

Williams College-Hopkins Observatory
Williamstown, Massachusetts 01267

[S0002-7537(90)05601-3]

The following report covers the period 1 July 1998 through 1 September 1999.

1. FACULTY AND STUDENTS

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

The department enrolled the most astrophysics majors ever: 8 juniors in the class of '01 and 4 seniors in the class of '00. Seniors are Rebecca Cover '00, Sara Kate May '00, Kevin Russell '00, and Brad Slingerlend '00. Juniors are Daniel Seaton '01, Joey Shapiro '01, Misa Cowee '01, Darik Vélez '01, Kenneth Dennison '01, Joel Iams '01, Duane Lee '01, and Matthew Silver '01. See <http://www.williams.edu/Astronomy/astromajors.html>.

2. RESEARCH

2.1 Pasachoff

Major activities included the analysis of data from the expedition to the total solar eclipse of 26 February 1998 and the planning for and expedition to the total solar eclipse of 11 August 1999. During the summer of 1998, Tim McConnochie '98 and Kevin Russell '00 worked on the 1998 data with Pasachoff in a study of the source of the heating of the solar corona.

Pasachoff mounted a major expedition to the total solar eclipse of August 11, 1999. The observations were made from a site in Ramnicu Valcea, Romania, about two hours' drive northwest of Bucharest. Pasachoff also advised Magdalena Stavinschi, Director of the Astronomical Institute of the Romanian Academy of Sciences in Bucharest, and her staff on the use of some of their large telescopes during the eclipse to make high-resolution observations of the solar corona.

The expedition was supported by grants from the Atmospheric Sciences Program of the NSF, from the SOHO Guest Investigator's Program of NASA, and from the Committee for Research and Exploration of the National Geographic Society, along with additional support from the Keck Northeast Astronomy Consortium and the Massachusetts Space Grant. Pasachoff is also Chair of the Working Group on Eclipses of the International Astronomical Union.

The experiments are in collaboration with Dr. Bryce Babcock, staff physicist at Williams College. The first experiment is a search for rapid oscillations in the corona, with periods of about 1 second. Coronal-green-line oscillations with periods in that short range are predicted by some theories that hold that the extreme coronal heating is caused by vibrations of magnetic loops.

The second experiment is a map of the temperature of the corona, using the technique of L. Cram of comparing the coronal and photospheric spectra at selected ultraviolet wavelengths.

The third experiment is to image the solar corona during the eclipse to compare with observations of the corona seen with the Extreme-ultraviolet Imaging Telescope (EIT) on board SOHO, in collaboration with scientists at NASA's Goddard Space Flight Center. The features seen at the eclipse outside the solar disk will be matched up with their bases seen on the disk with the EIT experiment. Further, the experiment uses a lens that gives an image at the same scale and with a green filter that matches a filter in one of the telescopes in the coronagraph system on SOHO. This observation was in collaboration with the late Guenter Brueckner of the Naval Research Laboratory, principal investigator of that experiment, LASCO (Large Angle Spectrographic Coronagraph), and is now in collaboration with Russell Howard and with other scientists at NRL. The comparison of our composite 1998 eclipse images with an image taken with LASCO's now-defunct C1 coronagraph will provide a calibration of how much light is scattered in the process of making an artificial eclipse on board the spacecraft.

An unusual aspect of Pasachoff's experimental teams is that they include so many undergraduate students. For the 1999 eclipse, participants included Williams College students Kevin Russell '00, Sara Kate May '00, Rebecca Cover '00, Daniel Seaton '01, Joey Shapiro '01, Misa Cowee '01, Darik Vélez '01, and Rossen Djagalov '02; Keck Northeast Astronomy Consortium Summer Fellow Alexandru Ene '02, a student from Romania who studied at Middlebury College and who is transferring to Harvard; and Mark Kirby '02, from Deep Springs College in Dyer, Nevada. Recent Williams alumni Timothy McConnochie '98 and Christina Reynolds '97 also participated. Scientific staff included Bryce Babcock of Williams College; Lee Hawkins of Wellesley College (now at Appalachian State University); Stephan Martin of Williams College; and Jonathan Kern, an optics designer at the LIGO Livingston Laboratory of Caltech.

