Publications Watch

By Andrew J. LePage

Notes on recent books and articles pertaining to SETI and bioastronomy.

The Astronomical Journal

May 1996, Volume 111, Number 5

"A Search for Protoplanetary Disks Around Naked T Tauri Stars," by Scott J. Wolk and Frederick M. Walter, pp. 2066-2076

In this paper the authors compare the infrared emissions of a sample of 39 pre-main sequence stars from the Taurus-Auriga association to a computer model to determine if any possess disks of dust. It is generally believed that these disks serve as the raw material for the formation of planetary systems. The computer models considered emissions from each star's photosphere as well as the effects from any starspots and a passive optically thick disk. The survey detected nine stars with a near-infrared excess attributable to starspots but two other stars show signs of a disk. Given the stars' estimated age of about one million years, the authors estimate that the circumstellar disks must have a lifetime of only about 100,000 years. The disappearance of the disk could be the result of strong disk or stellar winds, photoionization or it could be caused by accumulation of grains into particles too large to be easily observed in the infrared. This last reason would be the first step in the growth of planetesimals which serve as the building blocks of protoplanets.

July 1996, Volume 112, Number 1

"A Search for Artificial Signals from the Small Magellanic Cloud," by Seth Shostak, Ron Ekers and Roberta Vaile, p. 164

Until recently, most SETI experiments have either scanned a narrow range of frequencies over the entire sky or a broad range of frequencies for a selected number of targets. Described in this paper are the results of a "hybrid" search in which a large number of targets were monitored over a broad frequency range. The authors made use of the Project Phoenix hardware on the Parkes 64-meter radiotelescope to observe the Small Magellanic Cloud during the cooperative science period offered after Project Phoenix concluded its four month survey of the southern sky.

In early June of 1995, the team observed three portions of our galactic neighbor in the 1.2 to 1.75 GHz frequency range. Their observations had a frequency resolution of about one Hertz and were sensitive enough to detect a 19 Jansky signal. These three fields in the Small Magellanic Cloud were chosen due to the large number of stars in each (which was estimated to be greater then 10 million stars) and because the inferred arrangement of stars in this galaxy make it more likely that a signal was being intentionally beamed in our general direction. Although the distance of this galaxy results in about a factor of one million decrease in signal strength compared to a typical Project Phoenix target due to its extreme distance, this is offset by the factor of one million increase in the number of targets that appear in each 14-arcminute wide field. The observations, which were described as a preliminary experiment, did not detect any unusual signals indicating the absence of any transmitter with an effective isotropic radiated power (EIRP) of $1.5X10^{12}$ megawatts. Such a signal could be transmitted by a 100-meter radio antenna radiating $5X10^{5}$ megawatts in our direction.

Astronomy and Astrophysics

August (II) 1996, Volume 312

"Destruction Processes for Dust in Protoplanetary Accretion Disks," by W.J. Duschl, H.-P. Gail, and W.M. Tscharnuter, p. 624

This article gives details on the mechanisms for the destruction of the carbon and silicate components of the dust in a protoplanetary accretion disk as the particles slowly spiral in towards their forming sun. The location and concentration of the various components of the dust in the disk is thought to have a profound influence on the elemental composition of the planets that will likely form from it. The first component to disappear is carbon at a distance of about 2 AU where the disk temperature is around 950 K. Instead of vaporizing, the carbon particles undergo slow combustion as they react with free hydroxyl radicals in the surrounding environment. Silicate dust is much more robust and does not begin to vaporize until a distance of 0.6 AU, and would not disappear completely until temperatures of 2100 K are reached at a distance of 0.07 AU.

Astronomy and Astrophysics Supplement Series

September 1996, Volume 118

"Resolved Imaging of Extra-Solar Planets with Future 10-100 km Optical Interferometric Arrays," by A. Labeyrie, p. 517

The planets discovered to date outside of our Solar System have been found through the measurement of the reflex motion of the primary as the planet and sun orbit each other. In the near future, coronagraphic imaging techniques should allow the detection of these and other giant planets as dots of light circling their sun. In order to produce images capable of resolving these planets, imaging interferometry will be needed. Labeyrie examines the technical issues involved in such systems and compares them with several proposed systems. He concludes that resolved images of extrasolar planets could be made using ground-based arrays with baselines on the order of ten kilometers in length.

