2013 Boston/Cambridge Conference Retrospective

Roger Bailey

The NASS Conference at Cambridge MA was special for a couple of reasons, first to celebrate the 20th anniversary of NASS and second the opportunity to explore the exhibition of instruments in Harvard's David P. Wheatland Collection of Historical Scientific Instruments. Our local host was Sara J. Schechner, curator of the collection.

Fifty-six people attended the conference, forty-six being full registrants attending the technical presentations. Eleven participants were charter members, having joined NASS within the first year.

Registration and Reception were held at the Cambridge Courtyard Marriott Hotel on Thursday afternoon. Sixteen long term members were presented with cylindrical Shepherd's Dial kits made and donated by Brian Albinson. Recipients included: Ross McCluney, Fred Sawyer, Ken Clark, Don Petrie, Jim Holland, Bob Kellogg, Martin Jenkins, Sara Schechner, Steve Woodbury, Mac Oglesby, André Bouchard, Tom Hughes, Richard Koolish, Roger Bailey, Jack Aubert, and Helmut Sonderegger

Tickets were distributed so all could elect to take chances on the door prizes of most interest to them. To recognize the anniversary, this year twenty door prizes were given out providing excellent chances to win. The prizes, books and sundials, are listed below.

1-3 Reproduction Pewter Sundials from Williamsburg
4. *Sundials – The Art & Science of Gnomonics* by F. Cousins
5. *Anno's Sundial* by M. Anno
6-8. Acrylic Refraction Sundials by Hendrik Hollander
9-11. *Sundials: History, Art and People* by Mark Lennox-Boyd
12. *Sundials Old and New* by A. P. Herbert
13-15, CD Sundials donated by Dave Scott
16. NASS Mug
17. *Illustrating Shadows* book and CD by (and donated by) Simon Wheaton-Smith
18. *Analemmatic Sundial Sourcebook* donated by Larry Jones
19. *A Choice of Sundials* by Winthrop Dolan
20. *Sun in the Church - Cathedrals as Solar Observatories* by John Heilbron

On Friday morning we gathered at the Science Center at Harvard for a welcome to the Collection of Historical Scientific Instruments by Sara Schechner. The group was divided in four for rotating guided tours with smaller groups to the venues:

1. *Time & Time Again* - a new major exhibition of time oriented instruments including many sundials, orreries, and astronomical instruments.
2. *Time Life & Matter* - an ongoing exhibition of important scientific instruments. Thematic areas included colonial science, natural philosophy, astronomer's time, mind & body and physical matters.
3. *Special Display of Reserve Sundials* not normally on public display. Here Sara Schechner described the specific features of a collection of portable sundials, pillars, diptychs, universal equatorials *etc*.
4. *Behind the Scenes* look at the museum. Here the movable storage lockers were opened so visitors could quickly view the wide assortment of historical scientific instruments used at Harvard for teaching and research.

Sara Schechner displaying sundials

For the lunch break, we were free to choose among the many restaurants around Harvard Square, follow the Time Trials through the campus to visit "Timepieces" in the Semitic, Peabody and Natural Science Museums or to locate historic sundials. These included the Class of 1870 horizontal dial at Holden Hall, the Dudley Memorial Garden horizontal dial corrected for longitude and DST near the Lamont Library and the vertical declining dial "Veritas" on Smith Hall, Kirkland House.

Class of 1870 Sundial

Veritas Sundial

The afternoon session started at the Science Center at 3:00 pm with talks of general interest to members and guests alike.

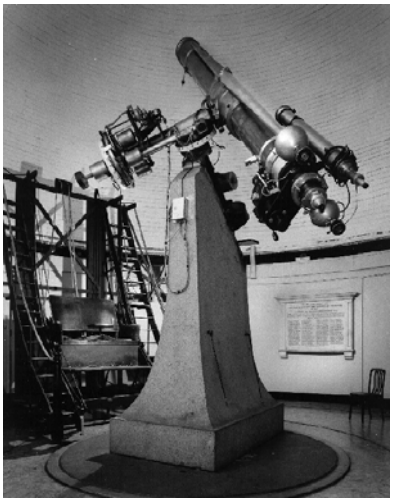
A NASS 20 Year Retrospective by Roger Bailey reviewed the origins of the society, its organization, objectives, membership activities and benefits for members. Ross McCluney, Fred Sawyer, and Bob Terwilliger were the first members and formed an organizing committee. The membership grew to 145 in the first year. Of this group, thirty-nine remain as members and eleven attended the Boston Conference, twenty years later. Membership remains stable at about 300 members. The Compendium, our quarterly journal is the most important benefit for members. The first issue was published in Feb 1994 and the 78th issue in June 2013. Fred Sawyer has been the editor and most frequent author with 185 articles. Bob Kellogg and Steve Woodbury have each contributed 31. Another sixteen authors contributed from 10 to

