



## A Short History of Sundial Time

by Chuck Steele

I grew up in a house that had mechanical clocks. As a young kid in Cub Scouts I was surprised and fascinated that people used to keep time with sundials. In a Cub Scout manual were the plans for a simple sundial you could make out of card board which I did. However when I took it outside and pointed the gnomon to Polaris, the cast shadow indicated the time an hour and a half off from the clocks in the house! So what good are sundials I thought. As a kid I didn't know about Standard Time, Local Solar Time or the equation of time. Sundials were used in ancient Egypt, Babylon, Greece, and Rome. Mechanical clocks began to replace sundials since you can see the time inside your home, know the time even on cloudy days and also at night. Back in 1275 the crown wheel, verge, and foliot clock escapement was invented. These early clocks had hand carved wooden gears. A replica of one the earliest wooden clocks is pictured below. Later the wooden gears were replaced by metal gears and pendulums which were much more accurate. The clocks were set to what the sundials showed as being the correct time thus showing Local Sun Time. But then, because the mechanical clocks were so accurate people noticed that during the year the sundial could be fast or slow from the mechanical clocks by as much as 16 minutes. This difference in average solar time and the sundial time is called the Equation of Time. Mean (Local) Solar Time was widely used for five centuries until the later part of the 19th century.



Thirteenth century crown clock reproduction with wooden gears. Note a rock is used as a weight, and the clock only has an hour hand. Not very accurate but better than a sundial. (One of my collection of clocks at home.)

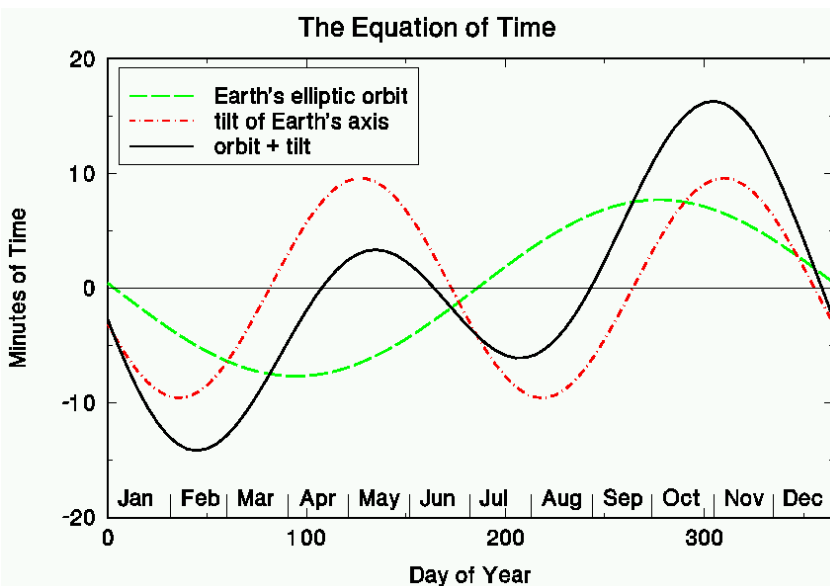


A sundial which features a linear dial and can be adjusted to show Standard Time. Built by the author. The gnomon in the shape of the analemma adjusts for the Equation of Time.

### The Rise of Standard Time:

With Local Solar Time every change in longitude means a different time. Once railroads crisscrossed America and people started quickly traveling from town to town, keeping accurate time got confusing as each town had their own unique time. Making train schedules became a nightmare. The Railroads proposed Standard Time for the nation which divided the country into 4 time zones. This made it much easier for people to know the time as everyone in a time zone could set their pocket watches to the same Standard Clock, so everyone's watch would agree with everyone else's time piece. Standard Time made most sundials obsolete, unless you lived on the center Prime Meridian of a Time Zone. However it is possible to make adjustments to Sundials to correct for longitude to show Standard Time and also the equation of time. The above Sundial (previous page) has several adjustments which allow for both longitude and latitude adjustments. The gnomon has a shape of the analemma which cast a shadow which accounts for the Equation of Time so that Standard Time can be directly read. Time is read by one edge of the cast shadow at the center-line of the dial. A graph on the base shows you which side of the shadow to read the correct time depending on the date. The dial is also numbered with both Standard Time and Daylight Savings Time.