The Astrophysical Journal

July 1996, Volume 465

"Astrometric Detection of Extra-Solar Planets: Results of a Feasibility Study with the Palomar 5-M," by Steven H. Pravdo and Stuart B. Shaklan, p. 264

One of the classic indirect means of detecting a dim or invisible extrasolar companion is through precision astrometry of its bright primary. Here Pravdo and Shaklan present the results of astrometric observations made of the open cluster NGC 2420 using the Palomar 5-Meter (200-Inch) Telescope fitted with the CCD-13 camera. Their results confirm earlier theoretical work on the utility of large aperture telescopes for high precision astrometry and determined that measurement uncertainties of only 0.1 milliarc seconds are possible with this particular instrument. The authors go on to examine the feasibility of a survey program that would observe

100 solar-class stars for the presence of Jovian planets in Jupiter-like orbits. If no such planets are found in this survey, it could be concluded that there is only a $3X10^{-5}$ probability that planets as large or larger than Jupiter form around at least 10% of solar-like stars. Such a survey could definitively determine if the arrangement of Jovian planets found in our solar system is typical or not.

Journal of the British Interplanetary Society (JBIS)

August 1996, Volume 49, Number 8

This issue of JBIS is the fifth part in a series devoted to exobiology (the previous part was published in November 1995 and reviewed on page 22 of the Volume 2, Number 2 issue of *SETIQuest*). The topics of this issue's seven papers are dominated by SETI. "Alternative Models for Detecting Very Advanced Extraterrestrial Civilisations" by Donald E. Tarter examines the consequences of two alternative models of extraterrestrial intelligence (ETI): The first is a significantly scaled up version of our own society which would use tremendous amounts of matter and energy for its activities. Present SETI thinking generally assumes this model of ETI. The other is one in which the evolution of technology quickly miniaturizes its technology to the level of nanotechnology and quantum engineering. The author concludes that it may be possible to contact such societies through the use of quantum communication.

A second paper, "Detection of Extraterrestrial Civilisations via the Spectral Signature of Advanced Interstellar Spacecraft" by Robert Zubrin, examines the issues of detecting the electromagnetic radiation produced by an ETI's spacecraft. It is reasoned that the power levels required to propel an interstellar spacecraft would likely far exceed the typical power levels used in communication. Various forms of propulsion are examined to determine what sort of signal such spacecraft would emit.

Other papers presented in this issue include:

"The Potential of SETI for Major Existential Models" by Jacques P. Vallee

"1/f Music vs. ETI's Oracle Machines—A Mesoscopic Loophole in the Barrier of Meaning?" by Salvatore Santoli

"The Impact of Nanotechnology Upon Interstellar Solar Sailing and SETI" by Gregory L. Matloff

"Traveling to the Other Side of the Universe" by Frank J. Tipler

"Space-Based Genetic Cryoconservation of Endangered Species" by Michael N. Maunter

The Journal of Geophysical Research—Planets

April 25, 1996, Volume 101, Number E4

"System Design of a Mission to Detect Earth-Sized Planets in the Inner Orbits of Solar-Like Stars," By David Koch, William Borucki, Kent Cullers, Edward Dunham, Larry Webster, Tom Miers, and Harold Reitsema, pp. 9297-9302

This paper examines in detail the requirements for a space-based instrument to determine FRESIP (Frequency of Earth-Sized Planets). To meet this goal the authors have proposed a system that is designed to continuously and simultaneously monitor 5,000 solar-like stars for brightness changes caused by the transit of any accompanying planets. Although these planets' orbits would have to be viewed nearly edge-on to be detected, this system in theory could detect as many as 50 Earth-sized planets in its survey. Such a census could help determine the size, location, and distribution of planets ranging in size from the Earth to Jupiter in other solar systems.

Since the paper was written, the proposed system has been modified to become Kepler which is being presented as a NASA Discovery-class mission. Up to date information on this mission can be found at http://www.Kepler.arc.nasa.gov.

