A Compilation of Relevant Articles from MMM's first 25 years, issues 1-250

Introduction: Every atom in our bodies, except hydrogen, has been forged in the fusion furnaces in the cores of stars long since exploded, peppering the interstellar gas clouds with them - clouds out of which future stars and their planets eventually formed. To recast a biblical phrase, "Of stardust thou art, and to the stars thou shalt return!"

Humankind was born in Africa, and for well over a hundred thousand years has been spreading from one continent to another, becoming an "intercontinental" species. Now we are crossing another kind of sea to another kind of continent, The Moon, then to others beyond, our next goal is to become an "interplanetary" species.

Whether we spread beyond our native solar system depends on many things, surviving our present and coming geopolitical, global financial, and environmental-economic crises just as important as leaping technological hurdles. But the call is there, and we feel it whenever we look up at the star-studded heavens on a clear night.

Moon Miners' Manifesto's purpose has been to help flush out, and then flesh out how we will establish a growing civilian beachhead on the Moon, Mars and beyond. Here and there, we've had a few articles peeping beyond our solar system, about what might lay beyond along our path "home." They are reprinted below.

Our near-term goal is to learn much more about what lies out there, by telescopes on the Moon and in space

INDEX MMM THEMES: Starbound!

ARTICLES:

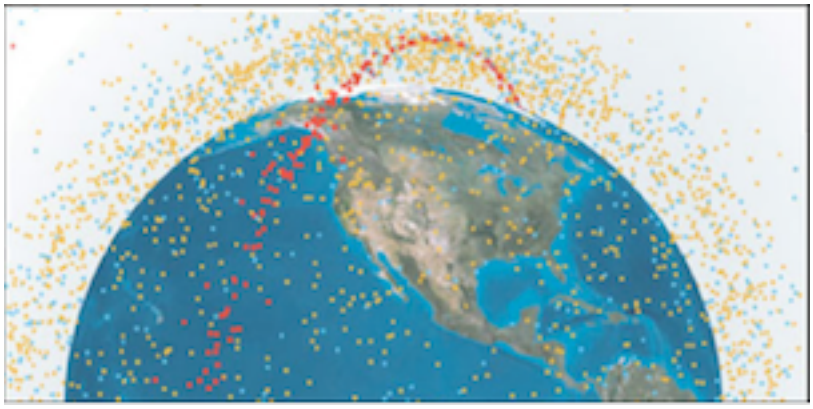
MMM #17 Design for an Amateur Lunar Telescope
MMM #36 Starbound
Would-be Starfarer's Quiz
Earth, Ga, Terra, Tellus
Hydro-tectonic planets: What is an "Earthlike Planet?"
Would-be Starfarer's Quiz #2
MMM #37 "Sun, Helios, Sol, Ra, Copernica;"
"Oceanids"
MMM #38 Of Tides and Stars
MMM #40 Brown Dwarfs
MMM #43 Alpha Centauri
MMM #44 More on Alpha Centauri;
Proxima Centauri
MMM #45 Welcome-Mat Worlds
MMM #46 Name Games for Planets Around Other Suns
Barnard's Star
MMM #47 Understanding Light-Time;
EMPIRE: Interstellar Empires are not possible;
MMM #61 Are We Alone?
What is a Humanoid?
Galactic Topography 101
Is there a Heliades Cluster?
Sending interstellar signals
Cheshire Messages
MMM #194 Are We Alone?
MMM #220 "Skyfields," a personal essay
MMM #247 Our Planets may be the offspring of a tryst between ProtoSun and another protostar
MMM #260 In Focus: To the Star - or Back to the Stars? Peter Kokh
Why an Earth-size planet around Alpha Centauri B is bad news, Peter Kokh
MMM #267 What if some stellar wonder were right in our backyard?

SPECULATION

"It Came From the Bowels of the Moon"

AFD (April Fools' Day) World Space News

MMM #124 Have your cremains put on an "interstellar drift trajectory"
MMM #144 A Brown Dwarf is discovered on a trajectory that could bring it into the Solar System
MMM #154 For a million dollars, Starchildren, Inc. will freeze anyone until "interstellar drives " are invented,
MMM #234 The LCROSS impactor plunged clear thru the Moon, emerging out the north pole towards -?

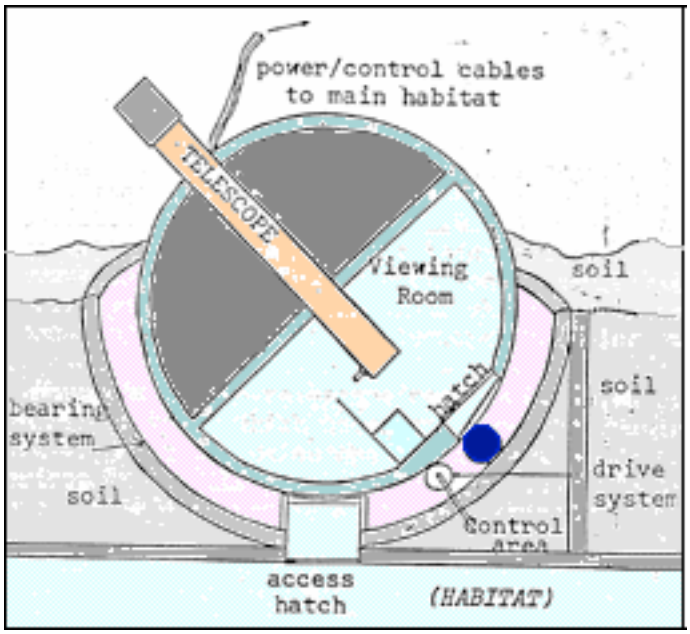


This not quite so "milky way" of debris could quarantine us on Earth for millennia - goodbye Stars!

MMM # 17 – July 1988

AMATEUR ASTRONOMY FROM THE MOON

It would be pretty awkward looking through an eyepiece with a space suit helmet in the way! How could you outfit amateur astronomers amongst the Lunan pioneer population? This was the subject of a design competition cosponsored by the (Milwaukee) Lunar Reclamation Society and the American Lunar Society in 1988. Of three entries, all ingenious, this was the winning design.



Access to a spherical viewing room is via a hatch in the ceiling of a pressurized habitat. Once inside, seated in the chair, the viewer and viewing room rotates in directions needed to aim the telescope at the desired target. The telescope would be an integral part of the pressurized, heated, rotating spherical viewing room, which is suspended by a low-friction smooth-running bearings system

This design was submitted by Ronald August of Hubertus, Wisconsin..

MMM # 36 – June 1990

Star•bound

Stardust Thou Art, and To the Stars Thou Shall Return!

New MMM Exclusive Series: Not "HOW?" But "WHERE TO?"

Disbelievers, contemptuous of popular talk of "travel" to the stars, abound. Indeed, the many hurdles are daunting! The enormous distances involved challenge comprehension. Total energy expenditures required compare with centuries of world energy consumption at current rates.

Yet the lure of the stars is "imprinted" on the very stuff that we are made of.

For, excepting hydrogen, which is mostly primordial, all the atoms of our bodies have been forged in the nuclear fires or violent death throes of stars that burned bright before our own Sun and its System coalesced from a cloud enriched with their collective ashes.

Many a book and article teases our faith that we will one day find a way to venture to other suns and the worlds we know must circle them. Little T has been written about where to head, and most of that we wish to challenge.

We start here on Earth, with a quiz and two articles, "**Earth=Terra=Ga=Tellus**" and "**Hydro Tectonic Planets**" we seek to define our own "home world" – our point of departure. "Planets Around Other Suns" looks at three ongoing searches for convincing proof that other solar systems do exist, and are common. [This last article is not included in this volume of MMM Classics: it has been superseded by events]

WOULD-BE STARFARERS' QUIZ

1. **Q**. What is the Sun's nearest stellar neighbor?
2. **Q**. How much further are Proxima and Alpha Centauri than the Moon? than Neptune?
3. **Q**. What is the closest star easily visible to the naked eye from most of the United States?
4. **Q**. Is the Sun just an average star?
5. **Q**. What is the nearest Sun-like star?
6. **Q**. How far out must you go before it appears no brighter than other stars?
7. **Q**. Of all the naked eye stars, which is intrinsically the brightest?

Answers to Starfarers' Quiz

1. **A. Proxima Centauri,** a small red M-type star, is just a little closer than the **Alpha Centauri** double sun of which it is a distant companion. This system lies 60° below the celestial equator, well below the horizon from most of the USA.
2. **A.** 106 million times as far as the Moon, and 9,000 times as far as Neptune.
3. **A. Sirius** is 8.7 light years distant, **Procyon** 11.3, **Altair** 16.6, **Fomalhaut** 23, and **Vega** 26 Light Years distant. With a small telescope, you can find **Barnard's Star** which is only 5.9 LY from here.
4. A. Stars come bigger, brighter, and hotter; and they come smaller, dimmer, and cooler. But there are far, far more stars smaller than the Sun, than larger. About 4% of stars are solar-type, perhaps another 4% bigger and brighter, and 92% smaller. Ours is well above average, and that often heard put down is not honestly deserved. However, most of the stars visible to the naked eye are in fact bigger and brighter.
5. **A. Tau Ceti**, just a bit smaller than the Sun is 12.8 LY away. Its spectrum is G0, a bit cooler and less massive than our G2 Sun. **Alpha Centauri** is actually a double star orbiting around its common center of mass. While the brighter of the pair is a GO, just a little hotter and more massive than the Sun, most astronomers consider binary stars to be unlikely or unfitting hosts for planets.
6. **A.** About 14 light days or 2 light weeks out (80 times as far as Neptune) the Sun would still be as bright as the Full Moon for us. At 1.84 light years, the Sun would be only as bright as **Sirius** the brightest star to us. From 4.3 light years, the distance as **Proxima** and **Alpha Centaur**i, the **Sun** would shine about as bright as Procyon, the 8th brightest star in our sky. The **Sun** would still be just visible to the naked eye in ultra dark country skies 50 light years out.
7. **A.** If **Deneb** and Rigel were as close to us as **Alpha Centauri**, they would both be about as bright as the Full Moon, or some 10,000 times brighter than **Sirius**. To receive only as much sunlight as Earth does, a planet would have to orbit Deneb or Rigel more than 8 times farther out than Neptune from the Sun! In our corner of the Galaxy, F+ **Deneb**, **Rigel**, and **Canopus** dominate all the space within 2,000 LY from here.

Should we Adopt a World-wide Name for Earth?

By Peter Kokh

To many people it would be an unimportant point. One might hope that as mankind moves out into the Solar System, we would do so with a common agreed-upon name for our Home Planet.

"T**he Earth**" - is the name we give it in ALL Indo-European languages. Whether we use the Germanic root ERD, the romance TER, the Slavic ZEML, the Hellenic GE, or Indic MAH, the reference to the solid earth = land beneath our feet is the same. Around the globe, names for our home planet use different sounds to express the same concept. Indeed, for other intelligent species on other worlds, the choice would be similar: earth=soil, sea or land+sea= shore. "Earth" seems to be a fully translatable name, **a vocational-relational term**, like 'parent'.

All the same, ought we not to agree on one internationally standard root-name to show pride in our ancestral home? What are the choices? Many science-fiction writers dislike "Earth" because it is so

provincially "English". This despite the fact that English, or Unilang as one language scholar now calls it, wherever it is one's first language, the second, or the third.

By far the most common suggestion, taken for granted as future-fact by some science-fiction writers and many of their readers is the Latin for earth=soil=land, **Terra**. Unfortunately, astronomers have been anything but helpful, and have indeed been quite busy of late naming every newly discovered continent-like or highland-like region on other worlds mapped by our probes, "Terra This" and "Terra That." Ishtar Terra and Aphrodite Terra are now the official names of the two continent-like highland areas on Venus.

So the astronomical community has already unconscionably turned "terra" into a common noun even though other choices such as Greek "chora" were available, and even though versions of Terra are already in daily use for "Earth" by 600+ million users of Latin-sprung French (La Terre), Spanish (Tierra), Italian, Portuguese, and Rumanian.

We could yet outsmart the mischievous astronomers either by forming a new noun working back from the adjective terrestrial, e.g, **Terrestra**, or by using Terra as part of a compound name, as in **Mariterra** for Sea-Earth. After all, naming a planet whose surface is 3/4 ocean for the 1/4 that is land, does betray a certain chauvinistic bias and lack of appreciation for precisely what makes our planet so very special! **Littora**, Latin for "shores", would convey this same essential duality of our world. Or we might simply call it Oceanus and be done with it, although the diverse ways in which the latter would be pronounced around the world is a big drawback.

Considering the problem thirty years ago, my answer was to turn to the Roman goddess of the Earth, **Tellus**. The genitive of Tellus, from which the adjective is derived is Telluris, thus Tellurian. **"Fellow Tellurians!"** - it trips off the tongue so lightly! This beats terrestrial (from terra) which is already being commonized, both as 'mundane', and as referring to the solid-surfaced inner planets in general.

The Greek tribes used several variants of **Ga, Gaia, Ge, Gea** from whence our own **Geo**- root. What about one of these? First a phonetic observation: G followed by E is pronounced hard in some languages and soft in others. So GE, GEO, GEA, would not be mutually recognizable to speakers of diverse tongues. Further, the combinant geo- has lost its Earth-specificity via promiscuous application to the study of all solid-surfaced worlds by take-the-easy-way-out NASA geologists who have balked at using the more correct selenology for the Moon, areology for Mars, etc.

The ideal Creek-derived choice would have been **Gaia** with **Gaian** as the adjective, that is, until James Lovelock and Lynn Margulis preempted the word to signify Earth-Life in general (which is certainly a valuable achievement in Earth-awareness whether or not one agrees with their "Gaia Hypothesis" that Earth-Life or Gaia is an entity in its own right). The variant "**Ga**" is available, but sounds like baby-talk cut short.

Terrestra, **Mariterra**, and Littora, could be innovative solutions. But **Tellus** remains the one classic choice without liabilities. At the same time it is scarcely a household word. The plus side of that, is that specialists wearing horse blinders have yet to lazily and thoughtlessly genericize it. But how could such a new-to- the-public name be agreed upon the world-around? It would probably take an international campaign and a near unanimous United Nations resolution before Tellus would start showing up in science fiction novels, newspapers, and textbooks.

Besides picking a name for our planet to be shared by all forevermore, we might pick another name for Earth-as-transformed by the emerging human planet-wide civilization or technosphere, or for this "planetization" itself, even as "Gaia" has been pressed into service to refer to the evolving biosphere of Earth. We could coin "**Anthropa**" from the Greek word anthropos (= man, gender not specified) to serve this purpose.

Having a shared name for Earth, will help foster the co-operative pride we need to renew our planet and keep it "whole". Still, Earth, by any name, will ever be THE most beautiful world (and word!) known to her far-scattering children. Your comments are welcome. **MMM**

What is an “Earth-Like Planet?”

HYDRO-TECTONIC PLANETS

By Peter Kokh

We've all seen the phrase "Earthlike Worlds" but just what does it mean? Different things to different people, of course. And that's because it is intrinsically imprecise, since there are so many varying definitions of just what the "essence of Earth" is. Some people use the term in contradistinction to the gas giant planets like Jupiter and Saturn, Uranus and Neptune (which actually should be subdivided in two pairs, just as I have done, and not lumped together!) In this sense they use Earth-like to refer to solid-surface rocky silicate planets such as Mercury, Venus, Mars.

But for those who yearn for the promised era when humanity will venture beyond the Solar System and reach for the stars, "Earth-like" conjures up worlds of continents and oceans, sweet oxygen rich air, teeming plant and animal life. In contrast to the first example, this use of the term goes much too far in the other direction. For Earth itself would only have met this test of "Earth-like" in the last current fraction of its long history! We must get to the heart of the question to find an altogether different, less ambiguous, phrase.

Until the second half of the 20th century, it was the common belief that the continents formed in their present position. There was no attempt to explain why this continent had this shape, that one another. These were taken as factitious givens. True, many of the more inquisitive had wondered about the teasing near match of coastlines on both sides of the Atlantic. In 1905 the German meteorologist Alfred Wegner proposed a comprehensive picture of how the continents may have all been one and slowly drifted to their present scattered positions. But for lack of evidence, his theory was widely dismissed.

In of the most dramatic and exciting of scientific paradigm shifts since Darwin, a sudden flood of evidence from matching mineral deposits, fossils, and traces of paleomagnetism pouring in during the sixties, confronted unprepared scientists with the incontrovertible proof that Wegner was right,in general, though he had many of the particulars wrong. It was not necessarily whole continents that drift, but great plates of oceanic crust on which the continents, or rather different sections of them, rest. Wegner's suggestion of continental drift gave way to modern "plate tectonics."

Evidently, unimaginably slow currents of molten rock deep below the surface nudge these plates this way and that, helped by repeated volcanic outpourings which rift continents asunder and push apart the pieces and the plates they ride upon. When something is pushed apart on a surface of set size, obviously somewhere else, something has to be squeezed together or give way in some other manner. And so most of the great mountain ranges on Earth have been raised by continental and subcontinental collisions taking millions of years. Hard to grasp at first! India, once clearly part of the African landmass, crashing into the underside of Asia, has raised the Himalayas. The Appalachian and Atlas Mountains were thrust up in a prior collision of North America and North Africa. Unthinkable? A few decades ago, but no more.

Continental collisions are not the only way pressure from spreading continents and plates is relieved. Often in a confrontation, one plate surrenders, so to speak, diving below the other whose edge rides up on top of it. The eastern Pacific ocean bottom is being thrust beneath the advancing west coasts of the two Americas. The coast-long deep ocean trench and ramparts of active volcanoes are results.

It is understandable then that geologists still bursting with the enthusiasm afforded by this new onrush of insights into the shape of present-day Earth, are alert for traces of plate-tectonics elsewhere.

We DO see great faults and rift valleys on other worlds. Mars' Valles Marineris is an example - a gigantic 3000 mile long by 150 mi. wide equatorial canyon complex too often unfairly and inappropriately compared with Arizona's Grand Canyon instead of with the equally vast, if not more vast, ocean trenches on Earth, or better with Africa's great rift valley system including the Red Sea bottom.

We see signs of incipient, quickly stalled rifting elsewhere, even on the Moon. As to continent-resembling features, there is the great Tharsis Uplift on Mars caused instead by eons-long continuous volcanism. And there are the two suspiciously continental elevations on Venus, Ishtar Terra near the north pole, and Aphrodite Terra along the equator. We've photographed volcanoes caught in the act of erupting on Io and Triton, and are being teased by a growing number of indirect indicators of current volcanic activity on Venus, such as lightning.

Magellan, the powerfully equipped synthetic aperture radar probe now on its way to Venus, will hopefully tell us the story of our sister planet's (nearly same size and mass as earth) past and present. If there are "ocean-basin" trenches along side "coastal" strings of volcanoes, that will reveal very much. This is unlikely, however. We already have enough lower resolution radar imaging of Venus to know that there are fundamental differences between the structure of her "oceanic" basins and those of Earth's. It is no longer clear that now bone-dry Venus once had oceans that boiled away. If indeed an early ocean was present, it likely did not survive long enough to be a major roleplayer in the shaping of today's Venus.

Role-player? Yes, for it seems that water has acted as a lubricant in the incredibly slow movement of crustal plates and continents. The ocean bottom crust is saturated with water, and when it is thrust below the advancing edge of a continent, drags that compliment of water with it, down perhaps as far as 400 miles below the surface. Indeed we are likely to find that on any world where there has not been a significant hydrosphere (ocean), incipient tectonic activity has been an abortive self-snuffing episode. In contrast, Earth is a "HYDRO-tectonic" world!

Is this the "new and improved" definition we have been looking for? It could well be. It is the oceans with the internal heat of the planet that have shaped and continue to shape our world. Is this plate tectonics necessary? Well without it, we would not have the rich mineral deposits that have fueled our technological crescendo. Nor might we BE in the first place. For it is not only the slate-clearing by periodic asteroidal impacts that has allowed stalled evolution to explore new manifestations of life, but also the continual separation and recombination of continental chunks. And without on-going renewal via mountain-building collisions, any original continents would long since have eroded away washing into the sea. Only "HYDRO-TECTONIC" worlds can be truly "Earth-like," in both the geological and biological senses of the term.

So when you next daydream of joining some interstellar exploratory expedition, searching for "M-class planets" (to use a Star Trek term), you'll know exactly what it is you are looking for. Forget places like **Tatooine** and **Arrakis** (Dune). We need to look for worlds with enough ocean, but not too much, and with active plate-tectonics. Life will be more than probable on such worlds and should develop in a catastrophe-punctuated way similar to that which "**Gaia**" (the new name for Earth-Life as a living system) has experienced. The state in which we find such worlds will largely depend upon their age which can be estimated even from Earth via an in-depth study of its sun's spectrum and circum-galactic orbital characteristics.

Some HTW's will be impetuous raw young worlds still awaiting the quickening of life. Others will be dominated by early microbial life and show signs of oxygen-sweetening of the air. And there will be those on which has appeared the metazoan multi-cellular life that has dominated our own planet the past 600 million years (but an eighth of our total history). There will be some on which the plate-tectonic engine has slowly ground to a halt, bringing any such world to the final eon-long chapter of its history. Eventually its sun would shine on a world gone the way of **Atlantis** as the last continental remnants, no longer being renewed, erode away and wash into the thickening sea-brine.

Can Hydro-Tectonic planets be detected from Earth? Yes and no. The next generation of space telescopes after Hubble, might be able to detect planets the size of ours, and as close to their parent suns as ours. Next we can look for the characteristic signatures of oxygen and methane. These gases can only appear on a hydro-tectonic world on which life has already arisen and evolved to the point where it can transform an original carbon dioxide atmosphere.

It would be interesting to equip a deep space probe with instruments to detect such a characteristic signature, and see how far out from the Sun, we can clearly detect Earth and tell what kind of world it is. The proposed TAU mission would go out one Thousand Astronomical Units, a thousand times as far from the Sun as Earth's orbit, not quite six light days. (Neptune is only 30 AU, 4 light hours away.) It is the intention to use the advantage of such distance to greatly refine our parallax-based knowledge of star distances. An HT-signature device (HTS) would make a great bus-mate for TAU.

While it is unlikely that life can arise in a fresh start except on a hydrotectonic world, it should be transplantable to other less friendly locales. And good transplant locations may be much more numerous.

That's another story! **MMM**

For an excellent, very readable, and well-illustrated book on Plate Tectonics,
might we recommend "**The Restless Earth**" by Nigel Calder, Viking Press 1972, SBN 670-59530-6]

Sun, Helios, Sol, Ra, Copernica

SHOULD “THE SUN” HAVE A NAME?

By Peter Kokh

While many could perhaps care less, it seems appropriate to this writer at least, that all peoples of Earth share one common name for their life-giving star. This is hardly the case.

"The Sun" is one single word into which we put two quite distinct references.

1. "The Sun" is our name for a particular star, the one we orbit.
2. "The Sun" is a vocational relationship (much as “father” is) which makes this star special: it centers a planetary system, which it bathes with warmth and life-giving energy.

In the first sense, "the Sun" is very unique, our very own star. In the second sense, it is a relationship of fostering paternity (and the origin of the idea of "the Demiurge" with semi-divine co-responsibility for our existence). And this relationship is most likely not unique. Any star with planets is, for them, "the Sun," then is a word a lot like 'Father' and 'Mother,' i.e. a title rather than a name.

So long as mankind's horizons and its expectations of spreading domain do not overflow the Solar-System-of-our-Origin, this dual function word serves reasonably well. But as we consider the eventual out-migration forming a human diaspora that could include any number of "solar systems," the need to come up with a non-generic name for our Sun becomes increasingly relevant.

Almost all science fiction writers who have been faced with the problem, have taken to referring to our Sun as 'Sol'. This choice has two burdensome liabilities. First, "Sol" is once more, "the Sun" in another language, ancient Latin. Second, the derivative, "solar," will very likely be used generically of all planetary systems, and of all star-planet relationships. In this light, "Sol" makes a rather poor and unhappy choice.

Other than Latin, we could borrow from the other classic language of antiquity. In Greek, the Sun is Helios. And again, the derivative, "helio-," is also already in use in a general sense (e.g. heliostats) and is likely to go with us to the stars as yet another generic. One way around this particular problem is to coin slightly altered adjectives to refer to out particular parent-star and its realm. For example, we could say Solaric System when we are referring to our own, and use solar systems in the generic. I can't think of a plausible parallel for helio-serving the same specific function, but I'm sure Greek-adepts could coin one. Then it becomes a matter of public education.

