AD ASTRA

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CLUB CALENDAR

Next Meeting: January 15, 8:00 p.m. at the Bradley building. *Early warning:* The March meeting will be a special presentation at the Fernbank Planetarium, *not* at the Bradley building. It will be held early, at 7:00 p.m. so as not to conflict with the regularly scheduled show.

Monthly Program: Dr. Robert Roper of the Geophysical Sciences Department of Georgia Tech will speak on Radio Observations of Meteors.

AD ASTRA is published monthly during the academic year by the Atlanta Astronomy Club, Inc. The AAC, a non-profit organization, is dedicated to the advancement of amateur astronomy, and fostering the social, literary, and educational needs of its members. Meetings are held on the third Friday of each month (second Friday of December) unless otherwise announced in this publication. Membership dues are $25 annually and include a subscription to *Sky & Telescope* magazine and use of club observatory facilities.

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Rick Clark, Richard Jakiel

Submissions: Article submissions are most welcome, and may be delivered to the editor for consideration.

CLUB MINUTES

The December 11, 1987 meeting of the Atlanta Astronomy Club was held at the Bradley building with President Lee Wilson residing.

Bob Hayward, from Fernbank Science Center, showed a film about the Crab Nebula. The film was very imformative. It chronicled the history of the Crab Nebula and the probability of the nebula being the Chinese "guest star" of July, 1054 A.D.. Scientists interviewed for this film explained how studying the Crab Nebula has helped astronomers understand the existence and creation of neutron stars.

WHAT TIME IS IT?

by Don Barry

"And she leaves at noon sharp." says the clerk at the railway window. Confident of the precision of your new 1863 pocket Elgin, just set by the courthouse clock of neighboring Decatur, you stroll off to the saloon. Just finishing your second draft, the whistle of the departing train blows as you look down in horror at your precise watch, uselessly indicating 5 minutes before the hour in the wrong time system.

In this manner were countless trips spoiled in the 19th century, when time was more reliably established by the rooster than the clock. For millenia, the calendar reigned supreme, and time was not often reckoned across the day. But industrialization, with schedules, navigation, and fragmentation of the daily routine, brought with it the ubiquitous clock, and the complications of time.

Back then, most municipalities kept their own time scales, with noon designated by nothing more than the town clock, approximately set by an appropriate Leader of the Community. This worked fine for commerce, but it was havoc with railroad schedules. In 1883, therefore, a uniform system of Standard Time was introduced, whereby each community would have identical time, or time differing by an integral number of hours, depending on the Time Zones.

This system of time zones, introduced by the Railroad Consortiums, eliminated the paradox of our traveler who had to contend with a myriad of conflicting time systems. It also simplified reduction of astronomical data and navigational calculations by providing the concept of a Master Time, then fixed at Greenwich, England, to which all time measurements could be reduced.

None of this would have been possible without the advent of accurate clocks, which had only been available since Galileo's time. His observations of the tautochronicity (equal time property) of pendulum motion allowed the establishment of the distributed system of coherent time. More importantly, with the advent of portable spring-based chronometers, the transport of time information to remote locations was allowed so that new time standards could be calibrated, and more importantly, accurate longitudes could be measured.

For many years, a master pendulum clock operated in an evacuated chamber in England, providing an accuracy to within a few seconds a year by which slave chronometers could be calibrated, and time information disseminated to the world. Secondary chronometers in remote locations could be recalibrated by astronomical observations once accurate longitude information was known, and the time system kept in coherence.

As with all the sciences, though, accuracy begets complexity. As clocks grew more accurate, discrepancies between clock time and earth time grew apparent, and soon it was obvious that the earth, which through its rotation generates our concept of daily time, was no longer as accurate as the clocks engendered to measure it. Another subtle complication arrived with acceptance of the theory of relativity, whose fundamental premise is that observations of motion and time vary depending on the perspective of the observer. While the world continued setting its clocks by the

Above: NGC 253, a barred spiral galaxy in Fornax. Observed at 95x. *Below Left:* The Crab Nebula, M 1(NGC1952) at 175x. *Below Right:* NGC 2158 at 240x, and P. Comet Borrelly, at 175x. All drawings by Richard Jakiel with the 20" f/4.5, except for NGC 2158, made with the 10" f/6.

SMALL, ROUND, AND DIM

by Rick Clark and Richard Jakiel

Now that 1987 has drawn closed, in terms of astronomy/astrophysics it has been an exceptional year. By far the most notable event has been Supernova 1987A, the supernova associated with the Large Magellanic Cloud. SN 1987A has been very notable for a number of reasons-- as the brightest supernova observed in nearly 400 years, for its unusual light curve, and for its peculiar underluminosity (absolute magnitude -15.5 or 1.3 x 10^8 times the sun's luminosity in visible light). After peaking at +2.9 magnitude in May 1987, it lingers now at the very edge of naked eye visibility.