"Multiresolution-Element Imaging of Extrasolar Earthlike Planets," by Peter L. Bender and Robin T. Stebbins, pp. 9309-9312

While all of the planets recently discovered circling Sun-like stars have been massive gas giants of one kind or another, scientists are already examining the requirements of not only detecting but eventually imaging the smaller, but much more interesting, Earth-size planets that should inhabit other solar systems. Here Bender and Stebbins examine the optical requirements of a system designed to produce multi-spectral images of Earth-like planets with 10 resolution elements across the planet. Images as crude as these could be used to determine composition of the atmosphere and surface as well as the distribution of clouds, ice, oceans and continents on these potentially habitable worlds. Such a system would require 15 to 25 large collectors over a 200 kilometer baseline in solar orbit. While there are many daunting technical issues associated with such a system, it is concluded that the unprecedented quality of the optics needed to suppress the image degrading effects of scattered light could make such a system virtually impossible to build with our present level of technology.

June 25, 1996, Volume 101, Number E6

"Statistical Characteristics of Extrasolar Planetary Transits," by William D. Heacox, pp. 14,815-14,821

For the time being, the best means of detecting Earth-sized planets would be through transits of these worlds across the face of their suns. Here Dr. Heacox presents the details of a Monte Carlo simulation to determine the number of planetary systems that would be aligned in such a way to produce transits. His results indicate that 1.2% of systems would be aligned so that one Earth-like planet could be detected (usually within a year) and between 0.07 and 0.14% would be aligned so that two or more planets could be detected. In addition, 7 to 10% of the systems showing the transit of a terrestrial planet will also display a transit of a large gas giant. Observations of such transits would give us the best chance of determining the statistics of planets in other inner solar systems with currently available technology.

Laser Focus World

July 1996, Volume 32, Number 7

"Modern Optics May Make Optical SETI Practical," by Jeff Hecht, pp. 99-104

This fully referenced article reviews the technical rationale behind optical SETI. Making liberal use of work by *SETIQuest* Editorial Board member Dr. Stuart Kingsley, the article goes on to describe the Columbus Optical SETI Observatory and details how a serious amateur astronomer can perform meaningful optical SETI with today's off-the-shelf hardware. The fact that this article has appeared in one of the leading trade journals in laser technolo-

gy should do much to educate a large number of the industry's scientist and engineers on the feasibility of SETI in general and optical SETI in particular. Readers wishing to learn more about optical SETI and Dr. Kingsley's work can read the *SETIQuest* articles "Optical SETI" written by Carl Helmers in premier issue, as well as "Justifications for Professional and Amateur Optical SETI" and "Columbus Optical SETI Observatory Improvements" by Stuart Kingsley in Volume 1, Number 4.

Nature

August 8, 1996, Volume 382

"A Self-Replicating Peptide," by David H. Lee, Juan R. Ggranja, Jose A. Martinez, Kay Severin and M. Reza Ghadiri, pp. 525-527

Before life arose, complex organic molecules capable of reproducing themselves had to develop. Described in this paper is the first known example of a self-replicating peptide. This 32-amino acid peptide is folded into a α-helix and is based on the structure of a yeast transcription factor. The authors discovered that this peptide autocatalyses its own synthesis by accelerating the condensation of 15 and 17-amino-acid fragments in solution. The next step is to construct a self-reproducing cross-catalytic system of two peptides. Such a system would collectively aid in their own production from raw resources found in the environment. Such a system would represent another important step in the development of self-replicating life forms.

Publications of the Astronomical Society of the Pacific

June 1996, Volume 108, Number 7

"Attaining Doppler Precision of 3 Meters per Second," by R. Paul Butler, Geoffrey W. Marcy, Eric Williams, Chris McCarthy, and Steven S. Vogt, pp. 500-509

The improved Doppler velocity measurement technique Butler, Marcy and their team used in their survey discovered or confirmed the presence of eight substellar companions around nearby sun-like stars from late 1995 to mid-1996. Their improved technique is at least three times more sensitive than their previous methods and it is within a factor of three of the theoretical limit of one meter per second. At this one meter per second level of precision, it is predicted that the Doppler signature of a planet would be masked by the random motions of the star's roiling photosphere. Such accuracy could be obtained using this equipment in conjunction with a 10-meter class telescope like the Keck Telescope in Hawaii.