The eclipse path was similar to that of the path of the 1724 eclipse, one of the first for which views from above of the path across the Earth were made. In the journal *Astronomy and Geophysics* of the Royal Astronomical Society, Pasachoff wrote about the maps provided by Edmond Halley for the total solar eclipses of 1715 and 1724. In the *Journal for the History and Heritage of Astronomy*, Pasachoff wrote not only about the eclipse maps but also about Halley's articles about the 1715 eclipse in the *Philosophical Transactions of the Royal Society*. Another article about Halley's work appeared in the Belgian journal *Ciel et Terre*. Pasachoff delivered an oral paper, "Halley's Maps and Descriptions of the 1715 Total Solar Eclipse," at the meeting of the Historical Astronomy Division that was part of the 194th American Astronomical Society meeting in Chicago, June 1999.

Continuing their collaboration on the overlap of astronomy and art, Pasachoff and Roberta J.M. Olson of Wheaton College participated in the September 1998 meeting of the Northeast American Society for Eighteenth-Century Studies. Pasachoff's paper was on the lives and comet drawings of William and Caroline Herschel.

2.2 Kwitter

Kwitter and her colleagues are continuing their studies of planetary nebulae, with a special interest in the nuclear processing that went on inside the parent stars. In addition to the evolutionary history of their progenitors, planetary nebulae as a class offer an opportunity to study the properties of the surrounding interstellar medium and the chemical evolution of the galaxy as a whole. Kwitter and Dick Henry (U. Oklahoma) have finished a new determination of carbon abundances in planetary nebulae. They used newly recalibrated archived data from the International Ultraviolet Explorer satellite to study the production of carbon in stars that produce planetary nebulae. Jim Bates '98, Leila Zelnick '00, and summer 1998 Keck exchange student Kelli Corrado (Colgate University '99) contributed to this project by analyzing spectra from planetary nebulae visible from the southern sky. Joel Iams '01 and Hugh Cowl (Wesleyan '00) accompanied Kwitter on an observing run at Kitt Peak National Observatory in June 1999 and worked with Kwitter and Zelnick. Kwitter, Henry and Bruce Balick (U. Washington) are working on a multi-faceted project to study planetary nebulae as individual objects and as probes of chemical evolution in the galaxy. They received a 3-year NSF grant for \$237,000 in support of this project.

2.3 Brenneman

Laura Brenneman '99 continued her 1998 summer research on spiral galaxies for a senior thesis. Her work with Paul Goudfrooij of the Space Telescope Science Institute continued through the year. They examined globular cluster populations in galaxy halos. Pasachoff was her on-campus thesis advisor.

3. MISCELLANEOUS

3.1 Pasachoff

Pasachoff was Carter Lecturer of the Carter Observatory, New Zealand, for 1998, and made a lecture tour to eight New Zealand cities in December. His term ended as Retiring Chair of the Astronomy Division of the American Association for the Advancement of Science and he chaired and organized a session on the latest NASA results at the general meeting in Anaheim during January 1999. He delivered a paper entitled "Spacecraft Exploring the Solar System: An Overview." Pasachoff continues as President of the Williams College Chapter of Sigma Xi. He has become the book reviewer for physical science for the *Key Reporter*, the newsletter of Phi Beta Kappa.

Pasachoff worked with Alex Filippenko of the University of California at Berkeley on a short textbook, *The Cosmos: Astronomy in the New Millennium*, to appear in July 2000

(Saunders College Publishing, being renamed Harcourt College Publishers). He completed the fourth edition of his *Field Guide to the Stars and Planets* (Houghton Mifflin Co.), copyright 2000. Third editions appeared of Richard Wolfson and Pasachoff's *Physics for Scientists and Engineers*, with versions both with and without modern physics.

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 the Subcommittee on Public Education through Eclipses of the IAU Commission on the Teaching of Astronomy. (See http://www.williams.edu/Astronomy/IAU_eclipses.)

