REFLECTIONS REFRACTIONS

of the University Lowbrow Astronomers

August 2000

The University Lowbrow Astronomers is a club of Astronomy enthusiasts which meets on the third Friday of each month in the University of Michigan's Physics and Astronomy building (Dennison Hall, Room 130, 110, or 807) Aug meeting in 110. Meetings begin at 7:30 pm and are open to the public. Public star parties are held twice a month at the University's Peach Mountain Observatory on North Territorial Road (1.1 miles west of Dexter-Pinkney Road; further directions at the end of the newsletter) on Saturdays before and after the new Moon. The party is canceled if it's cloudy or very cold at sunset. For further information call (734) 480-4514.

This Month:

August 18 - Meeting at 110 Dennison - D. C. Moons presents Terraforming Planets.

August 26 - Public Star Party at Peach Mountain Observatory - Dusk begins w/ Scorpius & Sagittarius right on the meridian for your observing pleasures. Lets hope its clear. Death to the mosquitoes!!!

Next Month and Beyond:

September 2 - Public Star Party at Peach Mountain Observatory - Jupiter (-2.5 mag, 42 ") and Saturn (0.0 mag, 19") are on the rise. Should clear the trees just after midnight.

September 15 - Meeting at 130 Dennison - Calling all VPs - what's our topic tonight?

September 23 - Public Star Party at Peach Mountain Observatory - Fall is here. Best observing of the year.

September 30 - Public Star Party at Peach Mountain Observatory - Hey, we get three star parties this month :-).

Photos Left: Lowbrows at the Brown Jug watering hole - July 14th's meeting

Issue: 3.5 arcmins

The RFLECTIONS Gazette

Amateur Astronomer Makes Record Double Star Split

By Chris Sarnecki

COST: Your Time, your effort

Dateline: Mid-Summer Night, '00. Place: Well Placed, High Overhead in Suburban Skies. Object: Epsilon Lyra, Double-Double. Everyone knows this star. We split each of the pairs many a time in a never-ending test of our scope's optics. So what is it doing here? Read on…

In the October '99 *REFLECTIONS* I indicated it was possible to split the stars Omicron 1 Cygni (mag 3.8) and 30 Cygni (mag 5) using only your own keen eyesight. At 5.5 arcmins of separation I thought that was an impressive split. In the January '00 *REFLECTIONS* I indicated an even better naked eye split. The tiny pair in the handle of the Pleiades (the seven sisters, M45) open star cluster it is possible to split the 5 arcmin pair of 27 Tauri, or *Atlas* at mag 3.6 and a 5th mag star known as 28 Tauri, AKA *Pleione*. Not bad; but wait, it gets better.

One mid-June evening I was outside panning around for Comet Linear S4. The comet was suppose to be a mag. 7 and I figured I could sweep it up in my 7 x 50 binoculars. Well I didn't find it. Not to waste the evening I decided to move over to Lyra and place the glasses on the Double-Double. Yep, It's still there I thought. Bring the binocs down and with my eyes still on the star I watched it for a moment, then all of a sudden it split. Right there before me. I split it again and validated my observation by confirming the orientation of the pair.

I thought how could this be? We are not supposed to split something that close. Rushing in the house I decided to consult *Burnham's Celestial Handbook*. According to this source Epsilon's pair is separated by about 3.5 arcmins and may be seen as a double "by very keen eye unaided". Wow! Since then I have located other sources confirming this (*American Nature Guides - Astronomy*, Ian Ridpath, Sue French's Lyre Lessons in *Sky & Telescope's* September 2000 issue).