Null detection results for two stars are given in this paper to illustrate the low noise level from the first year's worth of data using this improved method. When combined with earlier, lower accuracy data, it can be concluded that no Jovian planets were detected circling 107 Piscium or the famous τ Ceti with periods on the order of a half a dozen or so years. In the latter case at least, there is evidence that we are viewing this system nearly pole-on. Doppler velocity techniques have a very difficult time detecting the effects of large planets in such systems.

"Searching for Faint Companions to Nearby Stars with the Hubble Space Telescope," by Daniel J. Schroeder and David A. Golimowski, pp. 510-519

The Planetary Camera on the Hubble Space Telescope searches for dim companions circling 18 stars mainly within five parsecs of the Sun. Irregular azimuthal variations of this instrument's point spread function make a comprehensive search for Jovian planets impractical due to the large number of long exposure images needed. Instead this survey hopes to find close, dim stellar companions or possibly young brown dwarfs that still radiate a significant amount of energy in the near-infrared. This survey should be sensitive enough, for example, to detect a brown dwarf with an I-Band magnitude of 16.7 separated by at least one arc second (about 1.3 AU) from α Centauri A.

Science

June 28, 1996, Volume 272, Number 5270

"A Chemoautotrophically Based Cave Ecosystem," by Serban M. Arbu, Thomas C. Kane, and Brian K. Kinkle, pp. 1953-1955

A unique, virtually autonomous ecosystem exists in a cavern in the Molvive Cave system in southern Romania. Caves are fertile grounds for evolution and this cavern contains 33 newly discovered species as well as another 15 found previously elsewhere. What makes this ecosystem so unique is that it is completely dependent on microbial mats composed in part of chemoautotrophic bacteria that fix inorganic carbon using hydrogen sulfide dissolved from the surrounding rocks as an energy source. While the system's animals are still dependent on oxygen that leaks in from above, it is the first to contain land animals that do not depend on photosynthesis for producing the organic carbon upon which they subsists. This discovery is another hint of the diversity of potential ecosystems that may exist on extrasolar planets or may even still exist today below the surface of Mars.

July 5, 1996, Volume 273, Number 5271

"Late Proterozoic and Paleozoic Tides, Retreat of the Moon, and the Rotation of the Earth," by C.P. Sonett, E.P. Kvale, A. Zakharian, Majorie A. Chan, and T.M. Demko, pp. 100-104

The Moon's presence helps to stabilize our planet's axial tilt and many believe its tides helped to direct the evolution of the Earth's land animals. But the relationship between the Earth and its moon is constantly evolving. The tides are transferring angular momentum from the Earth to the Moon resulting in the lengthening of the Earth's day and causing the Moon to recede. Eventually the day will be too long or the Moon will be too distant to steady the Earth's obliquity—either of which would result in a condition that could render our planet uninhabitable. Understanding the rate of this change gives us insights into the stability of habitable conditions on our world and possibly for other worlds outside our solar system.

This paper describes the results of a series of measurements made of several ancient tidal deposits from around the world. These measurements allowed the investigators to calculate the length of the month and the day as far back as 900 million years ago. In this distant epoch the Moon was 10% closer than it is today and the Earth's rotation period was only about 18 hours long. Their measurements indicate that the Moon has been receding steadily from the Earth since the Late Precambrian.

July 19, 1996, Volume 273, Number 5273

"Oxygenic Photoautotrophic Growth Without Photosystem I," by J.W. Lee, C.V. Tevault, T.G. Owens, and E. Greenbaum, pp. 364-367

The evolution of plant photosynthesis was one of the most important developments in the history of life on this planet. The details of this all-important process, known as the Z-scheme, involves two biochemical processes: Photosystem I (PSI) and photosystem II (PSII). PSI is essential in a plant's assimilation of carbon dioxide and PSII splits water molecules into hydrogen and oxygen. It has been assumed that both PSI and PSII were needed for successful photosynthesis and growth but ten years ago researchers created two mutant forms of the green algae Chlamydomonas that have only PSII. This paper describes the results of experiments that show that this mutant form of algae can not only survive but grow and multiply with only PSII so long as the oxygen content of the environment is relatively low. The investigators surmise that PSII was the original form of photosynthesis and that PSI developed later so that plants could cope with the atmosphere's ever-increasing supply of oxygen.

