WASP

Warren Astronomical Society Paper

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COLONIAL ASTRONOMY

by Steve Franks

As the 18th century entered its last quarter, astronomy experienced a division into three rather distinct categories: observational, gravitational, and descriptive. Observational astronomy refers to that fundamental part of the science concerned with recording the exact positions of heavenly bodies and applying this knowledge to such practical concerns as timekeeping and surveying. Gravitational astronomy is the astronomy of Newton - the application of rigorous mathematical techniques to celestial motions. The actual physical makeup of the different bodies in the universe is the concern of descriptive astronomy. In the rapidly changing scene of America, each division exhibited remarkably rapid progress.

With the outbreak of hostilities on Lexington Green on the morning of April 19, 1775, the development of astronomy in America necessarily progressed at a much reduced rate, but it did not stop.

The most renowned academic scientist in the colonies, Prof. John Winthrop of Harvard, continued to teach while enthusiastically working for the Revolution. Despite his heavy involvement in the war, John Adams advanced astronomy in America, devoting considerable effort during the years 1779-80 in forming the American Academy of Arts and Sciences. The academy's purpose was "to cultivate every art and science which may tend to advance the interest, honour, dignity, and happiness of a free, independent and virtuous people." With Harvard, it soon cosponsored an expedition to observe the solar eclipse of Oct. 20, 1780. A truly remarkable feature of this trip was the projected location for the view of totality - Penobscot Bay, Maine - behind British lines! In the Age of Enlightenment, however, science was considered "above the battle"; thus the 10 man American solar eclipse expedition, headed by Samuel Williams, was allowed to proceed. (William, a student of Prof. Winthrop, was eventually his successor at Harvard.)

In the first volume of the American Academy's Memoirs, published in 1785, Williams described how his observations were carried out even "though involved in all the calamities and distresses of a severe war." He complained how the British officer in charge of the garrison at Penobscot Bay set a time limit "wholly inadequate to our purpose"; nevertheless, he described the phenomenon we now call "Baily's Beads," an effect which occurs the instant before and after totality when bursts of sunlight pass through lunar valleys along the rim of the moon. The effect was "officially" discovered in 1836 (about 56 years later) by British astronomer Francis Baily.

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Warren Astronomical Society, Inc.

The WASP

Warren Astronomical Society
P.O. Box 474
East Detroit, MI 48021

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April, 1991

1991 Officers:

President:	Marty Kunz	477-0546
1st V.P.:	Frank McCullough	254-8164
2nd V.P.:	Mike O'Dowd	268-7125
Secretary:	Robert Halsall	781-6784
Treasurer:	Jeff Bondono	731-4706
Librarian:		

Send membership applications and dues to:
Jeff Bondono
51054 Kingwood Shelby
Twp. MI 48316

The Warren Astronomical Society, Inc., is a local, non-profit organization of amateur astronomers. The Society holds meetings on the first and third Thursdays of each month, starting at 7:30 PM.

General Meeting on 1st Thursday:
Cranbrook Institute of Science
500 Lone Pine Road
Bloomfield Hills, MI

Business meeting on 3rd Thursday:
Macomb Community College
South Campus, Building B, Room 216
14500 Twelve Mile Road
Warren, MI

Membership in the Society is open to all. Annual Dues are:

Student:	$10	College:	$15
Senior Citizen:	$15	Family:	$25
Individual:	$20		

Along the many benefits of membership are:

Discount magazine subscriptions:

Sky and Telescope:	$16.00	(12 monthly issues)
Astronomy:	$14.00	(12 monthly issues)
DeepSky:	$ 8.00	(4 Quarterly issues)
Telescope Making:	$ 8.00	(4 Quarterly issues)
Odyssey:	$12.50	(12 lonthly issues)

Free copy of each WASP newsletter.
Free use of Stargate Observatory.
Special interest subgroups. (see subgroup chairperson)
Call list - don't miss unexpected events.
Free membership in Astronomical league.
Free Reflector (Astronomical League Newsletter)
Free use of W.A.S. Library. (see librarian)
Rental telescopes (see observatory chairperson)

Warren Astronomical Society Paper. The Wasp is the official publication of the Society. Each new issue of the WASP is made available at the Macomb meeting on the third Thursday. Non-members will be charged $1 for each new issue. Back-issues, when available, are free. Requests by other clubs to receive the WASP and other correspondence should be addressed to the editor. Articles for inclusion in the WASP are strongly encouraged and should be submitted to an editor on or before the first Thursday of each month.