It should be mentioned that a high-pressure front had recently past through our skies, cleaning out all the upper level junk and I had partially dark adapted my eyesight prior to making this observation. When making this observation the pair should spilt only momentarily, in those brief instances of steady seeing. I don't believe I have "keen" eyesight, just a persistent observing technique that most seasoned observers with decent long-range vision can duplicate. Try warming up your eyeballs by splitting Delta 1 (mag 5.5) and Delta 2 (mag 4.5) near by. Go back to Vega; turn southeast past near by Zeta and on to the 10-½ arcmin double star Delta. It just slightly further apart from Zeta as Zeta is from Vega. So try this yourself, let me know how you far, and don't forget to dark-adapted your eyesight.

Meltdown!

Science @ NASA

http://spacescience.com/headlines/y2000/ast31jul_1m.htm?aol

Comet LINEAR continues to disintegrate and could disappear completely within a few days.

July 31, 2000 -- Astronomers around the world continue to monitor the unexpected disintegration of comet C/1999 S4 (LINEAR). Intense solar heating apparently triggered a massive disruption of the comet's fragile icy core when it passed close to the Sun last week. It is still bright enough to see through small telescopes so even amateur astronomers can watch the comet as it dissolves. If you do plan to look, don't wait. Experts think that comet LINEAR might disappear completely in a few days.

Above: This R-filtered image of comet LINEAR was

captured on July 28, 2000, by M. Kidger at the Jacobus Kapteyn Telescope, Roque de los Muchachos Observatory, La Palma, Canary Islands. The innermost coma is elongated and rapidly fading.

The break up of a bright comet is unusual but not unprecedented. For example, comet Shoemaker-Levy 9 (SL-9) broke up before it struck Jupiter in 1994. SL-9 was discovered after it fragmented, so there is no record of what happened as it came to pieces. With comet LINEAR, astronomers have a ringside seat for the entire show.

"We have observed a few comets in the process of breaking up -- comet West in 1976, comet Ikeya-Seki in 1965 and others -- but never with so much detail as we're seeing in comet LINEAR," says Mark Kidger, an astronomer at the Instituto de Astrofisica de Canarias. Comet LINEAR's demise seems to be a bit unusual. "Cometary splittings rarely ever lead to the rapid disappearance of a comet like this - in fact, I don't know of another case".

Kidger was the first to notice comet LINEAR disintegrating as he monitored a cloud of gas (called the "coma") surrounding the comet's core using the 1-meter Jacobus Kapteyn Telescope. Comet LINEAR, which has been falling toward the Sun since it was discovered in September 1999, made its closest approach to our star (perihelion) on July 26, 2000. Perihelion is a critical time for any comet. It's when solar heating of the icy core is most intense and when the comet swings around for its long return trip to the outer solar system.

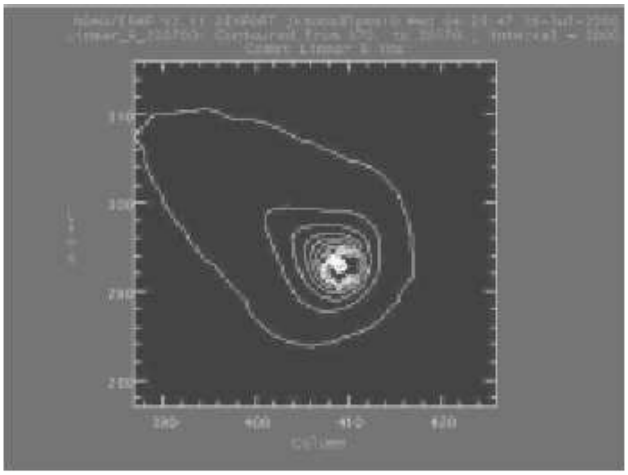
At perihelion there are very rapid aspect changes as regions of the nucleus previously in shadow are suddenly subjected to intense heating," continued Kidger. "This causes strong thermal stresses" that may have been a primary cause of LINEAR's breakup.

Something was already amiss the day before Comet LINEAR reached perihelion at a distance of 114 million km (0.74 AU) from the Sun.

