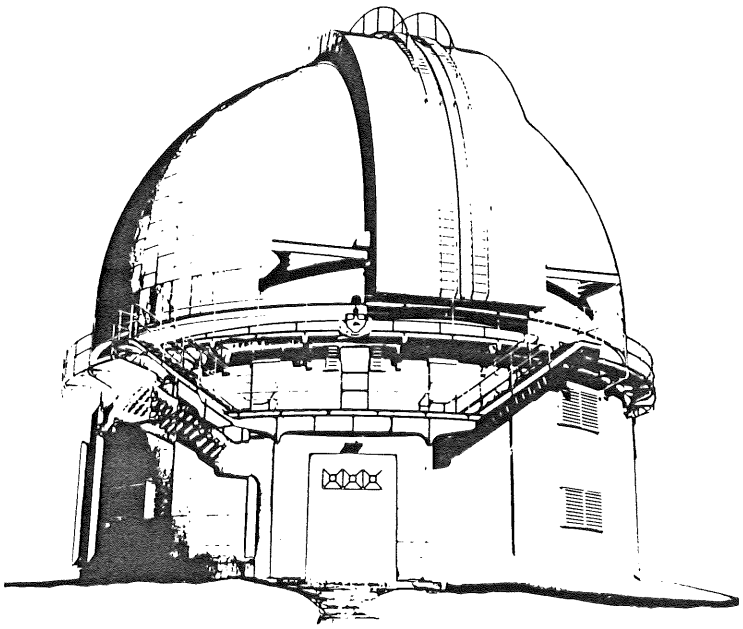

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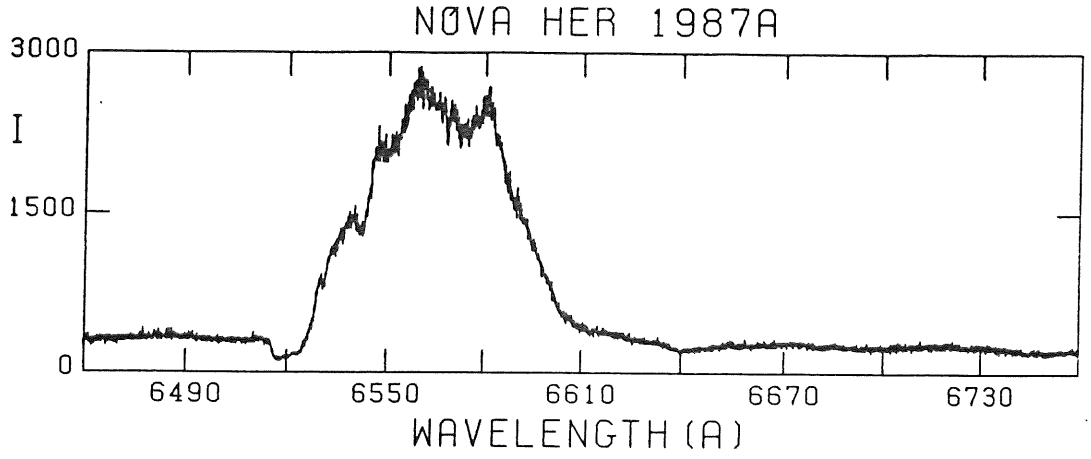

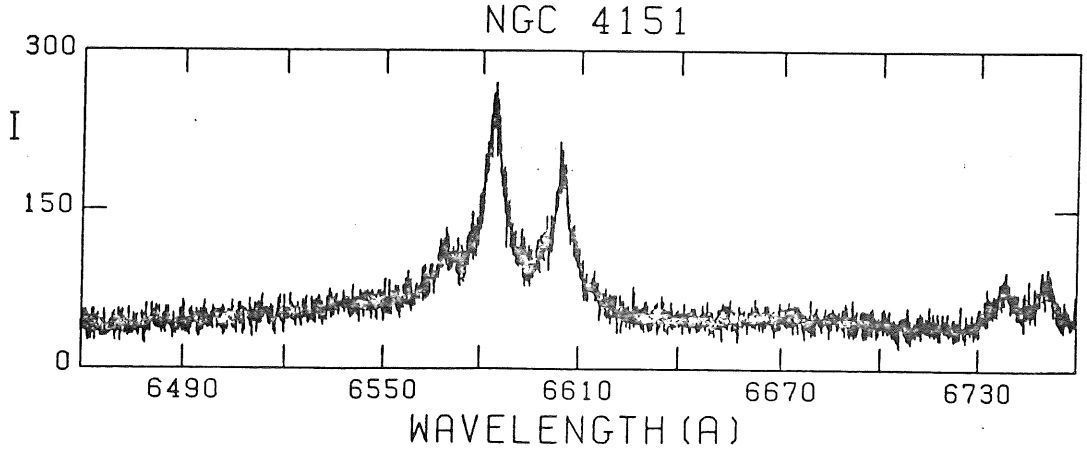

The DDO Shectograph Story

EDITORIAL

Many exciting things are happening in and around DDO these days, with the Supernova, the Mochnacki photon–counting spectrograph, the CCD, the Lester echelle/Reticon, and much more. This month we have concentrated on the first two, and the next issue will see more detailed accounts on the last two. In all these cases years of hard work are coming to fruition. Hearty congratulations to all concerned!

The Photometrics CCD was shipped to Chile in May, was installed and tested by Charles Slaughter, Marshall McCall, and Ian Shelton, and is working well. The first scheduled observers are theoreticians! Chris Rogers is going down in August to observe Bok Globules and Charles Dyer is taking the September dark run to observe gravitational lenses for variation. Exciting stuff, for a tiny 60–cm telescope. Now we need a 2–m for follow–up. More about the CCD in the October issue.

Stefan is justifiably proud of his new machine; it has great potential for being an improvement on existing versions at other observatories.

The Lester echelle has been completed for several years, but the Reticon packages have been plagued with problems. Now it looks as though everything is much closer to realization, though flexure is the main problem and fibres are the hoped–for solution. More about that in the October issue.