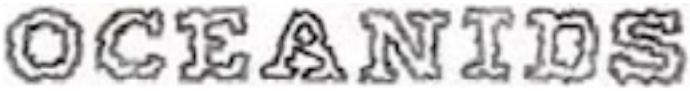
What about the ancient Greco-Roman god of the sun, Apollo? Alas, the word has existing currency (manned lunar program of the sixties) making it a confusing choice.

Already well known, simple, and easily internationalized, is "Ra", name of the ancient Egyptian sun god once revered in Heliopolis. But a case could be made for "Bast", another Egyptian deity who represented "the life-giving power of sunlight." Also lees known is the ancient Sanskrit "Ravi" and Hindu "Surya."

Quite a different solution would be to give our own Sun a proper name adapted from that of a figure in world history who played some especially significant role in our understanding of the Sun's place in the scheme of things. My vote would go not to any recent solar astronomer but to Copernicus, the first of our species to teach effectively that the Sun, not our Earth, is the center of our system. Now his name is already given to a very prominent lunar nearside crater. One way to avoid confusion would be to use a variant form of his name. Instead of the original harsh sounding Polish "**Kupernik**", we could use a feminine form of the common Latinization i.e. "**Copernica**". Admittedly this flies in the face of the almost universal chauvinist convention of using only masculine names for the Sun, with feminine ones reserved for Earth, i.e. the Earth-Mother/Sky-Father theme of folk myths.

Perhaps you would like to suggest yet another choice? My own preference?

I would pick "**Copernica**" and "**Ra**," in that order, over the other options listed above.
It's a wide open question! **MMM**



OCEANIDS: EUROPA-LIKE WORLDS MAY ABOUND

By Peter Kokh

Ever since the romantic pre-space age vision of a planet-wide ocean on Venus was so cruelly burst by the radar detection of surface temperatures there in the 900 °F range, and since our probes showed that the atmosphere on Mars was too thin to allow liquid water to subsist on its surface, we have had a growing appreciation of our water-laden home planet for the very special oasis which it is. But the revised popular notion that, in all the Solar System, Earth alone has appreciable reserves of liquid water, is mistaken.

Another Water World?

On their fleeting passes through the Jovian system, the four Pioneer and Voyager probes revealed an ice-crusted Europa, with a surface that has been aptly described as "smooth as a billiard ball". Absent are any crater relics of the earlier epoch of wholesale bombardment by debris left over from planet-formation, an ordeal apparently experience in common by all the planets and their moons. Europa's brilliant white crust is crisscrossed by narrow brownish streaks that show no topographic relief (height or depth). Global elevation differences do not much exceed a token hundred meters or so.

Apparently, the ice crust of this moon is thin enough to fracture under internal pressure from time to time, letting a water-brine of some sort erupt out onto the surface, quickly freezing the fracture shut. Europa, it seems, has an ocean! Water and vacuum do not socialize. But ice and vacuum get along quite well. Thus a thick enough self-derived icy "firmament" can contain an ocean just as effectively as a thick atmosphere.

However, some source of internal heat is needed to keep the ice crust from thickening until that's all there is. Europa, a little smaller than the Moon (1942 miles versus 2160 miles in diameter), is hardly big enough either to have long-retained any residual heat of formation, or to have undergone sufficient internal heating from radioactive materials in the rocky silicate crust that probably underlines its ocean - we know Europa's mass, hence its density, and can argue from that. Of the four great Jovian moons, Europa is the second closest in, and that's near enough to provide continuous heating from the tidal stress that characterizes its location deep down the throat of Jupiter's massive gravity well.

Europa: more water than Earth?

The guesstimates I've seen are that the ice crust is no more than 2-3 miles thick and that the globe-enveloping ocean below could be 60 miles deep. Even considering Europa's smaller size, 1/4 th the diameter and 1/16 th the surface area of Earth, that still amounts to 1.8 times as many cubic miles of water as in all Earth's oceans (back-of-the-envelope calculation). Any hypothetical Europans would be amused, if not chagrined, to read of Earth's boast to be the "water planet"!

A proper name for Europa's Ocean?

In Romant mythology, **Rhadamanthus was the son of Europa by Jupiter**. So "**The Rhadamanthic**" would seem an especially appropriate choice.

A Mind Probe of Europa's Ocean

Europa and its ocean supplied the supporting theme of a major motion picture: Arthur C. Clarke's "**Space Odyssey 2010.**" What might the conditions in this ocean be like? We would expect it to be devoid of dissolved oxygen. But any gases vented by submarine volcanoes, a plausible feature, once they reached a certain saturation point in the water, may keep collecting in gas pockets below the ice, eventually building up enough pressure to fracture it in the manner our probes have observed. There could be some dissolved salts from ash vented by these conjectured submarine volcanoes.

Deep Ocean Life on Europa?

Given the light Moon-like gravity, even at some sixty miles down, the water pressure would be only half that in the Marianas Trench in our own Western Pacific. Exciting? Conjure up story plots? Hold on! Enter another discovery 400 million miles sunward, down home in Earth's own ocean depths. Scientists have found thriving teeming oases of ocean-bottom life huddling around deep sulfur-rich hot water vents on the mid-ocean ridges. Here in absence of appreciable dissolved oxygen, hitherto totally unsuspected well-diversified colonies of life-forms evidently descended from familiar varieties - yet strangely, grotesquely, and beautifully evolved - live out secluded lives feasting on their exotic dietary bonanza, in a darkness whose totality is sometimes punctuated by the orange glow of quickly cooling erupting lava. We had once thought that all food chains, must begin with photosynthesis. Evidently, hot sulfur-rich mineral-laden water jets provide nourishment and energy enough upon which to base whole independent ecosystems. [For an amply illustrated early account, see National Geographic.November 1979]

It is the safer assumption that life could not originate in Europa's ocean - or that it could not have gotten much further than sulfur eating bacteria. On Earth, even if the sulfur-eating organisms at the bottom of the hot-vent food chains are native to such sites, the diverse multicellular metazoan creatures such as the tube worms we now find there, are surely cousins to long-familiar varieties and co-descended from ancestors that had evolved in oxygen-rich, photo-plankton fed ecosystems in much shallower seas. Yet it seems equally plausible that we might someday successfully transplant some denizens of our own ocean bottom vent colonies there, at the bottom of the Rhadamanthic. We could then hang around for some centuries to watch their progress from stations on the ice-crust-firmament above, using telemetry and teleoperated benthic probes.

We need to take a look-see

Where is the imagination of our planetary scientists that they have not yet brainstormed a mission to dispatch a drill-equipped probe to Europa? Well, drilling through some miles of ice is far more ambitious - as remote robotic missions go - than anything we've attempted to date, even skin-pricking comet penetrators. This is a mission for the next century, one that will generate a lot of suspense and expectation. Now that we have found relics of ancient, probably now extinct, native microbial life on Mars, shall we someday find evidence of existing microbial life in Europa's ocean? How far and how diversely will it have evolved?

Are there other water moons?

Some have suggested that Europa's larger siblings, Ganymede and Callisto, with 3.3 and 2.4 times as much surface area respectively, also may harbor vast oceans under their dirty ice crusts. But it is clear from the near saturation incidence of slumped craters on their surfaces that the ice crust on these moons must be substantially thicker, and that as a Moon consequence, water from below is far less likely to work its way up. Both moons are too far removed from Jupiter to benefit from tidally-induced heating. So it seems more likely that any oceans there are long since frozen through.

Saturn's close-in Enceladus also sports a smooth bright icy surface apparently regenerated in recent times. Again, tidal heating and water venting are suspect. Whether this much smaller world, only 310 miles across, still has a mini-sea under the visible surface is something else.

Whatever the case for Ganymede, Callisto, and Enceladus, in general, the conditions for the formation and maintenance of Europa-like moon worlds seem rather easy to meet in the vicinity of gas giant planets. And gas
giants should be quite commonplace throughout the galaxy. It will matter little if the Jove-like primary of the candidate moon does not orbit a sun-like star. Might they not even circle rogue gas giants and isolated brown dwarfs in the sunless interstellar reaches? (Brown dwarfs are dud wanna-be stars with not quite enough mass to trigger or sustain nuclear ignition and thus become true "stars". The jury is still out on whether they are relatively rare, or far more abundant than all other star types.) [As of 4/'00, similar sub-ice oceans are strongly suspected on both Jupiter's moon Callisto, and Pluto's moon Charon. - PK]

As Europa is one of a class of very special worlds that we might search for elsewhere we'll need a generic name for them. One possibility is "**oceanids,**" pronounced oh-SEE-a-nids. In mythology, the oceanids were daughters of Oceanus and Tethys. But "**europids**" (yoo-ROH-pids) would also work, taking their name from the first of the class to be discovered.

What really gets the juices flowing is the possibility that Europa-like worlds are far more common out there than Earthlike ones, outnumbering them by perhaps a thousandfold, or more. We ought to make it a top priority in the next century of two to see what we can do with Europa - exercising all

due environmental caution, of course. Farming the sub-glacial oceans of such moons could be an alternate ticket to the universe, one which many a star-faring civilization has adopted for its main thrust.

What would a humanoid culture in a Europa-type setting be like? How would it develop? Would they live like the fictional survivors of some sunken Atlantis - subject of several science fiction films and TV episodes - in pressure resistant glass and metal "bubbles" within which they breathe air - and live, work, and play much as we do? Hey, if you're looking for a fresh twist for your science fiction novel, why not brainstorm such a "stranger in a strange land" type of culture? What you come up with might be a truer caricature of the galactic "beyond-the-cradle mainstream" than is the world and civilization into which we've all been born. **MMM**

Life-friendly "E-Class" Planets May Vastly Outnumber "M-Class" Worlds

MMM #38 - September 1990

Star*bound Series Continued

OF TIDES AND STARS By Peter Kokh

Gut Feelings

I am forever grateful for having learned from the American philosopher William James that

Our temperament influences reason more than most of us care to admit.

When it comes to the cosmic place of people, it is temperament that predisposes

- some to give more weight to considerations that suggest we are unique, and
- others to give credence to considerations that suggest just the opposite.

Some people have an inner need, based neither on reason nor evidence, to hold that we are alone in the immensity of space and time.

Is a large moon necessary for life to emerge?

Often cited as argument, is the unexpectedly large size of the Earth's natural satellite, the Moon. By all indications, a planet of Earth's size and proximity to its star, ought to have no moon at all, or a very small one at best.

What has this to do with the presence of life on this planet? The Moon causes tides, and thus creates and maintains tidal pools in near-shore depressions, places where the proto-life soup of amino acids and other pre-organic molecules could stew and brew. In contrast, such molecules would be so diluted in the ocean at large that they might never interact sufficiently to get something really interesting going. And so, their argument goes, as most Earth-like planets would not be as fortunate in possessing such a large moon, they would not form tidal pools needed as incubators. This argument, articulated by some respected people, is nonetheless "in bad faith".

First of all, the Sun also raises tides, and while it is true that solar tides are much lower and weaker than lunar ones [the ratio is about 1 : 2 1/2], if the height of the tide is great enough not to be masked by common wave action, just how high it may be is quite irrelevant. The important thing is the availability of near-shore depressions with an erosion-resistant lip within reach of tide crest. Even if tide height were important, solar tides in up-flow cul-de-sacs like the Bay of Fundy are higher than the highest lunar tides in most other places. Continental placement vis-a-vis ocean currents is the major co-determinant of actual tide heights. All it need take is just one tidal pool to successfully concentrate and simmer a proto-organlc soup of the right recipe.

But let us accept, for the sake of argument that Earth may be unique in possessing such a disproportionately large moon (actually, Charon, in comparison with Pluto, about which it orbits, is proportionately much larger and closer). Let us also accept, for argument's sake, that tides relatively as weak as those raised by the Sun are insufficient to do the job, That still does not rigorously lead to the

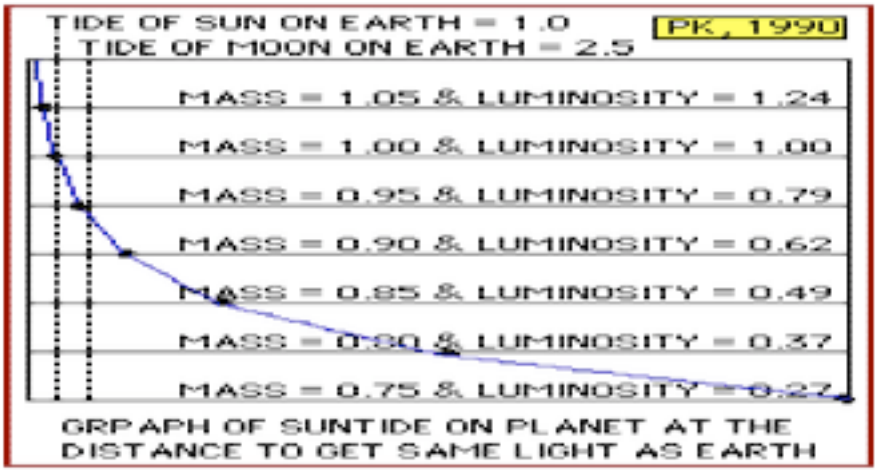
conclusion that life is unlikely to arise elsewhere in the universe even on planets that are otherwise of the right size, composition, and proximity to their central star.

Squelching the argument

Stars smaller and dimmer than ours will have eco-zones (in which the amount of light and heat per square meter is favorable to life) that are closer-in to their central star. But since a star's luminosity varies as the 4.5 power of its mass, and as tidal force increases inversely with the cube of the distance (not the square!), stars only 'slightly' dimmer than ours will raise tide significantly higher on any planets situated in their eco-zones to receive the same amount of light and heat as does Earth.

Tau Ceti, the most promising planetary host in the solar neighborhood (12.8 Lt yrs distant) has a 0.74 solar luminosity, and thus an eco-zone radius of 0.74 AU [1 AU = 1 Earth-Sun distance], but with 0.935 solar mass. It would hence raise tides of 2.01 mean solar value at an earth-like light/heat distance. And this approximates the present tides raised on Earth by the Moon.

E**psilon Eridan**i, also near and solar is smaller, dimmer. It must raise still higher tides on any earth-like world it harbors. And so on. Stars less luminous still might tidally arrest the rotation of any equi-lighted planets. See Graph:



Even a star of the same luminosity as the Sun or not too much brighter, can raise tides of lunar-like proportions seasonally (and that's all that is necessary) on a properly positioned moonless planet, if that planet has a sufficiently eccentric orbit. For example, if Earth had no major satellite but had an orbital eccentricity of 0.26 (e.g. swinging in as close to the Sun as Venus, and out half way to Mars), it would experience tides of lunar intensity for a few weeks each year near perihelion. The upshot is this: even conceding the rather crucial role of tidal pools in the successful origination of life on Earth, and even conceding that Earth may be uniquely blessed with a major satellite large enough and close enough to raise tides significantly higher than those raised by the Sun, It does not at all follow that the rise of life must be rare, let alone a once-in-a-universe, once-in-all-time occurrence.

On the contrary, the strong plausibility of equally effective and considerably more common "great tide" scenarios becomes a major argument for the opposite hypothesis - that life must he common. If ever we do reach the stars, we will find life-laden worlds!

MMM

MMM #39 - October 1990

[Star*bound Series Continued]

OORTFOAM

OORTFOAM By Peter Kokh

Consider for a moment how a fire-devastated virgin forest slowly rises up from its ashes; only few plant species colonize the wasted area at first, then as they grow, niches are created that can be exploited by other plants. It can be a century or more before the original biodiversity of the forest is restored. If the visiting devastation is very widespread, some areas may stabilize with a quite different mix of species than before. This is just a hint of what must have happened after a number of episodes of near global slate-wiping caused by large asteroid or comet impacts. When whole species, and sometimes whole families, of plants and wildlife are wiped out, hierarchical rebuilding of the niche-plexes of various ecosystems must chart fresh paths.

Surviving plants and animals, previously held in check by now exterminated dominant species, are suddenly freed to exploit new opportunities and effectively 'encouraged' to evolve to do so. The actual course of evolution has apparently been critically dependent on adventitious intervention of heedless celestial impactors. This periodic burst of freedom from the bonds of its own internal logic may be the only way it can be freed of its own ruts, even as the seed of some pine species can be freed of the host cone only through intense heat in an eventual forest fire.

Asteroids these days take much of the blame, or credit as I see it, for these clutch-hitting escapes from could-be evolutionary dead-ends. But comets, despite their lower densities, can arrive with far greater momentum if coming from well beyond the Asteroid Belt, indeed from well beyond the outer Solar System.

There are short- and long-period comets, tame or tamed inhabitants of the realm of known planets. They revisit the coma-inducing warmth of the inner Solar System on a regular basis. Then there are those rare visitors throwing out hoary tails along one-night-stand hyperbolic trajectories from out among the stars, with too much speed to keep them from returning thence.

In between there comes the infrequent visitor on a scarcely parabolic path which will bring it back Sunward some thousands of years hence. If we assume that such gelid objects could not have formed in such eccentric paths, but must have coalesced in some more rational more circular zone of protostar cloud material, where might that conjectured birthplace be? The answer according to Dutch astronomer Jan Oort, writing in 1950, was a vast spherical shell of pristine comet hulks thousands of times more distant from the Sun than Neptune or Pluto. Known as the Oort Cloud ever since, this region has been commonly imagined to drip Sunward great swarms of virgin comets whenever some passing star made an incursion into the neighborhood, clumsily disturbing their orbits in wholesale fashion. Balderdash!

One of the central assumptions behind all modern attempts at a scientific cosmology (or better, cosmogony: theory of the origin of the Universe as we now observe it to be) is the idea that what holds true anywhere, must, all else being equal, hold everywhere. Astonishingly, as religiously dedicated as most astronomers are to this principle, their seemingly unquestioning mass-attachment to the idea of Oort Cloud disturbances as the font of episodic cometary invasions of near-Sunspace gives it the lie.

SQUELCH ONE:

That comets with slow but enormous momentum in orbits tangential to the Sun, should somehow lose ALL of that momentum, and no less, to fall straight inwards, should happen about as often as every other lifetime of the universe. In other words, “it ain't too likely.”

SQUELCH TWO:

What's good for the Sun should be good for any other system-laden star. To think, even by default, that we are alone in having an Oort Cloud (if we do indeed have one, but that is not my dispute) borders on being self-discrediting. If, like two ships passing in the night, the Sun and another Oort-sporting star pass are another relatively hard-by (this should happen every few hundred thousand years or so) then it is far more likely that the Sun and its planets pass through the Oort Cloud shell of the other star, than that that star create precisely the kind of gravitational wake which will send ANY of our own Oort Cloud's inhabitants dead-on Sunward. Whatever comets may have restarted the stalled elan of evolution on occasion, have had at us from their orbits around other suns.

We are a long way from some General Theory of planetogenesis and solar system formation that will cover all the wide range of star and system types to allow us to say much more about "comparative oortology", if you will. But one thing is clear. Oort clouds are, according to the original theory, which it is not my purpose to question, too far out from their host suns, in comparison to average inter-star distances, not to loose members steadily by being routinely disturbed into some wide-ranging

brownian dance. The number of rogue comets no longer belonging to the gravitationally shepherded flock of any star, must be rising steadily since the onset of star formation in the galaxy.

Nearer home, all our probes bound for Jupiter and the outer planets (both Pioneers and both Vikings) have passed through the Asteroid Belt ('thick' only in the imagination of artists and writers of space opera) as if it wasn't there. Even the thickest parts of the nearer Kuiper and remoter Oort comet clouds are considerably less densely populated yet - than the Belt. However, the 'urgency' of population density (if one can speak so) is effectively relative to speed. Our proxies passed through the much thicker asteroid belt at a relatively slow 10 klicks a second.

A people-entrusted interstellar craft slicing through our galaxy-wide "Oort Foam" at perhaps a mere 10% of the speed of light i.e. 30,000 times swifter, would effectively densify comet spacing by that same factor. The odds against an actual (annihilateing) collision (the force of the impact increasing with the square of relative velocity) are still favorable perhaps, but only statistically. An ample time warning system seems a long shot. Traveling at near light speeds may cut down on exposure time to cosmic rays, the amount of non-recyclable consumables needed for the trek (energy-generating needs) and other dangers, but it'll surely demand its own special courage. **MMM**

Would-be Starfarers Quiz #2

By Peter Kokh

QUESTIONS

1. **Q.** How far from the Solar System would you have to travel before the star patterns of the familiar constellations became unrecognizable?
2. **Q.** Are all stars approximately the same age?
3. **Q.** Does the color of a star tell us anything?
4. **Q.** The Sun has 'sunspots' which come and go in pairs of eleven year cycles. Is this typical?
5. **Q.** Do stars ever collide with one another?
6. **Q.** Can the death of a nearby star effect the Sun itself, or life within our Solar System?
7. **Q.** Has the Sun always had the same neighbors?

ANSWERS

1. **A.** Bright nearby stars like Sirius, Procyon, Altair, Vega, Fomalhaut, Capella, and Arcturus would shift from their familiar positions by the time you reached ten or more light years from the Solar System in almost any direction. You'd have to travel a bit further before the stars in the Big Dipper started to shift noticeably, but Orion would hold its shape stubbornly until you were some hundreds of light years away. It may seem natural, and even romantic, to include the names of host constellations in the names of stars themselves (Alpha Centauri, Tau Ceti) but what constellations they "lie in" is entirely a matter of local perspective, so that these names betray a very provincial chauvinism. Such names would not wear well - if and when civilization reaches an interstellar level.
2. **A.** No. Star formation probably began shortly after the matter contained in our condensing proto-galaxy reached a certain trigger density, maybe 14 B years ago. Almost all of the smaller, less massive, cooler burning K- and M-type stars formed at this time are still around. The more massive, brighter, hotter burning ones, long since consumed all their nuclear fuel and came to the end of their "mainstream" lives to end up as degenerate dense white dwarf stars, as even denser neutron stars (pulsars), or even as black holes. The Sun is about 4.6 billion years old, the age of the Solar System in general. Most of the bright stars you see have to be much younger since they belong to the short-lived variety. Sirius and Procyon, have companion stars that have already burned themselves out. There are indications this may have happened to Sirius B within historical times.
3. **A.** The color is a direct clue to the surface temperature of a star, and an indirect clue to the rate and intensity with which it is consuming its nuclear fuel (hydrogen burns into helium, helium into carbon, etc.) Red stars are coolest, orange ones a bit warmer. Then come the solar-type yellows, yellow-whites like Procyon, and whites like Vega. Bluish stars like Rigel, burn hottest and brightest. Dwarf reds live the longest, the blues occupying the limelight just briefly. When we study the spec-

trum of a star, its light passing through a prism to reveal the various color components, we see telltale black absorption lines which indicate the presence of certain elements. In general, stars that have lots of 'metals' (here meaning anything heavier than helium) are younger, having formed at a period when star-forming clouds in our galaxy had become more peppered with heavier elements fused in the cores and supernova explosions of stars already dead. Thus solar-type stars poorer in 'metals' than the Sun, e.g. Tau Ceti, must be somewhat older, say six billion years or so.

