TRANSIT

The Newsletter of

Cleveland & Darlington Astronomical Society

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Analemma over Ukraine

Front page image:

If you took a picture of the Sun at the same time each day, would it remain in the same position? The answer is no, and the shape traced out by the Sun over the course of a year is called an analemma. The Sun's apparent shift is caused by the Earth's motion around the Sun when combined with the tilt of the Earth's rotation axis. The Sun will appear at its highest point of the analemma during summer and at its lowest during winter. Vasilij Rumyantsev (Crimean Astrophysical Obsevatory)

Editorial

Last meeting: 8 June 2007 - Keith Johnson delivered a talk on "Astrophotography" whilst seated in front of his computer. He walked us through the technique of using the free Registax software in processing AVIs obtained with a simple and inexpensive Webcam. His choice of subjects to work with were fascinating, an occultation of Saturn by the Moon and a series of Saturn captures. When first seen by non-astroimagers the processing seems hyper-technical but with a good guide through the process by an enthusiast like Keith showed it can be easily learned and that the software itself is very intuitive. The final results always justify the efforts involved judging from Keith's completed images.

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Next meeting : Friday, September 14, 2007 subject and presenter to be announced by the Secretary in his Summer Newsletter. Location, Wynyard Planetarium

Letters to the Editor :

From John Crowther :-

We had a 24 page Transit last month completing our 2006-2007 season before the summer break.

First from Rob Peeling we had practical advice to enable us to measure the heights of lunar mountains. But with just an ancient pass in GCE "Arithmetic Only" and limited instrumentation it was beyond me. But I could still work out the difference in apparent diameter between Saturn and the Moon from the amazing front cover picture of the recent Moon occultation of Saturn, and from these the magnification can be worked out.

Next came the Editor's article on the Reverend Thomas Espin. This was an interesting account of the achievements of this astronomer from the North East.
Bob calls him " Vicar Espin" but if my memory is accurate Jack gave a lecture on Espin some years ago where he said that the Clergyman was a Perpetual Curate (*absolutely right, Curate not a Vicar. Ed*), an office probably unique in those days and none existent now. He was wise to remain an assistant priest for then he was able to do his scientific work. Perhaps his father recognised his scientific genius and pulled some strings.

The Duggan's account of their visit to Jodrell Bank brought back long ago memories of our society's outing to Jodrell Bank. I remember learning from them that the 250 foot telescope is mounted on gun bearings from HMS "Vanguard".

Finally we had Dave Blenkinsop's "A life Under the Stars, part II". This was an interesting article from a dedicated observer and telescope builder. Roll on part III and also our next Transit.

John

From Mike Gregory :-

I enjoyed reading about the Reverend Espin. I don't know about Mount Espin (mentioned in the article) but I do understand that there is a crater named after him on the far side of the Moon. (*quite right Mike, not a mountain, it's a 75 Km crater just beyond the northeastern limb. It lies to the west-southwest of the larger Seyfert crater, and northwest of Deutsch crater. Ed*).

According to the Sky Catalogue 2000.0 (Vol 2), which was first published in 1985, almost all the Espin stars have been measured only once (the original measurements by Espin). However the 2004 CD edition of the Washington Double Star Catalogue does show that persons unknown have re-measured many of Espin's stars in the last ten to fifteen years. It remains to be seen how many examples show a definite sign of oscillation between the two components. In many, though certainly not all, cases, separation and position angle changes have proven to be negligible over a period of eighty or ninety years. This could be down to the measuring techniques of the individual involved though as many of the secondary components have magnitudes that require large apertures, they are thus beyond the domain of the average amateur.

Mike

Any new observations, any comments on local or international astronomy, ***anything*** *you want to share with your fellow members?*

Whoever said radio astronomy is OK but its not like the real thing?

from Bob Mullen

I just thought I'd keep the record straight for all those glass-gazers out there. How many people know that radio telescopes gave us all these great discoveries?

** The first known planets beyond the solar system (planets of the pulsar PSR B1257+12 in Virgo, found in 1991, four years before Swiss astronomers found the first planet of an ordinary sunlike star.

** Pulsars themselves, discovered in 1967, which turned out to be the neutron stars theorized to exist in the 1930s by several visionary astronomers and physicists including J. Robert Oppenheimer, who later built the atomic bomb.

** Quasars, discovered in the early 1960s, which turned out to be nothing less than supermassive black holes, millions to billions times more massive than the "ordinary" stellar-mass black holes which had been theorized earlier, but which were not discovered until much latter. Optical telescopes were needed to figure out what quasars were, but their very existence was revealed by radio astronomy.

** And how about this one from the old Bell Telephone Laboratories? The discovery of the cosmic background radiation, the glow from the Big Bang. Two radio astronomers shared the 1978 Nobel Prize in Physics for that baby and two others shared the 2006 Noble Prize recently for sophisticated measurements of the glow made with NASA's COBE satellite. (See my earlier blog on "The Story Behind the Nobel Prize.")

* The first observations of good –if indirect– evidence for the existence of gravitational radiation, as predicted from Einstein's General Theory of Relativity. That earned the 1993 Nobel Prize in Physics for a pair of radio astronomers. They were cited "for the discovery of a new type of pulsar, a discovery that has opened up new possibilities for the study of gravitation." And then there was the 1974 Nobel Prize, split between a radio astronomer who invented new methods of observation and another who was involved in the discovery of pulsars in the first place.

** The structure of our Milky Way Galaxy was not known in any great detail before radio astronomers began observing the radio emissions of hydrogen in interstellar space at a wavelength of 21 centimeters. Doppler shifts of the hydrogen radiation showed how fast various parts of the Milky Way are turning and allowed astronomers to map the space locations of the various spiral arms of the Galaxy. That's one of the more esoteric contributions of radio astronomy, but one appreciated and honored by all astronomers who know their stuff.