A sundial at the University of Cincinnati, when I was a student, kept remarkably accurate time within one minute (Pictured below right.) To read this sundial you had to turn it so an image of the sun lined up with an engraved analemma to the proper date. The large ring dial was inscribed with 5 minute increments so it was fairly easy to estimate the correct time within a minute. On a trip back to campus several years ago I was disappointed the sundial is no longer there.



The **Equation of Time** is the result of two factors. The Earth's axis tilt and the Earth's elliptical orbit. By adding these two sine waves together we get the Equation of Time the black line. Four times each year sundials can agree with clocks. Luckily the Equation of time is within 6 minutes or less of solar mean time during the summer months, so sundials can be made to read Standard Time & Daylight Time fairly accurately the months you are out in the yard.



The wall sundial shown below allows the time to be read at a distance due to its high location. Many European castles have such sundials which were in wide use for centuries. There are formulas for deriving the placement of the time lines for sundials. But I found that it was more accurate to paint the lines cast by the shadow on the date when the Equation of Time was zero at the precise time on the hour and quarter hours. While the formula gives exact angles in practice getting the gnomon pointing exactly to the celestial pole is a little challenging, as the wall prevents you from looking directly at Polaris, so I was forced to use a protractor with some limitations of accuracy. I'm pretty sure it is within one degree but that probable error allowed the sundial to differ from the Equation of Time by two minutes in early December and late January. My south facing wall is not on an east-west line, but is about 22 degrees off to the west, again plus or minus a degree. Small errors add up.

A small ball is attached to the gnomon and cast a shadow seen in the picture near the right mount support strut. The shadow of this ball travels left to right and down each day. In the summer the shadow is toward the bottom and in the winter near the top. A series of curved lines shows the path of the ball on the 20th of each month. On June 20th (the Summer Solstice), the ball shadow traces a hyperbolic curved line shown in red at the bottom. On the two Equinox each year the ball traces a straight line across the dial painted in green. If the wall were facing due south this line would be level. At the Winter Solstice the ball path is another curved line painted in blue. So while working in my yard in the summer often without a watch I can look up and see the correct time within several minutes if the sun is shining.

Wall sundial pictured to the left is the one I made last summer. The dial has increments for the hour, quarter hour, half hour, and has Roman numerals for Standard Time and Arabic Numbers for Daylight Savings Time. The gnomon is made 1/8" steel rod. The dial is simply painted onto the brick so this is a pretty easy project. The most expensive part was getting the support rods welded to the gnomon. Holes drilled into the mortar anchor the rods to the wall



Several year ago I purchased a garden sundial which was like my Cub Scout sundial. Yes it only shows local sun time which is nothing like what your watch shows. So if you want a useful sundial, make your own.

## Want to Touch the SUN!

By Jack Brisbin

By sending your name to the Sun you will be part of the first Space Probe to actually touch the Sun. Use the following link to submit your name, that will be included on a memory card that will fly on the Parker Solar Probe. The Solar Probe will come within 4 million miles of the Sun and will provide new data on Solar activity and improve our ability to forecast major space weather events. Paste the following link in your web browser. If you have friends or family members that are interested in the Sun this would be a great project to follow. But, to get your name on the Probe you have to submit it **before APRIL 27, 2018**. The launch is scheduled for August 2018.

[http://parkersolarprobe.jhuapl.edu/The-Mission/Name-to-Sun/?utm\\_source=Science+worth+knowing&utm\\_campaign=38a945a23d-Science+worth+knowing\\_12-21-17&utm\\_medium=email&utm\\_term=0\\_83c20124eb-38a945a23d-297664773](http://parkersolarprobe.jhuapl.edu/The-Mission/Name-to-Sun/?utm_source=Science+worth+knowing&utm_campaign=38a945a23d-Science+worth+knowing_12-21-17&utm_medium=email&utm_term=0_83c20124eb-38a945a23d-297664773)

The screenshot shows the 'Send Your Name to the Sun' form on the Parker Solar Probe website. The form is set against a background of the Sun and the spacecraft. It includes a 'VIP PASS' graphic on the left and a 'HOT TICKET' graphic on the right. The form fields are: First Name, Last Name, Email, and Confirm Email. Below the fields, there is a 'Submit' button and a note: 'You will be sent an email with instructions to complete the submission process.' The text below the form reads: 'Be a part of the first mission to touch the Sun! Submit your name and it will be included in a memory card that will fly aboard Parker Solar Probe spacecraft. Come with us as we plunge through the Sun's atmosphere, closer to the surface than any spacecraft before it, facing brutal heat and radiation conditions—and ultimately providing humanity with the first-ever close-up view of a star. Submissions will be accepted through April 27, 2018.' There is also a 'SHARE' button with social media icons for Facebook and Twitter.