4. **A.** Sunspots are slightly cooler regions on the surface (they are dark only in comparison!) associated with magnetic storms. Solar flares share the same timetable. We know stars have flares, paradoxically, the smaller and cooler the star, the brighter and mote violent these flares can be. Some dim red dwarfs brighten considerably during flares. On hotter, brighter stars, flares are almost unnoticeable. We have found gigantic sunspots on the bloated surface of Betelgeuse, a star nearing its death.
5. **A.** Compared to the immensity of space, the volumes occupied by even the largest stars are like mere points. Galaxies, in contrast, occupy much larger volumes of the space they cluster in, and sometimes do collide. We can see some galaxies in the process of collision. But while such slow-motion events surely have an enormous effect on the dust and gas clouds within the two galaxies, their individual stars must collectively pass clean through each other's interstellar spaces with no more than near misses. On the other hand, close binary stars can gradually orbit one another in ever tightening circles. Contact binaries have been observed. And quite often, in the pre-death bloating stage, one of the pair will expand to swallow the other. For hermit stars like our Sun, there is no danger.
6. **A.** It was probably a shock-wave from a bright nearby star dying in a supernova explosion that triggered the collapse of the dusty gas cloud from which the Sun and its planets formed. Some of the elements in our Solar System are present in atypical abundances for which this seems to be the best explanation. In general, all the atoms heavier than hydrogen within our bodies are star-ash from ancient stars long gone. But while the death throes of a nearby star like Sirius could certainly be a major happening in our skies (that there are no records of such a spectacle when Sirius B went Nova, may indicate it was behind the Sun in line of sight at the time), we are not 'currently' close enough to a potential supernova candidate to have to worry. But it won't be too healthy for those only a few light years from Rigel when its time cones!
7. **A.** Each star has its own orbit around the center of the galaxy, its own diverging trajectory, its own pace. It takes the Sun an estimated 250 million years to make one circuit. So our Solar System is only about 9 galactic years old. It is highly unlikely that the Sun is still any where near any of the stars populating the neighborhood of its birthplace. Nor, given chaos theory, could we ever reconstruct what stars were nearby at the time. You see, interstellar travel - by the stars themselves - has been around a long, long time. And we're aboard now!

MMM #40 - November 1990

BROWN DWARFS By Peter Kokh

Long before the term "BROWN DWARF" became the established currency for referring to substellar bodies without enough mass to contract gravitationally to the point where spontaneous nuclear igni-

tion can begin and be sustained, I felt that there must be innumerably more of such denizens of the dark [calling them dud stars, substars and finally "infrars" since they could shine only in the infrared than the stars themselves.

The argument is quite simple: among the known types of stars, the cooler and fainter the star type, the more of them there are, in a geometric ratio. Now if indeed there are far more "BD"s than visible stars, distances between then must be somewhat less formidable than those that quarantine stars and their planets-in- tow from one another. Our closest stellar neighbors, the double star Alpha Centauri with its tag-along, Proxima, are some 4.3 light years away (= 270,000 A.U.). As remote as this seems, more than 3000 times the known diameter of our Solar System, we are fortunate to have a neighbor so close.

If you take a list of all known stars within 10 parsecs (32.58 light years) as a representative sample, the "statistical average" distance between any one star system (binaries etc, count as one) and its nearest neighbor is 6.3 light years. There are some stars even 'luckier', of course. It's just a matter of breaks. One pair is only 1.1 light years apart. Stars drift and in the past we've come even closer than that to sundry stars, like "ships passing in the night".

Back to our story. If for every visible star system, I argued, there were ten "rogue" brown dwarfs, unattached to full-fledged stars, then the average distance between closest neighbor systems of either type must be 6.3 Ly times the reciprocal of the cube root of 11 (10+1) = 2.83 light years. That sounds a little more friendly - but don't get excited. It's still an unattainable distance given current demonstrated technology. If for every visible star, there were a hundred of such dark rogues, then that intersubstellar mean closest distance would be only 1.35 Ly. You have to remember that space is cubic!

A debate has been raging over whether the universe has "enough total mass" to be gravitationally closed or not. Will current expansion eventually stop, even as a ball thrown up into the air, to be replaced by some final epoch of infalling contraction, or will the expansion and 'thinning' go on forever? The total of visible stars and known gas and dust clouds in all the known galaxies adds up to only 10% of the mass needed to "close" the whole. Some propose that the conjectured swarm of unseen brown dwarfs may possibly account for most of the "missing" mass.

So now these illusive objects are no longer just an absorbing topic, as we idly daydream of alternate pathways into the universe at large. Searching for them has become a top priority!

Those searching argued that some brown dwarfs may retain enough heat from their original formation, the heat of contraction, to be detectable by special infrared-sensitive telescopes. Until recently, we could not conduct such searches.

The water vapor in our atmosphere effectively screens out the infrared part of the electromagnetic spectrum. But now, new instruments on very high peaks such as Mauna Kea on the island of Hawaii at 13,796 ft (4300 m) poke above most of this water vapor screen yet that is still not enough to provide the sensitivity needed. Nor do the brief flights aboard NASA's infrared-equipped Kuiper Airborne Observatory suffice. So when the IRAS (Infra-Red Astronomy Satellite) went up in January '83, the search for brown dwarfs became a top priority.

While IRAS did make a serendipitous discovery of previously unsuspected protoplanetary "dusty" disks around some nearby stars like Vega and Beta Pictoris, no unchallengeable evidence of brown dwarfs was detected. Many, even some of the investigators themselves, have jumped to the conclusion that the assumptions on which we've been postulating their existence are wrong, that there aren't any such critters.

IRAS was capable of detecting only those rare dwarfs with a fairly high temperature, such as they would have if they were recently formed. It is the more plausible assumption that the overwhelming majority of such substars were formed in the earlier waves of galactic star formation and have long since cooled to a point where they emit heat too feebly to be detected by our current state of the art instrumentation. Further, the investigators FAIL to admit, they have been looking only for brown dwarfs that are companions of known visible stars, not for those harder to find hermit rogues in sunless reaches. So these intra-stellar substellar curiosities may still lurk out there somewhere. If so, these hermit brown dwarf systems, despite the somewhat less intimidating distances between them, won't become stepping stones to the stars. It would be absurd to waste the fuel and the time needed to decelerate for a "pit stop" in such a system.

But, it is possible many of then have dwarf planetary systems not unlike Jupiter's, close-in and cold!.and, ample solar energy is not the only hook on which to hand our pioneering hat.

Circling some of these lonely dwarfs may be numbers of "oceanids" or "europids" [see MMM JUL '9O #37 article "Oceanids"], Europa-like moons with ample water oceans kept liquid by tidally-induced heating under vacuum-packed ice crust seals. Some day we may learn how to farm such oceantrove moons, starting with Europa herself.

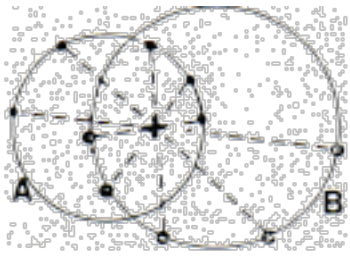
Communities of settlers could orbit in space settlements or live in shielded and insulated stilt-supported structures out on the ice-crust. For energy they could tap into strong magnetic differentials surrounding the brown dwarf or rogue gas giant, in much the same manner as OTEC (Ocean Themal Electric Current) schemes. This is a technology we probably must develop if we are serious about at-tempting to bring Jupiter's big Galilean moons into the human domain.

In a way he did not foresee, Arthur C. Clarke, co-author of "2001" the Movie (Saturn's Iapetus, not Jupiter, hosted the stargate monolith in the book version), Jupiter could yet become our dawn breakthrough point to the stars!

MMM

MMM #43 - March 1991

Star*Bound *series continued (**Not how, but where to?**)*
This series began with "Brown Dwarfs" in MMM #40, NOV' 90

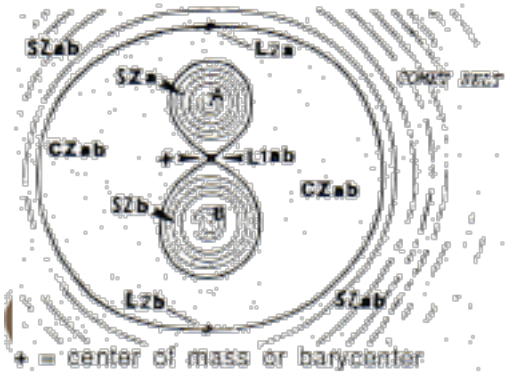


Any Planets in this Twin Sun System would have some Strange Seasons.

[NOTE: All deduced statistics are those of the author.]

Most everyone knows that **Alpha Centauri** is the name of the "star" closest to our Solar System (if you except its dim, distant, and insignificant companion **Proxima Centauri** a quibling light month closer).

But not everyone knows that Alpha is really two stars, "A" and "B," not just one. The two circle one another around a common center of mass or barycenter making this a "binary system."



In the illustration. ✚ is the center of mass or barycenter of the system. A and B are always on opposite sides of ✚ from one another in eccentric (0.52) 80 year orbits. And the more massive A is always proportionately closer to ✚ than B.

For decades, Alpha Centauri was "the" first stop on our road to the stars – at least for many science fiction writers. But this unquestioned common fact has changed in the past generation, as writers paid more attention to what astronomers had to tell us.

More than a third of the stars in the neighborhood of the Sun – and we must assume this is typical – have one or more companion stars in orbits ranging from close in to quite far out. It seemed obvious that planets would have a hard time forming and maintaining stable orbits in such binary or multiple star systems. Accordingly, we supposed that the process of condensation from the protostellar cloud had two forks. One path must lead to a single central star with a retinue of planets, the other to binary star systems without planets. Alpha Centauri was then dismissed as an unsuitable destination. We were sure there could be no planets to visit, much less to colonize.

The interest shifted to reasonably sunlike stars of the single persuasion. Alas, even the closest of these lies considerably more distant. Alpha Centauri is 4.3 light years away, 9,000 times as far away as Neptune, 270,000 times the Sun-Earth distance, and 100 million times as far away as the Moon. The closest marginally sunlike solitary star is **Epsilon Eridani** at 10.7 light years. Much more like the Sun is **Tau Ceti** at 11.9 light years. Tau Ceti, and single solar type stars further out, now became the most mentioned Sci-Fi target.

- But as supercomputers were made accessible to astronomers, simulations showed that in some binary systems wherein either the two stars were quite close, acting gravitationally as one on surrounding space, or far enough apart so that appreciable space surrounding each was minimally disturbed by the other's gravity well, planetary orbits that would be stable over billions of years were possible.

That is NOT to say that it is now considered likely that planets would arise in such umbrella regions!

But Alpha Centauri does falls into the second of these 'favorable' configurations. So let's take a second look.

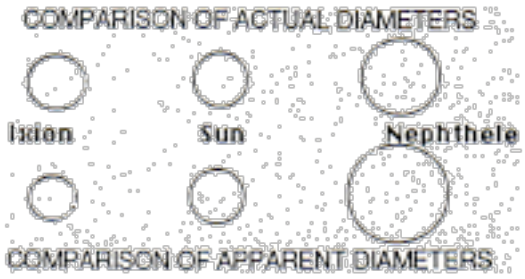
Alpha A and Alpha B revolve around one another in a very eccentric orbit once every 80.02 years. At their closest, they are 12.4 A.U. apart [1 A.U. is the mean distance of the Earth from the Sun i.e. 93 million miles or 149.6 million km]. This is about 25% greater than the Sun-Saturn distance. At their farthest, A and B are separated by more than 39 A.U. which compares with the mean Sun-Pluto distance. Simulations show that planets in inner system type orbits out to as far as Jupiter's distance (5 A.U.) would be stable around either of these stars. What more could one want?

The Name Game

Before we carry our musings further, a word about names. You may well wonder why the third brightest star in all the sky (after Sirius and Canopus) does not have a proper Arabic name. Alpha Centauri is so far south (-60 degrees) that it first clears the horizon, just, at about 29 degrees north. Simply put, out of sight, out of mind. But it does have a seldom used Arabic/Greek compound name: **Rigel Kentaurus**, in which Rigel means foot, i.e. the foot of the Centaur.

Meet Ixion and Nephthele

Now Alpha A is **slightly** more massive and brighter than the Sun, and Alpha B, though less massive and less bright, is nonetheless unrivaled until we get out to **Tau Ceti**. If there is even 'some' possibility that either or both have planets, shouldn't these two solar neighbors have names of their own? For the purposes of the discussion that follows, let us call them **Ixion** and **Nephthele** respectively, "King and Queen of the Centaurs."



While we are unaware of any other writer suggesting that in addition to their own separate families of close-in planets, it seems to us, judging from the orbital simulations above left (of stable vs. chaotic orbits around binary stars), that they could share a common family of outer planets, including a common "Kuiper Belt" and "Oort Cloud." While we have yet to detect planets in this system, as there "ecliptic" or median plane of rotation is not "edge on" to our own, that is to be expected.

As it becomes more and more clear that planet formation is a normal part of star formation, we can
consder ourselves fortunate to have such an interesting system as our closest neighbor. The Alpha A B C system C being Proxima) deserves to be our first exploratory target.

The Sun, Ixion and Nepthele in comparison

Ixion has 10% more mass than the Sun, shining 60% brighter. A planet placed around Ixion to receive the same amount of sunshine as does Earth (let's call any such planet a geophote) would orbit at 1.26 A.U. in 465 standard days. As Ixion burns hotter than the Sun, it may be slightly smaller in diameter and its yellow-white disk would appear smaller yet, in its geophote's skies. Let's call this imaginary world Ixion III.

Before you get carried away imagining what seas and continents grace these hypothetical worlds and what sort of life might have arisen there, consider this sobering fact. First, on Ixion III. At its dimmest, i.e. at its furthest point of the eccentric A-B orbit, Nephthele would appear to be only 1/3500th as bright as the sun (Ixion) but still the equal of 75 full moons, and it would creep slowly through the constellations at 2.3 degrees per local year. But when Nephthele was closest, and swiftest, covering 14.4 degrees per local year, it'd be 1/350th as bright as the sun, or 750 full moons!

T**he chaos for life of having two suns**

Now Nephthele completes a circuit of Ixion II's heavens in about 63 local years. For years at a time Nephthele would shine to one side or the other of Ixion in the daytime sky in a given season . Then for many years it would blaze brightly in what would have been the nighttime sky in that same season..If our Ixion III has an atmosphere, NO star would come out (at night, it never getting dark enough) for years during that season (other than the twin sun) and it would never get darker than a very bright twilight.

Climactically, Ixion III could have a normal set of seasons if its axis is appreciably inclined to its orbit as is the case with Earth. However, biologically, these annual seasons might be masked by the "white night" seasons of the greater "Nephthelean year." No matter which numerical system hypothetical natives of Ixion III might have, their 'century'-like counter would be calibrated by Nephthele's circuit through its skies, i.e. pegged to 63 some Ixion III years. Culturally, "the Moods of Nephthe le" would play as important a role - if not more important - than the yearly seasons.

Now on Earth, many species of plant and animal have physiological and behavioral patterns regulated by the succession of day and night. Analogous species on Ixion III would have to evolve regulatory mechanisms not confused by the changing pattern of nighttime light-seasons shifting for each generation. Earth has night-blooming plants, as well as nocturnal animals. It is difficult to imagine either finding a niche on Ixion III.

The most favorable pattern one could hope for, would have Nephthele at its closest and brightest during one hemisphere's winter 'nights' and furthest during that hemisphere's summer nights, and also find most of the temperate and tropical land mass areas arrayed in that same hemisphere, be it north or south. But that situation could be temporary in terms of geological time if the major axis of the A-B (Ixion-Nephthele) orbit slowly precesses. If so, that would pose even more formidable challenges to slow evolutionary adaptation.

A complex and disadvantageous setting to be sure. But the situation for our hypothetical Nephthele II is even worse. At its dimmest in that geophote planet's skies, Ixion, when most distant, would still be about a 1000th the brightness of the standard sun (here Nephthele), and equal to 270 full moons. At is closest and brightest, it would be 1/100th as bright as the sun, and the equivalent of 2700 full moons! When Ixion was above the horizon in what should have been night on Nephthele II, it would be as bright as a cloudy day.

As bad as this all sounds, we have analogous nighttime conditions in Arctic and Antarctic summers within the Arctic and Antarctic circles. But here on Earth, the pattern of "white nights" is the same year after year, presenting evolution with a fixed challenge. On either our hypothetical Ixion III or

Nephthele II, the pattern would shift in 80 Earthyear cycles, presenting much more of a challenge for adaptation. If one or both such planets have indeed formed in our neighbor binary system, life would have achieved much if it only attained levels that we would call very primitive, and there would be no higher plants or animals, let alone 'native intelligence'. With no established advanced flora or fauna to intrude upon, human colonists might be able to nurture food plants and husband farm animals all brought with them from Earth, in light-controlled enclosures. But such plants and animals would have a predictably hard time establishing themselves in the wild well enough to survive through the many years of the local white night seasons. In such a case, the land outside the immediate settlement areas would remain pristinely raw and primitive. The settler culture would probably grow in complexity beyond Earthly precedent.

Our recommendation is to forget Alpha Centauri as a prime destination - UNLESS, through instrumenta-tion and data enhancement techniques not yet achieved, we do discover that one or both stars in this system is a "sun" in its own right, i.e. that it/they have planets. I, for one, would be pleasantly surprised. Dream on, if you will, but don't bet your life savings on it! - MMM

MMM #44 - April 1991

[**Star*Bound**] series continued

More on ALPHA CENTAURI

By coincidence, the April issue of **Astronomy** magazine has an article on the possibilities for planets in the Alpha Centauri system, by Ken Crosswell. While carrying some information new to us (evidence that these twin stars are a bit older than the Sun) and using slightly different figures for mass and mutual separation, the writer reaches broadly similar conclusions. He gives a smaller diameter for **B [Nephthele],** and it is questionable whether he has taken into account its lower temperature and more diffuse illumination.

He is also much more conservative in allowing stable orbits only twice as far out as the Earth's distance from the Sun (i.e. 2 A.U.) to our 5 A.U. Let's agree with him that 'planets' could form only within the tighter range. Yet orbits for planetesimals or asteroids prevented from coalescing into a single body should be stable out to 5 A.U. Such an asteroid belt might contain significantly more matter than our own, with asteroids rather more closely spaced. This would probably result in impact-destruction of sizable bodies like Ceres, etc.

Out of his field, Crosswell's treatment of the potential biological problems is superficial and not to the point. While he is correct in saying the heat of either distant sun would pose no climate problems, he overlooks the potential for shifting seasons of 'white nights' to play havoc with biological rhythms. **PK. MMM**

PROXIMA centauri

Or, the Saga of The "M-Wave"

By Peter Kokh

Last month, we took a journey of the mind to 'nearby' Alpha Centauri, finding it an unpromising goal. What about Proxima Centauri, Alpha A and B's distant companion (sometimes designated Alpha Centauri C)? The actual separation is some 13,000 A.U. or about 75 light days so that Proxima [Latin for "nearest"] could have a full range of planets in orbits unperturbed by the beacon-bright twin stars in its sky. Ixion (Alpha A) appearing a little brighter than our full moon, Nephthele (Alpha B) a little dimmer. They would appear together in a fixed area of the sky, from 3-10 arc minutes apart at best, seasonally dominating the heavens. Proxima's orbit about them is so wide and slow, that this 'fixed' position would take about 3,000 years to drift a single degree. There are clues that Proxima may be only a billion years old, whereas Alpha Centauri A and B seem to be about 5 to 6 billion years old (a bit older than the Sun) so that Proxima may be a 'captured' companion. While 'white nights' wouldn't be a hurdle for biological adaptation here, it seems quite unlikely that Proxima could harbor a planet at 'geophote' range.

Consider:

Proxima, a dull red dwarf of class M5, isn't the dimmest star known (Wolf 359, an even duller M8 7.6 light years from us, can manage only a fourth as much light), but it does fall in the lowest percentile of true stars, those that shine with the light of nuclear fusion in their cores. In itself, that might make it an interesting star (or system) to visit. While planetogeny can hardly aspire to the level of science, given the current absence of data from any system but our own, it is possible to go out on a fairly sturdy limb and make these predictions [the writer's own]:

- Single stars considerably brighter than the Sun will have burned so hot in their youth before settling down to "main sequence" adulthood that nearly all gaseous matter will have been blown clear. Any planetary retinue would include only small hard-surfaced rocky-silicate planets like Earth, Moon, Mercury, Venus and Mars - no gas giants like Jupiter, Saturn, Uranus, Neptune!
- A star considerably less bright than the Sun, won't ever have burned hot enough to blow clear any of the gas left over from its formation. So if it has planets, they might all be gas giants, save for some moons and asteroids.

At least, that's my best bet. But for the sake of argument, what if there is a hard crust silicate planet at a range where it receives about the same light in watts/m2/sec as Earth? What could we say about it?

First, that's pretty close in. Proxima produces only one twelve thousandth as much light as the Sun, and our hypothetical habitable world must orbit only about 840,000 miles out from Proxima's center, let's make that 800,000 from its surface, a dull red disk many times the Sun's apparent diameter in our own skies. 'Proxima Prime' would circle its sun in only 60 hours - its year. At this intimate distance, less than 4 times the Earth-Moon distance, Proxima would exert an incredible tidal force on the hapless world, one more than 600,000 times as great as the Moon's tidal force on Earth. (Tidal force varies with the mass and inversely with the CUBE of the distance.) The planet would be quite ellipsoidal with the long axis aimed at and away from the sun, its rotation hard-locked.

If there were an ocean, it would have no tidal ebb and flow but be permanently piled deep on the sun-facing and sun-averted sides, submerging any highland continental areas, and correspondingly shallow (or dry-parted!) at the fixed dawn/dusk lines - this over and above an already egg-shaped crust. Plus its waters would range hot to warm on the nearside and cold to permanently frozen all the way through on the farside. Worse, this might not be a stable situation. Over time, incessant prevailing winds would carry any evaporated water vapor to the night side, adding to the amount of ice permanently cold-trapped there.

If the orbit of our conjectured Proxima Prime was not fairly circular, but say as eccentric as the Moon's or more so, tidal heating of the core from libration effects alone would keep the interior molten, resulting in major sustained volcanic activity through a thin, fracture-laced crust. The gases associated with volcanic eruptions on Earth would quickly have been worked out of the planet's interior, providing a thick atmosphere reeking of sulfur and brimstone. Instead of volcanic plumes and explosions, there would only be repeated gushing of lava, with some basin areas never having time to really cool down. This volcanic heat might help to prevent the eventual cold-trapping of the entire water endowment on the night side.

What if we put our orbit back half again as far, so that the permanently sun-facing portion isn't over-heated. That gives us an orbit one and a quarter million miles out, and a 'year' a whole 4.6 Earth-

days long. (Horoscopes would still change by the hour, making astrology a prestige profession if Proximians were as incorrigibly gullible as humans.) But even if, given that a higher portion of the radiation budget of such stars lies in the infrared, and that we may want an orbit even further out (lower light levels but with moderate temperatures) the situation does not change materially.

While there are probably no major hard-crusted planets around M stars at any distance, there could be sizable moons. But at suitable light/heat range, a moon would have to be impossibly close to even a Jupiter sized planet for the Jovian's tidal influence to prevail.

Okay, you are game and determined to establish a human/Gaia foothold here, despite these hardiness-evoking conditions come hell or high water. Well, hell will come, and any seas may at least boil now and then, for when stars this small have flares, they are of the big granddaddy kind. Proxima doubles, even triples in brightness and heat output for a few nightmare minutes on an erratic schedule. Possible warning signals, and probable flare seasons would lessen risk at other times.

We might be smart and choose to live along the dusk and dawn lines in the libration zone (might be the only dry zone anyway). Thus we'd minimize our risks and, occasionally, be able to see the stars. Yet, besides providing emergency sun-facing shelter for ourselves, we'd have to arrange some sort of fast automatically-deployed shelter for all our exposed crops (planted on sun-facing slopes) if we didn't want them prematurely rad-fried, rad-baked, or rad-broiled on the stalk.

Human beings - and, via genetic re-engineering, our plants with us - are extremely adaptable (adapting to the red-centered spectrum of such stars is a must). If there is such an unlikely world in this or any other red dwarf M-star system, it would take a special breed of people to accept the challenge, and an ever rarer breed to meet it effectively so as to survive long term.

Any strain of humanity (or of any other techno-sapient race) that managed to eke out so much as a stalemate on such a hostile host world, and go on to repeat the feat in one M-star system after another, would soon permanently dominate the galaxy. For seven out of ten stars fall in this class. What is more, M-stars burn their nuclear fuel at a miserly pace, and have stable lifetimes up to ten times or more as long as do solar G-type star-suns like our own.

To be sure, some M-stars are less challenging. Lalande 21185 is a relatively more massive M2 type star 8.1 light years away with fully 1/160th the Sun's intrinsic luminosity, so that its geophote range lies 7 plus million miles out, giving a year of 3 plus weeks, subject to a shaping tidal force 'only' a thousand times as strong as the Moon's distortion power on Earth.

