

Williams College
Hopkins Observatory
Williamstown, Massachusetts 01267

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The following report covers the period 1 July 1997 through 30 June 1998.

1. FACULTY

Faculty included Jay M. Pasachoff, Field Memorial Professor of Astronomy, Chair of the Astronomy Department, and Director of the Hopkins Observatory; Karen B. Kwitter, Professor of Astronomy; and Stephan E. Martin, Instructor in Astronomy and Observatory Supervisor.

2. RESEARCH

2.1 Pasachoff

A major activity was the expedition to the total solar eclipse of 26 February 1998. Pasachoff organized a scientific expedition that involved 8 students, including 4 seniors, two juniors, one junior here on exchange, and one senior from another college who worked for a colleague through our Keck Northeast Astronomy Consortium. All the astrophysics majors participated.

The eclipse expedition was to Aruba, where the weather forecasts based on experience from past years was the most favorable along the eclipse path, which was thousands of miles long but only about a hundred miles wide. One experiment studied the heating of the solar corona to its temperature of millions of degrees through a search for high-frequency oscillations in loops of coronal gas held in place by magnetic fields. Timothy McConnochie '98 wrote his senior thesis on the subject, and operated the equipment on site along with Bryce Babcock, Staff Physicist and Coordinator of the Bronfman Science Center. The experiment was supported by a grant from the National Science Foundation. A second experiment was aimed at mapping the temperature of the solar corona. Supported by the National Geographic Society, it was operated on site by Lee Hawkins of Wellesley College, the Keck Consortium technician; and by Carolina Artacho Guerra of Bryn Mawr College, a student participating through the Keck Consortium. A third experiment was aimed at linking the eclipse observations with observations from the Solar and Heliospheric Observatory spacecraft; it was supported by the National Geographic Society and by NASA. Pasachoff developed this observational plan in collaboration with Guenter Bruecker of the Naval Research Laboratory, Principal Investigator of the Large Angle Spectrographic Coronagraph (LASCO) on SOHO. Operated on site by S. Martin, the data were circulated in a press release by NASA in the hours following the eclipse, and then were studied further at Williams by Johan Kongsli '98, a senior doing an independent project. Students participating in setting up these telescopes and computers and in other aspects of the expedition included James Bates '98, Mac Stocco '98, Laura Brenneman '99, Craig Westerland '99, and exchange student Lisa Reinker '99. These students were the only undergraduates to be part of scientific eclipse expeditions. Col-

laborating staff included Babcock, Martin, and Hawkins, as well as Jonathan Kern, now optical scientist at the Laser Interferometer Gravitational Observatory at Caltech, who built equipment that was important for the experiments. Also collaborating was Robert Eather, who made an IMAX movie of the eclipse. In the summer of 1998, the data from all the eclipse observations were further studied by Kevin Russell '00, by Keck Summer Fellow Ben Knowles ('99) of Vassar, and by McConnochie. (See <http://www.williams.edu/astronomy/eclipse98>.)

Planning has begun for scientific experiments for the 11 August 1999 eclipse that will cross Europe. Pasachoff received grants from the National Science Foundation for the oscillation experiment and from NASA for observations in coordination with the Extreme Ultraviolet Imaging Telescope (EIT) on the Solar and Heliospheric Observatory spacecraft. Pasachoff is advising the Observatory of the National Academy of Sciences of Romania about the use of their telescopes at the 1999 eclipse, and will observe the eclipse from Romania. (See <http://www.williams.edu/astronomy/eclipse99>.)

A scientific paper that arose from observations that used the eclipse equipment to monitor the occultation of a star by Neptune's moon Triton appeared in *Nature*, 393, 765 June 1998. Pasachoff, Babcock, and McConnochie '98 are among the coauthors of the paper, whose first author is James Elliot of MIT. The paper, entitled "Global Warming on Triton," deals with joint results from our observing site in Hawaii and from the Hubble Space Telescope. The National Geographic Society gave two supplemental grants for these Triton observations, and Pasachoff, Babcock, and McConnochie participated in expeditions to Australia in August 1997 and to Hawaii in November 1997.