After you fill out the VIP pass you will get a e-mail confirmation request, within a couple of minutes but no later than 4 hours; E-mail example; ([NoReply-Parker-Solar-Probe@bitbucket.jhuapl.edu](mailto:NoReply-Parker-Solar-Probe@bitbucket.jhuapl.edu))



When you go to the web site click on the different menu titles and subtitles that describe the mission and the launch it is very informative and very educational.

## Lowbrow Messier Marathon

March 17, 2018

by Don Fohey



Left: Barry Wissmate setting up. Center: Jim Forrester, Doug Nelle, Barry Wissman discussion, John Manney puts on warmer clothes. Right: Jim Forrester adjust club 17" telescope. Photos by Doug Scobel

This year it happened! We had a Saturday night with a new Moon, and clear skies in late March for a very successful Messier Marathon. I arrived at Lake Hudson Rec. Area before sunset to find observers strung out along the entire length of the beach parking area. The Lowbrows were set up center and west of the beach frontage. Doug Scobel, Doug Nelle and Jim Forrester set up the club 17 inch telescope and tested the new servo cat drive. (The difficulties they were having were later determined to be caused by a loose center pivot bolt attachment to the ground board.) I set up my 10" push-to DOB between Barry Wissman, and Abe Oraiqat. In the dark I heard if not saw Chuck Steel, Joy Poling, John Manney and Jim Moscheck. Chuck visited most of the member telescopes enjoying celestial sights.

The evening began with a nice sunset and a delightful view of Venus and Mercury. Later in the evening the southern sky had a parade of planets. Jupiter, Mars, and Saturn were all in a line. The early evening objects were difficult. M77, M74, M33, M31, M32 and M110 are on the early list. I first tried for M77 and M74 but they were overwhelmed by the bright Western sky. I first saw M31 (Andromeda). I shared the view with Abe's daughter who may have been a bit underwhelmed by the faint fuzzy spot. At that time I could not see Andromeda's neighbors M32 or M110. I kept rotating between object until I saw M33 (Triangulum Galaxy), M32 and M110 were then visible. I found M77 and gave up on M74. M74 is bright at m10.0 but that brightness is disturbed as it is a large face on spiral galaxy. It just wasn't visible in the lingering brightness of the western sky. I don't believe any present were able to discern M74.

The rest of the evening was fun. I estimated that I had 5 min 30 seconds per object. I took the time to appreciate each object before logging and moving on. Barry, Abe and I shared views often. Abe verified with views thru my 10" that his smaller non computerized refractor view was indeed correct. An enjoyable part of the evening was that folks stopped by my telescope asking to see the planets or to share what I was looking at. I had not seen many of the open cluster in some time. I had forgotten how beautiful many were with brilliant stars in an ink black background.

It was cold with the temperature dropping to 24 degrees. Taking breaks to warm up put me behind my schedule making the evening somewhat hectic. Heavy frost formed on all equipment. My Telrad iced up beyond usefulness but I didn't need it. My digital encoder with Sky Safari made it easy to point to each object. I gave up about 5:30 am while looking at objects in Sagittarius. I could barely make out the constellation in the brightness of the horizon sky. Even M8 (Lagoon Nebula) was barely discernible. Shaking from the cold I went into my camper to warm up and take a nap. I woke to daylight with the last of the telescopes being loaded into cars. I logged 92 Messier objects. I believe Barry logged the most with 104.