NOTE: The mirrors in the telescope are being collimated so the telescope will be out of service for a few months. lecturers will bring their own telescopes for viewing at the lecture.

Stargate Observatory is owned and operated by the Society in conjunction with Rotary International. Located on the grounds of Camp Rotary on 29 Mile Road, 1.8 miles east of Romeo Plank Road, Stargate features a 12.5 inch F17 club-built Cassegrainian telescope under a steel dome. The observatory is open to all club members in accordance to the 'Stargate Observatory Rules.' Those wishing to use the observatory lust call the Observatory Chairman by 7:00 PM on the evening of the session. The Observatory Chairman is:
Mike O'Dowd 268-7125

The Society maintains a library of astronomy-related books and periodicals at the Macomb County Community College meeting room. See the librarian for library rules or to check out a book.

lectures are given at Stargate Observatory each weekend. The lecture will be either Friday or Saturday evening, depending on the weather and the lecturer's personal schedule. lecturers should check with the ranger at Camp Rotary early in the week to determine whether scouts will be at the camp, and to inform the ranger of the day and time of the lecture. If you cannot lecture on your scheduled weekend, please lake arrangements to switch weekends with another lecturer, or call the chairman as soon as possible. Upcoming lecturers are:

Robert Halsall	3-22/23	5-3/4
Jeff Bondono	3-29/30	5-10/11
Francis Stabler	4-5/6	5-17/18
Riyad Matti	4-12/13	5-24/25
Scott Jorgenson	4-19/20	5-31 6/1
Frank McCullough	4-26/27	6-7/8

Subgroups exist for those interested in specialized areas. Those interested should contact the chairperson, listed below:

Solar:	Ed Cressman	645-1837
Lunar/Planetary:	Alan Rothenberg	624-9339
Cosmology:	Mike O'Dowd	268-7125
Deep Sky:	Doug Bock	750-9369
Computer:	Larry Kalinowski	776-9720
Telescope Making:	Jim Houser	294-1952

The Call List is a list of people who wish to be informed of spectacular and unexpected astronomical events. Anyone who notices such an event calls the next person on the call list, who informs the next person, etc. A call list member can specify that he or she not be called at certain times. Any Society member is welcome to join the call list and can do so by notifying Jeff Bondono, 731-4706.

CALENDAR OF EVENTS

Thursday	March 28	8:00	Computer Group Meeting – Larry Kalinowski – 776-9720	
Thursday	April 4	7:30	WAS Meeting at Cranbrook	
Thursday	April 11	7:00	Cosmology meeting at Jeff Bondono's home. Contact Mike O'Dowd 268-7125 Topic - Galactic Dynamics	
Saturday	April 13	7:00	Deep Sky - Star Party at Doug Bock's 750-9369	
Thursday	April 16	7:30	JACK HORKHEIMER	followed by WAS Meeting at Cranbrook

APRIL 18
WAS MEETING AT CRANBROOK
7:30 PM

JACK HORKHEIMER

AN EVENING WITH STAR HUSTLER JACK HORKHEIMER

Enjoy a unique presentation on astronomy in the Institute's auditorium. Mr. Horkheimer stars in PBS's Star Hustler segments with tidbits on astronomy and space. He is also executive director of the Miami Space Transit Planetarium in Florida. This program is presented in conjunction with the Warren Astronomical Society.

WAS MEMBERS $3.00, NON-MEMBERS $5.00

SCIENCE AND THE SHUTTLE AMATEUR RADIO EXPERIMENT

Join astronaut-scientist Anthony W. England for a discussion of his Spacelab 2 mission. He logged 188 hours of space travel in 1985 and assisted with experiments in astronomy and physics during 126 orbits of Earth. While in Spacelab 2, Dr. England also communicated directly with hundreds of people around the world using amateur radio operations and inaugurated ham radio, two-way, slow-scan TV transmissions from space.

April 15, Monday, 7: 30 PM - CRANBROOK

COMPUTER CHATTER

by Larry F. Kalinowski

Last month's meeting delved into the MACINTOSH and AMIGA computers. The merits of each were discussed, as we 11 as their disadvantages. Our intentions were to steer the novice in the right direction, placing the individuals needs first.

KIM DYER surprised everyone by showing up with the 1atest shareware version of DEEP SPACE 3D. That's version 2.1. A lot has changed since version 1.3. It's now available for copying at our meetings, as well as, SKYGLOBE V 2.0. They will both run in HERCULES, CGA, EGA or VGA displays.