"The very first images on July 25th were enough to show me that something odd was going on," recounts Kidger. "The comet's inner coma was no longer teardrop-shaped (the solar wind flowing around the comet's head causes this shape). It had a shape like a short, fat cigar. My first thought was 'Shoemaker-Levy.' It looked just like those first images of Comet Shoemaker-Levy 9 after it was discovered."

Kidger's images on subsequent nights confirmed that something dramatic was happening and he announced his findings in an International Astronomical Union (IAU) Circular (IAUC #7467) on July 27, 2000. As news of the breakup spread, astronomers around the world trained their telescopes on the comet. In another IAU Circular (IAUC # 7468) published July 28th, three teams of observers reported that they too saw evidence of a major event in the comet's nucleus.

Above: The breakup of Comet LINEAR. Contours represent lines of constant brightness in Jacobus Kapteyn Telescope R-band images of the comet (credit: Mark Kidger). This 5-frame sequence spanning the interval from July 23rd to 27th shows the progressive elongation and disruption of the comet's



core. Each contour map is 40 arcseconds on a side centered approximately on the core of the comet. (Mark Kidger notes that "the unusual aspect of the innermost contours on the July 23rd frame is because this region was so bright that it saturated completely in the images in a 5 second exposure. On subsequent nights the comet was nowhere near saturation.")

Unlike comet Shoemaker-Levy 9, which broke into many well-defined bright fragments, comet LINEAR seems to be dissolving into an amorphous haze of gas and dust.

"There is some similarity of appearance to the two comets," says Brian Marsden of Harvard's Minor Planet Center. "An observation by Ian Griffin in New Zealand on July 29th shows the nucleus of C/1999 S4 (LINEAR) extended into a long, bright string. However, it does not seem to show discrete nuclei in that string, as D/1993 F2 (SL-9) did."

The differences between comets SL-9 and LINEAR result from their different sizes and distances from the Sun.

Comet Shoemaker-Levy 9 was larger than comet LINEAR, and it broke apart as the result of tidal stresses it experienced when it passed less than 100 thousand kilometers from Jupiter (within 1.4 Jupiter radii from the planet's center). SL-9 was far from the Sun (812 million km) when it fragmented and solar heating was not the primary cause of the break up. In fact, SL-9 wasn't even orbiting the Sun. The comet had been captured by the gravitational pull of Jupiter and was orbiting the giant planet instead.

Comet LINEAR is a much smaller object that has been losing mass rapidly during its approach to the Sun. The Hubble Space Telescope recorded a house-sized fragment blowing away from the core on July 5th and powerful jets of gas vaporized by solar radiation have been pushing the comet to and fro. Solar heating is a more important factor in its breakup than gravitational effects.

"The small size of comet LINEAR and its exposure to solar radiation is causing a more complete and rapid dissolution than we saw in Shoemaker-Levy 9," continued Marsden. "The initial break-up of SL-9 was surely caused by tidal forces from Jupiter. If they had not later collided with Jupiter, several of those fragments would presumably still exist. C/1999 S4 (LINEAR), on the other hand, will probably have completely dispersed in a week or so."

Below: Comet Shoemaker-Levy 9, pictured here in a Hubble Space telescope image, was broken into many pieces during a close encounter with the planet Jupiter in 1992. Two years later it came so close to the planet that the fragments actually plunged into Jupiter's atmosphere.

Comet LINEAR may still be bright enough for amateur astronomers to view in small telescopes, but it's fading fast. On July 27th, binocular observers in South America and Europe estimated the comet's visual magnitude to be +6.6 [*ref*]. That's almost bright enough to see with the unaided eye from dark-sky

The surface brightness of the innermost coma is fading fast," says Kidger. "This should translate to a somewhat slower fade of the outer coma [that binocular and small telescope observers see] as the gas and dust in it disperses and is not replenished. Typically a comet may take several weeks for the coma to expand and fade down to the brightness of the sky background."

