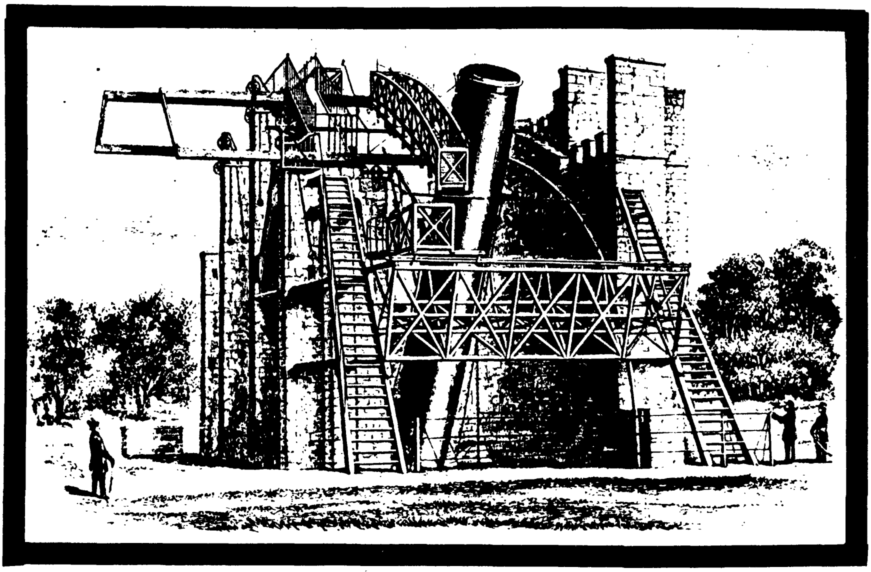
NOVA NOTES



Halifax Centre

Nov~Dec 1985
Volume 16
Number 6

1986 Halifax Centre Executive

Honorary President	- Dr. Murray Cunningham
President	- Norman Scrimger 12 Lynwood Drive HALIFAX, N.S. B3M 1Y9
Vice-President	- Cathy McLeod 4 Mott Street DARTMOUTH, N.S. B3A 2W4
Secretary	- Ralph Fraser 40 Murray Hill Drive DARTMOUTH, N.S. B2Y 3A8
Treasurer	- Randall Brooks 71 Woodlawn Road DARTMOUTH, N.S. B2W 2S2
NOVA NOTES Editor	- Patrick Kelly 2 Arvida Avenue HALIFAX, N.S. B3R 1K6
National Rep.	- Darrin Parker Room 7-1-2 High Rise 2 Saint Mary's University HALIFAX, N.S. B3H 3C3
Librarian	- David Chapman 8 Lakeview Avenue DARTMOUTH N.S.
Observing Chairman	- Gordon Hawkins 327 Arklow Drive DARTMOUTH, N.S. B2W 4S1
Mailing Address	- Halifax Centre, R.A.S.C. c/o 1747 Summer Street HALIFAX, N.S. B3H 3A6

NOTICE OF MEETINGS

Date: Friday, November 15th : 8:00 P.M.

Place: Nova Scotia Museum: meeting to be held in the lower theatre. Access from the parking lot and side entrance.

Topic: We will have be having 2 speakers at this meeting:

Darrin Parker will give us a report on what happened at this years General Assembly and also show us ome of the slides that he took while in Edmonton.

Dr. Murray Cunningham will be telling us about an astronomical site that he saw on a recent trip to Asia.

****

Date: Friday [redacted] December 13th [redacted] : 6:00 P.M.

Place: Halifax Exhibition Park
see enclosed map for directions

Topic: Public Halley's Comet Observing Session. See page 126 for details.

****

About the cover: The cover this issue shows Lord Rosse's giant 6 foot reflector which was located at Birr Castle in Ireland. In its day the world's largest telescope, it was used to first observe the spiral nature of some galaxies.

1986 EXECUTIVE

This year, just like last, we did not have any executive positions for which more than one person had been nominated or volunteered. As a result, the 1986 executive was "elected" by acclamation. The following is a list of the executive positions and who will hold each position for the upcoming year.

- Norman Scrimger will be completing his second term as President.

- The position of Vice-President will be held this year by Darrin Parker, who was our National Representative last year.

- Ralph Fraser moves continues in the post of Secretary again this year.

- After holding the position of Treasurer for the allotted limit of three years, Randall Brooks will be succeeded by David Tindall.

- Yours truly will be NOVA NOTES Editor for another year. Our new National Representative will be Doug Pitcairn.

- David Chapman will be the man with the books once more as Librarian.

- Gordon Hawkins is ready for another year of observing sessions as Observing Chairman.

I would like to thank those outgoing members of the executive on behalf of all of us for the fine job that they did over the last year and I would also wish all of the new members the best in the upcoming year.