The Supernova Celebration held in Convocation Hall on 24 April featured Ian Shelton before an audience of about 1500 people. Everything went more or less as planned. Thanks to Elizabeth Wilson, Dona Harvey, Marvi Ricker and many others, it was an event that we will all remember for a long time. Especially appreciated was the support offered by Peter Richardson, Principal of University College, who picked up more than half of the tab. (An event like that cost much more than you can image, or than I imagined!) For those who couldn't make it that night, we have included in this issue the programme and the concluding talk by David Dunlap, grandson of the benefactor of the DDO, which was very well delivered and gave everyone something to ponder as they left the Hall. What a contrast to the Minister for Science and Technology, who bumbled through an irrelevant speech! We really didn't plan it that way – honest.

rG

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Editors: Bob Garrison and Chris Rogers

Dear Bob,

I am sorry to have to send you the news that Dr. Stromgren died quite unexpectedly of a heart attack over the weekend (July 4). He was alive and full of interest in astronomy up until the end: let us all pray that we can have such full and fruitful lives. Of course, we are all very sorry that we shall no longer have the pleasure and the benefit of his company and wise counsel.

Regards, Richard Gray

THE DDO PHOTON COUNTING SPECTROMETER IN ACTION

by Stefan Mochnacki

On the 6th of February, 1987, the DDO photon-counting spectrometer saw its first starlight. It's a great compliment to our technical staff that it stayed on the 1.9 m telescope for a month after that, performing as predicted and suffering only one minor hardware hiccup. Despite being uncooled at the time, it yielded fifteen nights of good data during one of the clearest and coldest months of February on record. We are now building a fibre-fed spectrograph which will allow us to cool the image tubes below -30°C, as well as greatly improving the stability of the instrument.

The DDO-PCS project began in 1983, with an NSERC Equipment Grant of just under $90,000, plus our own funds. Our technical staff were busy with many projects at the time, so in 1984 I hired two undergraduates, Andrew Platzer and Lian Zerafa, to fabricate the electronics and to programme the controlling microprocessor, respectively. Our engineer Shenton Chew in the meantime took on the front end Reticon electronics, while Frank Hawker and Karl Kamper worked on the image tube stack. Dave Blyth and Archie Ridder worked on the mechanical parts. A number of small items were contracted out. Owing to the competing priorities for our staff's time, it all took far longer than I had anticipated.

Although colloquially known as the "Shectograph", after Steve Shectman who is usually credited as the designer of this type of photon-counting detector, in our case the design was largely that of Dave Latham and John Geary of the Center for Astrophysics, Cambridge, Mass. We fabricated it using more modern interconnect and packaging schemes (Speedwire and Eurocards), and considerably changed the design of the final digital stages (the PCS can be thought of as a hybrid digital-analog pipeline processor). The entire electronics box, including the on-board 6809 micro, was designed to ride on the telescope, and to communicate to the outside world via a standard serial link. The software for the on-board micro was written largely before the rest of the hardware was finished, making debugging easier. A PC "clone" is used as the host computer to receive and store the data; most of the time it just acts as a terminal emulator for the on-board micro, which handles data accumulation, graphic display of data during integrations, and many set-up commands.

The observing programme in February concentrated largely on fairly bright stars (9-10 mag), at a dispersion of 11 or 16 Å/mm (with a resolution of 0.5 Å or better). At -20°C in the dome, the dark count per 4000 pixels dropped to less than 10 per second, but at 0 degrees or higher we got 200 or more counts per second. The spectrum of the Seyfert nucleus of NGC 4151 on the cover was obtained on one of the colder nights; the redshifted H-alpha complex was recognizable after ten seconds. The spectrum has been flattened but not processed in any other way; the intensity scale corresponds roughly to the photons counted per pixel. The integration time was twenty minutes. The other spectrum is one of many taken of Nova Her 1987a, which had conveniently exploded for us. The relatively high signal-to-noise ratio is due to the brightness of this object. In neither case has the sky or dark been subtracted.

We expect the PCS to be in operation again this winter, in the fibre-fed spectrograph. Our experience this year shows that moderately high-resolution spectroscopy will be possible down to 15th magnitude, and some new optical elements for low resolution spectroscopy will allow magnitudes as faint as 17th to be reached.

Supernova Update

by Bob Garrison

Since April, the Supernova has continued to defy precise predictions (though as usual, some theoreticians are claiming that they knew it all along). The V magnitude continued to rise to a broad maximun of 2.88 about 22 May. After an initial slow decline, it began to fade more rapidly (5-6% per day) until mid June, when it slowed to a nearly constant 1% per day decline. As of early July, the brightness is about 4.3 and seems to be either constant or in a very slow decline.

During the first few weeks after the explosion, the spectrum changed dramatically, showing the change in composition and velocity. Now the spectrum is changing slowly, but is showing more narrow lines.

From the Director

On behalf of the Department, I am very pleased to welcome back Ray Carlberg , one-time post-doc with us, but who has now been appointed Associate Professor with tenure in the Physical Sciences Division of Scarborough College and in the Astronomy Department. Ray takes up his position on July 1.

I am also very pleased to announce that a permanent-status committee met on April 29, and unanimously recommended to the Chief Librarian that Marlene Cummins be awarded permanent status (the librarian's equivalent of tenure) and promotion to Librarian III. I'll take the opportunity to thank Marlene from us all for all her hard work on our behalf.

Don Fernie

CONGRATULATIONS

To Wendy Freedman and Barry Madore on the birth of their daughter Rachel Nicole. She arrived just in time for Mother's day.

To Mercedes and Donald Richards whose daughter Chandra Mercedes was born May 29. The Richards are moving to the University of Virginia (Charlottesville) where they will take up positions in the astronomy, mathematics, and child care departments, respectively.

To Dorothy Fraquelli (Ph.D. 1981) who was married on May 2 to Arthur Campbell of Athens, Georgia. Dot is presently at Space Telescope, and her husband is an engineer in Athens, so they will be maintaining a "distant relationship" for the present.