If there are any 'havens' around M stars, and if despite the growing sissification of our breed, there are a standout handful who want to head out that way (the "M-wave" or the "Emmers"), I'll cheer them on from my grave, happy to have turned back into star-dust before being presented with the chance to join up. MMM

MMM #45 - May 1991

[**Star*Bound]** series continued

CIRCLING SOME YELLOW-WHITE "F" SPECTRUM STARS MAY BE AN OVERLOOKED SCATTERING OF

WELCOME MAT WORLDS By Peter Kokh

The conventional wisdom about where we ought to look for indications of technological civilizations like our own and/or where we might find suitable new "Earth-like worlds" on which to sew the human seed has always been "circling stars like the Sun" in color and temperature: warm yellow G-spectrum stars - and perhaps also around those just a bit cooler and more orange: K- spectrum stars. This has been the prevalent view for many decades.

First there was the discovery that single unpaired stars that rotate slowly (as does the Sun, in about 28 days) are likely to be attended by a retinue of planets. Now every survey shows that in general, only G-, K-, and the even cooler, redder, and smaller M- spectrum stars are slow rotators. Some slightly hotter stars of a yellow-white or F-spectrum may also be slow rotators. The balance of hotter, whiter and bluer stars seem to rotate swiftly, in a matter of hours. The significance of this is that if the Sun could somehow draw in all its family of planets, as a spinning skater does his or her arms, its rotation would speed up to a mere two hours! In other words, by far the greater portion of the Solar System's angular momentum is invested in the orbital motions of the planets, not in the much more massive body of the Sun itself.

The conclusion that seemed universally drawn, never to be questioned, was that the hot)-, A-, and F-spectrum stars were lonely giants. In their ranks are most of the stars you see at night like Vega and Sirius (along with so-called G-, K-, and M- giants like Capella, Arcturus, and Betelgeuse either at the brilliant start or end of their nuclear burning stages). Stars likely to be planet-laden are smaller and fainter, visible to the naked eye only from nearby, a few light years at best.

I found it strangely disconcerting after the recent discovery of proto-planetary dusty disks of matter around Beta Pictoris, Vega, and most recently Fomalhaut, each too hot to fit the schema, that there were no public admissions by astronomers that the earlier comfortable expectation was wrong, and why. To me it seems the "skater-hypothesis", for want of a better word, was incomplete to begin with. In our own system, 98% of all the angular momentum invested in the planets is contributed by the "gas giants", 75% of that by Jupiter alone. Now hotter stars in their youth may easily have blown most of the hydrogen, helium, and other gasses out of their planet-forming regions altogether, so that only much less massive solid surface rocky silicate planets like Mercury, Venus, Tellus-Luna (Earth/Moon), and Mars could form. In such cases, the central sun would retain most of its rotational speed.

With this correction to the original insight, we might expect the planetary systems of hotter stars to be devoid of gas giants, and those of much cooler stars to include gas giant planets exclusively. In other words, in seeming poetic justice, the smaller the star, the more massive its total complement of of planets, and vice versa. The Sun, being in the mid-range, has some of both type of planets and just where you'd expect them to be. I have yet to hear anyone make that point.

But there is one other extremely important consideration. Hotter, more massive stars burn more intensely and exhaust their nuclear fuel much more quickly than do cooler, less massive ones. Some hot stars are veritable flash-in-the pans, their brief but spectacular lifetimes over in only a few million years. Our own star, the Sun, has burned fairly steadily for some 4.6 billion years already, and will probably enjoy a stable period of similar length down the road, before the drastic changes of stellar senescence overtake it. At the other end, the coolest red stars shine with a steady slow-burning light for a hundred billion years or more.

Now our galaxy, the Milky Way (the only name we've ever given it), is probably 15 billion years old, give or take a few. ALL those stars still burning since the original episode of star formation are small, faint, cool red M-stars. The vast majority of stars you can see at night are hotter and more massive and can only have come into existence in relatively recent times, perhaps after animal and plant life had already colonized Earth's continents. The average age of more sunlike G-stars must statistically be close to the Sun's age, since it is in midlife.

Perhaps you're on the ball and have already put 2 and 2 together. Stars brighter and more massive than the Sun by a certain threshold amount MUST reach the END of their stable lifetimes BEFORE life (assuming it to be naturally arisen and evolving at a catastrophe-punctuated pace similar to that on Earth, the only example we have to study) can REACH the stage of "reproductive readiness" now attained by Gaia (the name of Earth life as an interconnected whole). So while contrary to former expectations, hotter stars CAN have planets, any life that arises on those favorably placed, WILL BE nipped in the bud by the death of their sun before that life gets to the stage we see here. Again, that is assuming that the pace of asteroidal impact-caused break-outs of evolutionary ruts that has occurred here, is representative. Yes, that's a big "if" - but not an implausible one.

Now we are ready to take the discussion to the next level. If and when we reach the stage of technological achievement that WILL support the sending of interstellar settlement expeditions, arks (not necessarily slow) of people, plants and animals (at least in gene-bank form), then what target-types should we head for? The unanimous suggestion of would-be planet-steaders is to head for "Sun-like" G-star systems. Those who would build their own worldlets of proto-planetary debris, in the "space-colony fashion, have much more of a choice, of course.

Now for the fly in the ointment. This writer maintains that any truly "Earth-like" planet around a Sun-like star will already have its own indigenous living ecosystem. Whether it has produced some higher intelligence or not, we will have a moral duty to leave such biomes to their own natural evolution. In other words, if any suggested world is truly "Earth-like", we ought to consider it off-limits. Many will violently disagree, not because they question the moral principle invoked here, but because applying it would seem to deny them their entire list of "good" targets. They will be frantic, searching for reasons to put this moral "directive" aside.

There are three outs: The first two will have already occurred to many: 1) we go to systems with "Sun-like" stars but without truly "Earth-like" planets and "terraform" or render "Earth-like" those planets that just missed being so by dint of being a little too near or a little too far from their suns. Or 2) we do go to those systems with native life to settle not these planets themselves, but, in space colonies, all the space nearby, vantage points from which to study and observe them without interference.

Yet for the planet-drawn, there is a third out, one which seems much more interesting and intriguing! The moral principle we've stated above, will not apply, even to the most Eden-like of worlds, IF it circles a sun that must die before native life has any chance to blossom and quicken with spirit. Now mid-range F-spectrum stars, say F3-F8, are in this range of life-expectancy. They can expect 2+ to 4-billion years on the stellar mainstream, burning steadily enough to nourish life on properly placed planets.

My thesis is that these F-stars, not those on the usual G-star list like Tau Ceti or Epsilon Eridani, are the ones that should be setting our settlement juices flowing. If ethics are as universal as every philosopher holds, the same conclusion should "occur" to other intelligent species.

Now the hotter a star type, the fewer there are of that kind, and conversely, the cooler the more. Thus, despite first appearances, the attention-getting signpost hot stars that dominate skies everywhere are much rarer than the cool faint stars that swarm below the threshold of naked-eye visibility. Approximately 4% of the stellar population is of the Sun-like G-spectrum type. The somewhat hotter yellow-white F-stars form a smaller sampling, perhaps 2%. But if that's where the union of ethics and opportunity leads, that's where we should look to expand.

Procyon is easily the best known star of this type, at least to those of us in northern latitudes, and we might refer to such stars as Procyonids. But it is not itself a candidate, being part of a double star system. Its companion is a white dwarf, a hot but very tiny corpse of a once much brighter star, even brighter than the Procyon we see, that has already come to the end of its mainstream life. Procyon A must sooner of later follow its companion into oblivion.

But there are other stars visible to the naked eye which fall into our narrowed classification. As luck would have it, there are more of these visible in the southern skies than this far north. Among those apparently single stars (less than half) closer than 20 parsecs (65 Lt Yrs) with names or Greek letter or Flamsteed number designations, some of the following may be worthwhile:

· Candidate stars are listed in rising order of right ascension or celestial longitude.

· Those with the lower F#s have the shorter lifetimes; so those with the higher numbers like F7 and F8 are more promising bets.

· The more the light years distant, the less certain the distance estimate. Those within 10 parsecs (32.58 LY) are shown in boldface.

▫ Beta Cassiopeiae.....	F2	50 light years
▫ 6 Ceti	F6	53 LY
▫ 19 Ceti.....	F8	51 LY
▫ 44 Andromedae.....	F8	65 LY
▫ Nu Phoenecis.....	F8	45 LY

▫ 50 Upsilon Andromedae.....	F8	52 LY
▫ Gamma Doradi.....	F0	55 LY
▫ Zeta Doradi.....	F8	43 LY
▫ 111 Tauri.....	F8	52 LY
▫ Eta Lepi.....	F0	49 LY
▫ Beta Carinae.....	F5	58 LY
▫ **Beta Virginis**.....	**F8**	**32 LY**
▫ Alpha Corvi.....	F2	49 LY
▫ Sigma Bootes.....	F2	57 LY
▫ Alpha Prime Librae*.....	F5	57 LY
(* distant companion of Spica)		
▫ 45 Bootes.....	F5	65 LY
▫ Beta Trianguli Australis.....	F2	39 LY
▫ 58 Ophiuchi.....	F5	57 LY
▫ Zeta Serpentis.....	F3	65 LY
▫ **Chi Draconis**.....	**F7**	**25 LY**
▫ Psi Capricornis.....	F5	39 LY
▫ **Gamma Pavonis**.....	**F8**	**28 LY**
▫ Tau Psalterii.....	F5	60 LY

That's admittedly slim pickings. Of the prize contenders, Beta Virginis and Chi (pronounced Key) Draconis are visible to northern observers. Of these stars, perhaps some percentage have planets on which life has appeared, doomed to be tragically nipped in the bud before it can possibly reach full flower. Such worlds, since they cannot see maturity of life on their own, but only through "outside" intervention and acceleration, can attain deserving fulfillment only through settlement by intelligent species arising elsewhere.

Now some of these suns will be too young, any favorably placed planets not yet settled-down geologi-cally, on which life has either not begun or is only in the tentative stages. Ideal for us are worlds 2-3.5 billion years old with at least a few hundred million years of useful time left on their ticking-bomb suns. Yes, so what if after a few hundred million years we'd have to move? No one in Canada or Scandinavia seems too very bothered by the near certainty that their homelands will be wiped slate-clean by the next episode of advancing glaciers due within a mere 10-50 thousand years! While some few neurotically insecure types are already worried by the impending death of the Universe some hundreds of billions of years in the future (and speculate how we might cheat this common fate), for the over-whelming majority of us, the promise of some hundreds of millions of years around which to plan our lives and civilizations is quite generous enough.

By heading for the somewhat fewer and further "fated-yet-friendly" worlds around yellow-white F-suns, we'll find destiny enough, with an uncompromised conscience. What will be in store for those who take up the challenge to settle these unfinished raw worlds that would otherwise be condemned to remain such? We might take a look at the Earth of 1/2 to some 3 billion years ago. But that's a picture we can only see through the fog of time and not yet uncovered evidence. As best we know at this time, the first primitive life appeared on Earth when the planet was about a billion years old, or at least we've not yet unearthed indications of its presence much before that.

Early life was predominantly cyanobacteria, previously called blue-green algae. This very primitive life form dominated the planet for two billion years or more, and was largely responsible for sweetening the atmosphere by replacing carbon dioxide with oxygen.

The common view has been that the continents themselves were barren until about 500 million years ago, life being principally an oceanic phenomenon before that. But in Science News for December 9, 1989 an article entitled "Supersoil" tells of newly found indications that cyanobacteria had invaded the continents possibly a good billion years earlier. They apparently performed invaluable yeoman work by creating stable soils, greatly increasing the accumulative effects of weathering by contributing erosion resistance, and even reduced land temperatures substantially (soil being cooler than bare rock). These hearty microbes can withstand long periods of drought in a state of suspended animation, yet burst into frenzied activity within seconds of it starting to rain.

According to this reconstruction developed by Tyler Volk, New York Unive. and David Schwartzman of Howard University, Washington DC, (upon investigation of modern cyanobacteria-rich soils in Utah), the humble service performed by these cyanobacteria slowly prepared the continents to receive the first true primitive land plants much later on, which paved the way for the first amphibians, and so on.

While we might find some F-sun worlds further developed, with Cambrian type life in the seas and on the land, most such worlds we come across should be somewhere in the much longer cyanobacteria-dominated stage. If this life is of the dextro- or right-handed persuasion, as is all life on Earth, higher life forms tracing their ancestry back to Earth should transplant well (not without casualties), both in the seas and on the land. But if the indigenous life is built on left-handed molecules (stereoscopic twin molecules and organisms built of them, will have identical properties and characteristics but find each other mutually indigestible), we'd be hard put to establish food chains we could use to support our existence. We do not know at this time if so-called right-handed life is a 50-50 possibility, or if by chance it has become widespread throughout the galaxy by some sort of preemptive (but not necessarily purposeful) "seeding" as in the "panspermia" hypothesis.

At any rate, planets pre-readied by cyano-bacteria would seem a lot more attractive than totally barren worlds that would have to be terraformed from scratch. At least our yellow-white F-sun worlds will already have rich fertile soil and teeming seas and quite likely oxygen-sweet air, plus a future that belongs to us by default.

"**On to Chi Draconis!**" You read it first in MMM!

MMM #46 - June 1991

Star*Bound] series continued

NAME GAMES FOR

AROUND OTHER SUNS

NAME GAMES FOR PLANETS AROUND OTHER SUNS

By Peter Kokh

In the June 1990 issue of Astronomy, Deborah Byrd, the creator of the "Star Date" radio program, expresses her unease at the very real near term prospect that we will soon (at long last!) be discovering one new planet after the other - around other stars -and feel ourselves compelled to give names to these exoworlds. Names are how we prefer to handle things. We can use grid and/or cataloging numbers, of course. And for many objects literally too numerous to name, this is the only designation we ever give them.

Traditionally, the "right of naming" belongs to the discoverer. Some delight in this ritual sharing in "Adam's privilege"; some do not, and gladly leave the job to others. Our naming talents rely generally on naming the new after the familiar. Only seldom do we invent new names from scratch. It is easier, too, to follow precedents and soon practice becomes tradition. Most lunar seas (maria) are named after states of mind or weather, lunar craters after past astronomers. On Venus, we are naming the large features after mythical women, the small craters revealed by Magellan's imaging radar, after historic women.

The exceptions grate - like two lunar seas named after persons (Humboldt and Smyth) and one for a city (Moscow). And there are unfortunate cases of missed opportunity. The asteroids discovered to be orbiting in formation with Jupiter in the L4 and L5 Lagrangian points, 60o preceding and trailing Jupiter in its orbit about the Sun, have been named after heroes from Homer's tale of the Trojan Wars. But the chance to reserve L4 objects for the Greek heroes (the first dis-covered was designated #588 Achil-

les) and L5 for the Trojan heroes, was lost forever through the sloppy lack of forethought by one person.

A problem arises when the existing pool of names nears exhaustion. The asteroids were at first given names taken from Greek and Roman mythology - we had no idea how many we were about to discover! - until these began to run out. Now we find such whimsical names as "#1625 The Norc" (named after a computer), Most traditional name-pool sources have been already severely drained by the big flood of surface features revealed by space probes from Luna 3 's historic first photos of the Moon's previously unseen farside hemis-phere in 1959, to Voyager II 's recent grand finale at Neptune/ Triton.

The IAU, International Astronomical Union, has a committee to oversee the naming backlog and guarantee that there is a semblance of pattern and appropriateness. Even so, we have had to tap much more recent mythology to name the newly found moons of Uranus, with characters from Shakespeare's "Midsummer Night's Dream".

So what will we do if we discover exo-planets in great numbers? [MMM # 36 JUN '90 "Exo-Planets" p. 9 [MMM Classics #4]; and "Barnard's Star" this issue, below] I think this time we ought to prepare for the flood with some helpful ground rules. First, please note that only a few of the very brightest stars visible from Earth (and the Solar System) have names - those being given by early Arab astronomers. Vega, Deneb, Altair, Capella, Sirius, Rigel, Canopus, Alcor and Mizar, Betelgeuse - all these beautiful, venerable names are phonetic corruptions of millenium-old Arabic names. A few more stars have 'name-like' Bayer designations, combinations of Greek letters and a constellation name: Alpha Centauri, Tau Ceti, and Sigma Draconis, to name just three favorites of Science- Fiction. Next in line of name-like handleability are those with Flamsteed numbers like 66 Orionis, and special catalog numbers such as Wolf 359 and Groombridge 34. But then we are left with the vast majority which at best have such unpoetic anti-mnemonic handles such as AC+41o19-173 (which does speak to the initiated!).

Now it would seem silly to name a planet that circles a still nameless star!

RULE 1. Only exo-planets around named stars (and those with Bayer letters or Flamsteed numbers etc.) shall have names. Planets found around stars with catalog designations only, and all exo-planets at first, can be referred to using small Roman letters, in the pattern of starname/I.D>#-a, in the order of discovery within the system. As it is highly improbable that the first planet discovered within a system (likely the local equivalent of Jupiter) will conveniently also be the nearest its sun, a number designation would be premature. (Spica-a may turn out to be Spica VII)!

Remembering which new planets belong to which old stars may be a welcome bit easier for all if the following pro-mnemonic device is employed.

RULE 2. The first planet to be discovered around a named star will be given a name starting with the first letter of that star's name and so on. Thus in order of discovery, the planets around Rigel would be named R----, I---, G-----, E---, and L---, then R-- again etc.

To avoid hesitation, deliberate levities that will all too soon cease forever to be amusing, or ideological mischief, the choice could be left up to a computer program operating within the guidelines above, which would pick names from a two-tiered hat. Into the first tier could go names of make-believe planets from science-fiction literature and films published or released before a certain cut-off date such as the date of the discovery of the first exo-planet (imminent).

Some of these S-F names would be very familiar: Pern, Arrakis, Trantor, Tatooine, Vulcan. Others would be less well-known. Names of any fictional planets mentioned only in passing (mere name-droppings, not really part of the story) might be excluded, however. Collecting all these treasures would require a labor of love by a team of science-fiction fans. Such a project has sufficient appeal to be realized.

The hat's second tier could hold a pool of computer-generated random names that follow set rules of phonetic composition and spelling to be decided by a committee, filtered to remove those with chance objectionable connotations (e.g. Shat, Shet, Shot, Shut would pass but the i-variant might not). If names from 1-4 syllables are allowed, this pool should supply many thousands of choices. Beyond that, our compulsive naming appetite might be sated, and no one would care.

It is unlikely that we'll also tele-discover moons around any of these planets, or any surface features, until and unless we receive return data from actual interstellar probes, such as the Star Wisp suggested by Dr. Robert Forward. [cf. MMM #2 FEB '87, CLIPS p4]. So for the foreseeable future, we needn't

worry about naming such system-local details. Maybe they're better left to future interstellar pioneers themselves - if ever!

And for planet-laden, previously unnamed stars?

But back to the hordes of nameless stars! We might well consider giving names to at least some of those around whom we detect planets, in due recognition of that paternity, if you will. This can be done quite simply by the use of a formula that gives phonetic alphabetic value to the components of a current numeric catalog designation. For example, a, e, i, o, u, ai, au, eu, oi, ui could render 1 through Ø. Consonants could be chosen from alternating groups of ten: b, ch, d, f, g, h, j, k, l, m and n, p, r, s, sh, t, th, v, z, zh.

Given the example above, AC+41o19-173, ignoring the AC and using a 2-part form to reflect the celestial latitude/longitude information, and using the first consonant group for northern stars (+), the second for southern stars (-), we get Fa-Buinaud - suitably alien, suitably romantic, and above all suitably back-translatable to the original location-cuing catalog designation. Ignoring the catalog prefix DM, DM-53o117 becomes Ri-Bath. Te-Ditha translates -62o3371, Mau-Lusi +07o9533, etc. Catch the flavor?

Colorless number designations may be fine for stay-at-home astronomers with a wanderlust quotient somewhere near zero. But for those of us headed one-way outbound, something more Adamic would be a definite psychological crutch. Wouldn't you rather explain to some waning flame that you're leaving her (him), Earth, and the Solar System itself to colonize Cha-Zhula IV (four)- instead of "BD +21o0581-IV"?

Science-Fiction writers could begin such a custom of translating #s to names now, leaving the IAU to follow. Engage! <<< **MMM** >>>

AND THE SEARCH FOR EXTRA-TERRESTRIAL PLANETS

[Cf MMM #36 JUN '90 & MMM Classics #4
"PLANETS around Other Suns"]

Dr. George Gatewood of Pittsburgh's Allegheny Observatory has been searching for gas giant planets around nearby red dwarf stars. We called him 3/21/91 to learn of his progress and he is ready to make a "mild" statement about a "positive finding" for Barnard's Star, which at 5.9 light years (1.8 parsecs) is our closest stellar neighbor after **Alpha** and **Proxima Centauri**, and our solitary Sun's closest solitary neighbor. He observed a wobble "just outside the margin of error" and the "coming 6 month observing season could provide confirmation". - PK

[xb is a red dwarf star with a spectrum of M5, and a luminosity 1/2200th that of the Sun or some 6 times that of Proxima Centauri. Its suspected planetary system should consist of gas giant planets only. (cf. MMM #44 p. 7 col 2, Article on Proxima Centauri 2nd ◇ [this Classics volume, above, page) as our title font above attempts to suggest.]

[**Barnard's Star** was the suggested destination of the British Interplanetary Society's ground-breaking design study for the Orion Interstellar Probe. The reason it has a name, despite being so inconsequential a star, is that it has the highest Proper Motion ever noted, changing position relative to the background of 'fixed' stars at the fastest pace yet observed.] - <MMM>

MMM #47 - August 1991

[Star*Bound] series continued

Understanding ~~Light-Time~~
("space-time" as the "there-then")

In the ordinary theater of human affairs, it is quite practical to pretend that an absolute "now" of simultaneity exists, that distance is distance and time time. As we move out from the surface of our home/womb world, however, we find ourselves increasingly dealing with distances that can only be traversed - even in theory - at an every less commensurate rate. Distance Away becomes the equivalent of Time Ago or Time not yet To handle such "separations" or dislocations in "space-time" the term light-year and its derivatives have been invented.

It is 1.4 light seconds one way Earth to Moon;

500 light seconds (8 minutes 20 seconds) Sun to Earth.

3-14 light minutes one way Earth to Mars;

Moving out, Neptune is 1/6th light day away/ago and the round trip span across Neptune's orbit is a full light day.

Only comets are known to inhabit reaches a light week to light months in the there-then, and the nearest known neighboring star or star system, Alpha AB and Proxima Centauri, is so removed that it is all of 4 plus years* out of synch with solar time. (The average distance/dissynchronicity between closest neighbors in our part of the galaxy is 6. 3 light years, so we are lucky! Barnard's Star also lies within that figure.)

Imagine ever more remote ranges of space as a series of ONION SKIN LAYERS Considering the minimum time needed for round-trip travel/intercourse or for exchange of communication intercourse, we might designate these onion skin layers as follows:

CONTEMPORARY SPACE in the sense of Co-Generational, i.e. sharing the same generation, describes all space out to 10-13 light years. Within that range, round trip intercourse/exchange can take place within 20-25 years. The ambiguity of the "now" increases from the instant to the generation as one approaches that limit. Within "space" so defined, lie such familiar names as **Alpha Centauri, Sirius, Epsilon Eridani, Procyon**, and at the extreme, **Tau Ceti.**

CONSECULAR SPACE, i.e. wherein the ambiguity of the now degrades to the sharing of the same century, lie star systems out to 50 light years. Familiar examples are **Altair, Fomalhaut, Vega, Capella**, and **Arcturus**.

CO-MILLENNIAL SPACE, i.e. wherein exchanges of information can be completed within a thousand years, include stars out to 500 LY. Stars and worlds within this range "share" our universe if we extend the unstated time element of "our" to include 1491-2491 A.D.

SUB-EPOCHAL SPACE includes the rest of our Milky Way galaxy and its satellite galaxies like the Magellanic Clouds, out to 500,000 LY. We share only the same sub-million-year relevance.

Geo-galactic EPOCH-SHARING SPACE extends out to 5 million LY, allowing affinity and connection within the same 10 million year time frame between our galaxy and the Great Galaxy in Andromeda, M31, for example.

Geo-galactic PERIOD-SHARING galaxies lie within 50 million LY from one another.

Geo-galactic EON-SHARING galaxies within 500 million years from one another, can claim no more than sharing the same billion years.