SOURCES CITED IN PUBLICATIONS WATCH

As a service to our readers who may want to obtain the periodicals cited in Publications Watch, we will publish a list of the addresses on an annual basis, to appear in the fourth issue of each volume. The following is a list of periodicals referenced to date.

1. ***Ad Astra***
   National Space Society (NSS), 922 Pennsylvania Avenue SE,
   Washington, DC 20003-2140
2. ***Air & Space Smithsonian***
   National Air & Space Museum, Smithsonian Institution, Membership-
   Subscription Center, PO Box 420109, Palm Coast, FL 32142-9125.
   Tel: (800) 766-2149.
3. ***Analog Science Fiction and Fact***
   PO Box 5133, Harlan, IA 51593-5133. Tel: (800) 333-4561.
4. ***The Astronomical Journal***
   University of Washington, Department of Astronomy, Box 351580,
   Seattle, WA 98195-1580
5. ***Astronomy***
   PO Box 1612, Waukesha, WI 53187-9950. Tel: (800) 533-6644.
   Fax: (414) 796-0126.
6. ***Astronomy & Astrophysics***
   Springer-Verlag New York Inc, 44 Hartz Way, Secaucus, NJ 07096-2491.
   Tel: (201) 348-4033. Fax: (201) 348-4505
7. ***Astronomy Now***
   Lazahold Group, PRE Complex, Pallion Industrial Estate, Sunderland SR4 6SN,
   England.
8. ***The Astrophysical Journal***
   Box 37005, Chicago, IL 60637. Tel: (312) 753-3347. Fax: (312) 753-0811.
9. ***Astrophysics and Space Science***
   Box 358, accord Station, Hingham, MA 02108-0358. Tel: (617) 871-6600.
   Fax: (617) 871-6528.
10. ***Aviation Week & Space Technology***
    Box 503, Hightstown, NJ 08520-9899.
11. ***Bioastronomy News***
    Membership, c/o The Planetary Society, 65 North Catalina Avenue,
    Pasadena, CA 91106. Tel: (818) 793-5100.
12. ***Earth: The Science of Our Planet***
    Earth, PO Box 1612, Waukesha, WI 53187-9950. Tel: (414) 796-8776.
13. ***The Electronic Journal of the Astronomical Society of the Atlantic*** (EJASA)
    Astronomical Society of the Atlantic (ASA), PO Box 15038,
    Atlanta, GA 30333-9998. Tel: (404) 636-3642. E-Mail: ist@america.net
    http://www.america.net/(erg/asa.html ASA BBS: (404) 321-5904
14. ***Final Frontier***
    PO Box 534, Mt Morris, IL 61054-7852. Tel: (818) 357-5000.
15. ***First Foundation News!***
    The First Millennial Foundation, PO Box 347, 125 West 4th Street, Suite 204,
    Rifle, Colorado 81650.
16. ***Icarus***
    (International Journal of Solar System Studies). Send Subscriptions to:
    Box 620000, Orlando, FL 32891-8340. Tel: (800) 543-9534.
17. ***Inside NSS***
    National Space Society, 922 Pennsylvania Avenue, SE,
    Washington, DC 20003-2140.
18. ***Journal of the Astronomical Society of the Atlantic***
    PO Box 15038, Atlanta, GA 30333-9998. ASA BBS (404) 321-5904
    Tel: (404) 636-3642 e-mail: ist@america.net
19. ***Journal of the British Interplanetary Society*** (JBIS)
    British Interplanetary Society (BIS), 27/29 South Lambeth Road,
    London, SW8 1SZ, ENGLAND.
20. ***The Journal of Geophysical Research - Planets***
    AGU - Orders, 2000 Florida Avenue NW, Washington, DC 20009.
21. ***Laser Focus World***
    10 Tara Boulevard - 5th Floor, Nashua, NH 03062. Tel: 603-891-0123.