To Petrusia Kowalsky who graduated from the Faculty of Education, U. of T., and will be teaching physics at Bishop Strachan School next year. BSS is a venerable and highly-regarded private school for girls.

COMINGS AND GOINGS

Nancy Evans received a grant from the Canadian Astronomical Society's small grant program to support an upcoming IUE project. On May 22, she gave a workshop at the Givens/Shaw Public School, to encourage girls in Grades 7 and 8 to continue with math and science.

Christine Clement spoke at Careers Day at Riverdale Collegiate on April 8 about a career in Astronomy. She spoke at the annual meeting of the Canadian Science Writers' Association on Supernova Shelton 1987a. From May 22- June 1 Christine was at Las Campanas using the U of T 24-inch telecope.

Marshall McCall writes: As to Chile, how about

I went to Chile.

The CCD worked

I came back. I will try to do better later.

Don Fernie and Stefan Mochnacki attended the CAS/AAS meetings in Vancouver in June and Stefan participated in the Santa Cruz Workshop on Instrumentation in July.

Marlene Cummins went to the annual Special Libraries Association conference held this year in Anaheim in June. She chaired the astronomy workshop and is responsible, this year, for the astronomy section of the newsletter. Marlene is also involved in a joint international project to produce an astronomy thesaurus for the IAU.

Chris Stagg and family left Toronto at the beginning of June for Manchester, England. Chris took up a post-doctoral position in celestial mechanics there.

Farewell to three CITA post-docs: Jeff Bishop is going to Columbia, John Lattanzio to Lawrence Livermore Labs and Mike Fitchett to the Space Telescope Science Inst. Best of luck!

Chris Rogers attended the first week of the NATO Star Formation held at Whistler, B.C. following the CAS/AAS meeting (which he missed to go sea-kayaking in the Queen Charlotte Islands). Tatsuhiko Hasegawa, a post-doc working with Chris on dark clouds, was also there as were CITA post- docs Arnold Boothroyd and Hyung-Mok Lee. They met Francois Rouleau from U. de M. , who will be entering our Ph.D. program this fall.

Bob Garrison gave an invited talk at the Second Conference on Faint Blue Stars held in Tucson, AZ June 1-5. The title was "MK Classification of Evolved Blue Stars in the Halo". Bob also attended the joint CAS/AAS meeting in Vancouver where he was overworked more than most of the participants. He gave 2 invited talks on the supernova, "Supernova Shelton 1987A: The discovery and the News via Short Wave Radio from Last Night" and "The Media and Supernova Shelton 1987A: Science Writers Needed!", 2 press conferences, several interviews, a summary of the UTSO 2-m project, and a real research paper on the fading shell of Pleiase, in addition to a 2-hour taping session for a planetarium show.

Tom Bolton attended parts of the Royal Society of Canada at McMaster University May 31 to June 2. For him, the highlight of the meeting was a special talk by Prof. Herbert Simon of the Carnegie-Mellon University on "The Psychology of Scientific Discovery". The title is a bit misleading, because he actually talked about research on programming computers to make scientific discoveries by applying certain heuristic principles. They have had enough successes so far to suggest that perhaps some of us should be concerned about being replaced by machines. This work has been described in a new book, Scientific Discovery, which is reviewed in the 5 June 1987 issue of Science. The review contains most of the highlights of Simon's talk at the RSC meeting.

POTPOURRI

Mark July 23 on your calendars. That is the date for the annual picnic at the observatory. The fun starts at noon.

This summer at DDO the stellar astronomers have formed a small discussion group. This Group meets once a week, Thursday mornings, at DDO for informal discussions related to any aspect of stellar astronomy. The format for these discussions is evolving into a brief presentation upon some chosen topic by whom-ever is most qualified, liberally puncuated by questions and discussion arising out of the presentation. The topics included so far generally encompass the specific research interests of the group members. At the moment we meet at 11:00 am Thursdays at DDO. Any one who wishes to attend, or have their names added to the mailing list (to get an update of each week's topics) should send mail to Mike Fieldus.

We have a large group of summer students working with several of our staff.

Kim Venn (Rucinski) is the summer student supported by the Summer Employment/ Experience Development (SEED) program. She works on the high spectral and temporal resolution observations of Algol (Beta Per) obtained by J. Tomkin at McDonald.

Doug Johnstone (Duncan and Dyer) is working as an NSERC summer student on questions related to n–body simulations and cosmology.

Jayanne English (Rogers and McCall), another NSERC student, is developing CCD data reduction procedures.

Michael Richer (McCall), who enters our M.Sc. program this fall, is reducing polarisation observations.

Bill Hodges, Tom Bolton's youngest step-son, is working for Tom this summer at DDO. He is creating a bibliographic data base, and later in the summer he will assist in the entry of old DDO logbook entries into a computerized database. Bill will enter grade 11 at North Toronto Collegiate Institute next fall.

Rene Plume (Percy) is doing photoelectric photometry of variable stars with the 16" telescope on campus, and doing power spectrum analysis of one or two stars using data from previous years.

Robin Kingsburgh (Percy) is doing some photoelectric photometry using the new Optec solid-state photometer on the 8" telescope on campus. She is also helping John Percy and Petrusia Kowalsky develop teaching material for the Peel Summer Academy - a summer residential program for gifted elementary school students, held at and co-sponsored by Erindale College.

Revisionist's Corner

From an astrologer's column: (Things we astronomers didn't know about our field!)

Can you please describe for me what the difference is between astronomy and astrology? Please, Comrie, give me some basic lessons, and thanks. – Norman

Astronomy is the study of visible "bodies" of mass content in our skies. Some of these bodies, or things, remain in what would be considered to be a constant shape or place.

This is lesson Number 1: Nothing remains constant; nothing stands still, even though in both cases it may appear to.

Lesson Number 2: There is more to it than the eye can see and that the brain can dissect.

Now, when you put 1 and 2 together, you're back at the beginning. Nothing remains constant and, you can't see or understand it all in its totality.

