THE Prairie Astronomer

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March 1987

SUPERNOVA 1987A NEWS....

This is an article written by Leonard Abbey (CIS-76703,383) On March 15th, 1987 which relates the chronology of the LARGE MAGELLANIC CLOUD Supernova discovery.

I thought people would be interested in a summary of an informal colloquium given here at the Center for Astrophysics last Thursday (3/12), which attempted to summarize the current knowledge of the SN.

The talk was given by Robert Kirshner, the local SN expert and the IUE target-of-opportunity observer for supernovas. As you might expect, he's been immersed in the subject since the discovery.

Discovery was Feb 24.3 UT (all times are UT, BTW), by Ian Shelton, University of Toronto, working at Las Campanas in Chile. His plate of the LMC (3 hrs, starting at 24.06) showed a bright star, and he wondered why he didn't guide on it! Oscar Duhalde, the Chilean night observer also remarked that the LMC seemed different - then they realized something unusual was happening.

Some hours later, Albert Jones, an amateur astronomer, independently discovered the SN from New Zealand, and alerted the Auckland Observatory, who also then called the Anglo-Australian Observatory.

The LMC is about 50 Kpc (50,000 parsecs, where 1 parsec ~3.26 light years) away, giving a distance modulus of 18.5. The SN at magnitude V 4.5 is the brightest since that of 1835 in M31, and the nearest since Kepler's SN of 1604.

The best astrometry of the SN gives

R.A. = 5h 35m 49.95s +/-0.039,
Dec. = -69 deg. 17' 57.9" +/-0.27

From prediscovery plates, there are three stars nearly at that position: Sanduleak -69 202 within .1 arc-sec, type B3 I (a blue supergiant), 12th magnitude, and a fainter star 3" to the NE, said to be bluer. The 3rd star is seen as an elongation of the S-69 202 star to the SW, and is much fainter still. I'll try to draw a picture:

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        star 2 --> *
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S-69 202 = star 1 -->      *
         star 3 -->        *
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(note that east is to the left.) Actually, stars 1&3 are joined. Star 3 is hardly seen even on the long exposure prediscovery plates. Which one was the SN? Well, the far-UV spectrum as seen from IUE was dropping right from the discovery. The flux at 1800 A went down by a factor of 100 in the first two days. After it subsided somewhat, two blue star spectra at least one of which is a B3 at the position of S-69 202, and the other 3" to the NE are now seen.

Thus, the Sanduleak star was not the SN. The best candidate is that faint star overlapping it 0.1" away. This would, by the way, be about 600 AU (for comparison, about 25 times the radius of our

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solar system) separation at the LMC distance. This poses a problem for studies down the line, since the 12th magnitude star will make it nearly impossible to see the dwindling SN remnant, once it get to about 15th mag. As Bob Kirshner said: "I wish someone would blow it up!". A problem for Space Telescope, which has higher spatial resolution.

Timelines: lots of prediscovery plates of the LMC were taken. Because of S-69 202, 12th magnitude was the upper limit of the SN up to Feb 23.1 UT. Albert Jones scanned the area with binoculars at Feb 23.39, and did not see it. He is sure he would have if it were brighter than mag 7.5. A pre-discovery plate taken at 23.443 showed it at 6th magnitude, and on the discovery plate at about 24.1, it was about 4.5 mag. Thus, the SN went from below 12th to 6th mag in 3 hours (assuming collapse at 23.316, from below).

Neutrinos: The Japanese group (can't remember the exact name) recorded 11, two from the direction of the LMC, and the Irvine, Michigan, Brookhaven (IMB) group in Ohio reported 8 neutrinos, both groups at 23.316. The Mt. Blanc French-Soviet collaboration report of 5 neutrinos at 23.12 remains unconfirmed. Those 5 were very near its energy detection limit, while the IMB group reportedly had never seen such a strong signal.