Although one may feel "cheated" over events of the last few years visible from the southern hemisphere (i.e. Halley's comet and SN 1987A), things often correct themselves after a time. For the time being we will have to settle for the fading "spectacle" of comet Bradfield 1987s, and the brightest supernova remnant in the sky -- the Crab Nebula (M 1 or NGC 1952). Located about 1° northwest of Zeta Tauri, M 1 is the result of a supernova seen in 1054. At its brightest, it reached a magnitude of -5, and was widely observed across the world. In an 8 or 10 inch scope, the crab is distinctly "S" shaped, with some scalloping of the edges visible at moderately high magnifications. In the 20" f/4.5 at 175x, the crab's appearance is similar to that of popular photographs. The edges are quite serrated, with several prominent embayments evident. Several bright filaments are also visible embedded in the bright nebulosity.

Not far away is a brilliant open cluster, M 35 in Gemini. It contains over 100 stars brighter than 13 magnitude, with about two dozen stars of 8-9 magnitude. In an 8 or 10 inch, it is a spectacular cluster, but it is too large to fit in the low power field of the 20" f/4.5. Located just to the southwest is the small, dense cluster NGC 2158. This is a very rich distant cluster (sometimes classified as a sparse globular cluster) located over 16,000 light years away. In the 10" f/6 telescope at Villa Rica, about 15-20 stars of 15+ magnitude are visible embedded in a faint nebulous haze of unresolved stars.

Hopping down deep in the southern sky is NGC 253, a huge, highly inclined barred spiral galaxy. This spiral is the largest and brightest member of the Sculptor galaxy group: a group of large, dim spiral galaxies located about 7.5 million light years away. In the club's 20", NGC 253 seemed larger than the often quoted 22x6 arcminute dimensions. Using the 24mm wide-field Televue (95x) the galaxy stretched completely across the field. The central bulge is distinctly oval, and quite bright, with a small nearly stellar nucleus. Numerous dark rifts and bright patches can be seen throughout the length of the galaxy, producing a distinctly mottled look. Just a short distance away to the southeast is NGC 288, a large and fairly bright globular cluster. At 7.2 magnitude, it is probably one of the least observed bright globulars in the sky. In the 20", it was easily resolved into a relatively uncondensed swarm of 12 magnitude stars at low power (95x). NGC 288 has a general morphology very similar to that of M 55, except it is somewhat larger in size.

Periodic comet Borrelly put on a fine 7th magnitude show in December, and was observed on at least one occasion from Villa Rica. Several club members saw it on its last return a few short years ago, and as is usual for it, it showed a short well-defined tail, immersed in a large, thin coma with a distinct, starlike nucleus. Bradfield is now quickly becoming a ghost of its former self as it loops out on its highly eccentric

orbit, to return in a few thousand years.

Rick Clark writes of a personal (and to our knowledge, club) record set in December with the 20" telescope:

"The new Uranometria 2000.0 has opened up brand new horizons in deep sky observing. Who has ever heard of a Perek-Kohoutek or Sharpless object? The reason no one has ever heard of these objects is that they are deadly dim. When I first received my U2000, I tried to observe some of these objects, specifically PK objects, but they proved too faint to see.

Looking through the *Master List of Nonstellar Optical Astronomical Objects* by Dixon and Sonneborn I discovered why many of these objects are invisible. Most of them are dimmer than 16th magnitude and have huge angular sizes. But being the idiot that I am, I didn't give up. On the night of December 16, 1987, Don Barry and I were cruising through the galaxy clusters around M 34 when I noticed PK 144-15.1 one degree east of the large open cluster. I decided to take a stab at it, and lo and behold, there it was, my first PK object! It was very small, round, extremely dim, and possibly annular. Later at the Waffle House, we checked the MLNOAO for its vital statistics. It is 22 arcseconds in diameter, and magnitude 16.7! Others are challenged to break this magnitude record.

A BRIEF HISTORY OF THE THERMOMETER
condensed from
A HISTORY OF THE THERMOMETER AND ITS USES IN METEOROLOGY by W. E. Knowles Middleton

by Mark Brader

Daniel Gabriel Fahrenheit (1686-1736) was born in Danzig, then a semi-independent city affiliated with Poland, but German-speaking; he then moved to Denmark, and finally to Holland. He did not invent the thermometer, but did make ones that were very good for their time.

The concept of expressing temperature numerically was apparently invented by the physician Galen in the 2nd century. The first thermometer (if we use the word to mean a device for measuring temperature numerically) was most likely invented by Santorio, an Italian, about 1611. Its scale, incidentally, was divided into 48 intervals each labeled as 10 minutes, with 60 minutes making up one degree. Let us be thankful that no scale with degrees and minutes of temperature has survived! Galileo also used a thermometer about this time and it almost automatically follows that he has been credited with its invention; two other names sometimes put forward are Robert Fludd or Flud of Britain (unlikely) and Cornelius Drebbel of Holland (possible, but little evidence).