Astronomy is the study of that which is *now* considered to be measurable, chartable, on a path, following a pattern, making an orbit, spinning, being born and dying. Our Milky Way galaxy will continue presenting us with new motion once we have conquered the old.

Be that as it may, astronomy is imperative, it's exciting and an exact (at this moment in time) scientific study. As an astronomer, I found it all quite unfulfilling and quite unacceptable.

That was my conclusion, because astronomers seem to believe that the plotting of the map of the sky is it! You measure, calculate, determine, slot, categorize and then you go on to the next "body" and you measure, calculate, slot, etc. That didn't make complete sense to me.

Where does the energy go? With all that action whizzing by at great speed, colliding, disintegrating, living, dying, what is the result of all that action?

Astronomy is the study of measure and action. Astrology is the study of the reaction to all that measure of action. Astronomy, to me, is like applauding with one hand but then, so would astrology alone be. It takes the two.

It takes the two sciences together to be complete. The astronomer does the measuring and the astrologer interprets measure.

ON NOT SEEING HALLEY'S COMET IN 1985

Bright Star, would I were confident as some

That I had seen *you* through my telescope

And not the imprint of my grandson's thumb

Or some blue born of alcohol and hope!

Halley! You should be living at this hour!

Your comet needs you, Sir, and so do I!

Dupe of the media's persuasive power,

I nightly peer into a cloudy sky!

Unlike Keats' fabled watcher of the skies

Your comet never swims into my ken.

And I confess my only wild surmise

Turned out to be the lantern on Big Ben.

Meanwhile I stand here getting a stiff neck

Silent upon a roof of Tooting Bec!

[This was a successful Peter Plowden-Wardlaw contribution to the Financial Times Literary Competition earlier this year. Ed] Oxford 38, p34. 1986.

A Visit to IUE

by Nancy Evans

I visited Goddard Space Flight Center in May for an IUE observing run, to do some data reduction, and, of course, to visit old friends. The observing went well. Despite being in its tenth year of service, the available observing range for IUE is only decreasing very gradually. Currently, the sky available is the equivalent of being able to observe from declination +23 to -59 at any one time, with the whole sky accessible some time during the year. I did observe slightly outside these limits, and found one new surprising restriction. In order to use the two batteries equally, no power neutral observations are allowed. This means that if you are in a marginal region, extra heaters are now turned on to make sure that the batteries are discharging mildly.

I finished a magnitude limited survey of Cepheids to get an unbiased estimate of the fraction which have blue companions. In addition, I found a companion for a double-mode pulsator, from which an absolute magnitude for the Cepheid can be determined. In fact, it was brighter that either I or the peer review panel had anticipated, leaving enough time for yet another observation of SU Cyg at the end of the shift.

What's ahead for IUE? No sign of declining scientific interest in the number of proposals submitted this year. There are even two additional capabilities under consideration. A one gyro system (using in addition the two coordinates of the solar position) is being developed, just in case. In addition, it may someday be possible to strobe the camera, to accurately combine observations in phase for short period objects.

As long as we don't have another supernova to use up all the time.....

NEW DATABASE OF 1.88m PLATE RECORDS

by Brian Beattie

Have you ever wondered:

1) What program consumes the most time on the 1.88m?
2) What is the record for the number of observations of Algol on a single night?
3) How many times have stars of <u>your</u> favourite spectral type been observed with the 1.88m telescope?

Now you can obtain answers to these and other questions with the all-new database of 1.88m logbook entries using a high-end database management system.

A menu-driven database has been created that permits rapid queries and reporting of the 1.88m logbook information. Over the past few years, Jim Thomson has been entering the information onto a UTCS computer. At present about 2500 records are in the database, which is stored on the hard disk of one of the DDO's microcomputers. Once Jim has transported his entries from UTCS to the VAX, another 20,000 records will be downloaded to the micro. Ultimately, all photographic and digital observations will be computerized at the time of observing. All students and faculty are welcome to use this new database. No longer will you have to spend hours in the stuffy plate room to track down observations.

The creation of the database has been funded by Karl Kamper. For further information on the database please contact Karl or myself.

GASA GOSSIP

by Mike Fieldus

It has been a very long time since our last issue, so you the readers must be expecting all sorts of dirty and seedy gossip. Once again I am going to disappoint you and report the usual trite and boring acitivities of our graduate students.

First, however, the big news you have been waiting for all these months.... the volleyball playoffs. At my last report, I believe we were fighting for one of the four playoff positions availiable in our league. As you must have guessed, we ended up in second position overall and easily made it into the semi-finals. In our semi-final game, I would be exceedingly modest to say we played great. Volleyball of that calibre has never been seen from astronomers anywhere, including the famous east- west tournment at DRAO. Needless to say we won and advanced to the final.

The Final game was a different story altogether. Not that I am trying to lay the blame on any individual, but the Montreal Canadians were playing that night and our team captain Bob Hill was in a hurry to get home and watch them, Of course, losing three straight games was the fastest way to get out of the gym. After our performance in game 1, most team members realized that they would rather be watching the Canadians game, enabling us to produce one of the poorest showings in the history of organized sport. We lost.

On to much more important things. One of this month's topics is Alex Fullerton, the golden boy of the department. Alex is such a nice boy, never offending anyone, alway helpful and, considering his background, a reasonably interesting person. So one would expect he is well liked around the department. Have I got news for you. At the beginning of the year I sent a questionaire out asking the graduate students to provide some information on themselves, and to "fink on a fellow student" to add something interesting. Well, every questionaire returned save one chose to fink on Alex, and despite not being a modest person I blushed when I read some of his more exotic (erotic?) activities. Common decency (and an editor) prohibits me from listing these responses (of course).

On a much more interesting topic than Alex, word has spread amongst the graduate students of the first presidential impeachment in our history. Many people, it seems, are less than pleased with the efforts of our new president Bob Hill. Since his election, absenteism in the department has risen by at least 30% (half the department was away for the last two weeks of June!), productive research has dropped by a huge amount (how many graduate students have published papers since he became president?) and absolutely none of his election promises have been fulfulled (like making coffee drudge a paid position). And, more importantly, every other baseball team received 20 free beer tickets and ours only received 11. We know this isn't because we don't drink as much as other teams, but is it because our president drinks more than other teams? Let this stand as a warning to Mr. President – shape up or we'll elect you to another term!