** Radio astronomy has revealed dozens of molecules in interstellar space, containing up to 13 atoms apiece, according to NRAO radio astronomer, Claire Chandler, who spoke at a press conference in Charlottesville on June 18. These findings include some of the chemical building blocks of life as we know it. Another of the molecules studied by radio astronomy, carbon monoxide, is noxious on Earth, but a blessing in space. It acts as a tracer of the cold and dark giant molecular clouds in whose inky depths stars are born, around which planets form.

Besides the above discoveries and hundreds of others, don't forget that radio astronomy is the principal base of that single form of space research that most excites the imagination of people worldwide — SETI, the Search for Extraterrestrial Intelligence. Remember *Contact*, the 1997 movie version of a Carl Sagan novel, in which Jodie Foster attempted contact with aliens?

In early scenes, she worked with the National Radio Astronomy Observatory's "Very Large Array," the Y-shaped set of big dish antennas on the Plains of San Agustin in New Mexico. Then her efforts shifted to another great radio telescope, the 1000-foot great bowl at Arecibo, Puerto Rico. It's now clear that there are millions of planetary systems throughout our Galaxy. Some must be inhabited and one day we *will* hear from one of them.

In just five years time, two of the most powerful facilities in radio astronomy history should be completed, ALMA (the Atacama Large Millimeter/Submillimeter Array, at very high altitude in Chile amidst the driest desert on Earth) and EVLA (Extended Very Large Arra), which takes the New Mexico telescope to new heights of sensitivity through the installation of modern electronics as a major technological upgrade).

(with thanks to the Bad Astronomer for the facts)

Caroline Herschel – recorder of the stars.

from Tony Flanders

I had a strange sense of déja vu while editing an article for the August issue of *Sky & Telescope.* The article is by Michael Hoskin, who's probably the world's leading expert on Caroline Herschel, the first famous female astronomer. Caroline started her astronomical career as a deep-sky observer. Although she couldn't possibly match the 2,000-odd galaxies, nebulae, and star clusters discovered by her brother William, she did make some important discoveries of her own, including the great Sculptor Galaxy, NGC 253, and the breathtaking star cluster NGC 7789.

Hoskin has uncovered some new material, including a catalog of her discoveries that Caroline drafted but never published. He's pinned down the identity of Caroline's objects as well as anybody possibly could from the manuscript sources, but some questions remain. That's what makes this article so exciting to me: there's a real possibility that you or I, reobserving Caroline's objects with comparable equipment, might help resolve some of these ambiguities.

Anyway, Caroline's observing career was cut short when her brother decided to become a big-time deep-sky observer himself — and that's where my déja vu comes in. The July issue has an article by Paul Markov (RASC) about how to keep a logbook, and I wrote a little sidebar for it explaining why I prefer to take my notes on a digital voice recorder. My reasons eerily echo William Herschel's sentiments: "By going into the light so often as was necessary to write down my observations, the eye could never return soon enough to that full dilation of the iris which is absolutely required for delicate observations."

Just as I discovered 215 years later, it's wonderful to be able to take notes while looking through the eyepiece, and without compromising dark adaptation.

Andromeda Galaxy Might Steal Our Solar System from Milky Way

By Kher Than

Our solar system might get booted from the suburbs to the boondocks of our galaxy when the Milky Way merges with its neighbor Andromeda in a few billion years, scientists say.

New calculations by T.J. Cox and Avi Loeb of the Harvard-Smithsonian Center for Astrophysics show there is a small possibility that the Sun and its planets will be exiled to the outer reaches of the merged galaxy.

"You could say that we're being sent to a retirement home in the country," Cox said.

Their findings have been submitted for publication to the *Monthly Notices of the Royal Astronomical Society*.

A galactic dance

Computer simulations by Cox and Loeb suggest the Milky Way and Andromeda will make their first close pass in about 2 billion years. The two galaxies, currently separated by about 2.2 million light-years, are rushing towards each other at

about 310,000 mph (500,000 kph). One light-year is equal to about 6 trillion miles (10 trillion kilometers).

During that first close encounter, the two galaxies will circle around each other a few times and their stars will begin to intermingle. The Sun at that time will still be a hydrogen-burning main-sequence star, but it will have brightened and heated enough to boil away the Earth's oceans, other studies predict.

The new computer model finds there is a 12 percent chance that during this first brush between Andromeda and the Milky Way, the Sun will be pulled from its present position into a "tidal tail," a streamer-like cluster of orphan stars stripped from their parent galaxies.

After the galaxies circle each other a second time, there is a 3 percent chance our Sun will be more tightly bound to Andromeda than the Milky Way.

"To a certain degree, Andromeda will steal our solar system," Cox told *SPACE.com*.

"Milkomeda'

In 5 billion years, Andromeda and the Milky Way will have completely merged to form a single, football-shaped elliptical galaxy. Loeb jokingly calls this future galaxy "Milkomeda," but others have also referred to it as "Milkymeda" or the "Andromeda Way."

"It would be cool if it there was a Roman or Greek god that was the last one standing" to name the galaxy after, Cox said.

When the two galaxies finally merge, the Sun will be an aging star on the verge of inflating into a red giant. According to the new computer simulations, the Sun and its planets will get pushed out to 100,000 light-years from the center of the new galaxy-4 times farther than the current 25,000 light-year distance.

The pending merger of Andromeda and the Milky Way has become a part of astronomical lore. The first detailed computer models of the fated crash were made about a decade ago by University of Toronto astronomer John Dubinski.

The new simulation incorporates recent discoveries in galaxy formation as well as the effects of the local landscape of dark matter that surrounds both galaxies, Cox said. The dark matter "actually adds a little bit of drag on the two galaxies and speeds up the merger a bit."