Beyond that, **BIG-BANG SHARING** galaxies and what worlds they may harbor more distant = dissynchronous from one another than 500 million LY, share no more than all of time itself from the common beginning on.

[So what about "Parsecs"? A parsec (about 3.258 LY) is a unit of dislocation taken from parallax measurements that seems more sophisticated because it has no explicit reference to Earth-specific measures like the year (it does have an implicit reference to the arbitrary Earth-standard division of the circle into 360°). What astronomers with airs gain by use of the term is more than lost by the dropping of explicit reference to time.]

All of the above by way of a "reality check" for the article that follows. <<MMM >>

EMPIRE

One Fortunate Result of the Speed-of-light Barrier is that Multi-Star "Empires" cannot exist.

By Peter Kokh

"GIVENS" 1) Neither matter nor information can exceed the speed of light.

2) 'Usable' shortcuts through the fabric of space-time will never be found.

You may be an incurable romantic dreamer, unwilling to accept these statements as facts-of-life with a "big F". Self-delusion is your privilege. This discussion is for the rest of us!

* **Rule of Thumb:** A 6-months-round-trip time limit on information flow, sets a distance limit for sustained effective exercise of authority. This figure doesn't come out of a hat, but is based on historical experience and precedent on Earth, and it is our belief that it will continue to hold valid as we move out beyond circum-solar space. Beyond that range, simple logistics makes it urgently practical to be totally self-reliant rather than dependent in even the slightest way on the mother civilization, no matter how advanced the parent world, no matter how crude and primitive the settlement or colony or outpost.

In effect, that would set a limit of 3 light months out MAX! to any form of centralized authority. While this is 500-some times further out than Neptune & Triton or Pluto-Charon, it is only 1/17th the way to the nearest star system. That means that Earth=Terra=Tellus could not even establish an effective empire over the Sun's own Oort comet cloud.

Once we send out settlers (likelier in the low-maintenance travel-ready form of eggs and sperm, i.e. genetic materials) to even the nearest stars, they and their progeny will be very much on their own. If it takes nearly nine years (if not much, much longer) for Earth/Moon HQ to respond to a dire outpost emergency with so much as bare advice, why bother asking, or listening for that matter? The immediate and permanent need for total self-reliance will assert itself rather quickly as we prepare to leave the immediate parochial vicinity of the home system. As a corollary, it would be foolhardy to depart, "forsaking" circumsolar civilization, with anything less than enough personnel or gene pool, seeds or seed bank, tools and information to function as if the rest of humanity no longer existed - or cared (this later a not too unlikely scenario).

While many people appreciate the vastness of space in some inadequate way, very few have any sense of the equally vast, equally distancing effect of time dissynchronization with distance. The further removed in interstellar space-time, the less relevancy to one another can any two oases of intelligent resource-using life share or maintain. [See the previous article.]

* **Extra-solar settlement will be only weakly self-repeating.** It'll take each newly settled system perhaps one to several centuries to fully mature as a center of civilization in its own right with enough divertible, discretionary resources and energy to support interstellar repeater forays on its own.

* **Mature off-shoot pockets of Humanity and Gaia-Humanity** (where Earth-native or Earth-derived vegetation and animal life form the imported cradle for settlement in the absence of given suitable indigenous varieties) will effect one another in a totally multi-centric fashion, each being the center of out-spreading ripples of information: history, culture, science, art.

* **Living languages are ever being regenerated by their speakers** and drift too rapidly to serve as a means of communications between Alma Mater and Alumnae worlds, light-generations or light-centuries apart, the likely spacing of suitable settlement worlds. Either some frozen dead language, such as Latin, or some totally new construct especially tailored for efficient and unambiguous radio-transmission - in either case with absolutely pre-fixed vocabularies would work best. Such an immutable Lingua Franca must be agreed upon before the first star-bound settler ship leaves our Sol's system, and be treated as sacred, in effect "revealed", set forevermore. New terms must be transmitted as cumbersome paraphrases of the originally agreed upon vocabulary. Otherwise communication will break down irretrievably, progressively becoming mutual gibberish.

* **All this means that there can be no interstellar "empires"** in the sense of structured constituencies in which authority spreads out from a center - other than the 'authority' of the common petrified language. The Mother System might be tempted to reserve to itself a sole and privileged right to add new terms to the unifying tongue, but such terms would have to be transmitted along with periphrastic definitions for as long as needed to reach the furthest offspring communities.

Being "Keeper of the Language", however, is as far as the the mother world's authority could possibly extend. Even this quasi-sacerdotal prerogative could be a bad precedent, one inviting challenge. Those alumni
pockets furthest from the home-worlds would have the least reason for confidence that the parent civilization "yet" survives, and would be the most tempted to start rival papacies, thus beginning a slide into a communications anarchy from which there might be no recovery. Alas, if language is to unify, is must be a standard equally respected by all, mother worlds included.

* **The good side of these rather dim prospects for "interstellar and galactic empires" is that**, to the extent even benevolent, i.e. paternalistic, "empires" are necessarily wicked, we won't have to worry about fighting them, about throwing off the yoke of some "Imperial Authority". There can be no "Wicked Emperor of the Zenith". Alas, such a wealth of dramatic and exiting "space opera" is forever fantasy - however much fun it may be to read!

* **[Gaia-]Humanity may yet spread as "Reaches" or "Diaspora"** [discrete autonomous scatterings] rather than as true structured Empires. Each daughter system will be **a unique "alternate continuation of Earth history"** and of the mother civilization and heritage - each with its own flavor unique blend of unrepeated possibilities. Leaving the vicinity of old Sol will establish **an Epoch of Divergence.**

For a weak parallel, consider the many English-speaking nations of Earth, all with a very definite feeling of kinship, yet each fully independent and self-guiding. Out among the stars, only the feeblest analog of such a commonwealth could be maintained. Yet the affinity of common origins and pre-divergence cultural wealth will be cultivated as a treasured heritage.

* **It follows from all this that** in any contacts with the "reaches" or "diaspora" of other intelligent resource-transforming races, neither "side" will be able to act, or react, as a unit in any fashion at all. Rather it must be pre-agreed that each settled system is an equally responsible representative of the entire "family of human [or other] civilizations".

Nor would the "diasporas" of various 'neighboring' species necessarily compete for the same cubic or square real estate. One might prefer G-type suns with planets already sporting indigenous flora and fauna, like Pleistocene Earth. Another might prefer raw pre-Cambrian worlds around hotter yellow-white F-type suns, or seek out endowed but sterile worlds to transform to suit from scratch. Another may prefer systems in which there is ample debris to use as building blocks for space colonies, but without "distracting" planets. Another may prefer the ice-firmamented oceanic Europa-like moons of gas giant planets around feeble M-type red dwarfs or even around isolated brown dwarf substars, etc. etc. Thus it is possible that one or more separately originating diaspora could peaceably interpenetrate the same space-time and be only vaguely aware of one another's existence. But more likely, different families of civilizations are not likely to be neighbors in both space and time at once.

Social, political, economic, and ethnic injustices may persist in all inhabited solar systems anywhere. But whatever the evils lurking within each, relations between systems at interstellar levels are likely to be limited to an "angelic" plane. The virtual quarantine imposed by the vastness of space-time allows little opportunity for anything else.; Contact between independently arisen civilizations will seldom go beyond the most tenuous awareness of the other's existence, with the skimpiest of (rather worthless) surmises about mutual similarities and differences.

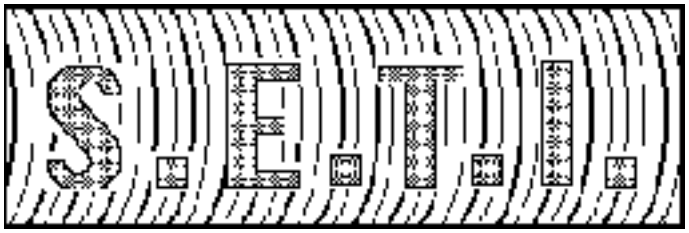
* **The one exciting exception to all this is the possibility of "Twin Civilizations"** in well-separated binary G-star systems (say a few light weeks apart) such as Zeta Reticuli. However unlikely in any given case, separate races could arise around each sun in such systems at least somewhere in this vast multi-billion-galaxied Universe. But that they would be near-contemporary to one another, even within a hundred million years or so, is demanding a lot of parallel evolution or compensating divergences. That possibility aside, even a solitary race spreading to a favorable and fertile planet around the other luminary of such a wide twin sun system, would probably be greatly advantaged by having such a sheltered interstellar springboard opportunity, and find itself the more highly motivated to become a truly Starfaring species.

We of Earth are given a great 1-2 boost first by an uncommonly large natural satellite, the Moon, and second by a resource-rich Asteroid Belt - assets that not all otherwise equivalent civilizations may enjoy. If we fail to become truly System-faring despite these handy stepping stones, it would reflect poorly on our species' character.

We have no such handy "training ground" for extrasolar adventures, discounting the Oort Cloud of comets. In this regard, it is statistically more than likely that some few other civilizations will have a natural edge on us.

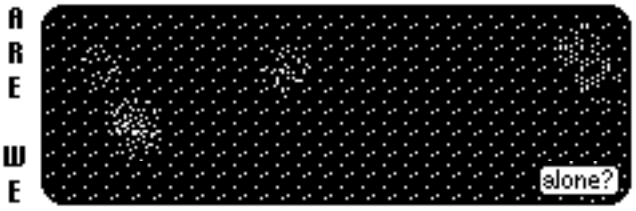
In other words, even such gossamer, ghostlike interstellar networks as might arise rarely here and there throughout the Universe, are unlikely ever to count among their number one spreading out from Earth. If we beat those odds, it will certainly be to our credit. <<<**MMM**>>>

MMM #61 - December 1992



S.E.T.I. Searching for ExtraTerrestrial Intelligence.

People despairing of making sense out of the chaos of life, or those who'd be their high priests, have looked to the heavens for messages from time immemorial. Astrology still blooms. But today a new search, previewed in 1960, seeks messages not from gods but from alien peers. In this issue, MMM looks at the odds.



By Peter Kokh

What nature does once, it can do again. To say we are alone hints at an emotional need to so believe. In the face of the vastness of the universe at any snapshot moment, even vaster through time, such views seem ill attempts at dogma.

First: the chances for "Earth-like" Planets

The famed "Drake equation" for estimating the likely number of current technological civilizations in our galaxy yielded an early back-of-envelope guess of some 280,000,000. Without going into the details of the equation which can be found in any book about Intelligent Life in the Galaxy or about the Search for it, it has become clear that the early estimates were wildly optimistic.

For one thing, the estimated size of the "eco-zones" around stars wherein planets would be neither too hot nor too cold turned out to be much too generous, for one simple reason. We have to look at the host star's whole life cycle and it has become clear that the old idea that "main sequence" stars burned with the same luminosity throughout their lives was wrong. Stars gradually get brighter and hotter, at a pace characteristic of their spectral type. Looked at that way, the solar eco-zone does not extend all the way from the orbit of Venus to the orbit of Mars as commonly thought but is much, much narrower. Had Earth's orbit been only a little bit larger or a little bit smaller, at some time in the past 4+

billion years either runaway glaciation or a runaway greenhouse would have ended the Sisyphusian rise of life up until that point.

Put another way, the chances of a planet having accreted precisely in the eco-zone instead of somewhere outside it are much smaller. Michael Hart's model gives a 28% chance for F5 stars (brighter yellow-whites like Procyon), an 18% chance for GO yellows like Alpha Centauri A, a 13% chance for G2 stars like the Sun, an 8% for G5 stars like Tau Ceti, only 0.3% for a K0 star vanishing to no chance at all for stars K5 or redder. A planet far enough from a K star (e.g. Epsilon Eridani) to avoid an early runaway greenhouse would slip into runaway glaciation about the time early life started producing an oxygen atmosphere. On the other end, stars brighter than F5 would come to the end of their stable lifetime just as life there was maturing. [see MMM # 45 MAY '91 pp 5-7 "Welcome Mat Stars."]

Somehow, some read these sobering facts to hint that Earth may be unique. Such a precipitous conclusion is inexcusably dishonest and unwarranted for these considerations only reduce the chances by an order of magnitude, dropping the BOE estimate to 28 million, still very appreciable.

But not just any rocky silicate planet in an eco-zone will do. It must be endowed with a water blanket not too stingy and not too deep, and massive enough to generate and sustain hydro-lubricated plate tectonics, inaccurately called continental drift. [see MMM # 36 JUN '90 pp 6-7 "Hydro-Tectonic Planets"] If one estimates that this requirement cuts the chances of a suitable womb world by an additional 2/3, that would still leave some 9 million more than our 1. With a typical spacing 250 light years apart, life-matured Earth-like planets with contemporary technical civilizations may not be common. Neither should they be rare. [Planets at an earlier stage of evolution that will remain inhabitable for long enough to make colonization worthwhile, even if not so long as to allow any indigenous life to mature, should be vastly more plentiful and more closely spaced.]

Second: the odds for the rise of Intelligence

There is another strain of pessimism that holds that intelligence is not an evolutionary value but something we can not expect on just any world where there is abundant life and a benign climate. Some hold this view because they want to protect the belief that intelligence arose by divine intervention, others because they cynically think intelligence is a cruel joke of nature. Even if you hold the former view, it should become clear upon honest examination that at least the precursors of intelligence, as manifested in the primates, do in fact confer survival benefits. While lower manifestations of life will cling on so long as there remain niches for them to exploit, there is a many-forking road of pyramiding advantages that keeps building towards a crescendo. Many a species has become fatally comfortable exploiting a temporary niche through dead-end specialization. It is successful - for a while. Yet there always remain less specialized populations capable of "making it" in a wider range of situations. This push to generalization, leads through omnivorousness and a climactic lowest common denominator nakedness allowing exploitation of all possible habitats without sorting into specialized species, to tool using adaptability to all hunting-foraging conditions and eventually even to agriculture. It is through generalization that a species transcends mastery of a specific niche to custodial dominance of a global complex of ecosystems. Wherever the maze of life has grown rich in its diversity, the opportunity to not just fit in but master an ever-widening and indeterminate set of conditions becomes the supreme selective survival value. The whole process of evolution must come to a boil in a global "caretaker species". Where there are planets lavish with life, the eventual rise of intelligence should not be unexpected. The path may be quite diverse in specifics and in its pacing, yet widely similar in its generic sequence.

Carl Sagan, overwhelmed by the vast complexity of the human genetic endowment, is one of many who regards humanity as highly improbable. But the rise of intelligence elsewhere hardly demands the exact duplication of the human genotype or the exact successions of choices on which it has been built. The genetic pathway to "humanoid" intelligence - different genetic makeup, same techno-custodial function [see the next article] - is forgivingly broad.

Evolution is precisely a mechanism that step by step works inexorably to reduce astronomical initial improbability until the light of day is seen. With the successive appearance of multi-cellular creatures, vertebrates, mammals and primates, a "humanoid" climax species became ever less improbable.

It is the overspecialized species that are nature's jokes, not culminatingly generalized species like ourselves! MMM

WHAT IS A HUMANOID - By Peter Kokh

The MacPaint title art above suggests an eyes-in-head viviparous (belly button) mammalian (teats) dexterous (arms, hands) biped living on the land of an ocean-shored planet with at least occasional clear nighttime glimpses of star-filled skies. Such a sentient would have enough in common with us in both structure and environment to merit the name "humanoid".

A Science Fiction term, "humanoid" has never been carefully defined. But its use is something 'everyone' seems to understand. We exclude such creatures that (for example) don't have their eyes in their head, eat by suction, have tentacles for arms, are radially structured like octopi - or have some other really "alien" trait. How having fur, feathers, or scales, or how height and build, or respiration, nourishment, or reproduction patterns affect the classification seems less agreed upon.

Our purpose is not to define "humanoid" in contrast to "alien". Instead we propose rather to look at how wide a range of possibilities within which the "generalizing" (vs. specializing) selective workings of evolution can work, and still produce an intelligent population with technical aptitude.

Our suspicion is that what we mean in our gut by "alien" will invariably turn out to be something nature can't produce in the first place. In our well-intended resolve to free our speculations of stubborn chauvinisms, our Sci-Fi writers and artists have perhaps gone to the opposite extreme and preferentially conjured up an ever expanding exo-zoofull of gratuitously alien chimeras that don't, and can't, make evolutionary sense. Between unexamined chauvinism and undisciplined fancy, there must be a middle ground. Let's find it.

"Life as we know it." Yes, we must be wary lest the singular planetful of life-forms we've been able to investigate so far may, in its shared characteristics, blind us to other possibilities, other pathways. Yet the chemical and geological processes that must universally underlie all biological possibilities are well enough known and understood for us to exclude with unhesitant confidence many of the wild-minded "why not" suggestions of how "life as we don't know it" might look.

Life on Earth is dependent on photosynthesis, using sunlight-power to run metabolical conversions at the bottom of the food chain via oxygen-carbon dioxide respiration. We've known for some time of methanogen bacteria that survive in anaerobic conditions. But we were all surprised at the sea bottom vent-side ecosystems that have been discovered in recent years in which the local food chain is based on bacteria that feed instead on dissolved hydrogen sulfide. But in both these cases, the creatures involved are clearly evolved from the photosynthesis-dependent mainstream. If it could be demonstrated that life could originate alongside submarine hot sulfur vents, it would not change the geological reality that such energy supplies are invariably extremely localized and would be hard-pressed to give rise to an emergent worldwide biota.

No, we know enough about biochemical possibilities to be fairly confident that wherever planet-transforming life has arisen, an original CO2-N2 atmosphere will be converted into a N2-O2 one. We won't find chlorine-breathers anywhere.

Our culture is a shore-based one. That is, we live on the land of an ocean-endowed world. Can it be otherwise? Surely there can be some range in the ratio of sea to land, but unless sea is dominant (one interconnected ocean, several unconnected continents) rather than land (one interconnected continent, several disconnected seas), a sustainably benign climate through the eons is unlikely, and the global spread of life might take far longer.

The "glass ceiling" for technological intelligence in sea-dwelling creatures is probably much higher than admitted. The octopus is unnecessarily held back by two factitious evolutionary choices which could have gone the other way: copper-based instead of iron-based blood; and a radially-symetrical nervous system that seems to resist centralization. Had these choices have been other, we might today have "wisefeet" - without fire or metal, but with a 'stone age' capacity to make and use artifacts, restructuring their environment as we do ours.

Invertebrate intelligence outside the sea is unlikely. The frequently suggested pathway of collective-mind social insect intelligence would seem to require the fanciful magic of ESP. Intelligence is supple, adaptable, self-reprogrammable - and the exoskeletal insectoid path scarcely lends itself to this.

It is no accident that we are naked skinned. This is a choice that leaves us capable of exploiting diverse niches in all climates, promotes personalizing bonding sexuality, and aids in producing young that are parent-dependent long-enough to allow education (passing accumulated technological experience and acquired know-how between generations) to supplant the paternalistic crutch of instinct. Within this general "humanoid" framework, much variation would seem to be possible.

Bearing the young live seems a more favorable choice than egg-laying, but is probably not the only path. Suckling the infant is likewise a non-exclusive preferred option. Warm-bloodedness, almost certainly necessary, has other ways to express itself than the mammalian. But "mammaloids" should be expected to more common. Could warm-blooded "saurians" have given rise to intelligence had not some uninvited killer asteroid mindlessly interfered? If so, it would likely have been a scaleless, featherless, naked erect hand-equiped biped with a paedomorphic head (baby-faced, as we are, probably due to selection by maternal favoritism). Despite its interestingly different ancestry, we'd be hard put to find an excuse not to call it "humanoid". Saurians and mammals do have a certain deep underlying genetic kinship - if you go back far enough.

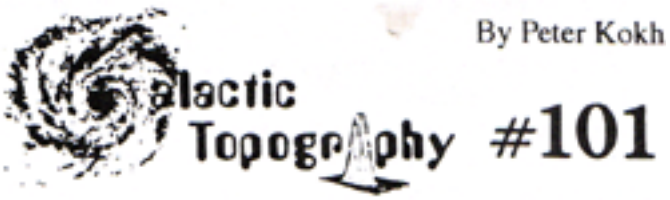
Among mammals, are tree-dwelling brachiated (arm-using) prehensile "primates" the only possible stock? Perhaps this is the most promising line, but can an otter-like pathway be ruled out? Finally, all sapient species must share what we call the "human condition" - struggling from birth to death in a "vale of tears". They must look like kin, act like kin. Our common "mother" is the Cosmos, our common "father" the path of generalization towards a capacity to be technology-using custodians of our host global ecosystem. When it comes down to it, we will find no honest "aliens," only genetically diverse ways to express being "humanoid". MMM

The conclusion that

√ either <u>our Galaxy must be already thoroughly colonized</u>

√ or else <u>we are alone</u>,

can only be made by someone who has never taken



GALACTIC TOPOGRAPHY #101 By Peter Kokh

Enrico Fermi posed the question now known as "Fermi's Paradox," If the galaxy is full of inhabited planets, why aren't "they" already here? The question completely discounts anecdotal "evidence" of UFO's, ancient astronauts and the like, and we have no big quarrel with that. Our quarrel is rather with Fermi's assumption that the first intelligent spacefaring civilization to emerge must inevitably colonize the entire galaxy in something on the order of a few million years.

First of all, such a statement assumes that interstellar travel will eventually become routine and easy, or that some other means of life- and civilization-propagation will be found such as uncrewed arks containing seed and germ plasm banks with incubators and robot nannies ready to swing into action upon arrival at some virgin stellar system, hundreds or thousands of years after departure. While many of us may hope that interstellar travel or propagation of our civilization is somehow possible, there are little grounds for confidence that it will be so easy that "any" intelligent civilization must inevitably master it.

Nor, given our own adolescent troubles as a techno-"custodial" civilization responsible not only for our own future but that of our home planet and of Earth-life in general, can we be optimistic that intelligent species are invariably long-lived. Many a civilization may get off to a promising start, as we have done, only to get irretrievably bogged down in nest-fouling pollution, undisciplined population growth, and tribal warfare, as we show signs of doing.

Surely some few inhabited worlds must survive their coming of age in good shape, and go on to homestead the rest of their native solar systems. And surely some further fraction of those will take the first bold steps to the stars. But unless they find such migration unexpectedly easy, and unless their civilization finds a way to ever renew its youthful vigor, is it not much more likely that having spread out a few dozen light years or so they will choose to rest content?

Even the vast majority of "space opera" science fiction yarns dare speak only of regional galactic empires. Suddenly, invoking population pressure, as if that were a transcendental given, Fermi proposes that any species that can launch a sputnik is bound to reach every star in the galaxy!

Yet the real problem with Fermi's assumption is that the galaxy is not an evenly spaced population of stars, much less one with no reefs to break the waves of expansion. Let's take a look at the galaxy's terrain.

SOME BACKGROUND FACTS:

1) It is about 29,000 light years (ly) from the Sun's position to the center of our Milky Way galaxy, and 22,000 ly to the near edge of the galaxy's central nuclear bulge which is itself some 14,000 ly in diameter;
2) 2) In our part of the galaxy, there is about one star per 275 cu ly which translates to an average separation of 6.5 ly between neighbors (we appear blessed to have four neighbors closer than that, three of them in the Proxima-Alpha Centauri system);
3) 3) The visually prominent spiral arms are in fact only 5% denser with stars and gas. Their most definitive character is the scattering of hot short-lived O, B, A stars, not serving us as spectacular destinations but rather as handy spatial landmarks; 4) the galaxy's disk, containing the arms, where we reside, is relatively thin, a couple thousand light years thick, in comparison to its 100,000 ly diameter.

This 1:50 aspect means that non-locally, a wave of wholesale expansion will proceed 2-dimensionally. And once the wave front extends from the nuclear bulge to the rim, further expansion will be only 1-dimensional. Thus not all newly colonized worlds will be poised to continue the wave and the early exponential rate of colonization will dissipate, or sputter out.

Further, there be reefs! Peppering galactic space every few hundred light years or so (especially in the arms) are "super-luminous" stars 10,000 to 60,000 times as brilliant as the Sun, such as Rigel, Canopus, and Deneb, the three nearest us. These monsters are very short-lived and will eventually produce cosmic supernova explosions. It will be of dubious wisdom to establish colonies around seemingly peaceful stars that happen to be neighbors of such giants. If an expanding galactic civilization steers clear of these "zones of avoidance." Some backwater pockets of stars are bound to be by-passed.