SUPERNOVA CELEBRATION

PROGRAM

Master of Ceremonies David Young, author & Playwright
Opening remarks George E. Connell, President, U of T
History of David Dunlap Observatory Professor Donald Fernie,
Chairman, Department of Astronomy & Director, David Dunlap Observatory.
U of T's observatory in Chile Professor Robert Garrison,
Director of U of T's Southern Observatory
The discovery of the supernova Ian Shelton, Resident Observer
at U of T's Southern Observatory
The significance of the supernova discovery Dr. Marshall McCall,
University Research Fellow, Department of Astronomy
Greetings from the Government of Canada The Honourable Frank Oberle,
Minister of State for Science & Technology
Laying the foundations for the future David Dunlap,
President, G.F. Thompson Co. Ltd.
(grandson of benefactor of David Dunlap Observatory)
Organist Elizabeth Anderson (who played star-theme music for 30 minutes prior to the celebration).

Laying the Foundation for the Future

Mr. President, Mr. Minister, Ian, Ladies and Gentlemen,

It is by circumstance of birth that I became the grandson of a major donor to the University of Toronto. And to expose all of my biases, I should also say I am a business man (a manufacturer, in fact) and not a scientist. So it is circumstance that gives me the honour of saying something to you, but it is from my perspective as a businessman that my few remarks could have some relevance.

Almost as an aside, the curious may be interested to know what it is like to be a descendant of a major donor. About 20 years ago, in the summertime , my sister arrived from Windsor to visit with her flock of children. It would be a great idea, or so I thought, if the great-grandchildren could learn something about the Observatory and, in as polite a tone as possible, I called the Observatory switchboard, said to the operator that I was David Dunlap, and that my sister and I and children would like to see if it would be possible for our small group to join the regular public viewing session that evening. In her best "I don't give a damn who you are" voice, she said the tour was fully booked, fully booked for the next several weekends and I had better be prepared to give weeks of advance notice to secure a spot. So much for being a descendant of a major donor!

But how did it come about, this gift? And here is to be found the point of my remarks. Did my grandmother wake up one morning and say to herself "I have some money to give away today. Wonder who I should call? What about those nice boys at the U. of T.? The Astronomers? I wonder if they would like a telescope? I think I'll give them a call."

Not so – believe me! Let the credit for the delivery of the gift rest where it should properly be – in the lap of the visionary, the prime mover – Dr. C.A. Chant. Only with his foresight, passion, energy and persistence did his dream become the D.D.O. reality.

That happened in 1930. But for another University project, could such a thing happen again? Could Dr. Chant's success be repeated today? – being the realisation of someone's life-long goal, by finding a major donor as a sponsor? How tempting it is to say: "But that was 1930, almost 60 years ago. Times have changed; taxes are higher; people have less to give away." If you believe that, then listen to this:

> In May of 1920, George Hale offered Dr. Chant this advice in a letter: "The problem of raising funds is, of course, difficult, especially at the present time when there are so many demands from all directions. In may own experience I have succeeded in securing funds for the Yerkes and Mt. Wilson Observatories only after repeated failures. In fact there is a very large element of chance in such cases, and the only way to succeed is to continue the search until the right person turns up. This may take many years."
>
> And further, this letter from Sir Edmund Walker, then President of the Canadian Bank of Commerce, sent in November of 1921:

"Dear Mr. Chant: I have your letter of the 2nd. I have examined attentively the pamphlet enclosed therewith and needless to say, I agree with everything you say as to the necessity of establishing a properly equipped astronomical observatory, both in the interests of education and the science of astronomy."

"I fear however that I cannot help you by suggesting any person likely to make such a gift at the present time. Those who have been liberal in Toronto heretofore are at the present time made to pay supertaxes on income which in every case within my knowledge has swept away the source from which donations have hitherto been made to any worthy cause ."

At this point, Dr. Chant in his book 'Astronomy in the University of Toronto' wrote: "That letter made me pause; and several other members of the Board, including my college-mate, H.J. Cody, and esteemed friend, Vincent Massey, expressed similar views and made me consider seriously what I should do. But I could not toss aside my observatory project. Perhaps in a few years financial conditions will change and money for a good cause will flow again more freely."

Imagine how Dr. Chant must have felt! On the other hand, imagine how he must have felt when he received this letter on the 9th of December 1926:

"Dear Prof. Chant: Among the many memories of my married life is the one connected with the study of the stars with Mr. Dunlap. I distinctly remember his great interest in your work. What you said about the many appeals is very, very true, and many good causes lie on my desk to be considered. Although I cannot just now promise definitely, I will assure you that I will keep it in my heart for consideration, for it appeals to me tremendously, and in the meantime, you can come and see me and inform me more regarding the matter. Very sincerely, Jessie Dunlap."

And then again, on December 20th, 1930: (4 years later, I should point out)

"Dear Prof. Chant: Thanks so much for the photos. Had a chat with Mr. Holden (her lawyer) and he says we can now get together and discuss the Great Announcement. What about Monday December 22nd in the evening? Always sincerely, Jessie Dunlap."

Sidney Smith said that Dr. Chant had a vision and pursued it for decades, undaunted by a heart-breaking series of difficulties, disappointments and delays. The campaign which he waged almost single-handedly over the years was planned with wisdom and conducted with courage. I say that the example of Dr. Chant and his fierce determination should serve as the inspiration for all those concerned with development dollars for the U. of T. Can it be done? Can any project be funded? – of course it can – just remember the story of Dr. Chant.

Now, finally, if that story is for development officers, the following thought ought to be impressed upon all potential benefactors, and that of course, Mr. Minister, includes the Government of Canada:

"To give away money is an easy matter,
And in many man's power,
But to decide to whom to give it,
And how large and when
And for what purpose and how
Is neither in every man's power
- Nor an easy matter.
Hence it is that such excellence
Is rare, praiseworthy and noble."