## Annual Treasurer's Report

By Treasurer Doug Scobel

### University Lowbrow Astronomers Balance Sheet 01 April 2017 - 31 March 2018

<u>Income</u>		<u>Expenses</u>		<u>Memberships</u>	
Dues	\$2,565.00	Phone (AT&T Messaging)	\$190.20	<b>Individual/Family:</b>	<b>39</b>
Extra for mailed newsletter	\$162.00	Newsletter printing/mailing	\$207.33	<b>Senior:</b>	<b>73</b>
Magazine subscriptions	\$468.00	Magazine subscriptions	\$468.00	<b>Student:</b>	<b>6</b>
Astronomical League	\$217.50	Astronomical League	\$220.00	<b>Out-of-state:</b>	<b>14</b>
Donations/Gifts	\$193.00	Donations	\$555.00	<b>Lifetime:</b>	<b>5</b>
Shirt/Cap sales	\$197.00	Guest speaker expenses	\$75.00	<b>Guest/Honorary:</b>	<b>6</b>
RASC publication sales	\$680.00	Shipping/mailing	\$32.99		
<b>Total Income</b>	<b>\$4,482.50</b>	RASC publications cost	\$648.50	<b>Shirt Inventory</b>	<b>35</b>
		Observatory maintenance	\$243.95	<b>Cap Inventory</b>	<b>10</b>
<b>Balance 01 April 2017</b>	<b>\$7,069.72</b>	17.5-inch Dob enhancements	\$2,617.66		
<b>Plus Income</b>	<b>\$4,482.50</b>	Miscellaneous	\$441.13		
<b>Minus Expenses</b>	<b>\$5,699.76</b>	<b>Total Expenses</b>	<b>\$5,699.76</b>		
<b>Balance 31 March 2018</b>	<b>\$5,852.46</b>				

Here's the balance sheet for fiscal year April 1, 2017 to March 31, 2018. Though we spent a lot of money on the 17.5-inch Dob, as you can see we still have a healthy bottom line. Here's an overview:

As of March 31 we have 143 memberships, an increase of 13 over last year. This is a high water mark for the club, at least since I joined in the mid-1980s.

The disparity between newsletter payments and outlay is a little misleading. A portion of our expenses were incurred last year, plus there's the overhead of printing a newsletter for one of our lifetime members.

Magazine subscriptions break even exactly. The dollar amount seems high; that's due to the annual group Astronomy magazine order that the treasurer makes every summer. There's a scattering of Sky and Telescope subscriptions in that number also.

This year 29 Lowbrows are also Astronomical League members, now that we are an A.L. member society. The difference between what members paid and what we paid out is the nominal \$10.00 annual fee that the A.L. charges, plus one member paid ahead for this coming summer's A.L. dues.

Most of the donations we received this year were smallish and not-so-smallish donations from various members that include them with their dues payments. Those donations are greatly appreciated! A \$50.00 donation from Crounse District Library, as a thank-you for the MCSS event, is included in that amount as well.

Our guest speaker expenses were for gift cards to two multi-time guest speakers, meteorite expert Sandra Macika and Dr. Claude Pruneau from Wayne State University.

Our largest donation going out is our annual \$400.00 donation to GLAAC for Astronomy at the Beach, with the balance being our annual donations to the International Dark Sky association and to sponsor the Peach Mountain Clear Sky Chart.

Our shirt/cap sales were from the sale of 4 T-shirts and 8 caps.

Shipping expenses include shipping a T-shirt to guest speaker and out-of-state Lowbrow David Austerberry, and postage stamps.

As you can see we make a very modest “profit” on our purchase and sale of RASC calendars and handbooks late in the calendar year.

The bulk of our observatory expenses went towards recoating the mirrors on the club’s 6-inch f/8 Newtonian reflector, and a Bluetooth adapter made by member Don Fohey for the McMath. A small part of the expenses were for observatory maintenance items.

The 17.5-inch Dob enhancements item is our total expenses for adding ServoCAT go-to and tracking to the telescope. The largest items were for the ServoCAT itself, an external battery and charger for powering it, and the SkyFi unit which lets us control the telescope from any mobile device running SkySafari. An expense to replace the altitude encoder is included in that amount, plus other maintenance items and supplies.

Miscellaneous expenses include the annual fee for our post office box, the cost of food and drink at the July meeting at EMU, expenses for maintaining our web presence, and the cost for printing our club flyers.

If you have questions or would like further detail then simply contact me. Also, I always bring the ledger with me to our monthly meetings should you wish to take a look at individual line items.