January 1998 brought the publication by Pasachoff in collaboration with Prof. Roberta J. M. Olson of *Fire in the Sky: Comets and Meteors, the Decisive Centuries, in British Art and Science* (Cambridge University Press, 1998). The book marks the culmination of a decade of research, which started with grants from the National Endowment for the Humanities and peaked with grants from the Getty Grant Program. Pasachoff is the only physical scientist to have received grants from either source. Olson is Professor of Art History at Wheaton College; the two were introduced by Prof. Sam Edgerton, now Professor Emeritus of Art, in 1986 at the time of Halley's Comet.

By invitation for volume 1 number 1 of the *Journal for the History and Heritage of Astronomy*, Pasachoff has written about the "Hopkins Observatory: Oldest Extant Observatory in the United States."

2.2 Kwitter

With Dick Henry (U. Oklahoma), Kwitter is finishing a new determination of carbon abundances in planetary nebu-

lae. They have used newly recalibrated archived data from the *International Ultraviolet Explorer* satellite to study the production of carbon in stars that produce planetary nebulae. Honors student Jim Bates '98, and summer 1997 Keck exchange student Kerrie McKinstry (Wellesley College '99) contributed to this project by analyzing spectra from dozens of planetary nebulae. As an adjunct to the ultraviolet observations, Kwitter and Henry obtained optical spectra on two observing runs at Kitt Peak National Observatory, using the 2.1-m telescope and Goldcam CCD spectrograph. In collaboration with Bruce Balick (U. Washington), Kwitter and Henry observed in New Mexico with the Apache Point Observatory 3.5-meter telescope and dual imaging spectrograph in May 1998. Astrophysics major Sara Kate May '00 also participated in this observing run. Kwitter, Henry, and Balick are working on a multi-faceted project to study planetary nebulae as individual objects and as probes of chemical evolution in the Galaxy (and possible in other galaxies as well).

Summer students working with Kwitter in 1998 included James Bates '98 and Leila Zelnick '00 as well as Keck Summer Fellow Kelli Corrado, Colgate '99.

3. COURSES

The survey courses in astronomy and astrophysics continued. Astronomy 101 was stellar astronomy, Astronomy 104 was galaxies and cosmology, and Astronomy 111 was the introduction to astrophysics. Kwitter taught a new course, Astronomy 211, to majors about data reduction and image processing methods, involving intensive use of the Astronomy Department's DEC Alpha system. A new course in the spring semester, Astronomy 334, was on the Hubble Space Telescope. Taught by Pasachoff, it attracted 67 students, largely upperclasspersons. Pasachoff also taught a junior/senior tutorial on the solar corona, Astronomy 408T.

Kwitter developed a new course, Astronomy 418, *Astrophysics of the Milky Way and Other Galaxies*, to be taught in Spring 1999. Under the guidance of S. Martin, the 24" telescope and auxiliary telescopes continue to be used in support of the astronomy curriculum. Over 150 introductory astronomy students completed over 900 observations of celestial objects over the course of the academic year. These included observations, photographs, and CCD images of the sun, moon, stars, nebulae, and galaxies. Martin developed Web pages for each of the introductory astronomy courses. These pages contain links to useful astronomy sites and provide a forum for students to display images that they have taken with the observatory's CCD system and with photograph cameras as part of their observing projects. Student observing TA's, responsible for operating the telescopes, participating in the research projects, and assisting introductory students with assignments, included Rebecca Cover '00, Laura Brenneman '99, Daniel Seaton '01, Robert Lyman '99, Mithandra Stockley '01, Robert Wittenmyer '98, Christopher Spence '00, and Daniel Anello '98.