There are many comparatively nondescript F5-G5 stars with planets blessed with mercifully prosaic nighttime skies like our own. These systems are likely to present enough of a terraforming and acculturation challenge to totally absorb all available settler energies long-term, leaving those with stellar wanderlust without the means to scratch the itch. Most of these virgin worlds will not be so rich and fertile that settlement there will soon thrive and overflow, even over centuries.

Possibly some forms of interstellar travel will work best in dust free areas, others through gas clouds. The galaxy has its versions of plains, steppes, and marshes. Can we just assume whatever means are founded will take us everywhere?

Nearer the star dense nuclear bulge of the galaxy's hub the greater incidence of supernovas, and greater back-ground radiation may make these regions unsuitable. Perhaps it is chauvinistic to think that because ours is a disk civilization that the disks of spiral galaxies are the only setting in which planetary systems can arise and be stable long enough to support the long term rise of life. But, it now seems logical.

Finally, this prediction: "Interstellar ranges of space-faring populations will come to interpenetrate to some depth before 'first contact' between the populations involved". The rationale here is that one species will prefer one type of star system to colonize, another species another kind, and that they will pass into one another's range without mutual notice. This is especially likely if their interstellar broadcasts are narrow band tight beam coded messages on arbitrarily chosen frequencies aimed at "keeping in touch", rather than omnidirectional anticryptographic beaconcasts on cosmically "obvious" wavelengths seeking to establish contact. First contact by accidental eavesdropping should be a very hit and miss affair.

Fermi's Paradox deserves little respect! MMM

IN SEARCH OF A LONG-VANISHED STAR CLUSTER

The HELIADES ???

THE HELIADES: DOES THE SUN HAVE LOST SIBLINGS?

If so, does Earth-Gaia have Cousins?

By Peter Kokh

Look up at a clear dark night sky, with your naked eye, through a pair of binoculars, or through a telescope - it does not matter - and ponder that more than half the "stars" you see do not live single lives, as does our domestic star, the Sun. In fact the clear majority of stars, to judge by a careful examination of the population in our own neighborhood out to 20 parsecs or 65 light years, are formed in pairs or triples, even pairs of pairs sometimes. It has been suggested that along the single road, planets are the happy consolation prize. But our current state-of-the-art detective capacities do not really allow us to yet test that proposition.

Look more carefully, and you'll find that many stars exist in clusters containing hundreds, thousands, even millions of members, all formed in one birthing spot at one point in time, and still closely associated. Naked eye examples are the Big Dipper, the Hyades (Aldebaran), and the beautiful Pleiades. Such clusters all seem to be relatively young (the still infant Pleiades are only about 150 million years old for example), and there is plenty of evidence to show that they are very slowly drifting away from one another, diffusing into the general star swarms of the Milky Way.

So the question arises, though the Sun was formed as a single star, was it yet born with dozens, hundreds, or thousands of others in a cluster that has since dissipated over the 4.6 billion years since? Does the Sun have unknown and undetected siblings born at the same time and place?

Not all stars born in a cluster are of the same mass. And mass is what determines how fast they will burn their hydrogen fuel, how brightly they well shine, what will be their spectral color, and how quickly they will consume themselves and die out with a bang or a whimper. So if the Sun indeed has cluster-mates, many of them might be quite unlike it, being heavier and brighter, or lighter and dimmer. All those brighter than spectral class F3 or 4 will have already come to the end of the road. Any big brothers of the Vega or Sirius type, for example, will now be little more than cooling "white dwarf" cinders. But they don't interest us anyway.

What is intriguing about the possibility of littermate stars to Helios (Greek for the Sun) i.e. of a vanished cluster me might aptly dub "the Heliades" [HEE-lee-a-deez), is that amongst its members might be a number (4-15%) that are in a size, brightness, and spectral range to sport a "temperate" eco-zone in which some "hydro-tectonic planet"* not too unlike Earth may find eons-long hospitable conditions for life to prosper and reach evolutionary maturity. Here the long odds against finding other intelligent species should be a bit shorter.

The Sun is only about a third as old as the Milky Way itself, so there are untold billions of stars out there that are much older, around which life may have arisen, prospered, and long since vanished. There are also many billions of stars, potential planet-boasting suns, that are much younger than the Sun, around which any life that has formed must be at proportionately earlier stages of emergence.

Does that mean that if we could somehow identify far drifting birthmates of the Sun, that we might find some around which life is at a generally equivalent state of achievement? It has become clear of late that evolution is not a steady smooth process, that it tends to settle down in stable equilibriums. It is only because of not-too-frequent catastrophic interruptions via asteroid impact that these stable ecosystems are destroyed, creating a new set of conditions for hitherto submissive species populations to exploit - some of them to succeed to dominance. The average pace of those slate-smearing strikes has a lot to say about how long it has taken to reach our present situation. If they occurred with only half the average frequency, Gaia (Earth-Life) might yet be locked in some earlier stage of vertebrate or pre-vertebrate achievement. If they occurred with twice the frequency, beings like us might have come and gone hundreds of millions of years earlier - or the pace of rut-breaking catastrophe might have been too fast to allow interim stable ecosystems to mature, thus knocking us back to "start", time and time again. Is the pace of needed interruptive chaos we have experienced on Earth about average? We've no way of knowing that. Lacking other examples to investigate, we can only make a weak assumption that it is so.

Now all else being equal, any sampling of Solar kin stars ought to prove significantly more rewarding than a random search of the Solar neighborhood. The kicker is that it may be more difficult to identify lost siblings of the Sun than to search the general swarm of stars at large for systems on which life has emerged and matured to an equivalent stage, and on some few of which intelligence may be struggling against the same odds of survival we face. In theory, we need only examine all the stars we see, filtering out those with transverse "proper motion" across the sky, searching the remainder for small radial motions receding from our current location.

In reality, most of our conjectured cluster mates must have wandered too far away by now to still be found hanging around in the observable neighborhood. Further, most neigh-boring stars in the general age bracket as the Sun, have probably drifted into range from elsewhere. After all, the Sun has already made some 18-23 orbital trips around the nucleus of the Galaxy. Over this span of "galactic years" 200-250 million years long, a lot of scattering has to have occurred.

If there ever was a "Heliades Cluster", that may be of no help at all to us in our search for galactic companionship. Nothing, however, can stop us from wondering. Does Earth have "cousins" out there?

Finally, if Earth does indeed have cousins, this says nothing for the similarity or dissimilarity to what we find on Earth of any life biota that may have arisen there - unless, of course, and this is unlikely, the cousin worlds were all "seeded" from some common source (if they were "seeded" at all). Intriguing as the possibility may be, looking for other members of the hypothetical "Heliades" does not seem to be an especially promising line of effort. MMM

Note: on April 9, 2012 this story (astronomers now believe the Sun has siblings) was online: http://www.space.com/15192-**sun-siblings-asteroids-earth-life**.html

We can't receive, unless someone "out there" is sending

By Peter Kokh

Our attempts at S.E.T.I., Searching for and hopefully receiving messages from a separately evolved intelligent population, assume another race's attempt at C.E.T.I., broadcasting and hopefully Communicating-to. Granted some appreciable number of comparable civilizations scattered throughout the Galaxy, the "big question" remains. Is anyone sending - or is everyone just listening. The answer could be disappointing.

It is enormously easier to listen than to send. It takes many orders of magnitude less time and energy. Our standard search strategy is to aim an antenna at any given star for just a fraction of a second. We trustingly assume that the sender is immeasurably more patient and dedicated, broadcasting a "hello there!" signal constantly, without intermission, for a very very long time. To have more than a nano-chance of successful contact, the sender must be prepared to beam the message towards selected or general targets, not for a few minutes, nor a few hours, nor a few days, nor a few weeks - or years or centuries - but perhaps for millennia! If the message sent were unrepeated or non-continuing, the chances against its arrival here precisely when we just happen to tune in, are staggeringly astronomical. This places the real "burden of contact" squarely on the presumptively broad shoulders of some understanding and perhaps heroically motivated sender.

In contrast, the famed "Arecibo message" beamed toward the distant, star-rich but likely planet-barren globular cluster Messier 13 in Hercules on 11/16/1974 was but a fleeting whisper that has no real chance of ever being heard. It was nothing more than a dishonestly misleading PR gimmick.

In contrast to the level of civilization needed either to beam sufficiently energetic tight-beam messages in a particular direction for a long enough time, or to send out an all-points beacon for a shorter time, that level of technology needed to indulge a puppy-like search of star faces for an adoptive smile, is rather crude. Those first able to listen, and with the greatest emotional need to hear something, anything, can hardly presume to be peers of those advanced enough to be able to send, and culturally mature enough to continue sending, with no more than blind hope that someone somewhere will hear.

We can only guess at the level of motivation needed to sustain such a sending effort. It could be a cheap-enough penny for a rich-enough society to toss our way without much further thought as if to some hapless sidewalk beggar. Or it could require sustained religious dedication of more than

cathedral-building resolve, if not messianic insanity. That our hopes of receiving seems to require so much greater a need to send on the part of the other guy out there should sober our expectations. UPSHOT: an honest non-self-deceptive estimate would be that only a small fraction of those civilizations technologically capable of a determined broadcasting project, actually engage in such activity in more than a playful way.

A civilization may not be able to broadcast interstellar signals effectively much before it has an effective circumsolar presence about its home system, and is able to erect giant antenna in space or on a moon's farside, or in some other quiet noise-shielded location. Perhaps it might even require learning to modulate the very light or other radiation of one's sun itself in order to piggyback a message on an existing energetic source that can run continuously for the thousands of years it may take to earn even odds that some other civilization out there will happen to turn an ear.

The typical sending civilization must not only be technically far advanced of the typical listening one, but also more "mature" having had to successfully survive the self-imposed threats to survival (runaway population, uncontrolled pollution, undisciplined military adventurism with dangerous toys) of its own cultural coming of age. To expect that a civilization at our current stage of history should be able to mount a successful S.E.T.I. search, requires a leap of faith - that "adult" civilizations would have any interest at all in talking to "adolescent" ones like ours. [see next article.]

One preferentially communicates with/to one's peers. Must we not expect that preference to be universal? The upshot is that if a sending civilization wishes to improve the odds its message won't be picked up by immature civilizations like ours, there should be several self-suggesting ways to arrange this, whether in choice of carrier frequency, frequency combinations, or message encryption.

One could, for example, choose a frequency or combination of frequencies (e.g. one carrying the x-value, another the y-value of a pixel interpretation grid) beyond the range of the Cosmic Background and Galactic Background noise BUT well in middle of expected atmospheric and telecommunications background interference. Then the successful receiver would have to be not merely above the atmosphere (very high balloon, or in orbit) but also in planet shadow (e.g. lunar farside). If a pair of frequencies is chosen for encryption, one might be in radio window maximum of telecom interference (AM, FM, VHF, UHF, etc.) and the other might be one in the molecular atmospheric absorption zone or in the photochemical atmospheric absorption zone (on either side of the visual window). That any likely civilization must grow up on a world with a similar oxygen-enriched atmosphere with abundant water vapor and some carbon dioxide and methane and ozone makes this strategy workable and obvious.

The UPSHOT is that if anyone is sending messages our way, we are not likely to be able to intercept them until we expand further into space and presumably grow up a little in the process. That's a hard notion to accept, an affront to our pride. We have come far, baby, but not yet far enough. The affront need not be taken personally by the scientists involved and supportive citizens. The affront, if that is what it is, is to the well-presumed immaturity of our civilization.

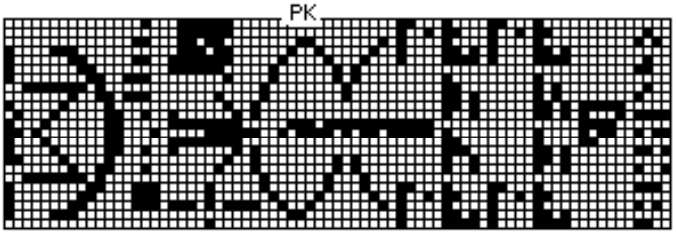
"The Prime Directive" of Star Trek notoriety is not some quaint Sci-Fi notion, but, by whatever other name, a norm of behavior for more advanced peoples towards those less advanced, one that MUST inevitably powerfully suggest itself universally. If so, nothing we are now able to receive may be beamed our way. We might have to wait, and grow. MMM

WHAT TO SAY TO UNKNOWN ALIEN LISTENERS?

Cheshire-casting By Peter Kokh

The famed Arecibo Message sent 11/16/74 towards the M-13 globular cluster (well-known to amateur astronomy buffs) had a stingy 1679 data bits. The idea was that as this number is a product of two prime numbers, 23 and 73, the receiver would realize that the message was to be decoded by ar-

raying the data bits, a series if 0s and 1s as full/empty pixels on a 73x23 grid. That gives a display which is surprisingly coarse given our current TV standards, let alone HDTV!



The message above intends (right to left) to set up a numbering convention, then tell that we are made of hydrogen, carbon, nitrogen, oxygen, and phosphorus; show the nucleotide and sugar phosphate backbone of our DNA and the number of nucleotides in our genes; show our biped shape and average adult height, our global population, the number and arrangement of planets in our system, and that ours is the third from our sun; finally the shape and size of the sending antenna. Given the limitations of the single 73x23 picture, that is a lot of supposedly 'interesting' information. But anyone receiving it is likely to find nothing surprising or out of the ordinary in it, and wonder why we even bothered to go through the effort.

There is already a considerable body of work setting up anti-cryptographic encoding procedures for radio messages, demonstrating the rationale behind the S.E.T.I. effort, namely that it IS possible for one civilization to convey significant information to another it has never met or knows anything about. Granted that, there are two questions:

√ What does the listening civilization hope to learn? and

√ What does the broad-casting civilization want to say?

Counter-intuitively, the one question is not the flip side of the other. The listening civilization expects to be the technological inferior and may even grudgingly grant that it may be the cultural, if not the moral, inferior as well. In addition to its basic curiosity ("Is there, in fact, anyone else out there?") there is genuine intellectual curiosity ("Are they biologically like us or are there significant differences?" "Where?" "How far away?" "How many?" "What is their diverse animal and plant life like?" "What is their home world like?" etc. etc. etc.)

Yet there are other questions not so purely motivated. Lets bluntly and honestly frame these questions! "Are there any scientific and technological insights we can garner which will give us shortcuts to the future so that we can slack off earning our place among the stars?" "Who's right and who's wrong on this philosophical or theological or economic point?" (We want to know so in stead of argument we can use ET endorsement as ammunition in our doctrinaire feuding.)

Some simply seek to know or be reassured that there is a way to overcome the problems threatening our survival as a species. Indeed even a simple electronic "hello" from a people that has, evidently, "made it" through its own troubled adolescence, would be telltale enough. And perhaps this is all we have the right, or need to know. Certainly it is the simplest possible message, one that needs no special coding and decoding, and one which in its utter brevity is supremely resistant to static and noise degradation. Once we know that success is possible, we should be more strongly motivated to find the way ourselves without our hands being held. Everything else is idle curiosity. Fun but unnecessary information.

The viewpoint of the sending civilization must be quite different. They may want to reach only those who have "made it" on their own to become spacefaring (not merely orbit-faring) civilizations. They will have realized the "prime directive" and be wary of giving insights that can be misused.

But affecting the shaping of the message may be a more pertinent, totally practical consideration. Is it the better strategy to send the same message to all points, diluting available power over the whole sky in the hopes of catching someone listening relatively nearby? Or is it the better strategy to use available power in a tight beam aimed at a more distant clustering of a probably greater number of listening civilizations? In the first choice, one would cover the neighboring few thousand light years of the sender's region of the galaxy. In the second, knowing full well that the probable proximity of even the nearest contemporary technical civilization might yet be far enough out to make reply meaningless and unlikely (e.g. 250 light years + 250, - 100), the sender, engaged in what can now only be a thoroughly altruistic exercise, realizes that distance and time mean nothing. The message then might be

more effectively aimed at a neighboring galaxy with far more potential listening civilizations in much less angular space.

Suppose a civilization well beyond our current state of advance already some 2 million years ago, but located in the great Andromeda galaxy (M-31, floating some 2 million light years away) so reasoned, and decided to put all its effort into a millennia-long broadcast that covered our entire Milky Way galaxy. We might just now be getting a call, while our callers may have long passed from the scene. In that light it would seem a silly self-occupied aberration for them to be talking about themselves and their world. Especially when there is an excitingly more elegant opportunity.

Instead of local geological, biological, and cultural trivia, they might chose to give us a real present, something we could never obtain for ourselves but would dearly love to have. Imagine someone in M-31 sending us a portrait of our own galaxy taken from their vantage point! Just one photograph in visual light or a whole multi-spectral album - either way it would show us what we had looked like 4 million years earlier when the light they recorded left the Milky Way.

If and when we do get a message, the contents may be the ultimate gift one intelligent civilization can give another, insight into themselves. Of the senders, all we'd have is their unmistakable "Cheshire" grin. MMM

MMM #194 - April 2006

ARE WE ALONE By Dave Dietzler pioneer137@yahoo.com

1. We have thought for a long time, based on our theories of stellar and solar system formation, that planets must orbit other stars.
2. In the sixties [we thought] we discovered large planets orbiting nearby red dwarfs by the "wobble" method.
3. In the nineties we did discover large planets orbiting stars like our Sun by the doppler method.
4. We have yet to discover planets the size of Earth orbiting other stars. The Terrestrial Planet Finder that will launch in 2014 will use advanced imaging technology to do this. It will even be able to analyze light from terrestrial type planets to detect oxygen and water vapor. We will be able to determine the mass of these planets and their distance from their suns to determine whether or not they are in the life zone.
5. Our next step will be to construct more sophistiated instruments, perhaps huge space telescopes, that can detect the spectra of things like chlorophyll or even Industrial pollutants. Perhaps we will develop instruments that can image these worlds; even see their continents and oceans.

6. Next, interstellar probes will be launched to inspect these worlds at close range. The most interesting targets will be the ones that are in the life zone, have oxygen and water, and possibly indications of life. The probes will probably be laser sail propelled or mag-sail/ particle beam propelled, and they will brake into the target solar system with magnetic sails. They could maneuver around in the target system with magnetic sails and make close approaches to the planets we are interested in, even go into orbit around them and drop small landing probes to the surface. These probes will be controlled by AI computers capable of independent decision making since they will be to distant for radio control from Earth.
7. Finally, manned missions to the stars.

Life-supporting planets may be rare

Mercury, Venus and Gas Giant planets cannot support life, but are interesting for other reasons. Earth sized planets outside the life zone will either be frozen or so hot they become like Venus. Marslike planets inside the life zone might support life. We don't even know for sure whether Mars has life now or did in the past and this is a question we hope to answer in the 21st century. The discovery of life on Mars, past or present, would be of great significance, and the discovery of life on planets orbiting other stars would be too. Earthside planets may be found with life at various stages of evolution like mere algae in the seas, plant and animal life in the seas, life on the land from higher plants to higher animals; but the greatest discovery would be intelligent life.

Do we know enough to define Intelligent Life?

How do we define intelligent life? Certainly, apes, dolphins and some other species indicate that they have some intelligence, but we hope to someday find creatures much like ourselves. They might be similar to highly evolved mammals or birds or even insect like creatures. Primates are not the only candidates for higher evolution. Bears stand upright at times and use their forepaws. Some ant species have been shown to engage in group work activities! To evolve to large body and brain size insects would have to develop a better breathing system and probably shed their exoskeletons in favor of endoskeletons. Unlikely!

Can civilization develop in the Ocean?

Octopi have been shown to engage in intelligent behavior but it is hard to see them existing on land, but what if large brained octopi evolved out there somewhere and built a fantastic civilization beneath their sea? They wouldn't have fire, metal working and electricity to be sure*, but they might know how to use harder stones to carve softer stones or corals or even polar ice into various implements and habitations.

For such creatures, exploring the land would be like our adventures into the deep sea or outer space. They might know how to harness other creatures found in the seas or even have advanced biotechnology. Certainly they would have vast knowledge of life in their seas, foods and medicines; language, something equivalent to poetry or song, and folk lore, even religion, especially if they are social creatures.

How could they store knowledge other than by memorizing and passing knowledge down generation after generation? What kind of writing could survive underwater? Perhaps they could make elaborate stone mosaics held together with some natural adhesive that last for decades before dissolution in water and are copied over and over again like books once were. If the evolved endoskeletons they might eventually evolve into land creatures and create advanced technology with fire, metals and electricity like the octospiders of Sir Arthur C. Clarke's **Rama** novels.

Technologically advancing civilizations

Finding civilizations at a similar level of technological development will require quite a bit of coincidence or “good luck.” We could transmit radio or laser signals at Earthside worlds and wait for a reply, but will they be listening at the right frequency?

So many factors were involved in the evolution of human civilization and technology, from leaving Africa and learning to live in the colder climates to the necessities of war, that we cannot expect other intelligent creatures to have followed the same pattern. Perhaps man with his phallic aggression and creativity is one of the few creatures who would build rockets and star ships. Most creatures on Earth are so well adapted to their environment that they don't need tools, but man was poorly adapted to his environment physically and used his brain to adapt his environment to suit his survival and reproductive needs by making tools, weapons to fend off large predators, building shelter, using fire, etc.

Other creatures in the universe, even very intelligent ones, might be so well adapted to their environments that they did not need to invent technology and subsequently even explore space. Their rate of reproduction might not be nearly as great as humans.

For us humans, year round fertility and sex drive has almost been a curse upon us that has lead to overpopulation and natural population checking mechanisms like epidemics, famine when local food supplies were outstripped and even war to keep us from over running nature for millions of years. This has also forced us to invent hunting, livestock keeping, farming, food preservation and medicine.

Creatures who mate only during the mating season and produce much smaller broods would not endure the cursed fertility that we have, mythologized as original sin, and would not have to invent so many things to promote the survival of their offspring. So while we might not be alone in the universe when it comes to life itself, even intelligent life, we might be very rare when it comes to technological civilization and even rarer when it comes to space faring civilization.

It isn't hard for me to believe that an intelligent species with much lower reproductive pressure could stay in it's equivalent of Africa for hundreds of millions of years with a technological level no higher than that of Egypt, as long as their planet did not undergo major climatic changes during that time. They might be a lot less curious than us apes too! These creatures might never reach into space or have radio or laser communication systems but they could offer much in the way of art, philosophy and theology.

We must explore Mars to answer the question: "Does life of any kind of life emerge on other worlds?" We must industrialize the Moon and solar system if we are ever to venture beyond into the galaxy. If we are to become the primary star faring civilization in this arm of the galaxy, it will be our duty to protect indigenous life on other extra-solar planets. We will go for the quest of knowledge and not to conquer, colonize and swamp space with humans, although there are probably worlds where we can coexist with native life, and worlds like the Moon where we can live without conflict.

<DD>

Editor's Remarks:

The aspects of "The Question," "Are we Alone?" are so manifold and convoluted that it would take a fair size book to begin to treat them all. In a short article, no writer can do more than touch on a few considerations of interest to him/herself. Certainly the aspects touched on here are significant.

What kind of worlds are suitable for intelligent life? We naturally define intelligent in terms of our own achievements in using our brains and hands to adapt to our world and adapt our world to ourselves. We remain "generic," unspecialized in any of the ways that risk setting a course for an evolutionary dead-end. We can at will specialize ourselves by choosing our tools, leaving our physical interface with nature as universal as possible.

We are air-breathing land creatures. Could technology-using species arise in the sea? *I think the author puts limits on a sapient octopod race that need not apply. The "Wisefeet" could stay in the water, yet build rafts on top of which they could conceivably use fire and other tools that require air. Our own Octopi have two strikes against them as to further advancement:

1. a very decentralized nervous system, and
2. copper-based blood instead of the 20 times more efficient iron-based blood we have.

Scratch those two misturns, and who knows how far invertebrate intelligence could go?

The chances that we will "find" intelligent life elsewhere are not as good as the chances that there "is" intelligent life elsewhere. It's not that civilizations do not want to be found, though that may not be an uncommon outlook. It's simply a question of technology and economics: it is far easier and cheaper to listen effectively, than to send messages effectively. To send with real hope of being heard, requires a centuries' long cathedral-building project of extreme and unquestioning dedication: one must broadcast in all directions of the sky for decades, centuries, millennia, or even more. Civilizations will be as far apart in time, in any given area, as they are apart in space, at any given time.