30 articles each. The Compendium has always been published both in print and as a digital version. The complete collection is available to members as a digital version on the NASS Repository. This CD also contains software, patents and digital books. NASS has held eighteen annual conferences since 1994 in Washington with eleven in the east and seven in the west including four in Canada. The most frequent presenters have been Fred Sawyer with 38, Roger Bailey with 30 and Bob Kellogg with 13 presentations.

A NASS 20 Year Photo Retrospective was shown at breaks during the conference. This collection of 282 pictures of NASS members enjoying sundials is available on Picasa web at this link www.tinyurl.com/NASS20Retro . The pictures were contributed by Ginny Brandmaier, Fred Sawyer Roger Bailey and others.

Trading in Time by Sara Schechner described her research on European pocket sundials designed for colonial use in American territories".

Portable Sundials in Austrian Museums was the topic for Ilse Fabian. In this presentation she gave a historical perspective with pictures and analysis of a rich assortment of various types of portable sundials in Austria. Ilse showed dials dating back to 1438 in museums in Wien, Linz, Salzburg, Innsbrook and Graz. Various types were described included quadrants, Regiomontanus dials, pillar, chalice and crucifix dials and diptych dials in ivory, brass or silver.


15" Great Refractor Telescope

Harvard Observatory: In the evening we were invited to visit the Harvard College Observatory to view the 15" Great Refractor Telescope from 1847. This was the largest telescope in the U.S. for 20 years and equal to the finest in the world. The 9" Clark Refractor from 1912 was also set up for viewing. We were shown the Alcor - Mizar, the double star system at the bend in the big dipper handle. We also visited the plate stacks, which is one of the world's largest collections of important historical astronomical photographs, so important in the pioneering work done at Harvard and now as a historical archive.

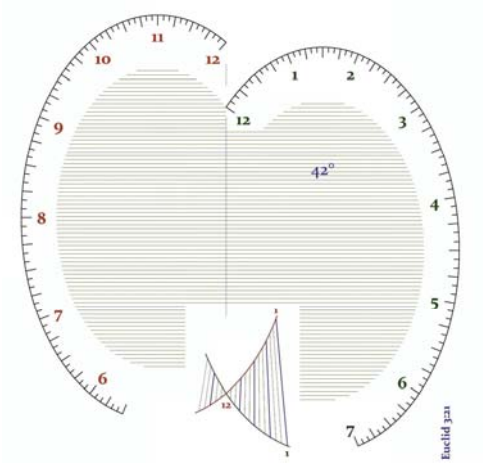
On Saturday the conference resumed back at the Marriot Courtyard Hotel at 8:30 with a presentation by Roger Bailey:

Counting the Sunny Hours: This presentation by Roger Bailey looked at ways to determine the hours of sunshine on a vertical declining sundial using the double daylight criteria. Assuming no shade or clouds, the sun will be on the dial if it is daytime at the location of the vertical declining and the location of the equivalent horizontal sundial. The challenge is defining those criteria mathematically. The presentation summarized the work by Fred Sawyer "Reducing a Plane to the Horizontal" (*The Compendium* 1(4)), Fer de Vries on "Extreme Hours of Sunlight" (*The Compendium* 2(1)), Robert Hough's "Duration" macro and Roger Bailey's 'New Dawn" spreadsheet.

A Devon Dialling Miscellany. Martin Jenkins was next up with a presentation on several topics including recently discovered Devon dials, a commemorative dial by Ben Jones, two sculpture dials in Martin & Janet's garden and his Cooke heliochronometer projects. The latest heliochronometer involved the design, machining and assembly of 103 components, over 300 hours of work. This was truly a labor of love!