There are three computer shows in the Detroit Metro area this month and next. They're located in LIVONIA - Mar. 23, MADISON HEIGHTS - Mar. 24, and SOUTHGATE Apr. 7. Call me for details or consult your daily newspaper computer section.

The next computer meeting will be on March 28, at 8:00 PM. It'll be dedicated to both novice and advanced users of the keyboard. At this point the program is still pot luck, but I promise you won't go away disappointed.

COLONIAL ASTRONOMY
Continued from cover page

While war's misfortunes continued to plague the nation, the growth of domestic astronomy continued, though often on circuitous paths. In 1778 Ezra Stiles was appointed president of Yale in New Haven, as that city was freed from hostilities with the war's movement southward. Stiles worked with Nemiah Strong, professor of mathematics and natural philosophy at Yale, studying the solar eclipse of 1780. Interest in the mechanical universe of the orrery continued, demonstrated by Harvard's acquisition of a second orrery in 1788 - this time of American origin, made by Joseph Pope, a local "mathematician, watch-maker and mechanical genius." The Pope orrery was mounted on a handsome mahogany frame, featuring bronze figures of Franklin and Newton. The rumors that the figures were cast by Paul Revere, though unconfirmed, persists until this day. A sidelight connected with the Pope orrery is the Harvard lacked sufficient funds to pay for it, and therefore sought special permission to hold a public lottery to raise the funds.

In later year, Thomas Jefferson initiated a plan to present a Rittenhouse orrery to the king of France as a fight of appreciation for wartime support. Jefferson also had other motives, feeling that in "sending both Rittenhouse and his Orrery to Europe," a blow could be struck against "those flimsy theorists" who might tend to ridicule American expertise in such areas. While Rittenhouse agreed to make one, the plan never materialized, and King Louis XVI's death by guillotine in 1793 closed the issue.

The earliest attempts to establish a national observatory are closely associated with David Rittenhouse. Following the excitement generated by the 1769 transit of Venus, Rev. John Ewing of Philadelphia suggested that a permanent public observatory be constructed. He enlisted the aid of British Astronomer Royal Nevil Maskelyne and Benjamin Franklin, who was in England at the time. Franklin was pessimistic about American competence in such matters and so nothing developed. In 1775, the American Philosophical Society made a serious effort to establish an observatory to be headed by their then prestigious colleague, David Rittenhouse. In their petition to the Pennsylvania assembly, the Society argued that among the reasons for constructing a local observatory were "Our Distance from the Chief Observatories in the World" and, strange though it may sound to any 20th century visitor to Philadelphia, "the purity and Serenity of our Atmosphere." The plan might have succeeded if the shooting on Lexington Green had not occurred, for Maskelyne, a member of the society, was then forced to withdraw from the project because of "the present unhappy situation of American affairs."

As the war ended, Rittenhouse started construction on his own brick observatory, British astronomer William Herschel had made the spectacular discovery of a new planet in 1781; thus when Rittenhouse's structure was completed in 1783, Uranus was one of the first objects he regularly observed. Local supporters tried to obtain public funds to convert his private observatory into a public one, even going as far as to suggest a mini-astronomer royal (Astronomer to the State of Pennsylvania), a post obviously tailor-made for Rittenhouse. The assembly liked the idea but not the financial commitment needed to make it a reality.

Postwar possibilities of an American observatory even excited Benjamin Franklin, who had long been pessimistic about American endeavors in astronomy. The ever-increasing number of exciting astronomical discoveries made on this continent prompted Franklin to declare, "I begin to be almost sorry I was born so soon." Only Franklin had the reputation to write to Herschel, suggesting that "Had fortune placed you in this part of America, your progress in these discoveries might have been more rapid." In typical Franklin fashion, he went on to quantitatively justify his bold suggestion by showing that the clean American air would permit 1/3 more days for observation than available in England!

Franklin knew well of what he spoke, for descriptive astronomy was the new astronomy of the day and Herschel, indeed, was its prophet. The spectacular contributions made by Herschel to the development of astronomy were enough to intimidate any European astronomer, not to mention astronomers in the developing country that was America at the end of the 18th century.

