

H·A·D NEWS

*The Newsletter of the Historical Astronomy Division
of the American Astronomical Society*

Number 31 May 1994

Kepler's Laws, So-Called

Curtis Wilson

Who first called Kepler's laws "laws"? Not Isaac Newton, who in 1686 wrote Halley: "Kepler knew y^e Orb to be not circular but oval & guest it to be elliptical." Surely the ellipticity of the planetary orbits could not be established on the basis of observation alone. Newton himself deduced it in Prop. 13 of Book III of the *Principia* from his inverse-square law of gravitation.

As for Kepler's area rule, Newton did not give Kepler credit for having established it, but took its approximate truth to be inferable "from the Phenomena." The circumsolar planets move in slightly eccentric near-circles, but slightly more rapidly at perihelion than at aphelion—an approximate verification of the rule, indicating to Newton (but not to Kepler) that forces act on the planets in the direction of the Sun.

Newton acknowledged Kepler's discovery of the third law ($P \propto R^{3/2}$, where P =planetary period and R =mean solar distance). But some of his disciples felt more general credit should go to Kepler. "The sagacious Kepler," said David Gregory, "had got the Scent of" the Celestial Physics, that Newton then "brought to such a Pitch as surprizes all the world." William Whiston called Kepler "the Parent of Newtonian Philosophy." But neither called Kepler's rules "laws."

The first to do so was Voltaire. In his *Elements*

In the last issue, "Class Notes" was devoted to the first part of David DeVorkin's discussion of Hertzprung, Russell and their diagrams. The second and final part of David's essay will appear in an upcoming issue.

of the *Philosophy of Newton* (1738) he wrote of the area rule:

This Law inviolably observed by all the Planets... was discovered about 150 Years ago by Kepler, who has merited the Name of *Legislator* in Astronomy, notwithstanding his Philosophical Errors... The extreme Sagacity of Kepler discovered the Effect, of which the Genius of *Newton* has found out the Cause.

Similarly, Voltaire called the third Keplerian rule a "law," and added that "Kepler, who found this Proportion, was very far from finding the Reason of it..."

As for the ellipticity of the orbits, Voltaire, without calling it a "law," posed it as one of three empirical premises implying the inverse-square law of gravitation (the other two were the third Keplerian rule, and the comparison of the Moon's acceleration to that of a falling stone on Earth). In taking the ellipticity of the orbits as an empirical premise implying inverse-square law, Voltaire was relying on a passage from Henry Pemberton's *A view of Sir Isaac Newton's Philosophy* (1728). Pemberton, Newton's editor for the third edition of the *Principia*, should have known better.

Why "laws"? The idea of natural law was medieval; it signified the divine decrees whereby different things received their natures. In the seventeenth century, with the advent of the mechanical philosophy, it came to mean "those rules of motion, and that order amongst things corporeal,"

Kepler's Laws continues on p. 2

Caplenor Award

George Webb—our man in Cookeville—has been awarded the Caplenor Faculty Research Award of Tennessee Technological University. This award, which honors the late Donald Caplenor, former associate vice president of the university, is presented annually to a faculty member for a single research accomplishment or for a career of research at the university. George is the first humanities professor to receive this award since its inception in 1984. He is the author of *Tree Rings and Telescopes* (University of Arizona Press, 1983) and *The Evolution Controversy in America* (University Press of Kentucky, in press), as well as numerous papers in the history of astronomy. ☆

— *Kepler's Laws*, from page 1 —

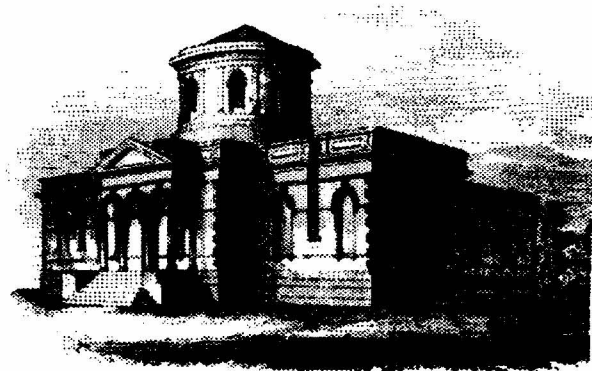
that God had established (Boyle). Such were Newton's *Axiomata sive Leges Motus*. Laws in this usage were fundamental principles.

But in his *Regulae philosophandi* (in the second and third editions of the *Principia*), Newton elaborated "the experimental philosophy," in opposition to the metaphysical arguments of the Cartesians and Leibniz. Partisans of Newton saw this experimental philosophy as a reaffirmation of Francis Bacon's *Novum Organum* (Voltaire called Bacon "the father of the experimental philosophy"). Science must build on a solid basis of experimental results. To propositions inferred by general induction from phenomena, one of the Newtonians whom Voltaire read, Willem Jacob 'sGravesande, applied the term "laws."