<PK>

"SKYFIELDS"

By Peter Kokh, from my cottage outside Florence, Wisconsin
near Iron Mountain in Michigan's Upper Peninsula ("Occupied Wisconsin" as I have always thought of it)

I don't ever recall writing something like this for MMM, but there is a time for everything. When I was 8+ in 1946, I went along with my maternal grandparents to visit their hometown of Florence with a view to buying vacation property. They found two acres, surrounded by farmland at the time - now new forest on one side planted by birds and squirrels and wind - on a dead-end country road. I am always amused when friends who have never been here put down the location because it is "not on a river or lake" where you can have the benefits of more bugs, more crowding, more noise, and more taxes. Here instead we have just peace and quiet with scarcely a half dozen cars going by all day. In the sixty-two years since, I have not failed to get up here at least once a summer except in 1961 when I was in England all year.

Geologically, this is an interesting area on the edge of the Laurentian Shield, the ancient heart of North America, where all over the place little waterfalls carry brooks and streams over this edge onto the newer sedimentary-glacial part of the continent to the south. Hiking into hidden waterfalls with my dogs has been a decades old pastime. Thirty years ago I found one on a county map that only a few old timers knew about. I set out to find it and parked as close as I could get at the end of a sandy road. After walking this way and that for two and a half hours I finally found it. I made it back to the car, went back to town and bought a can of yellow spray paint then drove back to the end of the road. This time having found the shortcut, I marked trees at 30 foot intervals. Today there is a nice trail and many people have seen what to me back then was a very private spectacle. I tell this story to locals, ending with "now, as Paul Harvey would say, you know the rest of the story."

It is here that I realized that there is a difference between beauty and awe, the beauty of life which strives to impose order, the awesomeness of the geological terrain which could care less about the life that learns to thrive on it. It is this combination of beauty and awe which touches the soul most deeply. Are the heavens only awesome? Or is life pervasive, imposing beauty? The "planned" faux geology of space settlements is too dishonest for me, proud to be a "planetary chauvinist."

Well it was beginning to look as if 2008 was going to be the second year since 1946 that I would not make it up here. No car, high car rental prices, high gasoline! Why I could fly from Milwaukee to Los Angeles and back for the cost of renting a car to come here for a weekend! But then as the 2008 summer season started to recede into memory, on the last day of October, I had a break. A friend of mine was going to Atlanta, and if he picked me up so that I could drive him to the airport, pick him back up on his flight home, and took care of his little aging Schnauzer Mitzi while he was gone, I could use his car. The temptation was too great and with a combination of guilt and joy, after dropping my friend at the airport, I picked up Mitzi and we headed north.

I have such a nice cozy place, an old 8'x30' 1955 house trailer set on a foundation twice as wide, with two more rooms and a conventional roof that I had designed and had built for a song in the mid-70s. The trailer I had found and had put there in 1969. For almost 40 years I have enjoyed the solitude in the northern woods under star spangled skies. Above my cottage sofa is a plaque I designed that proclaims "these are the good old days," in defiance of my grandmother's insistent claim that "those were the good old days."

Mitzi loved it as do all my friends, amazed at how much better peace and quiet with only the squirrels to scold you for intruding on their property, how much better that is than being on a lake or river!

Mitzi and I only stayed one night. It was not worth opening up only to close up in the morning. But this night the skies were incredible - not quite as unbelievable as the moonless skies in SC Utah at the Mars Desert Research Station, a hundred miles from the nearest town of size, but almost. Mitzi and I took a walk down the asphalt unlit road with nothing but the stars to light our way. Dogs do not imagine bears or goblins or monsters laying in wait along the roadside at night, and having strolled down this car-less road many a time at night with my dogs, I have lost all such fear as well.

This night the Milky Way was out in all its glory. I was walking toward Perseus and Cassiopia. For a while I thought I was looking at Andromeda (the great M31 spiral galaxy 2-3 million light years away) which I've seen many times in those northern dark skies. Tonight it looked as big as my thumb

extended at arm's length. But then, to my embarrassment, I spotted the V of Hydra and knew that I had been looking at the Pleiades all the time. Oh well, by any name it was wondrous. Actually, except for Andromeda here in the north and the Magellenic Clouds in southern skies, all we see by the naked eye lies within our own Galaxy – vast and wondrous enough!

The big dipper was below Polaris, but at 47 degrees north you could clearly see all of it above the trees. The summer triangle was obvious with Deneb, Vega and Altair, the latter two pointing to Fomalhaut, a dimmer star that still dominated the south. If you ever read the "Star Kings" (alternate title "Beyond the Moon") a 1950s galactic soap opera better than Star Wars, by Edmond Hamilton, you will remember Fomalhaut as a key kindgom in the galactic alliance.

As a boy of 9 during the great 1947 Flying Saucer scare, I used to hope one such celestial vehicle would land in those fields and whisk me away to see the wondrous sights of more advanced worlds. And through the years, many an MMM article has been started or finished here, or on the way here or on the way home.

I have always been puzzled that there are so many astronomers, amateur and professional, who can study the stars and never feel sucked up by them, never feel the need to go out there, to meet the stars half way, to look at them from the other side, that is from somewhere else looking this way. I always loved the stars and that is why I always wanted to go out there among them. As the King (Yul Brunner) would say in Rogers and Hammerstein's The King and I, "it is a puzzlement." By and large, astronomy clubs are as fallow as recruiting grounds as are science-fiction conventions. Go figure!

I named my little hideaway Elm Vue, because on the far side of these fields stood a tall solitary gigantic elm, long since the victim of Dutch Elm Disease and lightning. Were I to rechristen my sanctuary today, it would be as "Skyfields," for while, true, this place is not on a riverbank or lakeshore, it is on a beach that opens up to the sun and cloud-ruled sky by day and to the Milky Way and Northern Lights by night. Others can have their rivers and lakes, I have the Universe!

Someday people will be on the farside of the Moon. If they have crystal clear visors that catch no glare, they will see the Milky Way as no one can see it on Earth, not from Northern Wisconsin, not from SC Utah, not even in the middle of a six-month night in the heart of Antarctica. With no atmosphere, no haze, no clouds, no wind, one might see stars down to the 7th and even the 8th magnitude. Hundreds of stars, at any rate, to each one we can see in the ever fewer Dark Sky areas left on Earth. In the cities, one sees only a few hundred of the brighter ones at best. Is it any wonder that our young people don't get hooked on the heavens! Why they can't see them any more! But thank heavens for the Moon. It is the clearly round globe of the Moon that lets us visualize other planets in our own system and perhaps around most of the solitary (non binary) stars in the galaxy.

As a young man, I fancied myself employed by a Farside observatory, Earth forever out-of-sight, out-of-mind. I've always had a bit of a monastic streak. I'd be dedicated to studying the heavens, and especially listening for whispers from the stars, intelligent ones.

But I hear them now anyway. Nature never does anything once, you know. Some people have a dogmatic or emotional need to believe we are alone and misweigh or misinterpret every shred of evidence accordingly. But "they," our counterparts must be everywhere -- granted too far apart in both space and time to be contemporary neighbors, though all averages include exceptions.

But it is enough to know they are there, that however different we may be physiologically or culturally, we all share the same creative condition. We are born, we struggle to make sense of it all, we die. I look out there and say "Hi all of you," knowing that in all corners of the universe others are looking up, realizing this very commonality as well, and saying "hi" in return. Who needs words? Who needs messages? Who needs proof? Meanwhile we all give glory to the wondrous creative forces that have brought us into being and nourished us to the point where we are aware of one another even if only in such a mystical way.

Everywhere, life must be hard, full of hardships and tribulations, joys and suffering, but eminently worth the struggle. And are we not all, wherever and whoever we are, made of stardust? stardust from brighter stars that have lived fast and hot and strewn their fusion dust into the void to become the stuff of planets and plants and creatures? Of stardust thou art and to the stars thous shalt return. Well, maybe not literally. But even if not, it is difficult to look up at these spangled skies and not feel that you have returned to them, and to celebrate life with all who share it whenever, wherever, however.

In the omniverse, we all give praise.

I hope you enjoyed this little essay, this brief exposure to some of the things that have shaped my vision. Maybe some of these thoughts will nourish your own contemplations of the wondrous world we live in and the unknown wonders of the worlds we live among. In everything, down to the slug, the cockroach, the dandelion, there is wonder – and up to the clouds, the stars and beyond. Feed the wonder in your soul. There is so much nourishment out there with which to do so!

And remember, life here is all too short! Absorb all you can and expand your soul with whatever you can, for "these are the good old days!"

October 31, 2008 <PK>

MMM #247

Our Planets may be the offspring of a tryst between ProtoSun and another protostar

By Peter Kokh

The Sun's and its Planets isotopic "DNA" do not match!

The consensus from time immemorial has always been that the Sun and our family of planets from Mercury out to Neptune formed from the same rotating disk of gas and dusk, the Sun forming at the center and the planets at intervals further out in the condensing disk.

Suddenly, there is an unexpected mismatch in the solar and planetary "DNA" so to speak. The percentages of the isotopes of Oxygen and Nitrogen in the planets do not match those in the Sun. At this stage, everyone is perplexed, if not taken aback.

How this might have happened

We propose a simple scenario whereby this might have happened. The disk of matter around our protostar, the condensing Sun, intersected the disk of gas and dust in the process of forming another solar system. The two embryonic stars did not touch or exchange matter, but their two surrounding disks did, and in the process exchanged gas and dust, each disk peppering or seasoning the other with their unique signatures of elemental and isotope ratios. The above illustration is the writer's attempt to illustrate what that tryst might have looked like.

Would such a sexual stellar encounter been unique? Consider that many stars are formed in clusters as the host gas cloud forms little eddies that begin to condense. In such stellar nurseries, near passes and actual collisions with an exchange of dust and gas may be relatively common. While all the stars forming in a cloud may have similar characteristics, if the cloud is not homogenous in its composition throughout, systems with "mixed genes" may occur.

L: The famous Pleiades cluster of young stars – **R:** This stellar "nursery" is the famed Lagoon Nebula

In MMM #MMM #61 December 1992, page 7,

[MMM Classics #7, page 5 – a free download from www.moonsociety.org/publications/mmm_classics/]

In MMM #61m above, we ran an article with the title "Heliades Cluster" which posed the possibility that the Sun was not an only child but may have been born in a cluster. Helios being the Greek word for "Sun" we dubbed our hypothetical birth cluster the Heliades.

Since the Sun and our Solar System were born 4.5 billion years ago, we have circled the galactic core perhaps 18-20 times, and any differential velocity and vector between the Sun and its hypothetical cluster-mates may well have dispersed them so widely that we would be fortunate to identify any solar siblings.

The Evidence

So what is this difference in isotopes? The article we saw was this, dated June 26, 2011.

http://www.enewspf.com/latest-news/science-a-environmental/25123-**nasa-mission-suggests-sun-and-planets-constructed-differently.html**

"Researchers analyzing samples returned by NASA's 2004 **Genesis mission** have discovered that our sun and its inner planets may have formed differently than previously thought. Data revealed differences between the sun and planets in oxygen and nitrogen, which are two of the most abundant elements in our solar system. Although the difference is slight, the implications could help determine how our solar system evolved. We found that Earth, the moon, as well as Martian and other meteorites which are samples of asteroids, have a lower concentration of the O-16 than does the sun," said Kevin McKeegan, a Genesis co-investigator from UCLA, and the lead author of one of two Science papers published this week. "The implication is that we did not form out of the same solar nebula materials that created the sun -- just how and why remains to be discovered."

And so we propose the scenario above. As a rule the most probable hypothesis is that for which the odds are the highest, and the explanation the simplest. We think we nailed it, but it will be interesting to see what other hypotheses surface and if there is any way to settle the question with a high degree of confidence. We are all interested in our ancestry, and that goes for out solar system too.

PK

MMM #260

In Focus: To the Star – or Back to the Stars?

By Peter Kokh

Last month, we published issue #16 of the free PDF file newsletter, **Moon Miners' Manifesto India Quarterly** (**M3IQ**) – 4 full years under our belt! At the same time, we published the first issue of **To The Stars International Quarterly** (**TTSIQ**) essentially the same material, rearranged in a different way, and with a tittle that suggests a connection to the National Space Society, on whose behalf we are doing this to reach international space enthusiasts. NSS' long-running hard copy magazine is titled "Ad Astra" which is Latin for "To the Stars." TTSIQ is also cosponsored by the Moon Society, Space Renaissance Initiative, and hopefully by other organizations as well. But we don't want to talk about that right now, rather about those first three words "To The Stars."

http://www.moonsociety.org/international/ttsiq/ – **http://www.nss.org/ToTheStars/**

Recently, there is new enthusiasm that advanced physics may find ways to cheat the "Speed of Light Barrier" and NASA is supporting an effort to get people thinking about how a "100-year starship" could be built and flown. To reach the closest star system 4.3 light years away, Alpha Centauri, a binary with a distant third star, Proxima Centauri, in 100 years, we would have to maintain an average speed of 23% of the speed of light averaging acceleration and deceleration, meaning a peak velocity of near half the speed of light.

The honor of being the first (or among the first human{s) to visit another star system will be enormous, but few would go without prior telescopic or robot probe confirmed findings that a human-friendly paradise planet was awaiting our arrival, not some inhospitable planet, too hot or too cold, atmosphere too thin or too thick or unbreathable, no surface water, etc. etc.

Now it is conceivable that we might have learned all this from not yet deployed advanced and highly sophisticated exo-planet hunting space telescopes. Sending probes to a all exo-planet systems in "near" stellar space would be both expensive and generation-consuming, however desirable confirmation and elaboration of telescope findings might be. We will simply have to build more powerful, more capable space telescopes equipped to detect signatures of key atmospheric ingredients such as oxygen, nitrogen, methane, and water vapor.

The ability to determine if a world was of the terrestrial "land-sea" type should be the gold standard of telescopic ability. Why would anyone want to sacrifice decades of one's life traveling through empty space just to find another Venus, or even another Mars? The goal of such a venture should be nothing less than exploring what has been pre-determined to be "another Earth!"

Say that our super-scope found such a candidate. We should be able from its Sun's spectrum to tell the age of the system. Is the host star old enough that its "other Earth" had time to nurture life to the metazoan stage – multi-cellular plants and animals? Our world developed multi-cellular life only in the past 600 million years, that is, in the last 15% of its lifespan to date! Is that host star considerably younger or older than ours?

If the host sun was old enough, but not too old ... But how can we tell that with only one sample to test, that of our own home planet?

Without a prior visit by a fleet of very capable probes, with all the time delays (very long flight, long report back time, analysis time) sending humans would be a very big gamble. It would seem that despite all the hooplah over the 100-year Starship Project, that a fist human venture to a "nearby" star system is quite a bit into the future. Now to be honest, this writer is extremely skeptical that physicists will find a human-survivable way to make an end-run around the speed of light barrier.

There seems to be considerable new optimism that we will find new secret pathways not apparent to us now because our knowledge of physics and cosmology is considerably less complete than we had thought. At the same time, there is recognition that it will be one thing to get a ship to go that fast, quite another to be able to support human life over a number of generations for the duration of the ship.

An alternative, which we put forth many year ago, was to send fertilized human eggs and sperm in suspension, and only "when and if" we were approaching a planet that instruments aboard determined was capable of supporting human life, and not already inhabited by sentient beings, robots would combine sperm and eggs and put them in artificial wombs, and when ready for "birth." Nanny robots would nourish, and raise, and educate. Sort of like the sowing the seed everywhere, and somewhere it takes root and grows, other places not. No humans beings would make the trip, or be brought to term unless circumstances at a distant target star warranted. This avoids all the problems of "Generation Ships" and bypasses most of the problems facing human crews heading out into space without adequate knowledge of where they are heading. It also makes the speed of light irrelevant.

But the point is that we now know that amino acids, the building blocks of life as we know it, pervade the star clouds, and probably the universe. Exploding super suns are the incubators of these building blocks. Life is natural to the universe. Life on Earth may have been sown by the death-struggle output of many suns now gone.

In that light, it would be fitting to replace "To the Stars" with "Back to the Stars!" It would be a pilgrimage! The culmination of the epic of our species and of any intelligent species. But will we really embark on such a quest? Some species will, many will not. Of those that do, not all will succeed. But the universe is so large in both space and time, that we do not doubt that some, maybe many species will succeed.

Nonetheless, the age old dream of exploring, even settling far-flung star systems will not die. It will be there to urge us on, not to the stars, but back to the stars. Our sun is probably just one of a hundred or more that formed in a cluster, like the well-known Pleiades. But after 4.6 billion years, the Sun's crib-mate stars have long wandered off to considerable distances, very slowly drifting. The Greek name for our sun is Helios, after which Helium is named (this element was first detected in the Sun), so we have suggested the name Heliades for our birth cluster. One strong motive for an effort to seek out and identify and study the Sun's cribmates is that they are of the same age, and thus their planetary systems have had the same amount of time to evolve and mature. But just as in the Pleiades, our Sun's siblings will come in many sizes with differing spectra. We'll want to look at G type stars especially, though some low-F type stars with diminished lifetimes may be worth studying. Read the article "Circling some Yellow-White "F" Spectrum Stars may be a Scattering of "Welcome Matt" Worlds" from MMM # 45, reprinted in the newly published MMM Starbound Theme issue:

http://www.moonsociety.org/publications/mmm_themes/**mmmt_starbound.pdf**

You will find many other interesting and relevant articles in this issue.

in our "Out of Africa" epic, we humans have become thoroughly "Intercontinental." Becoming "Interplanetary" is the next chapter, but we have yet to establish a permanent presence on the "threshold" between the two, that is, on the Moon which is on the border between Earth-space and Interplanetary-space. But we will get there.

By the time our foothold on the Moon has gotten to the "no turning back now" stage, the next generations of Exoplanet hunters will have found some very, very interesting nearby solar systems. Such findings will feed the imagination of young people and interest in interstellar exploration will grow.

In the meantime, we should know if there are any human-survivable end-runs around the speed of light barrier. If not, maybe that is good, as it may have thwarted visits from any more advanced, colonizing (in the bad sense of the term) nearby intelligent species. (Personally, we believe the universe is swarming with other civilizations but that the average distance in both space and time is so great that encounters are most unlikely, and that is good, as culture-shock could destroy one or both.

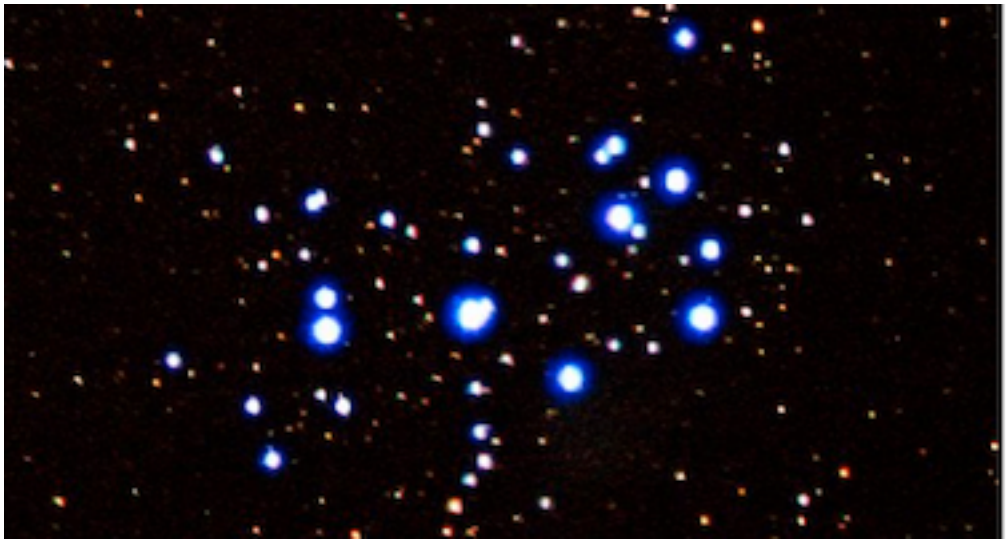
Among humans, it is quite clear that the majority in any society is quite content with a slowly advancing status quo. Few ever consider the long term epic path of our species. Thus to rely on political support will get us no where, unless the plan is misguidedly linked with short term military strife within our own population. Our civilization may stall in a static inwards downspiral. But somehow, somewhere, some of us will settle for nothing else but seeking out our cosmic destiny, even if it takes many generations, many centuries, many millennia.

Perhaps just the confirmation that we are almost certainly not alone, even if no contact has been made, will be enough for us to understand our own existence in perspective, and to encourage healthy cultural and spiritual growth. Read the article "Skyfields" in that same Starbound theme issue (address above)

We have humbly suggested that the biblical statement "of dust thou art and to dust thou shalt return" be paraphrased "of stardust thou art, and to the Stars thous shalt return." Well, we may never get there, but more likely we will indeed venture beyond our local vicinity. It is not "getting there" that will transform us, but just the effort to do so will make its mark on human culture and civilization in coming centuries.

"Isn't life wonderful?!" - Back to the Stars! It is who we are. It is a hidden human instinct. Keep the dream alive! **Below:** The Pleiades star cluster only 150 million years old.

PK



Links:

http://en.wikipedia.org/wiki/Solar_analog
http://www.astro.wisc.edu/~dolan/constellations/extra/nearest.html (26 closest stars)
http://www.atlasoftheuniverse.com/12lys.html (3 dimensional map of our stellar neighborhood)
http://100yss.org/ - http://en.wikipedia.org/wiki/100_Year_Starship
http://www.space.com/13135-100-year-starship-symposium-darpa-nasa.html
http://cosmiclog.nbcnews.com/_news/2011/11/02/8603075-reality-check-for-starships?lite
http://online.wsj.com/article/SB10000872396390444868204578066863905510662.html
http://www.tgdaily.com/space-features/66998-esa-steps-up-search-for-earth-like-planets

Why an Earth-size planet around Alpha Centauri B may be bad news

By Peter Kokh

The good news: Alpha Centauri B, the smaller of pair has a planet slightly bigger than Earth.

The bad news: This planet orbits its sun **at about a tenth Mercury's distance from our a sun,** so close that **sun-facing surface must be permanently molten**.

We ask why so close? The likeliest reason lies in a "detail" that I had previously ignored. First let's look at the basic "plan" of this system.

Alpha Centauri is really two stars, "A" and "B," not just one. The two circle one another around a common center of mass or barycenter making this a "binary system."

In an article I wrote about Alpha Centauri 21 years ago, I gave the two stars proper names. Why shouldn't the two major stars closest to Earth be given names?

1. Alpha A is **slightly** more massive and brighter than the Sun, and Alpha B, a bit less massive and less bright. If there is even 'some' possibility that either or both have planets, shouldn't these two solar neighbors have names of their own? For the purposes of the discussion that follows, let us call them **Ixion** and **Nephthele** respectively, "**King and Queen of the Centaurs**."
2. In the case of this double star, "during the pair's 79.91-year orbit about a common center, the distance between them varies from about that between Pluto (40 times Earth's distance) and the Sun to that between Saturn (9 x Earth's distance) and the Sun." [http://en.wikipedia.org/wiki/Alpha_Centauri]

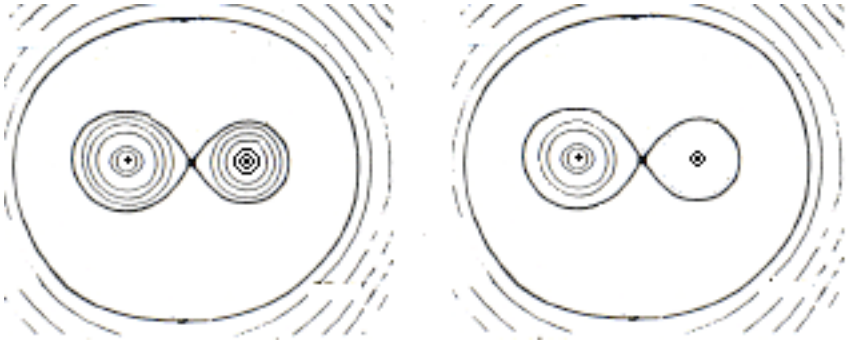
For some time, the common expectation was that orbital dynamics did not allow stable planetary orbits within a binary system. But there are a range of possible binary orbits, and such a generalization is not worth its repeating. First, binary stars cab orbit one another very close or at great distances, and anywhere in between. Second, their orbits about a common center of gravity an be anywhere from fairly circular to very eccentric.