Jenkins' Crooke Heliochronometer

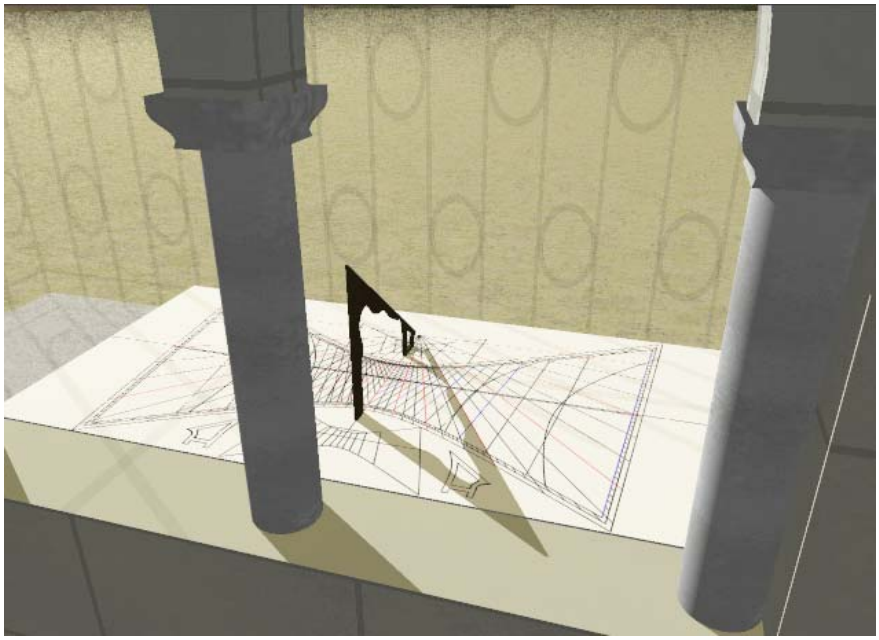
Wandering Gnomon Sundial Design: Again for this conference Fred Sawyer invented a new type of sundial to tell civil time. The design is based on a horizontal sundial with a double elliptic layout of hours and a wandering gnomon with a scale for its twice daily placement. Placing the gnomon at the appropriate position on this scale corrects the time indicated by the shadow among the hour points to show civil time with a longitude and equation of time adjustment. The double scales for gnomon placement share a common noon point, so the gnomon can be left completely stationary to indicate local solar time throughout each day, if so desired. Fred demonstrated the amazing results mathematically from the equations for the points on the ellipse and geometrically based on a lesser known proposition from Euclid. Fred designed and Mac Oglesby made custom "Wandering Gnomon" sundials for each full participant based on their latitude and longitude corrections. A placement table for every day of the year for each location was included with the operating instructions. These unique dials distributed at the conference dinner are appreciated mementos.



Sawyer's layout for a wandering gnomon dial

The midmorning refreshment break gave an opportunity for viewing displays, watching the NASS 20 Year Photo Retrospective slide show and discussions.

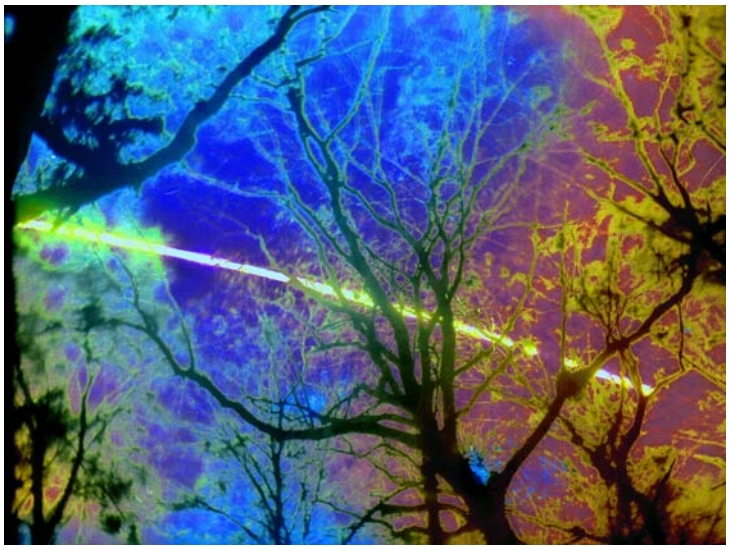
Animation of the Ibn al-Shatir Sundial by Bob Kellogg was the next presentation. In support of the Analemma Society proposal to build a replica of the famous Ibn al-Shatir Sundial at Observatory Park, Great Falls VA. The Ibn al-Shatir Sundial is the oldest surviving sundial with a polar gnomon, a significant technological change in Damascus in 1371. Roger Bailey has designed a replica adjusted for the new location and the project is seeking sponsors. Bob Kellogg took the sundial design and architectural sketches and developed an animation showing the path of the shadow on the solstices and equinox to demonstrate the function of the proposed sundial. He went through the details of the complex animation process as a guide for any seeking to produce such an impressive animation.