Voltaire's application of this term to Kepler's rules caught on. D'Alembert in the *Encyclopédie* (1751) spoke of two such laws, area rule and $P \propto R^{3/2}$, and added that these two laws "guided Newton in his system."

The first explicitly to number three such laws appears to have been Robert Small in his *An Account of the Astronomical Discoveries of Kepler* (1804). Small saw Kepler's discovery of his laws as exemplifying Baconian method; Kepler's laws, being empirically established, "were the foundations of the whole theory of Newton." Through the nineteenth century, Englishmen like John Herschel, David Brewster and J.S. Mill plumped for the Baconian interpretation of Kepler's laws as results of "induction from pure observation."

All this would have surprised Kepler, who knew



Dudley Observatory as illustrated in Elias Loomis' *The Recent Progress of Astronomy; Especially in the United States*, 1856.

Dudley Observatory Awards

Each year Dudley Observatory has a contest for the Herbert C. Pollock Award in the History of Astronomy and Astrophysics. A panel of judges recently completed its study of the submitted proposals, with the following results for 1994:

Pollock Award (\$10,000)

Joann Eisberg — "Beatrice Tinsley—A Scientific Biography"

Pollock/Dudley Awards

Ian R. Bartky — "Arbiters of the True Time: American Observatories in the Nineteenth Century"

James A. Voelkel — "Translation of the Complete Kepler-Fabricius Correspondence"

The next award deadline is December 1, 1994. Anyone interested in submitting a proposal is invited to contact Ralph A. Alpher, Dudley Observatory, 69 Union Avenue, Schenectady, NY 12308.

that physical hypothesis was central to his enterprise. (His claim in Chapter 58 of the *Astronomia nova* to have shown the untenability of orbital shapes other than the elliptical was a delusion, as D.T. Whiteside pointed out in 1974.) He had replaced a two-thousand-year-old tradition of epicycles and eccentrics, and achieved planetary tables embodying elliptical orbit and area rule, more accurate than any achieved before. But this revolution rested on a dynamics that Newton and we have to reject. Given Newton's *Leges Motus*, the facts required a radical reinterpretation; Newton supplied it. ☆

Treasurer's Report

(22 Jan '93 – 20 Jan '94)

Starting Balance		\$1902.81
Dues Income	\$ 524.00	
Meeting Income (July '93)	960.00	
Other Income	2899.91	
Interest	\$ 11.91	
IREX Grant	2888.00	
Total Income		4383.91
Assets		\$6286.72
Office Expenses	\$ 739.91	
Postage	\$ 621.88	
Supplies	43.53	
Bank Fees	74.50	
Meeting Expenses	\$2617.48	
July '93	\$ 772.19	
Jan '94 AAS	1845.29	
Total Expenses		3357.39
Balance		\$2929.33

Notes: "Meeting Income" consists of registration fees collected for our July '93 meeting at the Huntington Library. Expenses for that meeting are tabulated under "Meeting Expenses." Under "Other Income," the IREX Grant funded a Russian participant in the symposium "Astronomy and the State: U.S. and C.I.S. Perspectives" at the January '94 meeting in Washington. This grant happily exceeded the expenses of the meeting. A truly clever treasurer might have managed to retain the excess as a profit. Instead, we returned the unused funds (\$1533.55) in February. This will be recorded in next year's report. Two significant expenses for the symposium were not covered by the IREX grant. In arranging the symposium we made a number of phone calls to Russia at a cost of \$141.84, and we paid registration fees totaling \$450 so our C.I.S. participants could attend the AAS meeting. Later, we realized we could have saved on registration fees if we had first made our guests Affiliate Members of HAD. It is a lesson to remember for the future.

The cooperation of Peggy Kidwell, David DeVorkin and Ruth Freitag in auditing the treasurer's books is gratefully acknowledged. ☆

Tucson Meeting

Our next meeting will be held 8–9 January 1995 in conjunction with the AAS meeting in Tucson. We will have a total of four sessions, of which two will be special thematic sessions. The schedule is as follows:

Sunday, 8 January

1 p.m. HAD I: General contributed papers

3 p.m. HAD II: Special Session 1

Monday, 9 January

10 a.m. HAD III: Special Session 2

1 p.m. Business meeting

2 p.m. HAD IV: General contributed papers

The special sessions will be devoted to the topic "Teaching Astronomy Through History." These will be sponsored jointly with the AAS Education Officer and the Working Group on Astronomy Education.

We anticipate beginning with a review paper on past uses of the history of astronomy in college curricula. There may be further review papers dealing with new approaches for incorporating history into teaching, both in and out of traditional classrooms. History will be broadly defined to cover everything from prehistoric to modern and will include non-Western cultures. Among the relevant questions are "What are the goals of inserting history into an astronomy curriculum?" and "What history is appropriate for astronomy curricula for general liberal arts knowledge and for the specialized knowledge of the astronomy major?"