Above: On July 23rd, the Comet LINEAR's gaseous halo was bright and centrally condensed. Since then it has steadily faded as the core disrupts into an elongated train of debris. Credit: Mark Kidger, Jacobus Kapteyn Telescope.

Many well-known annual meteor showers, including the Perseids, Leonids and Geminids, are caused by dusty debris from comets burning up in the atmosphere of Earth. Such displays are harmless and beautiful. Unfortunately for meteor lovers, the orbit of comet LINEAR comes no closer to our planet than 28 million kilometers (0.18 AU). There will be no "Linearid" meteor shower. When comet LINEAR finally disappears from view in a few days or weeks, this memorable visitor from beyond the orbit of Neptune will be gone forever.

Anatomy of a Comet:

The **nucleus** of a comet is an irregular ball of ice and dust typically 1 to 10 km in diameter. When the nucleus approaches the Sun, sunlight warms the surface and the solid ice sublimes (turns to vapor). The resulting cloud of water vapor and carbon dioxide surrounding the nucleus is called the **coma.** Most comets come from the most distant reaches of the solar system, far beyond the orbit of Pluto. By the time they are as close to the Sun as the Earth, the coma can be larger than Jupiter. Together the coma and the nucleus form the **head** of the comet.

Right: This image of Comet Halley's nucleus was taken by the European Space Agency Giotto spacecraft during a flyby on March 13, 1986. Scientists estimate that about 10% of the surface was boiling off into space. The stuff that boiled off Halley in 1986 may one day be seen again during an eta Aquarid meteor shower.

When a comet is far from the Sun, only the head is visible as a smudge in photographs. As the comet nears perihelion (closest approach to the Sun) it sprouts two tails. The **dust tail** is composed of small (smoke-sized) dust particles carried off the nucleus by escaping gases. The dust tail shines by means of reflected sunlight and is the part of a comet that is usually easiest to see. A longer, blue-colored **ion tail** is made of charged gas that glows as electrons recombine with ions to make uncharged molecules. The gaseous ion tail is pushed straight away from the Sun by the solar wind, while the brighter dust tail traces the comet's curved orbit. Usually the two tails point in slightly different directions.

Below: This photograph of Comet Hyakutake highlights different components of the tail. The gold and red tail features are dust, made predominately of little bits of rock and carbon. The dust tail shines by reflecting sunlight. Extending past the dust tail is the comet's ion tail, shown here glowing in blue. The ion tail is composed mostly of ions of water, carbon monoxide, and cyanogen. The ion tail glows by emitting light when elections recombine with electrically charged ions to make uncharged molecules.

Charlie and Dave

Astronomy on the Beach

Held at Kensington Metro Park

On July 21st & 22nd 2000

A good time was had by all the Lowbrows!

Father and Daughter

Mark adjusting his telescope

The weather cooperated both evenings with cool temperatures for July. Clouds made their appearance at midnight on Friday night and 11:30 pm on Saturday. The park service indicated that upwards of 5,000 were in attendance making this a very successful outing. Comet Linear S4 was the star attraction shining at approximately 6th mag.

Photos of Lowbrows and their scopes by Dave Snyder.

Charlie and Mike

Chris and Jim

Our thanks to the Kensington staff that hosted this event along with GLAAC clubs.

Left: Paul and his homemade telescope

Right: Mike

Wow!!