Herschel began his astronomical career in 1774 when, at age 36, he built his first telescope; only seven years later he discovered Uranus during one of his sky surveys with a 6 inch Newtonian reflector. In 1783, he completed a reflecting telescope of 18 inch diametre. Ultimately, he built a giant 4 foot aperture telescope. These powerful instruments opened the heavens in a way unimaginable to American astronomers, for at the time of Herschel's death in 1822, America did not yet possess a telescope with an aperture of 5 inches!

Although these were incredibly productive years for descriptive astronomy (1774-1822), America remained the passive pupil as news of discoveries flowed westward across the Atlantic. Two new satellites, each, for the giant planets Saturn and Uranus, the oblateness of Saturn, bands on Jupiter, the seasonally varying Martian polar caps, and the asteroids (or minor planets) were all added to man's knowledge of the solar system. European astronomers measured the large-scale distribution of stars in space by systematic star counts, leading to the disk shaped or grindstone model of the universe. Star clusters, nebulae and the possible "island universe" were compiled in catalogues. Binary star systems were discovered and the sun's motion through space was measured. Some stars were even found to vary in brightness. That was the new descriptive astronomy at its best, and America was simply unable to compete with such a rapidly developing field. In that climate, however, America's turn to the practical side of astronomy was perhaps inevitable.

During the early years of the American republic, the three main concerns of the struggling nation were agriculture, manufacturing and commerce. These vital necessities caused "basic research" or "textbook knowledge" to be frowned upon. Astronomy, so popular in the early colonial days, became particularly suspect. Indeed, college graduates of 1790 were told in one magazine, "You are not to live in the sun, nor the moon, nor ride upon the tails of a comet ...A few astronomers are enough for an age!" The "Promotion of Useful Knowledge" became the chief concern of the Philosophical Society and the American Academy of Arts and Sciences.

Three areas where astronomical techniques could be applied to the needs of the nation were surveying, almanac writing and navigation. David Rittenhouse, in Benjamin Franklin's image, always had a reputation for being a "practical" man. After the war, he continued to survey by special Congressional appointments, helping settle territorial disputes. He clearly didn't enjoy it though, and in a letter to Andrew Ellicott, geographer of the United States, said that after the New York-Massachusetts boundary was settled in 1789, he would "bid adieu, forever, to all running of lines."

In applying astronomical knowledge to useful causes, however no Americans succeeded more than Benjamin Banneker and Nathaniel Bowditch.

Born in 1731, Banneker was the son of a freed slave. While he left no lasting mark on the science of astronomy his mastery of difficult astronomical techniques catapulted astronomy into the public and political domain. Banneker's first astronomical work, an unpublished almanac for 1791 -circulated by the Maryland Abolitionist movement, led to the 60 year old black being named to the surveying team assigned the task of determining the borders of the nation's new Capitol on the Potomac. That survey and the seven almanacs he later published demonstrated his proficiency in two of the areas where astronomy was considered adaptable to the nation's goals. "Better than any other lesson to be derived from Banneker's life and work," writes a biographer, "is the one he so admirably exemplified: that the thirst for knowledge is not limited to youth, and that the process of learning recognizes no barriers of race or creed."

The application of astronomical principles to the needs of early 19th century America reached its pinnacle in Nathaniel Bowditch, a self-educated man. His work was important to the development of astronomy because it introduced the use of new, sophisticated mathematical techniques developed by French astronomers to their American and English counterparts.

Bowditch's family had been shipmasters for over 100 years, so in 1795 he went to sea to merge celestial navigation principles with practical experience. The fundamental celestial reference books of the period were the English editions of Moore's the Practical Navigator and Maskelyne's Requisite Tables for the Nautical Almanac; Bannecker and other American almanac makers had long relied on them. Bowditch meticulously poured through these books, and found discrepancies in Moore's volume. This led to Moore's revised edition. The New Practical Navigator which referred to revisions by a "skillful mathematician and navigator." Bowditch pressed on with further changes, but the task became hopeless; he uncovered 8,000 errors in Moore's work (2,000 of which he traced to errors in Maskelyne's Requisite Tables).

Bowditch finally produced a new book, patriotically entitled The New American Practical Navigator. Published both in the United States and England in 1802, this book was a monumental effort, exceeding 600 pages in length, and filled with detailed explanation, tables, maps and magnificent illustrations produced from copper plates. Technically, it was a masterpiece, and so useful it was a veritable Bible to seamen. To sail with Bowditch, whether the man or his book, assured success. One ship's captain was so taken by Bowditch's ability to explain celestial navigation that he boasted, "I have a crew of 12 men, every one of whom can take and work a lunar observation as well, for all practical purposes, as Sir Isaac Newton himself, were he alive."