There should be opportunity for open discussion and for a commentator to address issues raised in the papers. We will be preparing a reference list of useful historical sources for teachers.

Call for Papers

An ad hoc committee, coordinated by David DeVorkin, is organizing the thematic sessions. We would like to plan these sessions as far in advance as possible. If you are interested in giving a paper, please send a brief (off the cuff) abstract to LeRoy Doggett by e-mail (doggett@ariel.usno.navy.mil) or fax (202-653-0179).

Looking ahead, the July '95 AAS meeting will be held in Pittsburgh. This will be the centennial of the *Astrophysical Journal*, of which Allegheny Observatory's James Keeler was a cofounder. Ron Brashear is organizing a thematic session on the *ApJ*. You can reach him at 818-405-2209. ☆

History Sessions at the IAU General Assembly

The XXIIInd General Assembly of the International Astronomical Union will meet August 15–27 in The Hague. Commission 41 (History of Astronomy) will hold a major session on Friday morning, August 19, centered around the 75th anniversary of the IAU. Friday afternoon will include reports on works in progress, including the Garland *History of Astronomy Encyclopedia* and the IAU *General History of Astronomy*. The Commission business meetings will be held August 18 at 4 p.m. (1600) and August 22 at 2 p.m. (1400), each lasting approximately one hour. ☆

Ich Bin HAD

Recently reflecting on the history of HAD, your editor recalled what must be HAD's second business meeting. Retiring Chair Jack Eddy, introducing his successor, Owen Gingerich, proclaimed our motto: Ich bin HAD. In the ensuing session of contributed papers, someone commented that in French our motto would be "Je suis HAD." Can anyone verify this bit of historical trivia? Was that the first statement of our motto? Who offered the French version?

In the midst of these reflections, I wondered how "Ich bin HAD" would come out in other languages. It would lose something, of course, for it seemed to be a double pun on John F. Kennedy's "Ich bin ein Berliner" and the good old American cry of the hoodwinked, "I've been had!"

Anyway, I pestered a few friends and posted an inquiry on HASTRO-L. Here are the results:

Greek: *E'ίμαι* HAD.

Estonian: *Meid on petetud*.

Welsh: *Rydw i'n* HAD.

Mandarin Chinese: *Wa shuh* HAD.

Russian proved to be a problem. The first attempt, *Ya GAD* (there is no H in Russian), means "I am horrible and despicable," which certainly doesn't apply to anyone in HAD, by Gad! This provoked the suggestion *Ya BOG*, which means "I am God" or "I come from 30,000 fathoms..."

The editor thanks Rolf Sinclair, George Gale, Demetrios Matsakis, Tom Annus, Wolfgang Dick, Bob McCutcheon, Katherine Bryant and Merry Maisel. Special thanks go to Steve McCluskey, who put up with this on HASTRO-L. ☆

Fellowship Announcement

The Smithsonian Institution Libraries/Dibner Library Resident Scholar Program offers two short-term study grants for 1995 with stipends of \$1,500/month for a term of one to three months to do research in the Dibner Library of the History of Science and Technology and other library collections of the Smithsonian. Historians, librarians, doctoral students and other scholars are invited to apply. Scholars are expected to be in residence at the Smithsonian Institution. The Dibner Library contains 15th–20th century books and manuscripts, specializing in the physical and applied sciences and technologies. Strengths include electronics, civil and mechanical engineering, chemical industries, textiles and ceramics, military history, instrumentation, and also microscopy, pharmacy and modern physics. Resources in the history of astronomy include star lists, astrological and early astronomical texts, such as Kepler, Apianus, Herschel and Nasmyth.

Deadline for applications: December 3, 1994.

HSS Survey of Audio-Visual Resources

The History of Science Society's Committee on Education is assembling a centralized database and sourcebook of all types of audio-visual resources for teaching the history of science, including films, tapes, slides, images, museums, traveling exhibits—even CD ROMs. They would like to know of resources that are available through your institution or that you have found useful. If you have any information, please contact Douglas Allchin, Department of Science and Technology Studies, Cornell University, 632 Clark Hall, Ithaca, NY 14853–2501. The committee plans to publish a summary of its findings sometime in 1995.

Joining HAD

Are you reading this over someone's shoulder in the library, office or observatory dome? Shame! You can read your own copy—guilty free—by simply joining HAD. For AAS members, annual dues are \$4; for others, Affiliate Membership in HAD is a mere \$10. For information, please contact LeRoy Doggett at doggett@ariel.usno.navy.mil or 202–653–1572. ☆

HAD Elections — Official Ballot

(Two-year terms begin in January 1995.)

