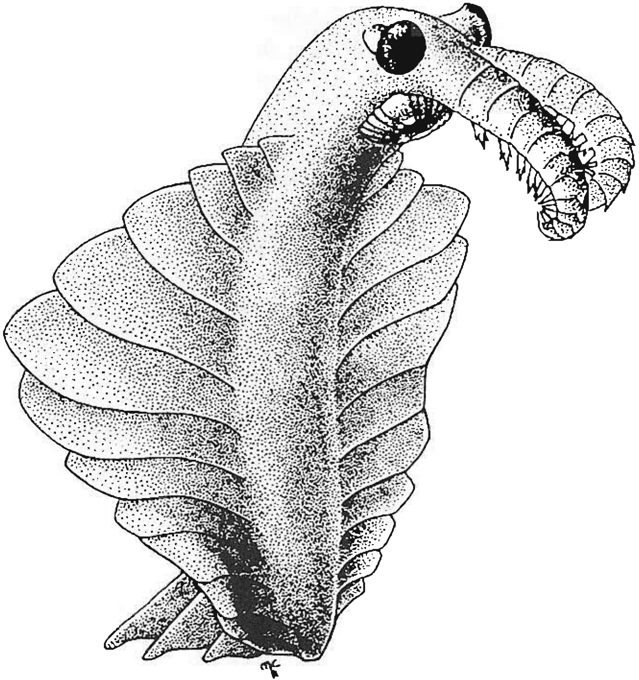


Figure 7: From Collins [9]. *Anomalocaris.*

Morris then imagines taking a trip in a submersile time machine, and describes the ecosystem of the 100-metre deep Burgess fauna. Because of continental drift, the continents were clustered in the southern hemisphere at the time, with North America tilted 90° to the east and straddling the equator. A time traveler would find himself short of breath since the oxygen content of the atmosphere was lower. There was little plant life on land, just small primitive mossy types in wetlands. A planet as alien as any a science fiction writer could fabricate in another stellar system.

The Burgess fauna is catalogued by Morris (with some nice colour plates showing them in life), with descriptions of each species both as a fossil and how it lived in the ancient waters. Were it not known otherwise, a reader might be unable to decide whether this was a science book describing genuine animals or a fictional catalogue of alien life on some planet discovered by the crew of the Enterprise, Capt. James T. Kirk commanding. The Burgess fauna emphasizes the point that we need not seek aliens among the stars; they are with us now and in our past.

Morris takes a chapter to consider the significance of the Burgess fauna, starting off with criticism of
Stephen Jay Gould's bestseller

WONDERFUL LIFE. Gould's book was published in 1989 and was based on less complete knowledge of the Burgess Shale. He worked on the assumption of far more body plans and strangeness in the fauna than was subsequently learned. From this mistaken start, he developed the hypothesis that evolutionary paths, influenced by random chance, have reduced the diversity of life significantly, as body plans are deleted by extinction. In contradiction, Morris points out that hard-bodied species of the Burgess Shale have normal abundance compared to other Cambrian localities with no soft-bodied fossils but hard-bodied faunas. It must be assumed therefore that had soft-bodied species been preserved elsewhere, the abundances and ratios would be about the same. The Burgess fauna would thus be a normal fauna, not an atypical ecosystem. The reason why we get so excited about it is because soft-bodied fossils are so difficult to come by.

From there, Morris goes on to consider the 'Cambrian explosion', when the number of fossil species suddenly increased. The exact trigger for this is unknown. Probable causes are increasing atmospheric oxygen, chromosome doubling (which allows one gene to mutate while the other carries on normal functions), cell adhesion (allowing multicellular animals), and tissue formation (allowing bilateral symmetry and nervous systems). The final boost was a rise in ambulatory predators, which began an arms race between predators on the offensive (claws, jaws, and teeth) and prey on the defensive (hard shells, scales, and spines).

The next step Morris takes is into today, where there are only 35 basic body plans of animals. When the Burgess fossils are reconsidered in better detail, it appears that they fall into these plans in such a way that it forces a re-examination of commonly accepted phylogenies (evolutionary paths). Say, as one example, that molluscs and annelid worms are more closely related than previously thought. But these phylogenies are not the matter of random chance that Gould thought in 1989. He felt that if evolution was restarted from the Cambrian, random chance would create an entirely different world today, with certainly no humans.

Morris applies the Tide of History theory, saying that ecological niches <u>will</u> be filled, and if not *Homo sapiens* then certainly some other hominid species would be where we are now. This is the same principle that Dixon uses in AFTER MAN to fill vacant niches with rabbucks and Stumpke with specialized snouters.

The Shape Of Thoughts On The Shape Of Things.

To sum up my reviews with two quotes published a century apart and still valid. William Carter wrote in 1865 that: " ... *we find that on our own planet every element, every region, and nearly every foot of space swarms with living creatures possessing an* *endless diversity of organization to suit an endless variety of condition ... And in the face of all this it seems to require a great strain ... to think that throughout all space life can be absolutely limited to one small globe.*" [1].

H.F. Blum remarked in 1965 that: "*Seeing only a part of the total change, we may conclude that evolution has followed a much more 'direct' course than it has, losing sight of the many alternative paths which might have been possible but were not followed.*" [2].

The new discoveries of prokaryotes living in extreme environments on Earth has changed our view of the probability of life elsewhere in the universe, since we know it can survive where eukaryotes cannot [7]. There will be false steps along the way outbound into space, such as the supposed Martian bacteria in the Antarctica which were the product of wishful thinking and political maneuvering for NASA budget money [8].

The Shape Of The Future. 2000-01-23

I was pruning some lilacs today in a park adjacent to an elementary school. A long strip of paper was embedded in the snow under the shrubs. I pulled it out and looked at it. It was part of a wall chart some schoolchild had done. Only the first section was present. Large carefully printed letters. I could see the child leaning over the paper, pencil firmly in hand, concentrating on the spelling of that first word. 'Precambrian'. It was a chart on the evolution of life, the child undoubtedly thinking of the mysterious beasts of the Burgess Shale as he or she labeled in the Cambrian era and clocked it at '460 million years', a time as abstract as any other ancient history such as the Vietnam War is to my young seasonal labourers or World War Two is to me, born a decade after Grandfather came marching home from the R.C.A.F. battalion.

What About <u>Real</u> Martian Fossils?

So the first Mars manned expedition lands and they don't find any life. Not too surprising. But what if they found fossils? Not dodgy microfossils that are subject to wishful thinking, but obvious macrofossils of critters. Fossils that would be accepted as such without hesitation if found in the Burgess Shale. I doubt there would be any really advanced life such as vertebrate tetrapods, but I am prepared to believe that Martian life may have made it up to the Cambrian level before the planet died.

If undoubted fossils are found on Mars, the question will immediately arise as to whether life evolved independently or was the result of panspermia. Constant asteroid or comet impacts throughout the solar system's history
have resulted in impact

debris being sprayed out into orbit and subsequently into another planet. Only one microbe has to survive the trip, embedded deeply inside a rock, going dormant during the trip, surviving reentry, and being liberated on impact. With constant showers of bolide impact material during the solar system's early history, such trips are not against probability [10]. Could we be the aliens?

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