Still from Bob Kellogg's Ibn al-Shatir dial animation

Short presentations followed beginning with:

A Guided Tour of the Maymont Dial by Steve Woodbury. The James H. Dooley Memorial is a 1922 sundial at Maymont VA. The pillar has many classical design influences with coats of arms, symbols of faith, hope, charity, and the four evangelists, the eight acts of Christian mercy *etc*. Also included are a reclining sundial near the top, three simple vertical dials on the octagonal pillar and a table to adjust to Eastern Standard Time. These sundials are significant historical artefacts but suffering from vandalism. The gnomon for the reclining dial is quite bent and twisted from its correct position. Steve was seeking advice on how to restore the gnomon.

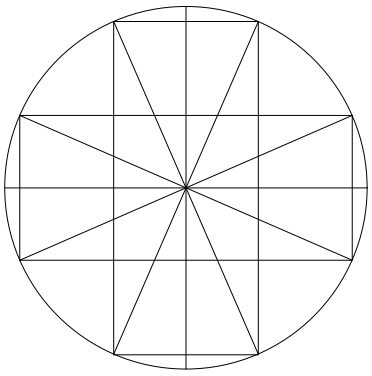
Design & Construction of an Equatorial Dial by Kevin McCarthy was the next presentation. Kevin was interested in adding an equatorial dial to the scenic hilltop garden "Jardin de Temps" at their residence on the US Virgin Islands. This large brass equatorial includes a movable insert time strip adjusted for the equation of time according to the shadow line on an engraved analemma shape.



October 24 Solargraph by Art Paque

A Solargraphy Update. At the Asheville conference Art Paque introduced us to solargraphy. This artistic technique uses b/w photographic paper with long exposures in a simple pinhole camera. A solargraph typically captures the daily path of the sun over the seasons against an interesting foreground, across the wide field of view. The image is formed directly in the silver on the overexposed photographic paper. The faint final image is digitally scanned, inverted and adjusted for color effects. Art showed one "lucky" image showing the interesting effects sometimes captured by this technique.

My Pilgrimage to Quitsato: Will Grant described his visit to the middle of the world, Quitsato, Ecuador (0.000°N, 78.1750°W). At Quitsato a large vertical pillar sundial casts shadows on the Andean Cross, a pattern with the diagonals crossing the center at 23.5° from the equator and meridian. He visited the site several times to observe the sunrise, sunset and midday shadows. He saw a similar sundial at San Paulo and a 3-D Andean Cross at Cotacachi. The concept of the equator and the path of the sun was well known in ancient cultures in South America. Further evidence was a pre-inca pyramid he visited. The walls had slopes of 23.5° and 47°.



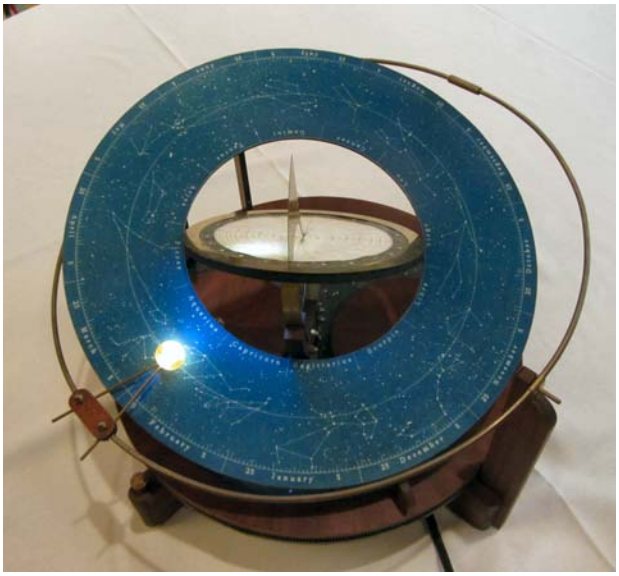
Following the lunch break, Larry McDavid was the first speaker for the afternoon session.