Cox cautions, however, that the new findings should be taken with a large grain of salt. "There are enough uncertainties that it should be regarded more as an exciting possibility than a quantified thing," he said

Our Lonely Future, 3 Trillion Years From Now

by Fraser Cain

When astronomers look into the night sky, they see back into time. The light from the most distant galaxies has taken billions of years to reach us. Astronomers can measure that these galaxies are hurtling away from us, as part of the Universe's expansion after the Big Bang. The more distant a galaxy is, the more quickly it's moving away from us.

We know that the Universe started from a single point billions of years ago, we know that it's expanding, and thanks to the mysterious dark energy, we know that this expansion is accelerating. In billions of years, distant galaxies will be speeding away from the Milky Way so quickly that they will recede from us faster than the speed of light. Their light will dim and fade away, and disappear from our view of the cosmos, forever inaccessible and unknowable.

And three trillion years from now, all the galaxies will have passed over the horizon, and faded from view. Future cosmologists will know of only one galaxy: ours. The Universe will appear static and unchanging, slowly cooling away. And this view will be the same from all points of view in the Universe. Physicists in every galaxy will only know of their own home, and nothing else.

This bleak view of our lonely future is all thanks to some new calculations from Lawrence Krauss from Case Western Reserve University and Robert J. Scherrer from Vanderbilt University. Their new article, called the "The Return of the Static Universe and the End of Cosmology," was recently award a prize by the Gravity Research Foundation, and will be published in the October issue of the Journal of Relativity and Gravitation.

"While physicists of the future will be able to infer that their island universe has not been eternal, it is unlikely they will be able to infer that the beginning involved a Big Bang," report the researchers.

Another powerful tool that astronomers use to know the Universe is the cosmic microwave background radiation; the afterglow from the Big Bang. The light from these early moments of our Universe has already been red shifted to longer and longer wavelengths with the expansion of the Universe. What used to be visible light is now microwave radiation, and will move through the radio spectrum. Eventually the wavelengths will be so large that astronomers will have no way to detect it.

Researchers also measure the quantities of hydrogen, helium and deuterium across the Universe. Their quantities match predictions for what should have occurred in the Big Bang. For a period, the entire Universe was like a giant star, converting primordial gas into heavier elements. Rapid expansion ended this period, and future elements were formed only within stars. Although the

quantities of these elements match predictions today, our future galaxy will have dispersed them and combined them so thoroughly that they'll be indiscernible as the helium produced in stars will dominate.

"Eventually, the universe will appear static," said Krauss. "All evidence of modern cosmology will have disappeared."

We can only hope that research done by cosmologists today is preserved, so future physicists can know that the true nature of the Universe, and not the static place they see around them.

The Summer Solstice

In the Northern Hemisphere, summer will officially begin at the solstice, on Thursday, June 21 at 2:06 p.m. EDT (11:06 a.m. PDT). The sun will reach the point where it's furthest north of the celestial equator. Summer officially begins in the Northern Hemisphere and winter begins for the Southern Hemisphere.

At solstice, the sun will appear to be shining directly overhead for a point on the Tropic of Cancer (latitude 23.5 degrees north) to the north of the Yucatan Peninsula, over the open waters of the Gulf of Mexico.

This changing of the seasons takes place because the plane of Earth's equator is tilted 23.5 degrees to our orbit around the sun.

How it works

During the course of the year, varying amounts of sunlight strike different regions of our planet. Both the angle of incidence of this radiation and the length of daylight change significantly. If the insolation alone - the total energy received from the sun - governed the temperature, we should be experiencing the year's hottest weather right now.

But the atmosphere in temperate regions continues to receive more heat than it gives up to space, a situation that lasts a month or more, depending on the latitude. A reverse process occurs after the winter solstice in December. So for many places, the hottest part of the year comes in late July and the coldest in late January.

Here's another example: In New York City on April 12 the insolation is exactly the same as on Aug. 31, but because of that seasonal lag, freezing temperatures are possible on the former date, while a 90-degree heat wave can occur on the latter.

Solar heating also depends on the midday sun's altitude in the sky, which controls its daily path and the number of hours it's above the horizon.

A northern city like Chicago can never see the sun directly overhead, but come Thursday at 12:52 p.m. CDT, the sun will attain its highest point in the sky over the Windy City for this entire year, standing 72 degrees above the southern horizon (a clinched fist at arm's length measures roughly 10-degrees; so for Chicagoans, at its highest point, the sun is just over "seven fists" up from the southern horizon).

Since the sun now appears to describe such a high arc across the sky, the duration of daylight is now at its most extreme; at mid-northern latitudes, the sun is above the horizon for more than 15 hours. And north of the Arctic Circle (latitude 66.5-degrees north) the sun remains above the horizon 24-hours a day (the so-called "midnight sun" effect).

Finally, there's a popular misconception that the Earth is now at its closest point in its orbit relative to the sun. That, however, is most definitely not the case.

In fact, on July 6th at 8:00 p.m. EDT, the Earth will arrive at aphelion, its farthest point from the sun in its orbit, at a distance of 94.5 million miles. Back on January 3rd, Earth was at perihelion, its closest to the sun. The difference between these two extremes is about 3.1 million miles or 3.3 percent, which makes a difference in radiant heat received by the Earth of nearly 7 percent.

Initially, it would seem that for the Northern Hemisphere such a difference would tend to warm the winters and cool the summers. The truth of the matter is, however, that the preponderance of large land masses in the Northern Hemisphere works the other way and actually tends to make the winters colder and the summers hotter.

The Drake Equation is obsolete

from George P Dvorsky

I'm surprised how often the Drake Equation is still mentioned when people discuss such things as the search for extra terrestrial intelligence (SETI), astrobiology and problems like the Fermi Paradox.