Thus Feb. 23.316 marks the time of core collapse. The duration of the event (seconds) indicates a neutron star was formed, as opposed to a black hole (milliseconds). The spread of neutrino energies puts an upper limit to the hypothetical neutrino mass at some tens of eV. This limit has already been established, so nothing new there.

UV observations - The IUE satellite has been observing the SN about 75% of the time since discovery. (Our atmospheric ozone blocks the far UV, of course, "...but we're doing something about that..." - Bob Kirshner :-)) As stated above, the UV was dropping fast right after discovery, down by a factor of 100 in the first 2 days. This is to be expected, as the UV comes from the stellar surface, heated by the shock waves from the core collapse, and then cooling rapidly. The interstellar absorption lines observed at the velocity of the LMC as well as our galaxy prove that the SN is in or behind the LMC. It is extremely unlikely to be from an undiscovered galaxy behind the LMC.

The SN's UV spectrum is very different from any type II previously seen. It looks much more like a type I, in fact. Type II's are thought to be core collapses of massive stars, while type I's are thermonuclear runaway when a white dwarf accretes matter from its red giant companion. The type II should have a lot of circumstellar matter (high stellar winds, old age leading to an extended atmosphere), hence the hydrogen lines usually seen. Bob's working hypothesis is that the progenitor was a relatively compact object without a lot of circumstellar matter. This poses problems with what is usually thought about SN progenitors, but is consistent with some of the optical, x-ray, and radio characteristics (below). Lots of modeling to be tried, here.

Optical observations - The obvious thing here is that the SN didn't get as bright as expected (4.5 versus 1.0). The fine error sensor on the IUE has been used as a V-band (more or less) photometer. By this instrument, the SN was at 5.0 at first observation, brightened to 4.5 over the next two days, and stayed there for a week or so. A slow slide to 4.6 for a week or so was followed by a return to mag. 4.5, where it remains today. These changes are actually a reflection of changes in the SN color, which have been extremely rapid. At discovery, the B-V mag was 0.0 (like an A0 star), and reddened rapidly to B-V = 1.0 (redder than a K star, as I recall) 10 days later. Other type II's have taken 4 to 5 times longer to change this much. Bob says this is consistent with a

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Club Library News...

Norma reports some new addtions to the club library.

Ron Veys Donated:

Murmurs of the Earth
Galaxies
4th Edition of Sedwicks
Astronomy Made Simple

Using Astronomy Book Club certificates donated by Norma and by Andy Corkill the book Celestial Mechanics and a set of Burnhams Celestial Handbooks were received, as well as Field Guide suggested by Dave Knisely.

Norma will have some of the newer books at the next meeting, as well as those being returned by members. She reports that so far everyone has been very good at getting books back by the following meetings for others to check out. If you have any donations or suggestions for the library, please let Norma know.

BACK IN THE GOOD OLD DAYS...

March 29, 1977:

The big news of the month was that two American astronomers discovered a swarm of moons around the planet of Uranus. Uranus was previously thought to have only 5 moons, but the new discovery showed that there could be up to 100 moons circling the planet.

Club president Larry Stepp reported the club activities for the month, including an open house at Behlen Observatory with the Omaha club, two stories run on channel 10 concerning the arrival of the Celestron-14 telescope for the City Observatory, helping out Jack Dunn with his Backyard Astronomy Class, and helping Professor Moore with public night at Nebraska Wesleyan.

Numerous reports of a UFO were received this month via a Soviet booster re-entering the atmosphere on March 13th. It appeared as a fireball in the western sky about 10pm according to newspaper reports.

Australian and British astronomers reported photographing a pulsar that is the faintest star ever sighted.

It was announced that the combined Astronomical League, Association of Lunar and Planetary Observers, International Occultation and Timing Association, and the Western Amateur Astronomers convention will take place in Boulder Colorado on August 10th through 13th.

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IT'S RENEWAL TIME...

JOHN LORTZ 3/87
DARYL HEHN 5/87
DANIEL COWELL 3/87
TED HILLER 5/87

Welcome!!!