These thermometers used air as the working fluid and their readings were therefore influenced by the current air pressure. The first liquid-in-glass thermometer was invented by Grand Duke Ferdinand II of Tuscany, apparently sometime between 1641 and 1654. For some decades after this every thermometer had its own different scale, though sometimes two or more would be calibrated to agree with each other.

The idea of defining a temperature scale by fixed points was invented by the astronomer Roemer about 1702. He used the freezing and boiling points of water as his fixed points, calling them 7.5 and 60 respectively! It was Roemer that put young Fahrenheit onto the topic of thermometers when they met in 1708. Fahrenheit began selling them in 1717.

Fahrenheit published an article in 1724 in which he wrote that the graduation of his (now well-known) thermometers was based on THREE fixed points:

"A mixture of ice, water, and sal-ammoniac or sea-salt", as 0, with the note "The experiment succeeds better in winter than in summer";

"Water and ice mixed together without the above-mentioned salts", as 32; and

"When the thermometer is held in the mouth, or under the armpit, of a living man in good health, for long enough to acquire perfectly the heat of the body", as 96.

But Middleton, considering the nonspecific phrasing of the first item and the strange note, concludes that it is in fact BOGUS: Fahrenheit was trying to disinform his competitors!

This does in fact make sense. Nobody else ever used more than two fixed points to define their scale; it would be surprising if they were in a convenient numerical relationship. Notice also that 96 - 32 gives a power of 2; this means that Fahrenheit could easily draw the temperature scale on his thermometers by repeatedly halving the distance between his two fixed points. (His meteorological thermometers were calibrated from 0 to 96, and of course 32 - 0 is 1/2 of 96 - 32, also easily measured off.)

Fahrenheit extrapolated his scale upwards and measured the boiling point of water as 212 degrees; "soon after his death" this was made the upper fixed point, and as thermometers became more accurate it was realized that body temperature was not quite 96 after all.

(It seems to me that the .6 in the famous 98.6 is also bogus and probably arises from over-precise conversion of 37 Celsius. After all, body temperature in a healthy person is not constant to the level of a tenth of a Fahrenheit degree, right, Craig? But I've never seen this point commented on anywhere.)

There then arose a great profusion of temperature scales defined in various ways. One thermometer from 1841 reads in the Old and New Florentine, Hales, Fowler, Paris, H.M.Poleni, Delisle, Fahrenheit, Reaumur, Bellani, Christin, Michaelly, Amontons, Newton, Societe Royale, De la Hire, Edinburg, and Cruquius scales. That's 18. Try THAT on your radio weather broadcasts!

The Swedish astronomer Anders Celsius (1701-1744) produced the first thermometer with 100 degrees between the freezing and boiling points of water, in 1741, but it was an inverted scale with 0 at boiling. Carl von Linne, alias Linnaeus, was apparently the first to flip it right way up and produce what became known as the centigrade scale, until 1948 when it was officially renamed the Celsius scale.

The other most significant scale of the 18th century was Reaumur's, named for Rene-Antoine Ferchault de Reaumur (1683-1757). He defined it in 1730 such that N degrees meant that his working fluid had 1+.001*N of the volume it had at the freezing point of water; but he used a poor working fluid and the scale was revised after his death so that 0 and 80 were the freezing and boiling points of water. Reaumur's scale was the one that centigrade had to displace in much of Europe, including France, as Fahrenheit's was in other countries.

The idea of an absolute scale was invented by William Thomson, Lord Kelvin (1824-1907), in 1848. The absolute scale using Celsius-size degrees became called the Kelvin scale, and the units were renamed kelvins in recent years.

OBSERVER'S ALMANAC

by Don Barry

Moon Rise, Set, and Phase

(All times are EST)

Date	Rise	Set	Phase	Date	Rise	Set	Phase
01/15	04:11	14:05	21%	02/06	21:51	09:28	90%
01/16	05:22	15:00	12%	02/07	22:48	09:51	84%
01/17	06:29	16:07	6%	02/08	23:46	10:16	76%
01/18	07:29	17:21	1%	02/09	----	10:44	67%
01/19	08:20	18:39	0%	02/10	00:48	11:16	57%
01/20	09:02	19:55	1%	02/11	01:54	11:55	47%
01/21	09:37	21:08	5%	02/12	03:02	12:44	36%
01/22	10:08	22:18	12%	02/13	04:09	13:43	26%
01/23	10:38	23:25	21%	02/14	05:12	14:53	16%
01/24	11:06	----	31%	02/15	06:06	16:09	8%
01/25	11:36	00:31	42%	02/16	06:52	17:26	3%
01/26	12:09	01:37	53%	02/17	07:31	18:42	0%
01/27	12:46	02:41	63%	02/18	08:04	19:55	0%
01/28	13:28	03:44	72%	02/19	08:35	21:06	3%
01/29	14:16	04:44	81%	02/20	09:05	22:15	9%
01/30	15:10	05:39	88%	02/21	09:35	23:23	17%
01/31	16:07	06:27	93%	02/22	10:07	----	26%
02/01	17:07	07:08	97%	02/23	10:44	00:30	36%
02/02	18:06	07:43	99%	02/24	11:25	01:36	46%
02/03	19:04	08:14	99%	02/25	12:12	02:38	57%
02/04	20:00	08:40	98%	02/26	13:04	03:35	66%
02/05	20:56	09:05	95%	02/27	14:01	04:25	75%