### Member Photos



Steve Winchester included this photo in an email to members on March 31st. “I was out looking at the moon last night in Ann Arbor, and what I saw was very colorful. I have not seen a “Lunar Corona” that colorful for years. It had an orange “mackerel sky” ring outside of bluish central area. Pastel colors all around, just plain neat! It held true to folklore too “Mackerel sky, not twenty-four hours dry”. Wish I’d heeded that and put the grill cover back on last night!”

### Upcoming Events

Open House at Peach Mt. Saturday April 14th.

Lowbrow Monthly Meeting Friday April 20th, 7:30pm Angel Hall  
 Speaker: Fr. Richard D'Souza  
 "Galactic Archaeology: Or What did your galaxy eat for dinner?"  
 Officer Nominations and Election.

Open House at Peach Mt. Saturday April 21st.

**UNIVERSITY LOWBROW ASTRONOMERS**

Meeting Minutes—March 16, 2018

The meeting speakers were Vice President Dave Jorgensen and President Charlie Nielsen. Dave did a Power Point show and tell with his home made interferometer he's dubbed "Micro LIGO." Dave discussed the nature of various types of waves—water, air and light; particularly how the wave/particle nature of light was expressed in his small unit and how his model demonstrated some of the properties of the LIGO experiment itself.

Charlie took up member Kathy Hillig's suggestion that the club examine at meetings some of the Night Sky Network Tool Kits the club owns. Tonight's was the "Glass and Mirror Kit," showing how lenses and mirrors bent/reflected light and how telescopes take advantage of these properties.

**OFFICER REPORTS:**

President Charlie Nielsen—The club is taking part in State Wide Astronomy Night after our April 20 meeting with demonstrations using the Night Sky Network Tool Kits. Also, the Michigan Math and Science Scholars annual observing session on Peach Mt. is scheduled for Tuesday, July 24.

Annual Elections: All officers present (President Charlie Nielsen, Observatory Director Jack Brisbin, Treasurer Doug Scobel and Vice Presidents Dave Jorgensen, Larry Halbert and Jim Forrester) agreed to serve another term. Newsletter Editor Don Fohey, Webmaster Krishna Rao and Vice President Adrian Bradley need to be heard from. Nominations can be made via email and at the April meeting. Self nominations are encouraged and accepted

Vice President Jim Forrester reported Instagram Monitor Ginia Forrester request of photos from the next night's Messier Marathon at Lake Hudson and that all submissions include the member's Instagram information (if any).

Observatory Director Jack Brisbin has been out to Peach Mt. and reports almost all snow melted and the road up the Hill from North Territorial is now passable.

Vice President Larry Halbert reported the new club brochures have been printed and distributed to several venues including the Ann Arbor District Library, the Leslie Science Center and Saturday Morning Physics.

Treasurer Doug Scobel reported a balance in the club treasury of \$5747. There are currently 141 members of the University Lowbrow Astronomers.

Member Mike Kurlyo reported interest in a telescope loaner program from staff at the Brighton Library. It was suggested he refer them to Lowbrow Amy Cantu, a librarian at the Ann Arbor District Library and one of the staff in charge of the Library's collection of telescopes.

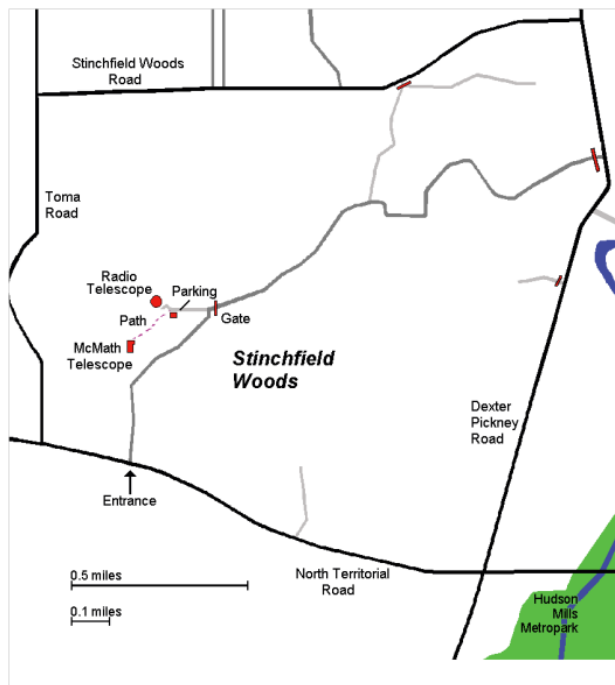
Submitted respectfully by,  
Jim Forrester  
Vice President