Now there are two parts to this situation. On the one hand, it would seem that "inner rocky planets" - such as our Mercury, Venus, Earth, and Mars - would have stable orbits around both Alpha Centauri A and Alpha Centauri B. Likewise, it would seem that there could be some "outer" planets - gas

giants and “plutoids” – in stable orbits around A-B’s common barycenter, as in the diagram above. But there is a sleeper in the data the repercussions of which I had not previously realized. And that is point 2 listed above, the very eccentric (off-center) orbits of both A and B around their common barycenter.

When the more massive A (Ixion) (1.1 times the Sun’s mass) vs. B (Nephthele) (0.9 times the Sun’s mass) when their mutual distance is at minimum (9.5 A.U. vs. 40 A.U.) must exert tidal pull on any of B’s planets that will increase the eccentricity of those planets orbits, until their maximum distance from B intersects or transcends the current distance of the barycenter between the two stars, and one by one are either flung out into interstellar space, or captured by A (see the bold figure 8 orbit in the graphic above.)

These same tidal forces my force planets fairly close to B to circle ever closer. All the rest of B’s original retinue will either have been flung into interstellar space to become “rogue planets” or captured by A.



Left: Original Planets **Right: most of B’s planets ejected, outer planet of A also ejected**

Could an Earthlike planet in orbit around A stay put? While B’s tidal power is less than A’s, it is likely to have distorted the positioning of A’s original retinue of planets as well, or at least left them in orbits of ever shifting eccentricity and distance from A. This is what I suspect, but I claim no expertise in orbital mechanics.

The upshot would seem to suggest that we would do well to cross binary systems off our list of potential future homes for mankind except for those who circle each other at a much greater distance. Note that Alpha Centauri A and B are also 6.1 billion years old, vs. 4.6 for the Sun. An interesting system, but the “good news that Alpha Centauri B has an Earth size planet” turns out to be “discouraging news” instead.

Hey, we are adults. We can take it. Let’s move on! **PK**

http://aether.lbl.gov/www/classes/p139/speed/Alpha-Centauri.html

MMM #267

What if some stellar wonder were right in our backyard?

By Peter Kokh

When I was growing up in Milwaukee in the late 1940s and through the 1950s, you could see many more stars in the nighttime urban sky than you can now. However, in 1946, after the war (WW2) was over, I went with my maternal grandparents “up north” to their hometown, Florence, Wisconsin, just across the state line from Iron Mountain, Michigan, and there they bought 2 acres on a dead end road, with an old farm house, and empty fields to the South and East. Years later, in 1969, I bought an old 1955 “house trailer” and put it along the East fence. Every year since 1946, except 1961 (I was in England all year), I have spent time up there. And one of the things I most treasure is the awesome nighttime skies, full of stars, the likes of which a city dweller could only dream.

In a way, except for the Milky Way, Earth’s skies, are rather prosaic. This is perhaps fortunate as far as legends and religions go. If that seems a weird statement, consider the impact on early cultures if one of the sights below were near enough to literally “dominate” the heavens, to the point of “being in our face?”

M31 Andromeda 2.6 million light years from us The Whirlpool Galaxy 23 million light years

Omega Centauri Globular Cluster 16,000 ly "Double Cluster" – h & χ Persei 7.500 ly

If one of these objects were located at a tenth the distance and thus a hundred times as brilliant, and dominated the sky for part of the year, what would have been the effect on early "prophets?" Would one of these sights be "God?" Or his "angels?" Should we be thankful our skies are just generally magnificent, or "so so?"

Actually, the galaxies relocated a tenth the distance, would still not be that bright. The photos are bright only because of the length of time the film was exposed. As to the Double Cluster, brought much closer, its stars would mix with other bright stars in the background, as is the case with the Big Dipper, most of whose stars belong to a very nearby cluster. The only object above that would be a real "wow" scene would be the large Globular Cluster, Omega Centauri. With nothing comparable elsewhere in the heavens that bright, it could well have shaped religions and cosmologies prior to the invention of the telescope, when we would find many other similar clusters.

Actually, the Northern Lights or Aurora Borealis, has played a significant role in Eskimo/Inuit/Samoyed legends, the swiftly dancing lights with shifting colors seems "mischievous, evil, something to worry about" – but hardly the apparently immutable brilliance of a nearby globular cluster.

Thank "Heavens" for Dust Clouds!

But there is another thing to be thankful for – the thick dust clouds which hide our own galactic core, lurking behind them in the constellation Sagittarius. Without the dust clouds, Our "hub" might make an incredibly awesome sight, extraordinary enough to affect legends and myths and early religions. As to the rest of our Milky Way galaxy, as it extends around the heavens 360°, it is too decentralized a sight to attract "worship." PK

Unpublished in MMM – Written October 2007

It's Time for some wild "what if" fun yarn, but just possibly a culture-shaking Discovery yet to come

It Came From the Bowels of the Moon

A **Science-Speculation Essay** by Peter Kokh –
http://www.moonsociety.org/humor/afd_news.html#hh

[Fun piece written for a Milwaukee Horror Con "It Came from Lake Michigan" the weekend before Halloween, 2007]

Many of us believe that it is likely that "other intelligent species" have come this way before. Perhaps as explorers, maybe as pioneers, or in search of lucrative trade. Maybe even as imperialists. Earth has been around for some 4.6 billion years having formed more than eight billion years after the first stars. Plenty of time for other, earlier civilizations to have risen and perished in that time. Astronomers believe that earlier stars and their planetary systems were less rich in the elements that form rocky worlds like ours. Yet that some may have not enjoyed life long before ourselves seems inconceivable.

Let's suppose for sake of argument, that we have been visited a hundred times since Earth was formed. Averaged out, that's one visit every 46 million years. And there is a 50-50 chance we have been visited as recently as 23 million years ago, and a 1 in 100 chance that someone came calling as late as 460,000 years ago.

Hmmm!? Now there is a problem with averaging things out that way. For one thing, the pace of visits should have started much more leisurely as "way back then" there were likely fewer intelligent civilizations than we imagine that there must be today. Then the pace gradually picked up. So the interval between visits may have decreased on a logarithmic scale. But who knows? Maybe we got lucky enough to have had a visit in the past ten thousand or so years since the ice age and the birth of human civilization as we know it. But also possibly, the Sun and Earth have been in the "boondocks," off the logical routes of interstellar exploration and expansion. All we can do is wonder "for the sake of argument."

Perhaps that 100 times in the lifetime of Planet Earth is too pessimistic. Perhaps it is too optimistic. One thing is sure. Time, and by that we mean the amount of time before the present, is as vast as space. The two go hand in hand. The chances of finding a contemporary civilization, one both nearby in space and nearby in time, are much slimmer than that of identifying a civilization whose Sun was once a neighbor of ours but which has either drifted far away, or that civilization has long succumbed to the ravages of time; much slimmer too than finding a contemporary civilization, contemporary in that we now detect its signals, though it is so far away that it too may have passed into oblivion since the message was sent.

But, again, for the sake of argument, let's say that our solar system has indeed been visited, explored, inspected, mapped, catalogued, etc. Let's say that this has happened more than once. Still the odds are over-whelming that our last visit might have occurred before the rise of modern man, cultural man, technologically inventive and scientifically curious man. This "last visit" could have occurred in the past 5 million years, at a time when the evidence of simian and primates was clear and the evidence that Earth would soon bring forth its own dominant species, a species which like their own, could alone help their homeworld's "Life" sprout elsewhere throughout their system and beyond. What message could have been left?

But just as plausibly, our last visitors may have come calling much earlier: in the age of the dinosaurs, or even earlier when multicellular life was first forming in the oceans and seas. But it might have been clear to the visitors even then that this young Earthlife had the potential to go all the way -- in time. What message for a far far future Earth-dominant species could the visitors have left, should they so have felt inclined?

That's one question. Another is where could they possibly have left a message or a calling card, even a "Cheshire Smile" for us to know that someone from somewhere and somewhen had come calling? Where could they have left it where it would not have been destroyed by the ravages of Earth's active geology and weather? Nowhere on Earth!

When Apollo 15 moonwalkers, David Scott and James Irwin, landed along side a portion of the meandering lunar valley known as Hadley Rille, they looked for clues to its origin. Running water could not have carved the valley. It was too winding to be a fault line. Soon, lunar geologists, or "selenologists," came to a unanimous conclusion. The rilles all appeared as features of various maria, frozen lava plains. The evidence was clear that the lava sheets have must have had little viscosity, or they would not have spread hundreds of miles. On Earth we find these kind of lava plains also, for example in the Pa-

cific Northwest. How the lava sheets spread is by rivers of lava. The top exposed to the cold of atmosphere, or on the Moon, the greater cold of space, soon congeals, then the sides. When the flooding has stopped, a lava tube is left. Some of these, too near the surface, collapse and become winding ditches. But whoa! On Earth lavatubes are typically 10-30 yards across and just about as high. If Hadley Rille was a collapsed lavatube, that tube must have been gargantuan, hundreds of yards across or more. Scientists soon realized that this could and would happen in the Moon's lighter gravity, just one sixth of our own.

Next question. Are all the original lavatubes collapsed? No! We see clear proof that at least some segments are intact, and probably whole tubes. Near the center of the Nearside lies Hyginus Rille, wandering for hundreds of miles. But here and there are interruptions, places where the rille "stops" and then, miles ahead, "starts" again. Those interruptions look like land bridges over the rille. Indeed, they are uncollapsed tube sections.

Now all the maria must have formed that way, but we do not see rilles everywhere. There must be many places where the original tubes are still intact with no surface entrances. Indeed, some maria formed layer upon layer. It is possible that each layer has intact lavatubes, gargantuan voids tens of miles long -- or longer. The Moon has bowels!

Someday, these "hidden valleys of the Moon" may harbor industrial parks, farms, even human settlements. What else? Well consider that they all were formed 2.5 and 3.8 billion years ago. They have been intact for an inconceivably long time. What a place to put the Grand Archives of All Mankind, even of all Earth Life! There, these records and artifacts would rest without decay in the cold black vacuum of these voids, until the Moon ceased to be. And there you have your answer. Our visitors could have left us an incomprehensible gift, safe until we became mature enough to find them.

Okay, we answered the 2nd question first: Where could visitors have left a message or record for us to find that would have been able to survive the ravages of time: geology and weather? In an uncollapsed lunar lavatube. Those that were intact would have been intact for billions of years already and should be for billions of years to come! Talk about security!

Now back to the first question: What would they have wanted to leave behind for us, whoever and what-ever we turned out to be? Now, of course, many of us Star trek fans know the answer. The Prime Directive would not only have mandated that we not find what they left behind until we were advanced enough to appreciate it, but that they not leave behind anything which would short-cut our own scientific and technological evolution but also anything which might play havoc with our culture or cultures. Yes there are skeptics and cynics, but it may well be that the only civilizations that survive to become spacefaring will have come to appreciate the hard way, as we have, that the Prime Directive is not something Gene Rodenberry thought up, but which intelligent species everywhere must come to appreciate. The wreckage of primitive cultures in our own past by sudden contact with more advanced cultures is evidence enough.

Suppose we believers in the Prime Directive are on to something? I propose that this would boil down to two simple guidelines: (1) tell the natives nothing about ourselves; (2) tell them instead about the past of their world; preserve for them records of that past that otherwise would be sure to be erased by plate tectonics and weather. In other words, all we, as the visiting species, leave behind of ourselves, is a "Cheshire Smile." That is how I propose the visitors, any one advanced enough to have wandered by, will look upon the opportunity. Here it is there message to us in their own thoughts.

"You will know that we have been here, that we foresaw the probability of the rise of a dominant species that could carry your planet's life beyond its spatial shores, and that we cared to give you a gift of knowledge about the state in which we found your planet when we passed by: the shape and position of its continents; mountains, and rivers, and lakes, and ocean trenches; the volcanic hot spots and rifts and plate boundaries; the weather and climate; detailed depictions and models of all the life forms, plant and animal and even microbial, that we had found. These are things you could never discover, no matter how valiantly you tried to reconstruct your planet and biosphere's past from the partial and haphazardly scattered clues that time has left behind.

"More, we can leave you an atlas of your heavens as they were then. They were full of stars and star clusters and nebulae that may now have drifted halfway around the galaxy. We can show you your neighboring galaxies to compare with the distribution you find today.

"But no, we won't tell you where else we found life in our explorations. No, we won't describe ourselves, our physiologies, our cultures, religions, or histories. But what can be more than to know just simply that we were here, looked forward to your emergence, and cared enough to reveal some of your very own past?"

Fun Fiction? Or serious speculation which someday we may find to be the biggest archeological find of all time. The greatest find of all time, and maybe for all time to come, may yet **come from the Bowels of the Moon! - PK**

AFD NEWS WORLD WATCH SERVICE

MMM #124 **DALLAS, TX. Nieman Marcus Inc.,** elite Department Store of the rich and famous, known around the world for its annual Christmas catalog of exotic and unique gifts "for those who have everything", has announced that the December 1999 "Millennium's Eve issue" will feature prepaid scattering of one's cremains, or those of a loved one, among the stars, "to mingle with the stardust from which we all came." Billed as "the ultimate pilgrimage home", the $2-7 million gift is the brainchild of Celestis, Inc.'s new competitor, Stardust Pilgrimages, Inc. Stardust will offer "more than symbolic" percentages of one's cremains into space - plus one's choice of destinations:

- High "eternal" Earth orbit $15K 10% cremains, $100K 100%* cremains
- lunar surface or solar orbit $50K 10%, $300K 100%
- Mars surface or comet tail $1M 10%, $3.5M 100%*
- **Interstellar drift "pilgrimage" $2M 10%m, $7M 100%***

[* limit 1.5 kilograms, or 3.3 pounds]

According to a Niemen Marcus spokesperson, Stardust cremains missions will not be flown until a certain minimum of orders are received. If a mission does not fly within 5 years of donation, the 40% downpayments will be refunded on request. **AFD NEWS**

MMM #144 **YERKES OBSERVATORY, WILLIAMS BAY, WI:** What appears to be either the faintest star ever discovered or a near maximum mass "brown dwarf" glowing ruddy from gravitational heating is hurtling towards the solar system on an intercept course. Dubbed "Swansong" or "Swan with attitude" by Armin Gideon, the amateur astronomer's assistant who found it, because it is coming at us out of the constellation Cygnus (The Swan) the borderline star was already only 8 light months out when it was discovered - less than a 6th the distance of Proxima/Alpha Centauri, a triple star system previously thought to be the closest stellar objects to the Solar System. Even this close, the new found object is only magnitude 26, not much over the limit of what can be seen with terrestrial telescopes.

Swansong is nearing the Solar System with a radial velocity of 35 kilometers per second. That's high but not unheard of. At that rate, it will pass the Sun, missing it by 600 million miles, a bit more than Jupiter's distance from the Sun, in about 5,700 years. That's literally "tomorrow" as geological time goes, in less than a solar heartbeat. The Sun is 4.6 billion years old and is expected to live "a normal adult life" for again as long, Gideon says.

We'll have to watch it a while to refine its trajectory enough to make planetary encounter predictions. Swansong could disturb Jupiter somewhat if the big planet happened to be nearby. But it could literally "bounce" Saturn or Uranus or Neptune clean out of the Solar System or nudge one of them into a highly elliptical orbit that would invade the inner solar system, threatening Earth.

On the other hand, if the major planets were on the other side of the Solar System at the time, Swansong might cause little orbital havoc. It is too soon to say. The Hubble Space Telescope is now trained on Swansong. It may be a while before we can tell if this intruder has any planets, moons, or other companions. Meanwhile, there is no immediate danger, and no disturbances of the solar system should be felt until a century or so before its closest approach. And once it passes, it will be gone for good. **AFD NEWS**

MMM #154 **PANAMA CITY, PANAMA** – First it was the cryonics gurus of the Scottsdale, AZ-based Alcor Life Extension Foundation (**www.alcor.org**) and others, who assured us that they could freeze us just before the moment of death, and bring us back once a cure for whatever ailed us is found, so that we could enjoy decades more life in the better, more exciting world of the future.

Now it is Starchildren, Inc. For a million dollars (more for frills, of course) they will clone anyone, safely freeze-store dozens of their viable embryos until "interstellar drives " are invented, guaranteeing that "your later day alter egos will have guaranteed priority consideration for interstellar flight slots as soon as or whenever these flights begin." Just how they would be able to deliver on that promise, granting that they might just succeed in the cloning effort, they do not say. Perhaps they plan to use the billions they hope to make to develop a warp drive of some sort themselves. First, no doubt, they intend to develop virtual reality warp simulators to help with the hard sell!

It is likely that they will have some takers. People will do anything if they think it is a way to cheat death if there is just a slight "believable" chance. Nor can anyone stop Starchildren, Inc. from trying. They are operating in the unrestricted enterprise zone of Panama City, Panama, beyond the jurisdiction of the U.S. or any other responsible power.

An intense and seductive advertising campaign is being test market abroad and is expected to be unwrapped for worldwide cable and satellite television audiences , hopefully by years end. The U.S.A. debut of the ad campaign is tentatively set for Super Bowl 2003.

Check out their website still under construction: **http://starchildren.com**/

They are not publicizing a mailing address or phone number at this time. "It is premature." explains Starchildren founder Dr. Andraster Cronos. "We are not quite ready to deal with inquiries at this stage. We are more concerned with perfecting our methods and our business plan. All I can tell you is that we have letters of intent from some three dozen persons in half a dozen countries, none of which will I name." **AFD NEWS**

MMM #224 "Inverse waffle grid" feature found in permanently shadowed South Polar crater by NASA instrument on Chandrayaan-1 lunar orbiter

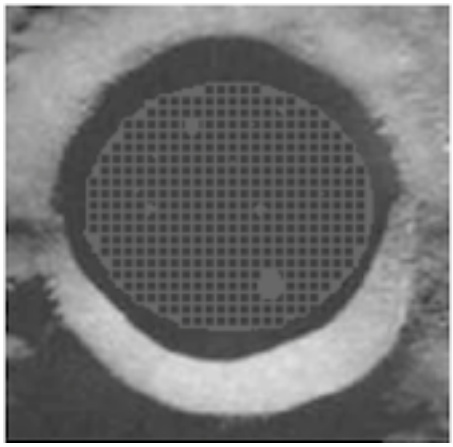
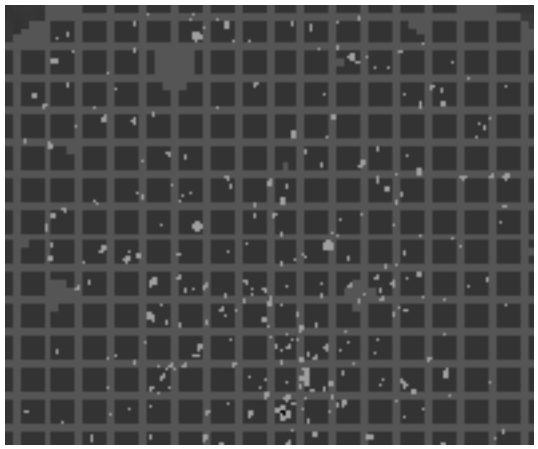
04.01.2009 Applied Physics Laboratory, Johns Hopkins U.

A series of Mini-RF synthetic aperture radar (SAR) strip overlain on an Earth-based, Arecibo Observatory radar image of the interior of Shackleton Crater on whose rim NASA is contemplating location of its lunar station, has revealed what seems to be an artificial pattern on the crater floor, an embossed inverse waffle like pattern of squares, each about 550 meters on a side with a grid of "alleys" about 100-some meters wide. The grid is 23 mounds wide E-W and 21 N-S.

Judging from the amount of pattern degradation by meteorite bombardment, this feature seems to be about 20-30 million years old.

So far no one has found a geological or geochemical process that might explain this degree of regularity.

No one at APL was been willing to speculate about the alternative, an intelligent origin. The reason for their reluctance is clear. The implication would be that the Earth-Moon system was paid an extended visit by an intelligent starfaring civilization 20-30 million years ago.

But speculation outside APL is that what we see here is “some sort of provisions stockpile or warehouse.” That poses the question: For us? For someone else who is still coming, and who has not yet arrived? We may never know. **AFD NEWS**

MMM #234 Fate of LCROSS Instrument Package a Mystery

03.31.2010 – NASA Ames Research Center, Moffet Field, Mountain View, CA. The Centaur rocket stage successfully impacted the Moon within the permanently shaded portion of Cabeus Crater near the Luna South Pole on October 9, 2009. And the impact splash-out debris cloud was successfully photographed and analyzed by the LCROSS probe proper, following close behind. There was no way, however, to record the impact of the latter. Now some are daring to speculate that it may not have impacted the surface at all. **Below left:** the Centaur rocket, **Below right:** LCROSS Instrument Package Proper.

Behind the wild speculation:

It seems that a millionaire space enthusiast, looking through his own personal 36" reflector in the desert mountains west of Las Vegas, did see something! Or did he? We leave his name out of it, as a simple beginner’s mistake had him looking at the wrong part of the Moon. Most amateurs know that through a telescope, the Moon's image is inverted, and south is at the top. Our unlikely hero, oblivious or forgetful of this, was looking at the bottom of the image, that is, at the Moon's North Pole. And he did see something! A few moments after the LCROSS instrument package telemetry signal was lost on schedule, he saw a small suddenly sunlit object “speeding downwards” (actually to the zenith above the north lunar pole) and he followed it for a few seconds before it disappeared.

While most people dismiss this as a sheer coincidence, astronomer Brad Jonathan believes that this strange sighting may not be a coincidence at all, that there is a connection between LCROSS disappearance over the Moon's South Pole, and the quick ascent of a small object skyward above the Moon's North Pole. "The permanent shadows at both ends in this case indicates that they may be connected by a "worm hole." The LCROSS impactor had been traveling at 6,000 miles per hour; and the Moon is over 2,000 miles in diameter, so unless its speed was somehow accelerated in its passage down the Moon’s axis through the core and then out the north polar “exit” you might expect emergence in about 20 minutes. But the object receding from the North Pole did so only a few minutes later, indicating that the alleged “worm hole” “tubeway” between the permanently shadowed craters of the Moon's two poles must have accelerated the object's speed considerably."

No one at NASA has been willing to comment on this “wild” “science fantasy” story.

But now the question is whether this presumed wormhole along the Moon's axis is primordial, or had been “built.” We do not know enough about it to even begin guessing. How wide is the hole? Is it of uniform width throughout? Is it straight or have some curvature? What happened to the material it displaced? Or did it not displace any lunar material? One thing seems certain; planetologists are unani-

mous in insisting this could not be a natural formation, the result of any known planet-building geological process. “I, for one, am not volunteering to go to the Moon, climb down into Cabeus, and jump into this ‘hole’ just to see what happens!” - Arne Saknussem X. **AFD**

So what is it? Some sort of sentient-made star-gate? It would seem that we need to do an experiment: drop something into the North Pole maw and see if it is similarly accelerated out of the South Pole maw. Current betting is that the acceleration effect works in one direction and we will find deceleration in the other, and that it is aimed at a target well outside the solar system. The Moon's north pole is pointed in the direction of Zeta Draconic, currently. But this changes over time.

At present, having never had a real live wormhole to study, we have no way of estimating its age. Where the “stargaters,” as they are now dubbed, came from, and over what time period their visits extended, is a guessing game. Their home system could very well be around some inconspicuous star that has yet to be named. So right now, and probably for a long time, we are left with only questions, mysteries, and wild speculations.

Indeed, without a series of experiments flying into both polar maws at varying speeds, it is not possible to determine how much of an acceleration or deceleration is provided and thus how much interstellar journey times might be shortened. The exit speed is clearly sub-light

Trying to narrow down the stargate target destination by studying the precession of the Moon’s North Celestial Pole is also pointless. There may be thousands of reasonable targets wherever it was first pointed.

Back on the Moon, the search is on for what we might find in the way of transportation support systems in the occasionally sunlit portion of Cabeus, but so far nothing there has caught the eye as out of the ordinary for floors of craters of this size. Nor have any surface features elsewhere on the Moon, puzzling enough to suggest a sapient origin, come to the attention of anyone other than writers for supermarket tabloids. **AFD News**