Fairly recent insights in such fields as cosmology, astrobiology and various future studies have changed our perception of the cosmos and the ways in which advanced life might develop.

Frank Drake's equation, which he developed back in 1961, leaves much to be desired in terms of what it's supposed to tell us about both the nature and predominance of extraterrestrial life in our Galaxy.

The Drake Equation

The Drake equation states that:

$$N = R^* \times f_p \times n_e \times f_l \times f_i \times f_c \times L$$

where:

N is the number of civilizations in our galaxy with which we might hope to be able to communicate and:
R* is the average rate of star formation in our galaxy
fp is the fraction of those stars that have planets
ne is the average number of planets that can potentially support life per star that has planets
fl is the fraction of the above that actually go on to develop life at some point
fi is the fraction of the above that actually go on to develop intelligent life
fc is the fraction of civilizations that develop a technology that releases detectable signs of their existence into space
L is the length of time such civilizations release detectable signals into space.

Arbitrary at best

The integers that are plugged into this equation are often subject to wide interpretation and can differ significantly from scientist to scientist. Even the slightest change can result in vastly different answers. Part of the problem is that our understanding of cosmology and astrobiology is rapidly changing and there is often very little consensus among specialists as to what the variables might be.

Consequently, the Drake formula relies on 'stabs in the dark.' This makes it highly imprecise and unscientific. The margin of error is far beyond what should be considered acceptable or meaningful.

No accounting for cosmological development or time

Another major problem of the Drake Equation is that it does not account for two rather important variables: cosmological developmental phases and time (see Cirkovic, "The Temporal Aspect of the Drake Equation and SETI").

More specifically, it does not take into consideration such factors as the age of the Galaxy, the time at which intelligence first emerged, or the presence of physiochemical variables necessary for the presence of life (such as metallicity required to form planets). The equation assumes a sort of cosmological uniformity rather than a dynamic and ever changing universe.

For example, the equation asks us to guess the number of Earth-like planets, but

it does not ask us *when* there were Earth-like planets. And intelligence itself may have been present as long as 2 to 4.5 billion years ago.

The Galaxy's extreme age and the potential for intelligence to have emerged at disparate points in time leaves an absurdly narrow window for detecting radio signals. The distances and time-scales in question are mind-boggingly vast. SETI, under its current model, is conducting an incredibly futile search.

Detecting ETI's

Which leads to the next problem, that of quantifying the number of radio emitting civilizations. I'm sure that back in the 1960's it made a lot of sense to think of radio capability as a fairly advanced and ubiquitous means of communication, and by consequence, an excellent way to detect the presence and frequency of extraterrestrial civilizations.

But time has proven this assumption wrong. Our radio window is quickly closing and it will only be a matter of time before Earth stops transmitting these types of signals -- at least unintentionally (active SETI is a proactive attempt to contact ETI's with radio signals).

Due to this revelation, the entire equation as a means to both classify and quantify certain types of civilizations becomes quite meaningless and arbitrary. At best, it's a way of searching for a very narrow class of civilizations under very specific and constrained conditions.

Rather, SETI should continue to redefine the ways in which ETI's could be detected. They should try to predict future means of communication (like quantum communication schemes) and ways to identify these signals. They should also look for artificial objects such as megascale engineering and artificial calling cards (see Arnold, "Transit Lightcurve Signatures of Artificial Objects").

The future of advanced intelligence

Although possibly outside the auspices of this discussion, the Drake Equation does not account for the presence of post-radio capable civilizations, particularly post-Singularity machine intelligences. This is a problem because of what these types of civilizations might be capable of.

The equation is used to determine the number of radio capable civilizations as they conduct their business on their home planet. Again, this is a vary narrow view of ETI's and the space of all possible advanced civilizational types. Moreover, it does not account for any migratory tendency that advanced civs may have.

The Drake Equation does not tell us about exponential civilizational growth on

account of Von Neumann probe disbursement. It does not tell us where advanced ETI's may be dwelling or what they're up to (e.g. Are they outside the Galaxy? Do they live inside Jupiter Brains? Do they phase shift outside of what we regard as habitable space? etc.). This is a serious shortcoming because the answers to these questions should help us determine not just where we should be looking, but they can also provide us with insight as to the makeup of advanced intelligence life and our own potential trajectory.

In other words, post-Singularity ETI's may represent the most common mode of existence for late-stage civilizations. And that's who we should be looking for rather than radio transmitting civs.

Are we alone?

Michael Crichton once put out a very weak argument against the Drake Equation. He claimed that SETI was a religious endeavor because it was a search for imaginary entities. He is wrong, of course; we should most certainly search for data where we think we might find it. I believe, despite the low odds, that it is reasonable to assume that our search for life on other planets is warranted. Even a negative result can be meaningful.

Consequently, SETI should keep listening, but *expect* to hear nothing. If we should suddenly hear something from the depths of space, then we will have to seriously re-evaluate our assumptions.

At the same time we should find better ways to detect advanced life and tweak the Drake Equation in such a way as to account for the missing variables and factors I mentioned earlier.

Again, and more generally, we should probably adopt the contact pessimist's frame. Back in the 60's and 70's, when the contact optimists like Sagan, Shklovskii and Drake ruled the Earth, it was not uncommon to think that *N* in the equation fell somewhere between 10x6 to 10x9.

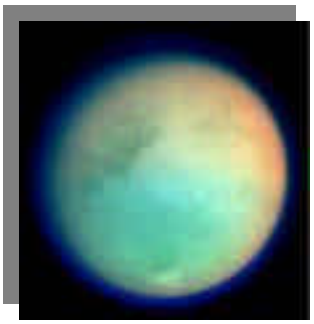
These days, in the post Tipler and Hart era of astrosociobiology, cosmologists and astrobiologists have to take such factors into consideration as Von Neumann probes, the Fermi Paradox, the Rare Earth Hypothesis, stronger variants of the anthropic principle and catastrophism.