### Places & Times

Monthly meetings of the University Lowbrow Astronomers are held the third Friday of each month at 7:30 PM. The location is usually Angel Hall, ground floor, Room G115. Angell Hall is located on State Street on the University of Michigan Central Campus between North University and South University Streets. The building entrance nearest Room G115 is the east facing door at the south end of Angell Hall.

Peach Mountain Observatory is the home of the University of Michigan's 25 meter radio telescope and McMath 24" telescope which is maintained and operated by the Lowbrows. The entrance is addressed at 10280 North Territorial Road, Dexter MI which is 1.1 miles west of Dexter-Pinckney Rd. A maize and blue sign marks the gate. Follow the gravel road to the top of the hill to a parking area south of the radio telescope, then walk about 100 yards along the path west of the fence to reach the McMath Observatory.



### Public Open House / Star Parties

Public Open Houses / Star Parties are generally held on the Saturdays before and after the New Moon at the Peach Mt. Observatory, but are usually cancelled if the forecast is for clouds or temperature below 10° F. For the most up to date info on the Open House / Star Party status call: (734) 975-3248 after 4pm. Many members bring their telescope to share with the public and visitors are welcome to do the same. Mosquitoes can be numerous, so be prepared with bug repellent. Evening can be cold so dress accordingly

### Lowbrow's Home Page

<http://www.umich.edu/~lowbrows/>

### Membership

The University Lowbrow Astronomers membership dues are \$30 per year for individuals or families, \$20 per year for students and seniors (age 55+) and \$5 if you live outside of the Lower Peninsula of Michigan. Membership entitles you access to our monthly Newsletters on-line at our website and use of the 24" McMath telescope (after some training). A hard copy of the Newsletter can be obtained with an additional \$18 annual fee to cover printing and postage. Dues can be paid at the monthly meetings, by PayPal, or be check made out to University Lowbrow Astronomers and mailed to:

**The University Lowbrow Astronomers**  
**P.O. Box 131446**  
**Ann Arbor, MI 48113-1446**

Lowbrow members can obtain a discount on these magazine subscriptions:

**Sky & Telescope - \$32.95/year or \$62.95/2 years**

**Astronomy - \$34.00/year, \$60.00/2 years or \$83.00/3 years**

For more information about dues or magazines contact the club treasurer at: [lowbrowdoug@gmail.com](mailto:lowbrowdoug@gmail.com)

### Newsletter Contributions

Members and non-members are encouraged to write about any astronomy related topic. Contact the Newsletter Editor: Don Fohey [donfohey@gmail.com](mailto:donfohey@gmail.com) to discuss format. Announcements, articles and images are due by the 1<sup>st</sup> day of the month as publication is the 7<sup>th</sup>.

### Telephone Numbers

President: Charlie Nielsen (734) 747-6585  
 Vice President: Adrian Bradley (313) 354 5346  
 Jim Forrester (734) 663-1638  
 Larry Halbert  
 Dave Jorgensen  
 Treasurer: Doug Scobel (734) 277-7908  
 Observatory Director: Jack Brisbin  
 Newsletter Editor: Don Fohey (734) 812-3611  
 Key-holders: Jim Forrester  
 Jack Brisbin  
 Charlie Nielsen  
 Webmaster Krishna Rao

**A NOTE ON KEYS:** The club currently has three keys each to the Observatory and the North Territorial Road gate to Peach Mountain. University policy limits possession of keys to those who they are issued. If you desire access to the property at an unscheduled time, contact one of the key-holders. Lowbrow policy is to provide as much member access as possible.

### Email to all members

[Lowbrow-members@umich.edu](mailto:Lowbrow-members@umich.edu)



## University Lowbrow Astronomers



Member Club



Astronomical League Member Society  
#201601, Great Lakes Region

University Lowbrow Astronomers  
P.O. Box 131446  
Ann Arbor, MI 48113

STAMP