22. ***Marsbugs: The Electronic Exobiology Newsletter***
    Julian Hiscox, Microbiology Department, BBRB 17, Room 361, University of
    Alabama at Birmingham, Birmingham, AL 35294-2170
    E-mail: julian_hiscox@micro.microbio.uab.edu
23. ***Mercury***
    Astronomical Society of the Pacific, 390 Ashton Avenue,
    San Francisco, CA 94112
23. ***Nature***
    Subscription Department, 345 Park Avenue South, New York, NY 10160-1743
    Tel: (800) 524-0384. Fax: (615)377-0525.
24. ***New Scientist***
    Oakfield House, 35 Perrymount Road, Haywards Heath, West Susex RH16 3DH,
    England.
25. ***OE Reports***
    OE Reports is a publication of SPIE, the Society of Photo-Optical Instrumentation
    Engineers, PO Box 10, Bellingham, WA 98227-0010. Tel: (360) 676-3290. Fax:
    (360) 647-1445. E-mail: oer@spie.org
26. ***The Planetary Report***
    The Planetary Society, 65 N Catalina Avenue, Pasadena, CA 91106-9899.
    Tel: (818) 793-1675. E-mail: tps@genie.geis.com
    http://planetary.org/tps/
27. ***Publications of the Astronomical Society of the Pacific***
    Astronomical Society of the Pacific, 390 Ashton Avenue,
    San Francisco, CA 94112.
28. ***Science***
    American Association for the Advancement of Science, PO Box 1810,
    Danbury, CT 06813-9764. Tel: (800) 731-4939. Fax: (202) 842-1065.
    E-mail: membership@aaas.org
    http://www.sciencemag.org/
29. ***Science News***
    Science Service, Inc., Subscription Department, PO Box 1925 Marion, OH 43305.
    Tel: (800) 247-2160.
30. ***Scientific American***
    PO Box 3186, Harlan, IA 51593-2377. Tel: (800) 333-1199.
    Fax: (212) 355-0408. http://www.sciam.com
31. ***SearchLites***
    The SETI League, PO Box 555, Little Ferry, NH 07643. Tel: (201) 641-1770.
    Fax: (201) 641-1771. E-mail: info@setileague.org
    Membership Information: (800) TAU-SETI
32. ***SETI News***
    SETI Institute, 2035 Landings Drive, Mountain View, CA 94043.
    Tel: (415) 961-6633. Fax: (415) 961-7099.
33. ***Signals: The NAAPO Newsletter***
    NAAPO, Signals Subscriptions, c/o Otterbein College, Department of
    Physics/Astronomy, Westerville, OH 43081. Tel: (614) 823-1516.
34. ***Sky & Telescope***
    Sky Publishing Corporation, PO Box 9111, Belmont, MA 02178-9111.
    Tel: (800) 253-0245. Fax: (617) 864-6117.
35. ***Smithsonian***
    Membership Data Center, Smithsonian Institution, PO Box 420309,
    Palm Coast, FL 32142-9143. Tel: (800) 766-2149.
36. ***Spaceflight***
    British Interplanetary Society (BIS), 27/29 South Lambeth Road,
    London SW8 1SZ, England.
37. ***Space Technology Innovation***
    NASA Office of Space Access and Technology (OSAT), Code XC,
    300 E Street SW, Washington, DC 20546.
38. ***Space Policy***
    Turpin Transactions Ltd, Distribution Centre, Blackhorse Road, Letchworth,
    Herts SG6 1HN, England. Tel: 0462-672555.
39. ***Space Views***
    c/o Boston NSS, 5 Driftwood Lane, Acton, MA 01720.
40. ***StarDate***
    McDonald Observatory Public Information Office, 2609 University Avenue,
    Room 3.118, The University of Texas at Austin, Austin, TX 78712.
    Tel: (512) 471-5285. Fax: (512) 471-5060.