To new PAC Member Joseph Turek. We're happy to have you aboard!!!

President's Message

The Deed Has Been Done. On March 24th, I delivered a check for $100, earnest money for our purchase of the decommissioned Atlas Missile Site, to Firth Co-op. On the day before, Del Motycka and I went to Firth and had a final sit-down with the Co-op manager, then went to the site in a driving rainstorm to ponder where we wanted to draw the final boundaries.

For those who have been out to look at the property, and know where the boundary stakes had been placed tentatively, we have now agreed to pull the East boundary of our parcel in to the west shoulder of the access road, and, to compensate, extend our parcel further towards the south. It now will extend comfortably south of the trees so we can do anything we want with all of them. It also provides some space for tiering individual observing sites south of the missile pad.

This manipulation of boundaries allows the farmer to our north to access his property simply by extending a road due north from where the present access road turns west into our property.

The Co-op has agreed to remove the junk automobiles from the site prior to closing. They have also agreed to let us take some earth off their property to help fill in the silo access shaft and level our property, and they will allows to begin using the site from now until we formally take possession; a new lock is on the gate, and we have a key. So, anybody who wants to go down and try it out can stop by my place and pick up the key.

A side note: it appears we will have a brightly-lit neighbor sometime soon, although it shouldn't cause us any problem. The Beatrice FM station, KMAZ, says that they have obtained FAA and Gage County approval to erect a 740-foot tower about 1-1/2 miles northeast of Cortland, at a site just inside the Gage County line. We reckon that places them about 1-1/2 to 2 miles West-Northwest of us. It's not in a direction that many people will want to point their scopes, so Rick Johnson, Del and I decided there was little cause for concern. We have no definite word on whether the tower will be outfitted with standard aviation red beacons or strobes.

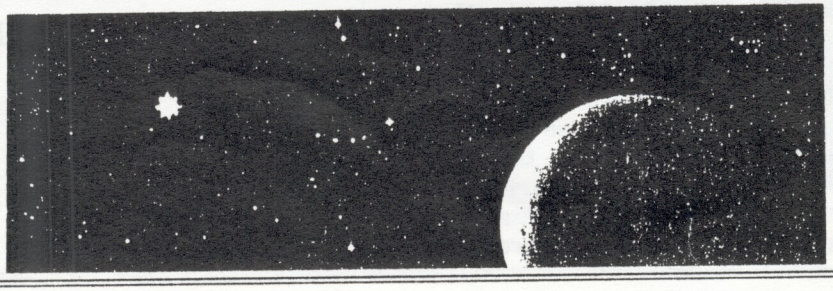
We will want to get a crew together early in April, as soon as the Co-op removes the junk cars, to start cleaning up the site. With enough bodies, I think we can do a respectable job in one day. Please come to the next meeting prepared to get serious about volunteering cleanup time.

Some folks around Firth have already expressed an interest in taking a look through our telescopes, according to Dick Osterhaus, the Co-op manager. We want to quickly establish a rapport with our neighbors, so we might try to engineer a Star Party on Friday, April 25, and put some invitations out around the area. The more local interest--and members--we can get, the less likelihood of continuing vandalism at the site.

It is starting to get exciting now! A chunk of Prairie under dark skies that we can call our own, and begin to develop into a permanent home for the club telescope. From a personal standpoint, I might finally have found an excuse strong enough to motivate me to complete my Messier list!

Come to this month's meeting, and let's talk plans.

Lee Thomas



Upcoming Events...

BY JOHN LORTZ

Midstates Convention:

I finally received information on the Midstates Convention to be held in Kansas City this year. I'm not sure if everyone in the club got the info, so I'll pass it along to you here.