==

GAWKER'S REPORT

Definition: Gawker--- One who gawks at the heavens

Time: Tuesday Oct. 22 / 85
Place: Entrance to Oakfield Park
(44 55'N 63 35'W)
Present: Glen Roberts, Doug Pitcairn, Pat Kelly
M.V.M. (Minimum Visual Magnitude): 6.5
Weather conditions: No clouds or wind
Equipment: Celestron C8, Baush & Loumb 4000
7x50 binoculars
Objects observed: Our first sighting of M82
Halley's Comet, M1(Crab),
M35, M36, M37 M38

If members would like to have their notes included in the Gawker's Report, please send in BRIEF observation reports using the above format and we will include them in the following issue.

Doug Pitcairn

==

PUBLIC HALLEY'S COMET OBSERVING SESSIONS

With the growing public interest in Halley's Comet, the Halifax Centre in conjunction with Saint Mary's University will hold two public observing sessions at the Halifax Exhibition Park on the Prospect Road. The dates are [redacted] December 6[redacted]th and [redacted]y December 13[redacted]th with the time set for 7:00--9:00 P.M. As the site is to the south west of Halifax, the southern sky should not be plaqued with light pollution, and Halley's Comet should be fairly bright by then. Once again you are invited to bring along your telescope and be ready to answer a lot of questions. If you are bringing a telescope, we hope to begin setting up at 6:00. See the enclosed map for directions to the Exhibition Park.

THE EXPLOSION OF A SUPERNOVA

The Chinese were amazed in July, 1054 to note a new star glowing in the constellation of Taurus. It burned so brightly that it was brighter than Venus, and indeed it could be seen in broad daylight for some 23 days! Within a year it has vanished. What was it?

This spot is now marked by the first of Charles Messier's famous "pseudo-comets" known as M1, the Crab Nebula. It was a supernova, one of the most violent events in the universe. A very massive star had reached the end of its life and exploded.

Until recently, this summed up most of what was known of these objects. But if stars collapse at the end of their lives, why would the resulting implosion spew so much matter outward? Thanks to super-computers such as the Cray-1, we have a clearer understanding of the events which take place.

So let's jump into our handy time-space machine called imagination and take a quick look at a massive star's life. By massive, we shall confine our search to something with about 12 to 18 times the sun's mass.

All stars begin by gathering up loose material (mostly gas) that is generally lying about unemployed. Gravity provides the reason that this process takes place. If the region of formation is rich in matter, then a larger portion will gather into a ball.

As material is gathered, gravity increases. And this helps gather more material. This circle continues until enough is collected to build up heat, through friction, in the ball's center. This center is composed mostly of hydrogen, as this is the most common element in the universe. Given enough pressure and heat, four hydrogen atoms will weld together to form one helium atom. A small amount is left over, which is released as photons and neutrinos. They are extremely small particles.

But, because this helium forming process occurs at a fast rate, all those tiny photons and neutrinos add up to form a powerful outward blowing "wind". This helps to stop the effect of gravity, and the two forces reach a state of equilibrium: a compromise of two opposite actions.

All of this sounds good, but does there ever come a time when all of the hydrogen is converted to helium? If this happens, what becomes of the "wind"?

In actuality, when about two thirds of the hydrogen is used up, the abundant helium gets in the way of the hydrogen atoms. The welding process loses efficiency; in other words less and less helium is being produced. And this means the "wind" dies down.

For small stars, it takes billions of years to happen. But for the stars we are considering, only a few million years are enough. The reason is that large stars use up their materials faster to counteract the much larger force of gravity that they must contend with.

Now comes the interesting part! Without a strong "wind", the central core is compressed by gravity; this collapse takes less than a minute! With a smaller core, the temperature rises to the point where the helium combines to form carbon. This then rekindles the "wind", and tends to blow the outer layers outward. The tremendous heat released ignites the hydrogen in the shell around the core into producing helium. So now, we actually have two stars; one within another like Chinese boxes (a group of boxes that fit inside each other).

After a while, the process of converting helium to carbon also becomes inefficient and another collapse occurs. The shrinking globe in the centre stops when conditions when conditions cause the carbon to form neon. Again, the surrounding shell then converts helium to carbon, and another shell outside it is busy changing hydrogen to helium. We now have three stars stacked together!

This carries on and another collapse occurs: now the core is producing oxygen from neon. Yet another collapse causes oxygen to change to silicon in the core. All the while, more outer shells are being formed. The final step occurs when the silicon core forms iron. But in case you may be wondering when it will all end, fear not. Iron is the last step. It cannot form into any other element and still produce a "wind".

It took 7 million years to get to the first collapse. But each step afterward happened more quickly. Helium burning takes half a million years, carbon only 660 years, neon a mere year! The final steps: oxygen takes half a year, silicon only one day! By this time the core has gone from 15 million degrees to over 400 million degrees!

Let's pause for a moment before going on. In our imagination, we have gone from millions of years to a single day - quite a stretch! But I hope you are not dizzy yet. Events happen at much faster rates from here on in! Here is something to ponder before we shift into overdrive. Stars shine at brightnesses ranging from brown dwarfs, which can hardly be seen, to millions of times brighter than the sun. Over this whole range, the masses change very little in comparison. The smallest stars are only one hundredth the mass of the sun, while the largest are about one hundred times. This range is only four magnitudes (the number of powers of ten involved), whereas the brilliance spans 12 or more magnitudes!