The Dent Dipleidoscope - A Sundial by Another Name Larry McDavid described the Dent Dipleidoscope, an instrument to determine the noon transit of the sun to set clocks. The technique depends on observing on the instrument the merging of the single and double reflected images of the sun.

The concept originally used a prism but Edward J Dent a London clockmaker patented a version using mirrors in 1843. The technique was quite useful to precisely set clocks and chronometers before time signals were available by radio. Later universal versions used setting circles, compass and telescope. The instruments can resolve the time of the images merging to perhaps 6 seconds of time, but accuracy depends on proper alignment to the meridian.

Designing the Northern Virginia Community College Dial. Bob Kellogg worked with Gino Schiavone on a large sundial at NVCC. In the presentation he outlined some of the challenges of working on a project with architects who have little appreciation of sundial design. The initial concept drawings by the architect were "a bit misguided" with the hour lines set at a uniform 15° spacing, the gnomon set to 30° rather than the latitude of 38°, and trees to the south would shade the dial. Bob wrote DeltaCAD macros to prepare drawings for a gnomonically correct dial with as much gnomon offset to the south as possible considering the placement of the footings. The latest pictures showed the gnomon set in place in concrete circles. Not yet in place were the artistic elements, the lines, markers numerals *etc.* by Gino Schiavone. In the end, the collaboration between the architect, artist and gnomonist has been successful.

"Design of the Annosphere" John Goodman described the Annosphere, a sundial without the sun, that he designed and built. The concept is to show the apparent path of the sun through its annual cycle mechanically using an epicyclic gear train to achieve a reduction ratio of 1 day rotation in one year of 365.242215 days. This he achieved with four epicyclic gears with teeth of 511/227 and 206/465. The sundial disc in the center rotated once per day showing sunrise, sunset and the hours. The linked outer ring rotates once per year and the position changes through the gear train to show the seasonal movement along the ecliptic. See www.annosphere for details.



Goodman's Annosphere

Pilkington Sol Horometer

Pilkington Gibbs Heliochronometers Geoff Parsons reviewed mean time sundials, specifically Pilkington Gibbs Heliochronometers and Pilkington Sol Horometers that show clock time using longitude and equation of time corrections. The sundial component is a simple set of vanes on a rotating equatorial hour disc. This is rotated until the spot of sunlight from the small hole on one vane projects onto the central line on the other. Time is indicated by the position of the aligned disc with the scale on the equatorial base plate. The dial is set for latitude and longitude for the intended location at the factory but can be adjusted by the user. What makes this a heliochronometer is the equation of time correction cam inside under the date ring. This corrects the position of the aligned hour disc for the OQT correction for

the date. George James Gibbs invented the sundial in 1906 and went into partnership with William Pilkington to manufacture and sell the instrument. Fewer than 1000 were sold. Pilkington independently patented the Sol Horometer in 1911 but only about 50 of this model were sold. This instrument shared the base design but replaced the vanes with a light box for better contrast and improved the longitude adjustment. The equation cam was replaced by a patented arrangement of sliding scales. Geoff ended his presentation with a picture of his heliochronometers, a PG heliochronometer, a sol horometer and a Schmoyer on his balcony in Portsmouth UK.

John Smith's Rectifying Days Fred Sawyer entertained us with a look at John Smith, (1650-1730) and Smith's interesting program of keeping clocks set to tell true solar time. John Smith had an interesting career in diverse occupations, in religion as a chastised Unitarian, in medicine as a cheerleader for water drinkers, and as a clockmaker and champion at rectifying clocks. Equation of Time tables had been published by Christian Huygens in 1665 and John Flamsteed in 1672. Clockmakers like Thomas Tompion and John Smith included tables, but Smith's were intended to "rectify" the clock to show true solar time. Smith's concept was to correct the clocks on ten "Rectifying Days" in a way that would keep the error within reasonable bounds with minimum effort. His first table was not very successful but the second table published in 1694 reduced the maximum error to 3'33" by making ten adjustments per year on specified "Rectifying Days". Fred showed an adaptation of Smith's method, using modern EQT values and the Gregorian calendar, producing a maximum error of 3'30" with no end of year residual error.