Put another way, as we continue to search for advanced ETI's, and as we come to discover the absurdity of our isolation here on Earth, we may have no choice but to accept the hypothesis that advanced life does not venture out into space for whatever reason (the most likely being self-destruction).

Our other option is to cross our fingers and hope that something radical and completely unpredictable lies on the other side of the technological Singularity.

Earth's Future glimpsed on Titan

From Space.com



The enigmatic Saturnian moon Titan is still yielding surprising new details years after scientists first pierced its thick haze veil. The vision now emerging of Saturn's largest moon, with its giant dunes and oceanless surface, is perhaps a glimpse of Earth's desert future.

"Titan may be very different from Earth today, but maybe not Earth tomorrow," Jonathan Lunine, Cassini-Huygens interdisciplinary scientist at the University of Arizona, told *SPACE.com*.

The surface of Titan was a total mystery before the Huygens probe infiltrated past its dense hazy atmosphere in 2005. After a seven-year voyage aboard the Cassini spacecraft, Huygens spent roughly two-and-a-half hours parachuting down and then sent transmissions from Titan's surface for another 70 minutes before Cassini moved out of range. The mission was a joint project of NASA, the European Space Agency and the Italian Space Agency.

"Even though we have only four hours of data, it is so rich that after two years of work we have yet to retrieve all the information it contains," says François Raulin, Huygens interdisciplinary scientist at the Laboratory of Environmental Physics and Chemistry in Paris.

Lunine explained that "a number of instruments aboard Huygens simply require quite a lot of calibration and cross-checking to get a sensible result."

Episodic rain

Stereoscopic images from Huygens now reveal extremely rugged terrain in the bright highlands north of the probe's landing site. This includes channels divided by ridges that can rise some 500 to 650 feet high, with slopes of 30 degrees. Their shapes suggest they are drainage channels, cut by liquid methane falling as rain, findings detailed in a special issue of *Planetary and Space Science* magazine.

"Rains on deserts on Earth can take be spaced by months to years, but on Titan we're talking about hundreds, maybe thousands, of years between episodes of major rainfall that comes down perhaps violently," Lunine said. "Because Titan is so much further from the Sun than Earth is, it takes longer for solar energy to evaporate methane and build it up in the atmosphere enough to generate storms."

The fact that methane apparently moves from the atmosphere to the surface and back again on Titan just as water does on Earth makes Titan "in some ways the best analog for an Earth-like planet we have," Lunine said, as compared to Mars, which has too tenuous an atmosphere, or Venus, which has just the opposite. "Essentially all the processes we see in Titan are in some sense connected with methane, just as processes on Earth are in some sense involved with water."

Desert world

Before Huygens penetrated Titan's haze, scientists suspected oceans of liquid methane and ethane covered its surface, evaporation from which could explain the smog-like compounds in its atmosphere.

Instead, they found giant dunes likely composed of sugar-sized hydrocarbon grains girdling its equator, each stretching up to 60 miles long across dark plains that bear markings suggesting occasional flash flooding.

Any surface lakes and seas might be confined to Titan's polar regions.

"There's a sense here of a desert world. Not in terms of being hot-Titan is very cold-but in terms of being very dry," Lunine said. "Titan lacks oceans, but someday Earth will, too, as the sun increases in brightness, boiling the oceans away and leaving Earth a desert planet."

Hidden liquid

Mysteries remain as to where the liquid that carved Titan's valleys, channels and gullies is hiding. Enigmatic radio waves Huygens detected could help reveal this liquid is hiding in the deep interior of Titan, perhaps released by geysers or vulcanism.

The probe's Permittivity, Waves and Altimetry (PWA) sensor detected an extremely low frequency (ELF) radio wave during Huygens' descent. If this signal is natural and not accidentally generated by the instrument, studying how ELF waves resonate on Titan could shed light on any oceans that may exist below Titan's surface and how deep they are. Researchers have already ruled out electrical interference from the instrument itself.

As to what may have generated this ELF wave in the first place, no one is quite sure yet.

"It might be generated by an interaction with Saturn's magnetosphere or related to Titan's intrinsic fields," suggested Fernando Simões, a member of the PWA team. "Titan is proving to be an intriguing environment."

Star Balls?

from Rob Peeling

The headphones crackle slightly, a voice says, “Incoming, range one hundred and fifty thousand kilometres, speed 17 kilometers/second. Lock on for intercept and SCRAMBLE!” A brief scrabbling of fingers to follow the command and then slammed back into the seat as the starfighter leaps into the sky. Within a minute the sky has darkened. Two minutes and the stars are out. The force crushing you into your seat continues. The moon slowly swings across your view, visibly growing as the machine continues to accelerate. You scan the star field before you intently. There it is! You’ve spotted one star blink out. Your hand shoots out. The radar screen comes alive showing the target. The cursor blinks rapidly and a tone announces missile lock-on. There is a slight lurch as a pair of missiles leaves the craft. Then chaos. The threat receiver goes berserk. You reach for the manual control and swing hard to the left. This is going to be a hell of a dogfight…

Science fiction or science fact? Could George Lucas’s Stars Wars vision with opposing space fighters swarming round the Death Star ever be reality? Perhaps it would be better for humanity if the answer were no. I thought I’d take a look to see if the laws of physics as we currently know them would absolutely rule out any chance of that the Empire Strikes Back.

I have done a few calculations using little more than Isaac Newton’s three laws for motion and his Universal Theory of Gravitation. I imagined that our hero (that’s you isn’t it?) takes off to intercept the aliens from Stockton and that they are ending towards the east coast of America. The star fighter weighs 25 tonnes (seems a reasonable estimate for the craft you see in the movie) and accelerates all the way to interception at 2g (enough to squash you into your seat but not to incapacitate you). According to my calculation you’d be on the tail of the enemy and ready to fire your missiles in about 15 minutes.