The convention will be held at Avila College in Kansas City on July 24, 25, and 26. Highlighting the convention will be a special speaker (it wasn't announced who) on Saturday evening, and astrophotography contest (with two categories..... Solar System and Deep Sky, with two subcategories.... Color and Black & White), a telescope making contest, and a side trip to Powell Observatory which houses a 30-inch newtonian relflector belonging to the Astronomical Society of Kansas City. The observatory will be open for observing on both Friday and Saturday night.

A registration form was included with my letter, so anyone needing one can contact me for a copy. Individual registration before June 30th costs $10.00 ($13.00 after June 30th) and family registration runs $13.00 ($16.00 after June 30th). Air conditioned college dorm rooms are being made available for Friday and Saturday Nights at $48.00 per person. The room includes linen and four meals (3 on Saturday and 1 on Sunday). The meals can be purchased without accomodations for $20.00.

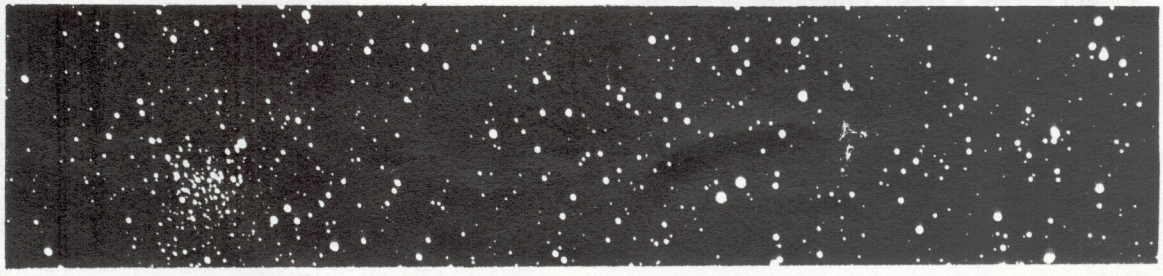
The Prairie Astronomy Club hopes to have a good turn out for this year's convention since it's just a skip away. We hope to present a mini audio/visual show on the PAC's new observing site, and I hope there will be some entrants in the Astrophotography Contest. Please remember to mark this weekend on your calender!!!

Astronomy Day 1987:

The date and place for this year's Astronomy Day festivities was set at the last meeting. Because of some problems with the new management at Gateway, we have arranged to be in the central square of East Park Plaza this year on Saturday, May 9th. Norma is acting Astro Day Chairperson this year with three other PAC members acting as sub-chairpeople. Rick Johnson is in charge of the computer display, Dan Neville in charge of the telescope display, and John Lortz is in charge of the other displays (i.e. whatever else we can find!).

Working times and plans will be discussed at the next meeting, but tentative plans for the general display area include two color monitors running various video presentations (including some of the Hyde Observatory programs put onto tape), a poster display, a display of members photographs, pictures and a map of the new Atlas Site, a wrap up on Halleys comet, Astronomy Books and magazines, PAC informatin handouts, and a signup sheet to receive further info on the club.

Of course, anyone with ideas on what they would like to see included in the display can contact any of the above mentioned members or any of the club officers. The club has lots going for it this year and we need to let the public know how active we are. Let's really hit 'em this year!



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relatively compact progenitor with little circumstellar matter. The maximum brightness may have been lower because of the same factors causing the rapid evolution.

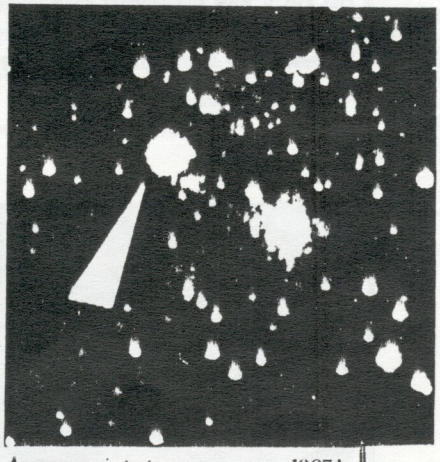
The first observations showed P-cygni profiles in H alpha, beta, and gamma, at about -17,000, -14,000, and -12,000 km/sec, respectively. P-cygni profiles, which show a blue-shifted absorption with emission to the red side, are typical of expanding gas shells illuminated by a hot interior source. The different velocities arise because the different lines 'see' to different depths in the expanding photosphere. As the system evolves, the outer parts become more transparent, and we see to greater depths, where the expansion is now slower. Thus, the velocities have declined since discovery, to about -12,000 km/sec in H alpha. The outermost gas is still moving at 17,000 km/sec, but we don't see that part any more. (At 17,000km/sec, I calculate that shell to be >400 AU (about 5x the solar system) in diameter by now!)