Those words are from a fellow by the name of Aristotle – a man, who along with Dr. Chant, enjoys some reputation. It's a message worth selling.

Lastly, Ian, with your permission, I should read to this group what I wrote to you in Chile:

"Dear Ian: In making her gift to the University of Toronto over 50 years ago, my grandmother intended that Canada have a place in the forefront of astronomy. With your magnificent discovery, that place was never more secure. Our family shares your excitement and lauds your accomplishment."

Ian, congratulations, and ladies and gentlemen, thank you very much.

David M. Dunlap
President
G.F. Thompson Co. Ltd.

SUPERNOVA SHELTON 1987-A

(program description)

Since the Feb. 23 discovery of Supernova Shelton 1987-A by University of Toronto astronomer Ian Shelton, astronomers from around the world have been communicating via computer network with the University's astronomy department for the latest information.

It is the first time since 1604 that astronomers have been able to view the early stages of the death of a massive star and to observe a supernova so close to Earth. (The star is located in the Large Magellanic Cloud galaxy, 163,000 light years away).

Supernova experts such as Professor McCall at U of T are avidly observing Supernova Shelton because it provides the first opportunity to test modern theories about the evolution of supernovae. McCall is particularly interested in assessing theoretical models of supernovae by studying Supernova Shelton's changes in brightness.

The supernova has already defied predictions, says Robert Garrison, a U of T astronomy professor. Instead of reaching a maximum brightness and then fading, it brightened by a factor of 2,000 in less than two days and then maintained a constant brightness for almost two weeks.

Since about 12 March, Supernova Shelton 1987-A has been brightening by about 2-3 percent per day, so it is now a factor of 2 brighter than it was during the plateau phase (26 Feb. - 12 Mar.). This is confusing to theoreticians, because while some predicted that it should have brightened suddenly by an additional factor of 30-50, others predicted that it should have started to fade weeks ago. Neither group predicted this long pause.

The colour is very red and continues to redden, though not as rapidly. According to returning observers, it is a gorgeous red against the silver-gray colour of the Large Magellanic Cloud, especially when observed without a telescope.

The spectrum of a supernova tells astronomers about the temperature, pressure, turbulence, velocity, and chemical composition of the exploding shell. The spectrum of Supernova Shelton 1987-A has evolved from a simple hydrogen spectrum to an extremely complex mixture of lines of many different elements under a variety of excitation conditions. Nothing like it has ever been seen before, though it is beginning now to look more like a traditional supernova.

One of the advantages of the University of Toronto monitoring program is its continuity; we have watched the spectrum evolve from night to night and have seen features develop and disappear, thus helping to unravel the complexity. Because all previous supernovae have been very distant and thus difficult (faint) to observe in detail, and because none have been observed so early in their evolution, this will help astronomers to understand supernova spectra better than ever before.

This rare explosion, which is visible only in the southern hemisphere, gives astronomers essential clues about the nature of the Universe. Already, the explosion has allowed astronomers to put severe constraints on the physical characteristics of the elusive, high-energy subatomic particle known as a neutrino.

Professor Barry Madore, a U of T astronomer, explains that he is using the explosion to provide a more accurate measurement standard for extragalactic distances. More information about the formation of metals heavier than iron will also be gathered. And, since light from the explosion will travel through clouds of gas between the Large Magellanic Cloud and the Milky Way, more will be learned about the chemical composition and density of these clouds.

At the hub of this discussion is the astronomy department of the University of Toronto. Twice daily, Garrison discusses the latest supernova observations via shortwave radio with Shelton, the resident astronomer at U of T's small observatory on Las Campanas Mountain in north-central Chile. Until the supernova is fainter, it is most practical for such small telescopes as the U of T's 24-inch telescope to take data. And while many facilities made some observations of the supernova, U of T is one of the very few observatories continuously monitoring the star.

These data are transmitted via computer to astronomers around the world who , in turn, enter their findings and exchange thoughts on theories put forward about the supernova's behaviour. Garrison, Director of the U of T's Las Campanas Observatory, explains: "Astronomy is a very international science. We're in the fortunate position of having discovered the star and we possess the right facilities to make intensive daily observations. Unlike other types of scientists, astronomers can't repeat experiments that are cosmic in nature so we must share our information."

Garrison is studying the temperature and chemical evolution of the supernova through spectra taken by Shelton. Shelton is also continuously monitoring the supernova's brightness and colour changes. Another U of T astronomy researcher, Dr. Nancy Evans, studied Supernova Shelton the day of the discovery from the perspective of ultraviolet spectra using NASA's International Ultraviolet Explorer satellite.

U of T's southern observatory will continue to monitor the supernova for the next few years, until it becomes too faint for a small telescope. Garrison says that by then he hopes funds will be raised for a new two- meter telescope which would allow U of T to continue to observe this event.

At present, the observatory is funded by endowments to the University of Toronto's David Dunlap Observatory and by a Natural Sciences and Engineering Research Council grant. The Carnegie Institution of Washington , D.C. owns Las Campanas Mountain where U of T's southern observatory is located.

LIBRARY NEWS

by Marlene Cummins

The library has purchased a "corporate membership" for Canada Remote Systems, a supplier of public domain and user supported software for various types of micro computers. See Marlene for details.

PAPERS SUBMITTED

PREPRINTS BY FACULTY AND STUDENTS RECEIVED IN THE ASTRONOMY LIBRARY

Duncan, Martin, Thomas Quinn and Scott Tremaine. The formation and extent of the solar system comet cloud. (CITA preprint) 87.6.4.

Dove, J.E.; Rusk, A.C.M.; Cribb, P.H. and Martin, P.G. Excitation and dissociation of molecular hydrogen in shock waves at interstellar densities. (Already pub'd- ApJ V318 p379.)

Evans, Nancy Remage. The orbit of the classical cepheid SU Cygni. 87.6.15.