By Bernard Friberg

That's one word to describe it, but it still does not do it justice. I am referring to the event last night (Aug 11/12, 2000) at Peach Mountain, the Perseids . Not a storm, but a persistent producer of meteors. There were bright ones, there were dim ones, and there were very bright ones leaving a lengthy trail and lighting up the area. This was just an introduction to the main event. When darkness descended upon us we noticed a definite glow to the North, a curtain of light. It would slowly expand and contract, it would get brighter and then dimmer, but not entirely going away. This was during a moonlit sky. When the Moon approached the trees and went behind the trees, the main event started, an Aurora display that probably surpassed all other displays for this area (this was by far the best display as witnessed by those attending this event). An area to the North would get brighter, then started to slowly expand upwards. Then it would slowly fade and other areas would get brighter and expand horizontally and vertically. Then horizontal waves would start at the horizon and then move up past the zenith to 45 degrees above the South, taking 3 seconds. As the minutes rolled by, these waves taking 3 seconds became faster and faster and then would take only a 1/4 second to traverse the 135 degrees of the sky. This wave phase lasted maybe 20 minutes. Towards the end of the wave phase the sky started to pulsate, areas would light up and then dim, at the rate of 3/4 sec in different areas of the sky. This rate of pulsing eventually increased to maybe 5 or 6 times a second and covering almost the entire sky. A small area, maybe 20 degrees above the Southern point was not included during most of this display. At the height of the display even some of this area was included. Almost the entire sky was pulsating, waves were emanating from all directions, searchlight beams of light emanated from the horizon, it was so bright that one could read a newspaper. Vivid green , white and some red predominated. Periodically this display was punctuated by a meteor, it was incredible!! For most of us this was the display of a lifetime. If only one person saw this, no one would believe, but there were witnesses. (Note: We are planning a special section on our website about this aurora display with pictures).

The Perseids and the Aurora

By Dave Snyder (ed - extracted from two e-mails from DS)

As some of you know, we spent last evening (Friday night/Saturday morning, Aug 11/12, 2000) at Peach Mountain observing the Perseids. The moon was almost full and did interfere with the observing, but nevertheless, here is what we observed (based on the multiple observer method, no single observer saw this many objects). The observation rates are averages, we often observed bursts of several meteors followed by a period of several minutes with no meteors:

From 9:50PM-1:00AM: 27 (or about one every 6 minutes).

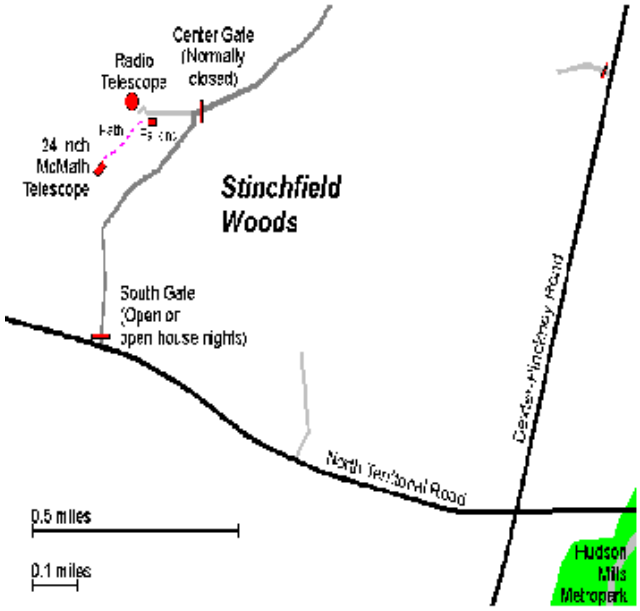
From 1:00AM-2:30AM: 45 (or one every 2 minutes). From 2:30AM-5:00AM: 126 (or almost one every minute - however distractions from the aurora, see below, probably meant the real number was higher). From 5:00AM-5:30AM: 13 (one every 4 minutes - however daylight and distractions from shutting down activity no doubt reduced these numbers).for a total of 211 for the evening. Based on a rough estimate of the limiting magnitude and published information on the Perseids, if the moon had not been present these numbers would have been higher by a factor of about 2.2.

However that wasn't all, those of us who stuck it out until the early morning were presented with an excellent aurora display. I've seen aurorae before, but never as dynamic as this one was. We first saw some lights in the early evening. However around 2:30AM, it intensified. By 3:30AM we saw pale green lights along the horizon that climbed into the sky, at times covering 3/4 the sky. The amazing thing was how dynamic it was. Most of the time at least part of the aurora was pulsing (I'm guessing here) about 6 times a second. There were ripples and/or curtains whose shape constantly changed. A few times we saw more intense green lights or red lights. This continued for an hour (until about 4:30AM) at which time it became much less active.