So far, so good but how is the starfighter powered? What is the source of energy that gets you up into space and leaves you with the ability to weave and manoeuvre in a sci-fi space fight?

The space shuttle uses hydrogen and oxygen as fuel for its rockets. NASA has recently tested a rocket motor using methane and oxygen which they say is even more effective. The video of the test firing can be found on YouTube and is

pretty impressive. My calculations show that you'd need 280 tonnes of methane and oxygen to lift the 25 tonne fighter plus yet more to lift the fuel itself. That's why the shuttle booster rockets and fuel tanks are so big. What this tells us is that if only chemical rocket technology is available then Star Wars simply can't happen.

What happens if the starfighter is nuclear powered? This is the point at which I expected simple physics to simply say, "No way, Mr Lucas". To my considerable surprise it turns out that if you have a nuclear fusion powered spacecraft (using deuterium or heavy hydrogen) then you only need 15 grams of fuel to get into space and ready to fight. No problem finding space for that in a 25 tonne machine.

However we haven't finished, it might be nuclear powered but we still need it to be a rocket and that means having to squirt something out of the back. How about water? It's cheap and there is plenty about. If we use nuclear power to heat the water and blow it out of the rocket nozzle fast enough then we can play Top Gun. How fast is fast? I did the calculation for the speed of sound at sea level, 330 metres/seconds (that's fast isn't it?). Unfortunately you'd need 940 tonnes of water to reach that alien. The rocket exhaust needs to be still faster. How about 1000 times faster at 330 km/second? This is 0.1% of the speed of light and so not necessarily out of our technical reach. Now we're talking. It now takes just over 100 kg to reach the enemy and our spaceship can easily carry that much and have plenty left over for duelling with Darth Vader. Move over George Lucas, here we come!

Star Gazing

from Nick Hill (Yorkshire Poet Extraordinary)

Next time there's a dark clear night,
When all around is black not bright,
And there's no smiling from the moon,
No stir of light to wake the gloom,
Then this is just the perfect night,
To study all the stars so bright

The perfect night of celebrations,
And learn of all the constellations,
The night sky speckled with diamond Bizars,
Millions of rainbowed, shimmering stars,
Orange, yellow, white and red, a hint of purple overhead,
Light for aeons being shed although the source is often dead.

The reason for this quite clear,
When time is measured by light year,
A distance almost beyond comprehension,
Like never ending lines in school detention,
This mystery, inch by inch, so slowly unraveled,
By astronomers and the few space traveled.
If you seek to make a start,
Perhaps a study of Astronomical chart,
Then looking at the Northern Sky,
Some patterns emerge before the eye,
The first one that you'll spot I'll wager,
Will be that of Ursa Major.

Some call this'The Great Bear', few know why or how,
Much better known as it appears, 'The Plough',
Leo behind, Bootes at the rear, Lynx, Auriga, Taurus, lie in front,
And slightly lower are Gemini, the Orion on the hunt,
This most famous constellation, of Betelgeuse , belt and all,
Depict a hunter and his club, from Rigel to stand tall.

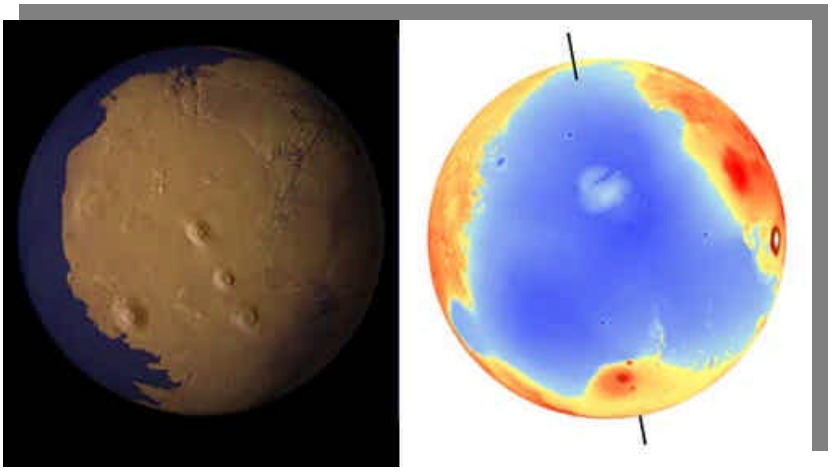
Above the Plough through Merak and Dubhe, trace Polaris true,
The North Star in Ursa Minor's tail, guiding me and you,
And all around is Draco (Dragon), Cameleopardis (Giraffe),
To Cepheus (King), Cassiopeia (Queen), Big W for a laugh,
Cygnus will often appear in the shape of a long necked Swan,
Opposite is Perseus, above this, Triangulum.

It's quite a start to learn a chart a way around the sky,
To see the shapes and recognize each one so far, so high,
Dependent on the time of year, to the arc of where we live,
Requiring now a monthly chart and what that time will give,
Andromeda is looking down from our Milky Way,
To see if you are watching her so very far away.

(Nick has written a book - Poems from the Past "A Life of Rhyme" – a review of some funny aspects of Yorkshire and life in general, he also knows a thing or two about astronomy. Contact the Editor (Bob) for more details on book availability).

An Ocean on Early Mars?

from Taylor Perron/UC Berkeley printed in Nature



A view of Mars as it might have appeared more than 2 billion years ago, with a low-latitude ocean filling the lowland basin that now occupies the north polar region. Topographic deformation of features that ring the basin, which are hypothesized to be shorelines formed by an ancient ocean, suggests that Mars experienced significant true polar wander--reorientation of the planet relative to its rotation axis--that brought the planet into its present rotational state. The margins of the ocean shown here account for the topographic deformation that would have resulted from this reorientation. Sinuous features near the top of the image are valleys carved by large floods that may have supplied the ocean water. The image was generated using Viking Orbiter images and topographic data from
the Mars Orbiter Laser Altimeter on board the Mars Global Surveyor spacecraft.