The early decades of the 19th century were marked by amazing growth in descriptive astronomy spurred by the rise of large telescopes. Herschel and other European astronomers set a rapid pace of discovery.

In gravitational astronomy, giants of the German scientific school included Carl Gauss (1777-1855), Friedrich Wilhelm Bessel (1784-1846) and Johann Encke (1791-1865). They greatly advanced our ability to mathematically handle experimental data, to derive celestial orbits, and to account for gravitational perturbations upon the two body problem caused by "extraneous masses." In 1838, Bessel determined the parallax of a star (its shift in angular position due to the annual motion of Earth about the sun) which was a long overdue observational verification of Copernicus, using the star 61 Cygni, approximately 10 light years distant. The angular shift in position was therefore about 1/3 second of arc, a remarkably delicate measurement then impossible on our side of the Atlantic. With mathematical astronomy still beyond access to the American astronomers, Bowditch was a major figure in its introduction to the English speaking world. In the decades following the outbreak of the War of 1812, Bowditch carried out the enormous task of translating, with commentary, Laplace's epic summary of mathematical astronomy, Mecanique Celeste. The translations were published in four volumes from 1824 to 1839; Laplace's fifth volume was only partially completed when Bowditch died. Bowditch' s translations assumed an importance far beyond American acclaim, for the mathematical methods of astronomy developed in Europe were nearly as unknown to the British astronomers as they were to the Americans. Just as British shipmasters had become dependent upon The New Practical Navigator, so did Bowditch's translation of Laplace become the only really good volume available to English astronomers. We have seen how the role of astronomy in early America was no better than the country's status as a developing nation. The elegance and mathematical rigor of European astronomy was yet to be embraced and the lack of adequate telescopes kept American observers at an amateur level. Astronomy's domestic survival, in fact, seemed to be due almost entirely to the raw enthusiasm of John Adams' "free, independent and virtuous people." The high point of the early era is probably a choice between the far reaching consequences of the 1769 transit of Nathaniel Bowditch. The transit's effect was of more importance to Americans, while the contributions of Bowditch were more fundamental to the course of astronomy. Perhaps the best testament to the lasting work of Bowditch was given by the latter day American astronomer, Simon Newcomb, in his Sidelights on Astronomy:

> While the great mathematical astronomers of Europe were laying the foundation of celestial mechanics their writings were a sealed book to everyone on this side of the Atlantic, and so remained until Bowditch appeared, early in the present century. His translation of Mecanique Celeste made an epoch in American science by bringing the great work of Laplace down to the reach of the best American students of his time.

Concerning early American astronomy, Newcomb further commented:

> American astronomers must always honor the names of Rittenhouse and Bowditch. And yet in one respect their work was disappointing in results. Neither of them was the founder of a school. Rittenhouse left no successor to carry on his work. The help which Bowditch afforded his generation was invaluable to isolated students who, here and there, dived alone and unaided into the mysteries of celestial motions. His work was not mainly in observational astronomy, and therefore did not materially influence that branch of science.

Newcomb's meaning is clear. American astronomers were not at the forefront of the science during the colonial period, or during the early republic. Basic instruction and simple observations were their domain, always with a look toward application rather than theoretical speculation. American astronomers were, however, well aware of their striving status, and perhaps a bit too sensitive about it. They wanted to be accepted as equals by Europeans and tried mightily to demonstrate their competence.

Humility seemed the best approach to the American Academy, so in the preface to its first volume of Memoirs (1785) it noted that, "The astronomical and mathematical papers in this volume will, perhaps, be the last entertaining of any of the collection, and will have the smallest number of reader ...Few, if any of them, contain deep speculations and obtuse researches and calculations: but they are chiefly of the practical kind."

It must have been with particular pleasure, therefore, that when the volume was reviewed in 1788 by the British magazine Monthly Review, it was declared to be "proof that philosophical pursuits are carried on with vigor in the American States." European approval of America's early endeavors was not always the case, however, for in the previous year, the second volume of Transactions of the American Philosophical Society (1786) was condemned by the British Critical Review as being full of "empty speculation and disputed theories." It further suggested that Americans "might be more usefully employed in accumulating facts than in constructing systems."

Reference:
Revolution in Time - Landes
Astronomy Comes of Age - Roberts