(----) indicates phenomenon does not occur on given day.

EYE ON THE SKY

The mothballed Salyut space station makes a number of bright evening passes in January, but Mir does not reappear in the twilight skies until February. The Mir orbit may be unsettled due to the recent crew replacement by the Soviets -- the crew now aboard is expected to be the first to stay a full year in space. These adventures in long-duration spaceflight are perhaps intended to presage a manned mission to Mars by the end of the century. Meanwhile, our own space program languishes in bureaucratic torpidity and political machinations.

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Wednesday evening, 06 January 1988
 Time(EST)   Az    El  Range RA/2000 D/2000  Mag
06:55:02PM 213.3 17.6 01230 22:53.6 -29d32 +2.9
06:56:21PM 203.6 35.6 00766 00:03.4 -17d06 +1.9
06:57:39PM 136.7 65.1 00520 02:33.5 +14d32 +1.5
06:58:57PM 065.5 36.7 00754 05:53.2 +37d28 +2.7
Shadow entry.
 SALYUT 7              USSR              D/S=0.62

Thursday evening, 07 January 1988
 Time(EST)   Az    El  Range RA/2000 D/2000  Mag
06:23:52PM 205.5 16.7 01267 22:55.0 -33d53 +3.1
06:25:10PM 191.2 32.4 00820 00:14.3 -22d55 +2.4
06:26:29PM 135.5 51.9 00592 02:39.6 +04d11 +2.2
06:27:47PM 076.3 33.7 00801 05:24.3 +28d13 +3.2
06:29:05PM 061.1 17.6 01243 07:01.2 +33d25 +4.1
Shadow entry.
 SALYUT 7              USSR              D/S=0.58

Sunday evening, 24 January 1988
 Time(EST)   Az    El  Range RA/2000 D/2000  Mag
07:26:00PM 330.7 16.5 01293 19:18.7 +58d33 +2.7
07:27:19PM 347.5 30.4 00865 20:06.5 +78d58 +2.0
07:28:37PM 037.7 44.9 00654 06:56.6 +59d06 +1.9
Shadow entry.
 SALYUT 7              USSR              D/S=0.53

Monday evening, 25 January 1988
 Time(EST)   Az    El  Range RA/2000 D/2000  Mag
06:54:45PM 334.5 15.4 01342 18:26.2 +60d35 +2.8
06:56:03PM 352.9 27.2 00936 17:34.7 +81d02 +2.2
06:57:21PM 036.4 37.5 00743 07:28.3 +60d21 +2.3
06:58:40PM 081.6 28.0 00913 07:19.9 +21d35 +3.8
Shadow entry.
 SALYUT 7              USSR              D/S=0.48

Thursday evening, 28 January 1988
 Time(EST)   Az    El  Range RA/2000 D/2000  Mag
06:59:01PM 289.6 15.6 01329 21:03.3 +24d44 +2.6
07:00:19PM 269.9 27.1 00935 22:25.8 +14d39 +1.9
07:01:38PM 226.5 35.3 00772 00:27.9 -08d19 +1.7
07:02:56PM 185.3 25.7 00964 02:34.1 -30d14 +2.7
 SALYUT 7              USSR              D/S=0.48

Friday evening, 05 February 1988
 Time(EST)   Az    El  Range RA/2000 D/2000  Mag
07:27:35PM 208.2 27.8 00671 02:04.6 -22d51 +0.3
07:28:51PM 137.0 63.6 00377 05:06.3 +13d11 -0.5
Shadow entry.
 MIR                   USSR              D/S=0.75

Monday evening, 08 February 1988
 Time(EST)   Az    El  Range RA/2000 D/2000  Mag
07:04:36PM 280.4 19.7 00865 22:26.6 +19d13 +0.4
07:05:52PM 324.0 27.2 00687 21:33.5 +58d29 +0.1
07:07:08PM 005.9 19.0 00889 14:18.2 +74d17 +1.1
 MIR                   USSR              D/S=0.51
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