There were reports of observers seeing about 90 meteors per hour on the evening of August 11/12. These were at very dark sites. This seems about right to me: having a site 0.75 magnitude darker than we had and assuming everyone is observing in comparable manner, the darker site should have larger rate by a factor of 1.8 (this would account for the difference and seems quite plausible). There was a report of a Geomagnetic Storm which would have caused an aurora during the period 2AM-5AM August 12 (exactly the time we observed the aurora). The storm was listed as G3 (on the NOAA scale of Geomagnetic disturbances). Based on information from http://www.sec.noaa.gov/NOAAscales, this was not the strongest event that could occur nor was it that rare. Geomagnetic storms are listed as on a scale that goes from G1 (the weakest) to G5 (the strongest). There are on average 200 G3 events per solar cycle (with each cycle lasting 11 years). This contrasts with 100 G4 events and four G5 events per solar cycle. The immediate question is: None of us had seen anything quite like that display. Was this event really that unusual? I don't know the answer. However there are several things to keep in mind. Just because there are 200 events doesn't mean an observer will see 200 aurora. About half of these events will occur during daytime for any specific location and thus cannot be observed. You also need to reduce the number again to take into account cloudy weather and the fact that few people will spend the entire night watching the sky EVERY evening. So most of us will miss many of these 200 events. With a little investigation I found there are occasional aurora which have (as Terrence Dickinson and Alan Dyer describe it) "patches of light pulsing on and off over the sky," which seems an apt description of what we observed. I suspect that many details may go into determining why one specific event appears as a static aurora and another appears as a dynamic aurora. For one thing, I suspect the fact that we were very dark adapted because we had spent several hours watching for meteors may have had something to do with it. I know every other time I've seen aurora, I had NOT been that dark adapted. Also I suspect a stronger aurora will not necessarily appear more dynamic. More light may simply drown out some of the subtle pulsing effects that otherwise might be observed. And there may be physical factors that go into it as well. Anyway those are my guesses for whatever they are worth.

Places and Times:

Dennison Hall, also known as The University of Michigan's Physics and Astronomy building, is the site of the monthly meeting of the University Lowbrow Astronomers. It is found in Ann Arbor on Church Street about one block north of South University Avenue. The meeting is held in room 130. Monthly meetings of the Lowbrows are held on the 3rd Friday of each month at 7:30 PM. During the summer months, and when weather permits, a club observing session at Peach Mountain will follow the meeting.



Peach Mountain Observatory is the home of The University of Michigan's 25 meter radio telescope as well as the University's McMath 24 inch telescope which is maintained by the Lowbrows. The observatory is located northwest of Dexter. The entrance is on North Territorial Road, 1.1 miles west of Dexter-Pickney Road. A small maize-and-blue sign marks the gate. Follow the gravel road one mile to a parking area near the radio telescopes. Walk along the path between the two fenced in areas (about 300 feet) to reach the McMath telescope building.

Public Star Parties:

Public Open House/Star Parties are held on the Saturday before and after each new Moon at the Peach Mountain Observatory. Star Parties are canceled if the sky is cloudy at sunset or the temperature is below 10 degrees F. Call 480-4514 for a recorded message on the afternoon of a scheduled Star Party to check on the status. Many members bring their telescopes and visitors are welcome to do likewise. Peach Mountain is home to millions of hungry mosquitoes - bring insect repellent, and it does get cold at night so dress warmly!

Amateur Telescope Making Group meets monthly, with the location rotating among member's houses. See the calendar on the front cover page for the time and location of the next meeting.