Evans, Nancy Remage. Fixed pattern noise revisited. 87.7.7.

Fernie, J.D. A new scale of classical cepheid color excesses. 87.5.28.

Fernie, J.D. A check on EU Tau. 87.7.7.

Kim, K.-T., P.P. Kronberg and T.L. Landecker. The rotation measure of back-ground radio sources seen through the supernova remnant OA184(G166.2+2.5) 87.7.7.

Madore, Barry F., Douglas L. Welch, C.W. McAlary, R.A. McLaren. Near- infrared observations of cepheids: the distance to NGC 300. 87.5.26.

Martin, P.G. Hydrogenic radiative recombination at low temperature and density. (CITA preprint) 87.6.4.

Percy, J.R., A.E. Napke, M.G. Richer et al. Photoelectric and visual photometry of P Cygni. 87.5.15.

Rusk, Raymond. The brightness and polarization structure of compact radio sources. 87.5.11.

Sanders, D.B., B.F. Madore, et al. Ultraluminous infrared galaxies and the origin of quasars. 87.05.15.

Sasselov, D., E. Zsoldos, J.D. Fernie, A. Arellano Ferro. Multisite observations of UU Her: 1985 results. 87.6.3.

Stagg, Christopher. A photometric survey of the bright southern Be stars. 87.4.15.

Thompson, Ian B., P.G. Martin. Optical polarization of Seyfert galaxies. 87.5.12.

Welch, Douglas L., Robert A. McLaren, Barry F. Madore, Christopher W. McAlary. Distance moduli and structure of the Magellanic Clouds from near-infrared photometry of classical cepheids. 87.5.5.

Welch, Douglas L., Nancy R. Evans, Ron W. Lyons, Hugh C. Harris, Thomas G. Barnes III, Mark H. Slovak, Thomas J. Moffett. The orbit of the classical cepheid U Aquilae. 87.5.12.

REPORT ON THE WORKSHOP ON SNR/ISM

K.–T. Kim, Dale Frail, and Mike Bietenholtz

From June 8 to June 12, 130 astronomers gathered in Penticton, B.C. for IAU Coll. 101, "*The Interaction of Supernova Remnants with the Interstellar Medium*". The three of us were at this meeting and what follows is a short description of what we found new and interesting in supernovae (SN), supernova remnants (SNR) and the interstellar medium (ISM).

SN now come in three types : 1) SNIa, carbon deflagration of a WD, 2) SNIb, core collapse of a massive star with no hydrogen (Wolf Rayet stars ?), and 3) SNII, core collapse of a massive star with a hydrogen envelope.

It is well known that SN exert a strong influence on the structure, kinematics and dynamics of the ISM. There was a great deal of discusion on how SN "prepare" the local ISM before exploding. In addition the effects of an inhomogeneous medium on the structure and evolution of SNR's is starting to receive serious attention. Spitzer's spherical clouds have been tossed aside in favor of the more realistic filaments or "sheet-like" clouds. The dominant contributions to the weight and pressure of the ISM are now recognized to be the warm ionized medium and the warm neutral medium. SNR's could provide the source of heating for these media via dissipative Alfvén wave interactions with gas particles, otherwise most of the energy goes into the elastic compresion of the field.

There are more than 5 different shocks used in describing the interaction of either stellar winds or SNR with the ISM : 1) Forward shock, 2) Reverse shock, 3) Reflection shock, 4) Rarefied shock, 5) Secondary shock. It is worth pointing out that if a cloud is shocked than it is most likely to be squashed into a sheet–like shape due to a secondary shock, which is the shock reflected and propagated around the cloud and pressing the opposite side of the cloud. One interesting point is that, when interacting with numerous cloudlets, a shock wave is deflected such that it is able to produce tangential velocity dispersions of up to $100 - 200\ km\ s^{-1}$.

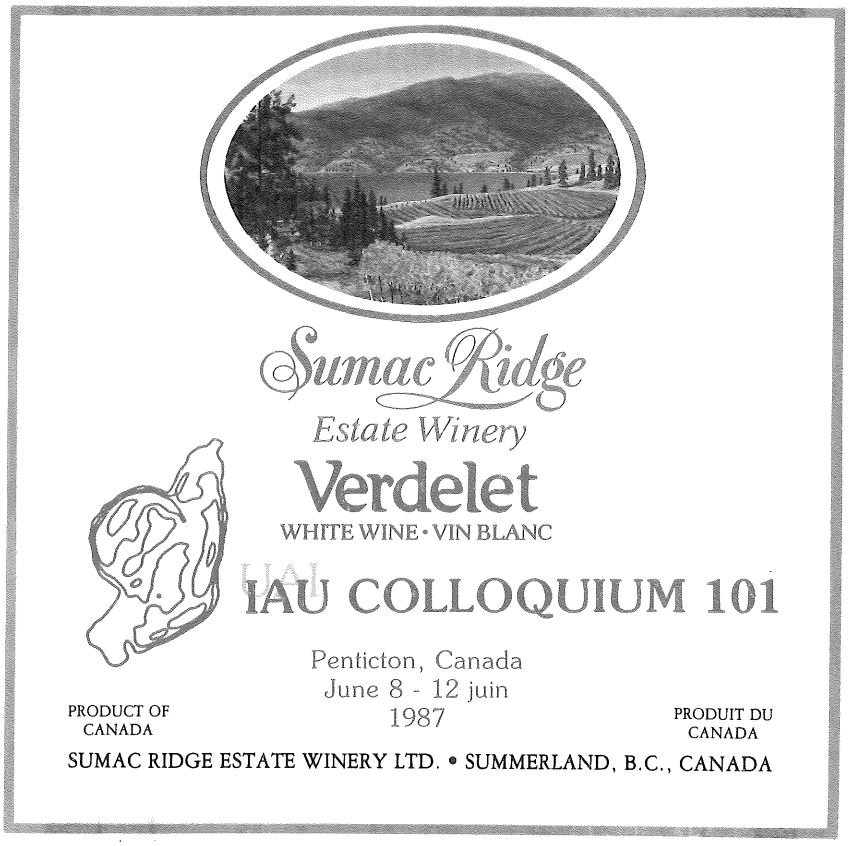
We were warned at this meeting that E_p/E_f, which is the ratio of the energy associated with the relativistic particles and the magnetic field, might be much greater than what is commonly assumed in energy equipartition arguements for estimating the magnetic field. This situation is very serious for young SNR's like Cas A or Kepler. The null detection of $\gamma-$rays from Cas A, implies that there is a very weak magnetic field, and therefore the radiation efficiency a factor of 1000 lower than equipartition arguements assume. In Kepler's case the ratio is a factor of 200 lower. This non-equipartition situation can be understood if the magnetic field in young SNR's is dominanted by the radial component. In this case, field amplification by the shock is significantly reduced and the synchrotron radiation is reduced accordingly.