The photosphere, i.e. the visible surface, is also expanding, although not quite as fast. By translating the B-V colors into a black-body temperature and luminosity curve, then comparing to the observed visual magnitude, a size can be derived. On Feb. 25th, less than two days after ignition, this was 1.5 AU (between Earth's and Mars' orbits), while about 10 days later, March 7th, it was 10 AU, or Saturn's orbit. The photosphere is now (March 13th) computed to be 30 AU in radius, or the radius of Neptune's orbit! The rate of increase is slowing, although still impressive.

X-ray, radio - Not seen at all in x-ray, and only weakly in the radio. This is consistent with a lack of circumstellar matter, since these photons are thought to arise from interactions of the shock wave with circumstellar material.

THE FUTURE, or questions of interest:

1) Nucleosynthesis
   - study heavy metal abundances in the later optical spectra.
   - test light curve variations against possible radioactive decay power sources, such as radioactive nickel.
   - study the gamma ray emission (a direct look at nuclear processes) after the shell becomes transparent to them.
2) Explosion dynamics
   - the neutrino pulses & energy spectrum should test theories of the collapse to a neutron star.
   - UV & optical line shapes will provide density profiles of the blast.
   - direct angular diameter measurements will help tie down some shell characteristics.
3) Stellar remnant
   - will we see a pulsar in the radio or x-ray? Its characteristics?
   - IR studies of possible interstellar dust heating, other shock wave interactions.
4) Distance scale
   - optical velocities over time, coupled with the photospheric expansion will provide a direct calibration to the LMC.



Gabriel Martin/Cerro Tololo

Arrow points to supernova 1987A.

OBSERVING CHAIRMAN'S REPORT

by David Knisely

The next scheduled star party is on Friday, April 24, and will probably still be held at Earl's unless things go unusually well with the cleanup at our new observing site. I think that we may want to start thinking about a dedication star party sometime in May or June, so stay tuned to this column.

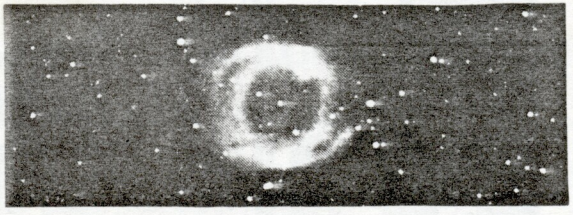
Ursa Major is a good place to hunt for big galaxies. A good example is visible in a four inch, appearing as a faint fat fuzzy cigar with a star in the middle. An eight inch will show hints of detail and a ten inch shows the irregular dark lane running down the length of the galaxy. Less than a degree to the south-east is the fairly large planetary nebula M-97, also known as "The Owl Nebula". Visible in a four inch, this object shows as a faint fuzzy disk of light with absolutely no resemblance to an owl. An eight inch will show one of the "eyes" as a vague dark spot off center, and a ten inch aperture will show both eyes vaguely.

Up above the end of the handle of the Big Dipper is the large but dim galaxy M-101. The best way to find it is to go about five and a half degrees east and one half south of Mizar. It can be seen in a good pair of 10x50 binoculars, but is very difficult for small telescopes due to its large size. M-101 appears as a large dim fuzzy area with a slightly brighter middle when viewed in a six inch. An eight inch makes the nuclear region stand out better but adds only a hint of detail in the outer haze. On a good night, a ten inch will begin to show this object's spiral structure in the form of numerous fuzzy patches in the outer haze.