In the 1990s, however, NASA's Mars Global Surveyor mapped the Martian topography to a resolution of 300 meters, and found that the shoreline varies in elevation by several kilometers (more than a mile), rising and falling like a wave with several thousand kilometers from one peak to the next. Because shoreline elevations on Earth, measured relative to sea level, are typically constant, many experts rejected the notion that Mars once had oceans.

UC Berkeley scientists have now discovered that these undulating Martian shorelines can be explained by the movement of Mars' spin axis, and thus its poles, by nearly 3,000 kilometers along the surface sometime within the past 2 or 3 billion years. Because spinning objects bulge at their equator, this so-called "true polar wander" could have caused shoreline elevation shifts similar to those observed on Mars.

When the spin axis moves relative to the surface, the surface deforms, and that is recorded in the shoreline," said study coauthor Michael Manga, UC Berkeley professor of earth and planetary science.

"On planets like Mars and Earth that have an outer shell, or lithosphere, that behaves elastically, the solid surface will deform differently than the sea surface, creating a non-uniform change in the topography," added primary author Taylor Perron, a former UC Berkeley graduate student now a postdoctoral fellow in Harvard University's Department of Earth and Planetary Sciences.

Perron's calculations show that the resistance of Mars' elastic crust could create several-kilometer elevation differences for features like a shoreline, in accord with topographic measurements. The Arabia shoreline varies in elevation by about 2.5 kilometers, while the Deuteronilus shoreline varies by about 0.7 kilometers.

"This is a beautiful result that Taylor got. The mere fact that you can explain a good fraction of the information about the shorelines with such a simple model is just amazing. It's something I never would have guessed at the outset," said co-author Mark Richards, professor of earth and planetary science and dean of mathematical and physical sciences at UC Berkeley.

Richards goes so far as to add, "This really confirms that there was an ocean on Mars."

Richards pointed out that the tilt of the rotation axis of a planet actually remains fixed relative to the sun, but the crust moves relative to this axis. The question remains: What caused Mars' rotation axis to move relative to the crust?

Any major shift of mass on a planet - within the mantle, or between the mantle and the crust to form a volcano, or even via impact from outer space - could cause a shift of the rotation axis because a spinning planet is most stable with its mass farthest from its spin axis. Richards has modeled true polar wander in Earth's past that was generated by the upwelling of hot mantle in the interior of the planet, which some scientists claim shifted our planet's rotation axis 90 degrees some 800 million years ago, tipping the planet on its side.

Perron, Manga, Richards and their colleagues calculate that on Mars, an initial shift of 50 degrees from today's pole, equal to about 3,000 kilometers on the surface, would be sufficient to disrupt the Arabia shoreline, while a subsequent shift of 20 degrees from today's pole, or 700 kilometers, would have altered the Deuteronilus shoreline.

Interestingly, today's pole and the two ancient poles lie in a straight line equidistant from the planet's biggest feature, the Tharsis rise, a bulge just north of the equator that contains Mars' most recent volcanic vent, Olympus Mons. Tharsis is the largest volcano in the solar system, and formed about 4 billion years ago, not long after Mars solidified. Dynamically, the relative positions of Tharsis and the pole path is exactly what would be expected for any mass shift

on Mars that is smaller than the Tharsis rise, since the planet would reorient in a way that keeps Tharsis on the equator.

"This alignment is unlikely to occur by coincidence," the team wrote.

Manga has a hunch about the mass shift that precipitated the tilt of Mars' rotation axis. If a flood of water had filled the Arabia ocean about 3 billion years ago, to a depth some have calculated at up to several kilometers, that mass at the pole might have been enough to shift the pole 50 degrees to the south. Once the water disappeared, the pole could have shifted back, then shifted again by 20 degrees during the deluge that created the Deuteronilus shoreline.

Because it's unclear whether the two shorelines represent separate inundations or whether one is the receded shoreline of a larger sea, an alternative scenario features the Arabia ocean receding to the Deuteronilus shoreline, shifting the pole from 50 to 20 degrees. Then, once the Arabia ocean disappears entirely, the pole returns to its current position.

Richards is skeptical of this, however, pointing out that thermal convection within the hot interior of Mars could also have caused the poles to wander.

"There must certainly be thermal convection in Mars now because Olympus Mons had new lava flows very recently, within the last 100 million years," he said. "But the jury's still out."

Manga said, too, that the source of the water, while unknown, must have produced a deluge greater than any observed on Earth, since huge canyons are cut in the flanks of the Tharsis rise. The water may have evaporated, but it may also have sunk back into underground dikes, frozen near the surface but possibly liquid below.

The study, whose coauthors include Jerry X. Mitrovica and Isamu Matsuyama, will appear in the June 14 issue of the British journal *Nature*. Mitrovica, who is with the Department of Physics at the University of Toronto in Ontario, Canada, and was a visiting Miller Professor at UC Berkeley, and Matsuyama, who is with the Department of Terrestrial Magnetism at the Carnegie Institution of Washington in Washington, D.C., have developed models for the effect of polar wander and internal dynamic processes on the surface deformation of Mars.

The work is part of UC Berkeley's BioMars project, funded by NASA's Astrobiology Institute. The research also was supported by UC Berkeley's Miller Institute for Basic Research in Science, the Natural Sciences and Engineering Research Council of Canada and the NASA Mars Data Analysis Program.