4. COLLEGE ACTIVITIES

Pasachoff continues as President of the Williams College Chapter of Sigma Xi.

On February 26, 1998, most Williams astronomers and astronomy students were at the total eclipse in Aruba. Christy Reynolds '96, an Astrophysics grad student at Dartmouth, supervised observation of the 18% partial eclipse that was visible in Williamstown.

4.1 Planetarium

The Milham Planetarium was run by Mac Stocco '98 and by Jim Bates '98. Shows were "The Beauty of Mars," and "Total Solar Eclipse!"

4.2 Colloquia and lectures

Andrea Dupree of the Harvard-Smithsonian Center for Astrophysics, President of the American Astronomical Society, spent several days on campus giving talks and meeting with students as a Bernhard Visiting Fellow. She gave a public lecture called "Gone With the Wind: Mass Loss From the Sun and Stars" and a colloquium entitled "New Structures in Stellar Coronae."

Daniel Britt of the Lunar and Planetary Laboratory, University of Arizona, Project Scientist for the Imager for Mars Pathfinder (IMP) camera that landed on Mars in the summer of 1997, spoke about the results.

James B. Kaler of the University of Illinois gave a colloquium on "211 Years of Planetary Nebula Research," participating in the Class of 1960's Scholars Program that gives students increased time with the speakers.

Prof. Kwitter gave a colloquium on "Planetary Nebula Abundances: Problems and Possibilities."

Students doing independent work gave talks, including James Bates '98 on his planetary nebulae work; Johan Kongsli '98 on the link of eclipse observations with the SOHO coronagraph in space; and Timothy McConnochie '98 on the oscillation eclipse experiment.

5. OUTSIDE ACTIVITIES

5.1 Committees and Panels

Pasachoff served as Chair of the Astronomy Division of the American Association for the Advancement of Science and chaired and organized a session on the latest NASA results at the general meeting in Philadelphia during February 1998. He is now Retiring Chair, and is organizing a session for the January 1999 annual meeting in Anaheim. He completed his term as American Physical Society/American Institute of Physics Member at Large of the Forum on Education.

In his eclipse work, Pasachoff was busy not only on scientific tasks but also on educational tasks relevant to the safe observing of the eclipse by populations across the Americas, through his roles as Chair of the Working Group on Eclipses of the International Astronomical Union (IAU) and as Chair of a Subcommittee on Public Education through Eclipses of the Commission on the Teaching of Astronomy of the IAU. (See http://www.williams.edu/astronomy/IAU_eclipses.)

Kwitter continues her term on the Space Sciences panel of the National Research Council Associateship Programs Review. The NRC is the principal operating agency of the Na-

tional Academy of Sciences and National Academy of Engineering, and awards postdoctoral and senior associateships at national facilities.

5.2 Colloquia

Pasachoff lectured about the Hubble Space Telescope at Science College, Concordia University, Montreal (1998) and to the Williams Club of Albany. He has been appointed Carter Lecturer by the Carter Observatory, New Zealand, for 1998, and is undertaking a lecture series in eight New Zealand cities in December.

Kwitter gave a colloquium entitled "Planetary Nebula Abundances: Problems and Possibilities," at Wesleyan University in April 1998 and then at Williams.

PUBLICATIONS

Papers

Buell, J.F., Henry, R.B.C., Baron, E., and Kwitter, K.B., "On the Origin of Planetary Nebula K648 in Globular Cluster M15," *A. J.*, 483, 837, 1997.

Elliot, J.L., Hammel, H.B., Wasserman, L.H., Franz, O.G., McDonald, S.W., Person, M.J., Olkin, C.B., Dunham, E.W., Spencer, J.R., Stansberry, J.A., Buie, M.W., Pasachoff, J.M., Babcock, B.A., McConnochie, T.H., "Global Warming on Triton," *Nature*, 393, 765, 1998.