The Equation of Time and a Prototype Sidereal Time Sundial Tom Hughes is interested in how Flamsteed determined the equation of time, the difference between solar time and clock time. He conjectures that Flamsteed used the transit time of stars to determine sidereal time and the noon transit of the sun to determine solar time. Could the sidereal time and solar time be tracked simultaneously on one instrument? Tom has developed a sidereal sundial to do just that, to determine sidereal time and solar time simultaneously. This sidereal sundial consists of a polar gnomon with an equatorial disc at 90° to the polar axis and an ecliptic disc tilted at 23.5° to the equatorial disc. He uses this sundial to determine solar noon and rotates the polar axis gnomon with the discs attached until the ecliptic disc shadow is minimal. When the ecliptic disc is aligned to the sun he then reads the sidereal time on the scale on the equatorial disc. Solar time and sidereal time can thus be measured at the same instant. This could allow measurement of the equation of time throughout the year. His results have been within a few seconds around the equinoxes but less accurate near the solstices when the declination of the sun changes slowly.

Half-Analemma Noon Mark & Viewing Polaris in Daylight Bill Gottesman had set up a telescope at the hotel and showed us that Polaris was easily observed during the day. Other bright stars and planets can be observed as well but aligning the telescope to find them is more difficult. Polaris moves very little being less than 1° from the polar axis. His presentation provided details of the set up for his 4" telescope.

The next topic was Bill's interest in removing the ambiguity of solar noon marks using the analemma. You need to know the month to know which side of the analemma is the correct one to use. His solution was to flip half the analemma curve onto the other and determine the average curve. He then proposed using a dove prism to flip the spot of light projected onto the noon mark for the time of the year the analemma curve was also flipped. In theory this should work. The difference between the averages was quite small except near the winter solstice.

The third part of Bill's presentation described the surprise birthday present for his wife, a pair of sundial ear rings with her birthstone as the gnomon and an emerald marking the time of her birth. We were all impressed in many ways with his special birthday surprise.

Sawyer Dialing Prize Presentation: This year the Sawyer Dialing Prize was awarded to André Bouchard "In recognition of two decades of his promoting, preserving, extending and exemplifying the *patrimoine Québecois* of dialing and gnomonics".

André Bouchard accepting the Sawyer Dialing Prize from Fred Sawyer

"During the first 15 years of the CCSQ (la Commission des Cadrans solaires du Québec) André made numerous presentations on gnomonics, adopting objective and descriptive ways in order to highlight the specific elements of particular dials and dialist styles. Now, in his role as editor of The Gnomonist / Le Gnomoniste he states that he is rediscovering the fundamentals of philosophy. This is evident by his concern to carefully show that sundials through symbolic meanings of time and place cast both shadows and beauty onto the world." This philosophy was the theme of his presentation.

A Beautiful Spiral Dial in Québec: A New Case Study in Aesthetics & Gnomonics André showed pictures of a sundial built in 2008 on the shore of the St Laurence River at Point aux Outardes Park near Baie-Comeau. The sundial is a 270° helical spiral. The polar gnomon and its supports simulate bull rushes. A sculpture of geese in flight was added later. It is a beautiful dial, technically and symbolically correct as outlined in André's philosophical presentation.

On Saturday the conference dinner was held at the conference hotel. Each participant received a conference gift. For full participants, this gift was a wandering gnomon sundial designed by Fred and made by Mac Oglesby.

On Sunday morning the technical presentations started at 8:00 am.

An Easter Dial? – Commemorating A Moveable Feast: Barry Duell continued his research on significant alignment of the stairs of the Senba Toshogu Shrine in Tokyo Japan. Is there an Easter alignment? The range of dates provides many opportunities. Perhaps the first full moon after the spring equinox has some symbolic meaning in Japan as it has in so many cultures, not just the Jewish Passover and Christian Resurrection. The shadows grazing the stairs exist during the range of Easter dates. The significance and meaning of what might be chance occurrences remains speculative.