The possibility of dust destruction through excessive dust heating in shock heated regions might be investigated by detecting IR radiation from SNR's. Coupling of dust to gas is significantly enhanced by the presence of a magnetic field. The sputtering processes, whose time scale is $\tau \approx \frac{10^6 a(\mu m)}{n_{gas}}\ yrs$, tends to make the dust grain size smaller, and this effect causes the dust to gas temperature relation to flatten from $T_d \propto T_g^{0.30}$ to $T_d \propto T_g^{0.02}$ and thus causes the dust temperature insensitive to gas temperature when $T_g \geq 10^8\ K$ (due to penetration of speedy particles through grains). Moorwood found a very good correlation between the [Fe II] line strength (at around 1.6 μm) and the strength of H_β which provides an excellent density indicator. [FeII] is usually locaked up in grain and sputtered off and excited by gas, thus it is also a good incator of strength of the shock. Based on the study of SNR's in LMC, the correlation is found to be about $\frac{S[FeII]}{S[H_\beta]} = 0.2$.

Among the most prominant lines detectable from SNR's are [OI] 6300, [SII] 6716, 6731, [NI] 5200, and [OII] 3726, 3729. In SNR 3C58 (which is crab−like, flat spectrum, and shows a high degree of polarization) [NII] was found to be the most prominant line instead of [OIII] and [SII], the usual indicators of shock heating. An interesting observation associated with 3C58 is the presence of low velocity gas, whose absolute radial velocity is $v_r \leq 300\ km\ s^{-1}$, amid of gas of velocity dispersion of $\sim 900\ km\ s^{-1}$ and relatively high velocity filaments of $+1000\ -\ -1075\ km\ s^{-1}$. Thermal−dynamic instability could be to some extent suppressed by introducing a higher conductivity which essentially flattens the radial temperature gradient. While no thermodynamic instability in temperature range, *i.e,* $\sim 10^4 \sim -10^6 K$ ([CIII][OIII]channel), in temperature ranges of about $10^2 - 10^4 K$ ([CII]channel) and $10^6 - 5{\cdot}10^7 K$ ([Fe]channel), the heating function is either flat for the former or negative for the latter thus results instability (more heat then no more cooling).

Basic assumptions in modelling the X-ray emission from SNR's are 1) Collisional ionization equilibrium (CIE), 2) Thermal equilibrium between ions and electrons, 3) Maxwellian distribution, 4) Homogeneous ISM and 5) Sedev solution (Homologous). Highlights of X−ray observations include 1) Two Temperature Components of X−ray emitting gas, 2) Large overabundance of Si, S, Ar, Ca but [Fe] (reverse shocked) are under solar abundance, 3) Sweeped-up mass is generally too big, *e.g.,* Cas A $\geq 45\ M_\odot$ or Tycho $7\ -\ 45\ M_\odot$. Based on Pup A, Cas A, and Cyg Loop observations, there arose doubts on the validity of assuming collisional ionization equilibrium. One component fits (with a reverse shock) of the X−ray spectra have been very succesful but the abundance is not well defined with either a one or two component model. From Cas A X−ray observations, Markert found significant discrepancy in temperatures in the sense that the

temperatures are higher with [Si] and [S] but lower with N_e and this is interpreted due to primary and reverse shock and further reinforced the Non-Equilibrium nature of X−ray emitting SNR. The sweeped-mass calulation with data collected with EXOSAT for SNR's in our galaxy and LMC is in average about $2 - 10 M_{\odot}$ which is acceptable.



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July 1987

PRELIMINARY SCHEDULE
JULY - DECEMBER 1987

UNIVERSITY OF TORONTO
60-cm Telescope
Las Campanas, Chile

1987	OBSERVER (programme)	INSTRUMENT
16-19 July	Filhaber (Coutts-Clement)	Camera
31 July	Shelton (A.Wehlau: UWO)	Camera
1-6 August	Filhaber	UBVRI Phot, Spectro
7-16 August	Garrison	Spectrograph
17-27 August	Rogers	CCD
28-31 August	Filhaber (Webster/Dyer)	CCD
1-17 September	Filhaber	UBVRI Phot, Spectro
18-27 September	Dyer	CCD
28 Sept - 6 Oct	Filhaber	UBVRI Phot, Spectro
7-29 October	Hill/McCall/Madore	CCD
30 Oct - 16 Nov	OPEN	----
17-20 November	Filhaber (Dyer/Webster)	CCD
21-26 November	Quintana	Phot
27-30 November	Filhaber (Coutts-Clement)	Camera
1-11 December	OPEN	----
12-23 December	Selman	Phot
24-31 December	Rogers	CCD

MOONS		Chilean Holidays (Please avoid travel to & from mountain)	Resident (John Filhaber)
Full	New		
11 Jul	25 Jul	15 August	5-23 July
9 Aug	24 Aug	11-18 September	31 July - 9 August
7 Sept	23 Sept	12 October	17 August - 7 October
7 Oct	22 Oct	1 November	29 October - 13 December
5 Nov	21 Nov	8 December	
5 Dec	20 Dec	25 December	
4 Jan	19 Jan	1 January	