A far easier and more spectacular spiral galaxy is M-51, the Whirlpool Galaxy, located in Canes Venatici about two degrees south and one half west of 24 CVn. It can be easily seen in a 60mm refractor, appearing as a moderate sized fuzzy disk with a small bright core, along with its companion NGC 5195 which is almost touching the main galaxy. A six inch will give some hints of structure in M-51, with an eight showing the spiral arms vaguely. In a ten inch at moderate to high power, the sight is glorious with knots in the arms being visible with averted vision. If you want more of a challenge, try the pair of nearly edge-on spiral galaxies NGC 4636 and NGC 4656, located about six degrees south and two west of Alpha. 4636 is the brighter and larger of the two, showing as a long cigar shaped patch of light when viewed in a six inch aperture. An eight inch will begin to show some slight mottling in the galaxy as well as the tiny elliptical companion galaxy along side. NGC 4656 is less than a degree south and a bit east of 4636, and is difficult to see in a six. An eight inch shows the galaxy as a faint streak with a peculiar "hook" on the north-east end.

In Coma Berenices are two interesting galaxies, NGC 4559 and 4565. 4559 can be found about half a degree south and a degree and a half east of Gamma. It shows as a fairly large elongated fuzzy patch with irregular edges when viewed with an eight inch reflector. NGC 4565 is a beautiful edge-on spiral which is about two degrees due south of 4559. A six inch shows it as a long fuzzy needle of light with an egg shaped nuclear region. When viewed in an eight inch, the galaxy looks quite a bit like its photograph, showing a hint of the dark lane across the center. A ten inch shows the dark lane well along with some mottling, making the galaxy a prime target for these warm spring evenings.

For those of you who are (Horrors!!!) tired of galaxies, take a good look at one of the most beautiful and yet underobserved globular star clusters in the sky, M-3, located just over six degrees east and a half north of Beta Comae Berenices. Visible in binoculars, this cluster shows a wealth of stars in a six inch telescope at high power, with larger instruments making it a glorious sight to behold.



at the last meeting...

The meeting was underway at exactly 7:30pm (the Hyde Supervisors meeting got over early!!!) with 24 members present and 6 guests. The business meeting was fairly short, starting with a brief discussion concerning Astronomy Day 1987. It will be held on May 9th at East Park Plaza this year. It seems Gateway wants us to have it only if we setup both on Saturday AND Sunday. NOPE!!! East Park promises that we will be in the center of the plaza as long as we don't have any food or nude dancers. The first rule was acknowledged but there was some heated discussion concerning the dancers. Details on the event were curbed until next month.

The new Atlas Site was discussed. The survey will take place next Saturday, and the actual border of of the purchase will be determined. It was mentioned that one stipulation of the purchase would be that the cars be removed from the area. Once the purchase is finalized a cleanup chairperson will be appointed by Overlord Thomas and the club will get the place in shape.

The club voted to approve the Astronomical League's Bylaws Revision. There is still no date on the Midstates Convention that the PAC hopes to attend in force.

The program was presented by Lee Thomas. It was an excellent audio/visual show about Uranus.

THIS MONTH'S PROGRAM...

Earl Moser will present a PAC History!!!

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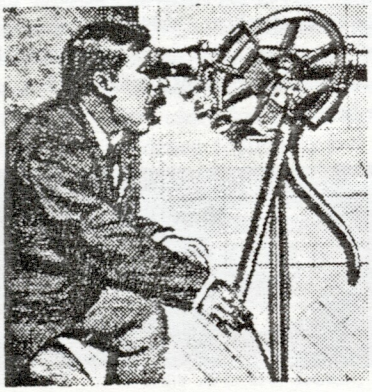

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Next PAC Meeting
March 31, 1987