Henry, R.B.C., Kwitter, K.B., and Buell, J., "Planetary Nebula Abundances, Stellar Yields, and the Galactic Evolution of ^{12}C and ^{14}N ," *Rev. Mex de Astron. y Astrofis. Conference Series*, 7, 30, 1998.

Henry, R.B.C., Kwitter, K.B., and J. Buell, "Toward an Understanding of Nucleosynthesis Patterns in Intermediate-Mass Stars," in *Planetary Nebulae*, IAU Symp. #180, ed. H.J. Habing and H.J.G.L.M. Lamers (Dordrecht: Reidel), p. 236, 1997.

Jacoby, G.H., Morse, J., Fullton, L.K., Kwitter, K.B., and Henry, R.B.C., "Planetary Nebulae in the Globular Clusters Pal 6 and NGC 6441," *A. J.*, 114, 2611, 1998.

Kwitter, K.B., and Henry, R.B.C., "A New Look at Carbon Abundances in Planetary Nebulae. III. DDDM1, IC 3568, IC 4593, NGC 6210, NGC 6720, NGC 5826, and NGC 7009," *Ap. J.*, 493, 247, 1998.

Books

The fifth edition of Pasachoff's undergraduate astronomy text, *Astronomy: From the Earth to the Universe* (Saunders College Publishing, 1998) was published. It is accompanied by a CD-ROM of photographs as well as an Instructor's Manual and other ancillaries. Supported by the publisher, S.

Martin is Webmaster and works with Pasachoff in keeping up to date a World Wide Web site with information about the latest advances in astronomy. See <http://www.williams.edu/astronomy/jay>. Leon Golub of the Harvard-Smithsonian Center for Astrophysics and Pasachoff published a graduate text, *The Solar Corona* (Cambridge University Press, 1997). (See <http://www.williams.edu/astronomy/corona>.) Roberta J. M. Olson of Wheaton College and Pasachoff published *Fire in the Sky: Comets and Meteors, the Decisive Centuries, in British Art and Science* (Cambridge University Press, 1998). Pasachoff is revising his *Field Guide to the Stars and Planets*, preparing the fourth edition. A 1998 update of the third edition, with tables and graphs valid through the year 2000, was published (Houghton Mifflin Co.). A 1997 update of his *Peterson First Guide to the Stars and Planets* (Houghton Mifflin Co.) was also released. Pasachoff completed the mss. for two junior-high books in press at Prentice-Hall: *Astronomy and Sound and Light*. The first was published in August 1998. Kwitter and co-author Steven Souza have written three books for the "Hands-On Science" activity series published by J. Weston Walch for junior high and high school students. The first of these, *Atmosphere and Weather*, was published in October 1998; the other two are *Force and Motion*, and *The Solar System*.

Encyclopedias

Pasachoff, 1998, "Planets," "Solar System," *World Book*. Pasachoff, 1998, "Olbers's Paradox," "Steady-State Theory," "Big-Bang Theory," *Encarta 98* (Microsoft, CD-ROM). Pasachoff, 1999, "Background Radiation," "Cosmology," "Ether," "Inflationary Theory," and "Interstellar Matter," *Encarta 99* (Microsoft CD-ROM). Pasachoff submitted the main astronomy entry for *World Book*, to appear in the 1999 edition, the first complete rewrite of that entry since he and Naomi Pasachoff jointly provided it in 1980. Pasachoff wrote the main entry on Eclipses for the new *Encyclopedia of Astronomy and Astrophysics* (Macmillan and Institute of Physics). Pasachoff continues on the science board of the *World Book* and as consulting editor for astronomy of the *McGraw-Hill Encyclopedia of Science and Technology* and Yearbooks. He continues on the advisory board of *Odyssey*, an astronomy magazine for children.

Book review

Pasachoff, "Ancient eclipses and the rotation of the earth" by F. R. Stephenson for *Isis*, 89, 521, 1998.

Jay M. Pasachoff
Karen B. Kwitter