Membership:

Membership dues in the University Lowbrow Astronomers are $20 per year for individuals or families, and $12 per year for students and seniors (age 55/+). This entitles you to the monthly REFLECTIONS newsletter and the use of the 24" McMath telescope (after some training). Dues can be paid to the club treasurer Charlie Nielsen at the monthly meeting or by mail at this address:

6655 Jackson Road #415
Ann Arbor, MI 48103

Magazines:

Members of the University Lowbrow Astronomers can get a discount on these magazine subscriptions:

Sky and Telescope: $29.95 / year
Astronomy: $29.00 / year

For more information contact the club Treasurer. Members renewing subscriptions are reminded to send your renewal notice along with your check when applying through the club Treasurer. Make the check payable to "University Lowbrow Astronomers".

Newsletter Contributions:

Members and (non-members) are encouraged to write about any astronomy related topic of interest. Call or E-mail to Newsletter Editors at:

Bernard Friberg (743)761-1875 Bfriberg@aol.com
Chris Sarnecki (734)426-5772 chrisandi@aol.com

to discuss length and format. Announcements and articles are due by the first Friday of each month.

Telephone Numbers:

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Vice Presidents: Dave Snyder (734)747-6537
Paul Walkowski (734)662-0145
Doug Warshow (734)998-1158
Treasurer: Charlie Nielsen (734)747-6585
Observatory Director: Bernard Friberg (734)761-1875
Newsletter Editors: Chris Sarnecki (734)426-5772
Bernard Friberg (734)761-1875
Parking Enforcement Lorna Simmons (734)525-5731
Keyholders: Fred Schebor (734)426-2363
Mark Deprest (734)662-5719

Lowbrow's Home Page:

http://www.astro.lsa.umich.edu/lowbrows.html
Dave Snyder, webmaster
http://www-personal.umich.edu/~dgs/lowbrows/

Monthly Meeting

August 18, 7:30 pm

Room 130 Dennison Hall

Physics & Astronomy Building

The University of Michigan

D. C. Moons

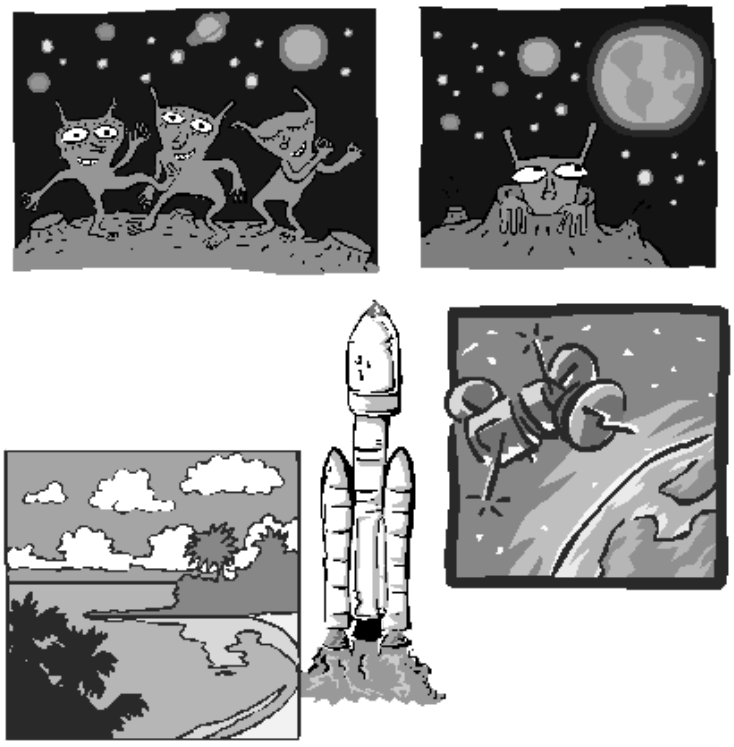
Presents

"Terraforming Planets" . . .

Or

Saving the Universe

(Mankind actually)



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Lowbrow's WWW Home Page:
www.astro.lsa.umich.edu/lowbrows.html

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