Second Hand Sale on the Moon – Sales Brochure

from Bill Christensen

If you could salvage all of the material that human beings have left on the moon, you could open a fairly substantial junkyard

Mission	Object Description	Condition	Year
Luna 2	Small spherical craft with sensors	Poor (crash landed)	1959
Ranger 4	51 high sensor platform, failed solar panels	Poor (crash landed)	1962
Rangers 6-9	#6 arrived but failed, others sent photos	Poor crash landed)	1964-5
Luna 5,7,8	Sensor platforms/retro rockets, soft landing	Excellent (dead batt)	1966
Surveyor 1-7	Sensor platform w/solar panels, soil analysis	Excellent	1969
Luna 10-12	Satellites with MP3 (played " Internationale")	Poor (crash landed)	1966-68
Luna 13	soft landing, cameras, soil analysis	Excellent (dead batt)	1966
Luna Orbiter 1-5	satellites, solar panels, 70mm cameras	Poor (crash landed)	1966-1969
67Explorer 35	Satellite with sensors, switched off 1972	Poor (crash landed)	1967
Apollo 10 – 17	Lunar lander, descent and ascent stages	Excellent	1969-72
Apollo 15-17	Lunar Roving Vehicles, good shape, low milage	Good	1971-72
Luna 15	Unmanned lander, sample return	Poor (crash landed)	1969
Lunokhod 1	Robotic Lunar Rover R/C from Earth	Good	1970
Lunokhod 2	Robotic Lunar Rover, with upgrades	Good	1973
Luna 23-24	Platform style, left descent stage	Good	1974
Hiten/Hagromo	Satellite Lunar probes	Poor (crash landed)	1990
Lunar Prospector	Sensor-laden looking for water	Poor (crash landed)	1998
Smart – 1	Satellite with Hall effect ion thrusters	Poor (crash landed)	2003

Venus Beats the Stars for Brightness

by Rich Talcott

That bright point of light you see hanging in the western sky after sunset is none other than Venus. Aim your telescope at it, and you'll find it's more than a point. The "evening star" currently displays a disk some 25" across and just under half-lit.

Sure, Venus appears bright. Even a casual stargazer can see it beats Jupiter, the second-brightest light in the evening sky. (Jupiter now stands low in the southeast during the early-evening hours.) Venus seems to shine even brighter as it sinks lower and the sky grows dark. It doesn't set until around 11:30 P.M. daylight time, well after astronomical twilight ends at mid-northern latitudes.

But just how bright is Venus? To quote Maxwell Smart: "Would you believe it's brighter than all the visible stars combined?" If you don't buy that statement (and who among you KAOS aficionados would), let me show you.

Let's calculate how bright all the naked-eye stars would appear if they were combined into a single point. To do this, we need to make some assumptions.

First, we'll assume the faintest naked-eye stars glow at magnitude 6.5 — a good estimate for middle-aged eyes from a dark site. We'll also assume the atmosphere does not dim stars, so a star just above the horizon appears as bright as it would at the zenith. Finally, we'll calculate the combined brightness of all the naked-eye stars and divide the result by two to get the answer for one hemisphere.

If we add the 21 stars brighter than magnitude 1.5 (from Sirius at —1.46 to Regulus at 1.35), they combine to a –3.09-magnitude star. If we then assume all 71 2nd-magnitude stars (those between magnitudes 1.50 and 2.49) can be approximated by 71 stars of magnitude 2.00, they sum to magnitude –2.63. This should yield a good estimate because, even though the brighter stars would have a disproportionate effect, there are more fainter ones.

Adopting the same approach for the 192 3rd-magnitude stars, 625 4th-magnitude stars, 1,963 5th-magnitude stars, and 5,606 6th-magnitude stars gives a total brightness for the nearly 8,500 stars of magnitude –4.98. If we then restrict this to one hemisphere of the sky, the brightness falls to magnitude –4.23. Throw in Jupiter for good measure, and you reach magnitude –4.45.

That's bright, to be sure, but Venus currently tips the scales at magnitude –4.5 — and it will brighten another few-tenths of a magnitude by July. So, as you watch Venus gleaming one of these balmy evenings, take a minute to realize how special our earthly neighbor is.

The Solar System in one Year

Let us imagine a timescale in which the age of the Solar system is approximately 4.6 billion years but expressed as one complete Earth year.

Lets say the Solar system comes into existence one minute after midnight on 01 January.

Primitive life appeared by early May but fish did not evolve until mid-November and the first forays onto the land surface was achieved at the very end of November.

Reptiles ruled the world during the first weeks of December, the Dinosaurs died out by 15 December while mammals came unobtrusively into the picture but only on the morning of 31 December did ape man appear.

The whole story of Homo sapiens is compressed into the last hour of the last day of the year. Jesus Christ arrived on Earth a minute before midnight on 31 December.

Extracted from "Bang" by May, Moore and Lintot

Transit Tailpieces

Last month's barred spiral galaxies joke really was bloody awful!!!! Try this one:

"M81 is a nice neat, symmetrical object, but M82 is a Messier object." *Neil H.*

For Sale : Tal reflector 2M 150mm with motorised equatorial mount, 1200mm focal length, misc eyepieces and filters, with wooden boxes for telescope and motor. Offers. Contact Wynyard Planetarium 01740 630544 or e-mail b2mullen@hotmail.com (seller has lots of astro bits and pieces including Mamiya and Vivitar 35mm SLR film cameras).

Articles : Please send contributions for the newsletter to Bob Mullen, 18 Chandlers Ridge, Nunthorpe, Middlesbrough, TS7 0JL, 01642 324939 (b2mullen@hotmail.com) Copy deadline date is the 20th of each month.

Help needed : To conduct Solar observing sessions for schools during the IHY the Planetarium needs the assistance of members who own solar telescopes or safe solar filters for use on our various telescopes. Those members lucky enough to own such equipment and willing to loan their equipment on certain solar viewing days would they please contact Ed or Bob at the Planetarium 01740 630544