Pasachoff worked on several encyclopedia contributions: "Astronomy" for *World Book*, 1999; "Background Radiation," "Cosmology," "Ether," "Inflationary Theory," and "Interstellar Matter," for *Encarta99* (Microsoft CD-ROM). He prepared "Eclipse" for the *Encyclopedia of Astronomy and Astrophysics* (Institute of Physics and Macmillan) and "Astronomical Tables," a chapter in *Physicists' Desk Reference* (Springer-Verlag).

Pasachoff continues on the science board of the *World Book* and as consulting editor for astronomy of the *McGraw-Hill Scientific Encyclopedia and Yearbooks*. He continues on the advisory board of *Odyssey*, an astronomy magazine for children. Pasachoff wrote "Williams College's Hopkins Observatory: The Oldest Extant Observatory in the United States," in volume 1, number 1 of *Journal of Astronomical History and Heritage*.

3.2 Kwitter

Kwitter continued her term on the Space Sciences panel of the National Research Council Associateship Programs Review. With co-author, Steven Souza, she has written three books of hands-on experiments for J. Weston Walch publishers. Kwitter taught a new course, "Astronomy 418, Astrophysics of the Milky Way and Other Galaxies," in Spring 1999. (See <http://www.williams.edu/Astronomy/CoursePages/418/418.html>.)

3.3 Martin

Martin continued his responsibilities for maintaining the World Wide Web pages for the Astronomy Department and, sponsored by Saunders College Publishing, for Pasachoff On-Line, a site devoted to contemporary updates to Pasachoff's introductory astronomy textbook, *Astronomy: From the Earth to the Universe*. Martin also 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 photographic cameras as part of their observing projects. Carlett Malcolm '01 worked on design aspects of web pages. (<http://www.williams.edu/astronomy>).

3.4 Students

Under the guidance of 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.

Student roof TA's, responsible for operating the telescopes, participating in the research projects, and assisting introductory students with assignments, included Laura Brenneman '99, Rebecca Cover '00, Robert Lyman '99, Daniel Seaton '01, Joey Shapiro '01, Jason Slingerlend '00, Christopher Spence '00, Mithandra Stockley '01, Rossen Djagalov '02, and Johanna Heinrichs '02.

The Milham Planetarium was run by Kevin Russell '00, Sara Kate May '00, Erik Klemetti '99, Daniel Seaton '01, Darik Vélez '01, and Bethany Cobb '02. The fall show was "The Beauty of Mars." In the spring semester, Russell wrote a new show, "A Total Solar Eclipse!" Summer shows were given by the summer research students. The Planetarium is supported in part by the Brandi Fund.

During the summer of 1999, the following Keck exchange students were in residence at Williams: Hugh Crowl (Wesleyan '00) working with Karen Kwitter and Alexandru Ene (Middlebury '02) working with Jay Pasachoff. Williams students working on research in the summer of 1999 were Joel

Iams '01 and Leila Zelnick '00, working with Karen Kwitter, Kevin Russell '00 and Sara Kate May '00 working with Jay Pasachoff, and Misa Cowee '01 working with Steve Martin. Rebecca Cover '00 worked at the Harvard-Smithsonian Center for Astrophysics (CfA) on a joint project of Pasachoff and Nancy Evans and Scott Wolk of the CfA. Joey Shapiro '01 worked at the Imaging Processing and Analysis Center (IPAC) of Caltech. Dan Seaton '01 worked at the Haverford astronomy department as part of the Keck exchange. Duane Lee '99 worked at the Wesleyan astronomy department as part of the Keck exchange. Matt Silver is working in Australia on junior-year abroad with Lawrence Cram, Mills Professor of Astronomy at the University of Sidney. Feng Zhu '02 worked on various astronomy web sites as an office of Information Technology Mellon Fellow. Darik Velez '01 did library work on eclipse experiments as part of the Mellon Minority Undergraduate Fellowship Program.

3.5 Colloquia

Colloquium speakers included Paul Goudfrooij, Space Telescope Science Institute, "Dust and Ionized Gas in Elliptical Galaxies," as part of the Class of 1960's Scholars Program; and Kim McLeod, Wellesley College-Whitin Observatory, "Quasar Hosts, and How They Seem to Know About the Monsters in Their Middles."

Jay M. Pasachoff
Karen B. Kwitter