The Sundials of R. Newton Mayall at Harvard: Sara Schechner focused her presentation on the life work of Margaret Mayall as a Harvard astronomer although most of the popular books on sundials and astronomy list her husband and co-author R. Newton Mayall first. Margaret Mayall was hired by the Harvard Observatory in 1925 to work with Anne J. Cannon on the magnitude and spectral classification of stars. This led to her work on variable stars, becoming Recorder for the American Association of Variable Star Observers in 1949. She married in 1927 R. Newton Mayall, a landscape architect and member of the AAVSO. Their book "Sundials: How to Know, Use and Make them" was first published in 1938. The 1973 second edition is more familiar to most NASS members. The presentation also outlined the struggles to maintain the AAVSO after the Harvard Observatory withdrew funding and accommodations in 1952. For details see her AAS obituary here. http://aas.org/obituaries/margaret-walton-mayall-1902-1995

A Disposable Sun Compass: As Frank King was unable to attend, Fred Sawyer presented this in his place. We often need to determine north when laying out sundials or determining the declination of walls. Frank devised a simple sun compass suitable for a specific location and date. For such purposes he wrote a program to calculate the azimuth of the sun through the day for the required location and date. This he printed as a compass with a time ring. The compass is easy to use. Lay it flat, add a vertical gnomon, and turn the card until the shadow aligns with the civil time. The compass is now aligned to true

north. For the conference he produced 53 versions of the compass card for the conference location in Boston, one card for each week of the coming year. This can be scrolled like a flick book to see the change from week to week. Frank has made the Post Script file available for anyone to hack to enter their own specific location data. This presentation, flick book and program were included as a digital bonus with *The Compendium* Sept 2013.

Two Analemmatic Sundial Projects: Bob Kellogg outlined his collaboration on a couple of analemmatic sundial projects: an Eagle Scout project with William Spriggs in Herndon Virginia and an elementary school project in Waterbury VT with a school teacher, Carrie Dessureau. The first requirement in laying out a sundial is finding true north. Bob provided guidance on the Indian Circle method, the shadow method and determining solar noon with the NOAA Solar Calculator. From the north line, the east west line can be established with the Pythagorean 3-4-5 triangle. Bob provided an Excel spreadsheet to calculate the walkway and hour points based on local parameters: latitude, scale, longitude and time zone. The spreadsheet then calculated the local dimensions. The hour lines were laid out using distances measured from the center and the end of the north axis. Both dials were constructed and artistically painted by the local teams.

A series of Short presentations followed:

NASS Flash: Fred Sawyer distributed and explained the flash drive provided to all full participants. As before, this contains treasures: almost all the conference presentations, associated videos and programs and a cornucopia of utility programs. This flash drive even includes the latest version of the NASS Repository CD. Again thank you Fred for providing this benefit to conference participants.

Windowsill Noon Mark: Ken Clark described a simple noon mark suitable for a south facing window. He used Piers Nicholson's website www.solar-noon to calculate a calendar giving the civil time for solar noon at the location. He modified the table adding a center section with a bold vertical line. This he printed on 3M transparency film and stuck it on the window. The sundial is just a simple disc with a line oriented south in line with the vertical line on the transparency.


Fred Jaggi and Planetarium

Making an Orrery and a Planetarium: Fred Jaggi had displayed a couple of orreries. One was a model including all the planets, the other the sun earth and moon. The presentation focused on the Lang Planetarium, patented by A. Lang in 1897, USP 578,108. Being skilled in the art, Fred used the information and drawings in the patent to make his own version.

A Great Grandfather's Orrery: Roger Bailey showed pictures of a homemade orrery discovered when a friend was settling her mother's estate in France. This orrery made by her grandfather in the late 19th century includes the sun and all the planets up to Neptune. Turning a crank moves gears and chains to move the planets through their orbits. The orrery was an interesting discovery related to her great grandfather's interests and skills.

NASS: Designed by Disney? Ross McCluney recounted how his involvement with the construction of the sundial at Disney team's headquarters in Florida inspired him to a new interest in sundial design. See "The Team Disney Sundial" (*The Compendium* 4(4)) for details. This interest in sundials led him to search for other sundial designers and makers. He contacted

Fred Sawyer and Bob Terwilliger. In 1993 these three formed an organizing committee defining the what why and how for the North American Sundial Society. Ross was the chairman or president for the first two years as Fred went to work on mailing list, *The Compendium* and the Sundial Registry, and Bob served as the first secretary/treasurer. The rest is the successful history of NASS.

The 20th Annual NASS Conference will be held in Indianapolis IN (Aug. 2014). Details to follow – but you can begin planning your participation now. If you plan to attend and have a talk you would like to present to an attentive, appreciative audience, contact Fred Sawyer now ! (fwsawyer@aya.yale.edu)