HAD Chair

- ☐ **Woodruff T. Sullivan III**, Professor of Astronomy at the University of Washington, has served as HAD Vice Chair and Chair of the Obituary Committee for the past two years. He earned a Ph.D. in astronomy from the University of Maryland. His astronomical research concerns galaxies and SETI. His historical research is on early radio astronomy; he edited *The Early Years of Radio Astronomy* (1984) and compiled and edited *Classics in Radio Astronomy* (1982). Woody's magnum opus on the history of early radio astronomy is *still* not finished (although 90% done). If elected, he'll have an excuse for further delay. "I am a fanatic re softball, Scrabble, sundials, and other fun things beginning with 's'."

HAD Vice Chair (vote for one)

- ☐ **David DeVorkin** is an historian of science at the National Air & Space Museum, Smithsonian Institution. He has published extensively on the history of modern astronomy and astrophysics, including his most recent books, *Science with a Vengeance: How the Military Created the U.S. Space Sciences after World War II* and *Race to the Stratosphere: Manned Scientific Ballooning in America*. David has served the HAD in various capacities, most as a result of his 8-year tenure as the second HAD secretary/treasurer. His degrees include a M.Phil. in Astronomy from Yale University and a Ph.D. in History of Astronomy from the University of Leicester, England. He would like to see the HAD develop more thematic programs to attract both astronomers and historians of science to HAD sessions, and will work to that end as Vice Chair of the HAD.
- ☐ **Michael Zeilik** is a Professor of Astronomy at the University of New Mexico. In his teaching, he specializes in introductory courses for the novice, non-science major student. He has been supported by grants from the National Science Foundation, NASA, the Exxon Educational Foundation, and the Slipper Fund of the National Academy of Sciences for innovations in astronomy education, delivery of astronomy to the general public, and astronomy workshops for in-service teachers. His research activities includes a study of the astronomy in the historic and prehistoric Pueblo world. Mike earned his A.B. in Physics with honors at Princeton University and his M.A. and Ph.D. in Astronomy at Harvard University. He has published four textbooks on astronomy and ten articles in ethno/archaeoastronomy. He would like to see HAD attract a broader audience of non-astronomers, including anthropologists and archaeologists to sessions on archaeo/ethnoastronomy.

Also see other side. ➡

Official HAD Ballot (page 2)

HAD Committee (vote for two)

- ☐ **Robert McCutcheon's** research interests are in the history of Soviet/Russian science and technology. He has several publications on the history of Soviet astronomy—particularly on the political repression of astronomers during the Stalin period. Since 1993 he has chaired HAD's International Relations Committee, and he helped organize HAD's January 1993 session on "Astronomy and the State: U.S. and CIS/ Soviet Perspectives." He holds an M.A. in Soviet Affairs from Georgetown University and an M.S. in astronomy from Yale University. (Bob also has a "day job" as a spacecraft attitude analyst with Computer Sciences Corp., a contractor to Goddard Space Flight Center.)
- ☐ **Richard Walker** is an astronomer at the U.S. Naval Observatory in Washington, D.C., where he worked in the Time Service and Astrometry Divisions before transferring to the Flagstaff Station in 1966. His research field is binaries and variable star detection in open clusters. Dick has backpacked, alone, five hundred miles along the Nile in search of "off-the-road ruins;" he relaxes by hiking in the deserts of North and South America in search of petroglyphs. He believes the study of archaeoastronomy can lead to basic understandings between us and our ancestors, but that more caution and scientific skepticism are needed in this formative branch of science.
- ☐ **Barbara Welther** is an historian at the Smithsonian Astrophysical Observatory. She has a broad interest in the development of astronomy in Europe and the United States during the 19th and 20th centuries, as well as a particular interest in the role that women have played in that development. A special interest is Annie Jump Cannon, about whom she prepared a major exhibit and produced a video for middle-school students about Cannon's childhood and career. For this work, Welther received the Annie Jump Cannon Award for Distinguished Achievement last spring. From 1987 to 1989 Welther served as a Councilor for both the HAD and AAVSO. Currently, she continues to serve as a member of the Planetarium Advisory Committee at the Boston Museum of Science. In the spirit of the Smithsonian, Barbara enjoys "increasing and diffusing" the history of astronomy, especially in settings where it inspires young students.
- ☐ **Tom Williams** has been an amateur astronomer for over thirty years. Since joining HAD in June 1984, he has presented a number of papers at HAD meetings and has been an invited speaker at several history symposia. He retired two years ago, and is now in his second year as a graduate student in history at Rice University. Tom's interests in the history of astronomy include the histories of variable star astronomy, of observatories in the United States, of the profession of astronomy, and of amateur contributions to astronomy.

Send your ballot to
LeRoy Doggett
Nautical Almanac Office
U.S. Naval Observatory
Washington, DC 20392

Ballots must be received by 27 December 1994. Please sign the back of the envelope.