Back to our quickly changing star. To recap, we have now reached the point, after seven and a half million years, where we have a star with an onion-like structure. Each layer is one element burning or welding to form another. And in the centre, we have silicon (mixed with some sulphur, incidentally) burning to form iron. But iron cannot form into other elements a still produce the "wind", so the final collapse begins.

It takes only 5 milliseconds (five thousandths of a second) for the core to collapse! This core is a ball of iron about 1 500 km in diameter. It shrinks to a mere 5 to 10 km, but then something remarkable happens.

During the collapse, the incredible pressure forces protons and electrons to reform into neutrons and neutrinos. The neutrons stay behind and get squashed further, but many of the neutrinos escape, lowering the pressure and temperature. Neutrinos are very small, to the point where they are rarely stopped by anything. About 100 billion of them are flowing through you and the entire Earth each second.

A point is quickly reached, however, when even the slippery neutrinos are trapped in the core. Material is falling inward at velocities ranging from 2 000 to 40 000 km/s. The speed of sound in material this dense is also in the same velocity range. At the point where the speed of sound matches the speed of infalling material is a boundary. Anything underneath this boundary is in direct communication, resulting in what is known as a homologous unit. In other terms, the core is perfectly smooth and round. Any deviations are smoothed out by the resulting sound waves.

The core is now nuclear matter, a mixture of neutrons and some neutrinos. Because of the homologous boundary, nothing escapes. But this edge is moving inward very quickly. The core is compressed beyond its equilibrium density (where the pressure pushing apart the neutrons and neutrinos equals the gravitational pressure pressing inward) and then bounces back.

Aha! This is the beginning of the answer to why collapsing superstars end up spewing matter outward into space.

The rebound of the core sets up a shock wave. Computer studies show that this wave travels outward at the incredible rate of 30 000 to 50 000 km/s. At this speed, it takes only a fraction of a second to work its way out of the core and into the outer layers. Of course, this shock wave has to contend with the inrushing material. Because it moves faster than the local speed of sound, it is not confined to the core. And it is so powerful that it actually reverses the flow of the material!

It takes a few days to work its way to the outer layers of the star. It eventually reaches a point where the strength of the outer layers cannot handle the tremendous force, and anything beyond this point is then blown off into space.

When we started, I was careful to mention that the stars we are considering would be from 12 to 18 solar masses. It seems that in stars over 1[illegible] times more massive than our sun, the final moments of the supernova take a slightly different route.

In these instances, the shock wave actually gets stalled about 150 km from the center. The wave gets used up fighting the incoming material, and also in breaking up the atomic components into neutrons and neutrinos. However, all the trapped neutrinos in these cases actually start another shock wave going about [illegible]50 km from the center.

Well, let's return to the less hectic environment of Earth. The Crab Nebula was used to start this journey, but how big was it? By analyzing all the data it is felt that it was a supernova of nine solar masses. Supernovas are rare events, though. Only three have been seen in our galaxy in the last 1 000 years. But, because they are so bright, astronomers detect about ten per year from other galaxies. It is these that have provided some means of checking the results of the computer studies.

Statistically, we are due for another celestial treat like M1. From all the research, it seems that the most likely candidate to go supernova is the star Eta Carinae.

reprinted from "The Starseeker"
Calgary Centre

VOYAGER 2 AND ITS URANUS ENCOUNTER

As a supplement to Michael Grace's article on the upcoming encounter between the Voyage 2 spacecraft and the planet Uranus, I have included several diagrams from the November issue of *Sky and Telescope* magazine which should make the geometry of this encounter easier to grasp.

The first two figures show the trajectories of both Voyagers 1 and 2 as viewed from about a 45 degree angle with respect to the ecliptic (Figure 1) and as viewed from above (Figure 2). Notice that the course of Voyager 1 will not carry it past any of t he outer planets as it was felt that the information that could be obtained from a "polar" view of the Saturn system (it was this manuever which caused the large change in the Voyager 1's trajectory) outweiged the benefit of any further encounters especially since Voyager 2 would still pass by both Uranus and Neptune.

Figure 3 shows three views depicting how Uranus will appear from Voyager at three different points in the encounter. The shaded area of the planet corresponds to its night side.

Figure 4 shows the view of the flyby as seen from Earth. When the spacecraft is behind the rings, changes in the strength and frequency of its radio signal will yield information on the ring particles' size and abundance.

Figure 5 is plotted looking down on the Uranian system with Voyager 2's path lying in the plane of the page. The U-like symbol marks the line along which the rings and the satellites pass from below the ecliptic (upper half of figure) to above it (lower half). About 3 hours after coming closest to Uranus, the spacecraft will be hidden by the planet as seen from both the Sun and the Earth.

Patrick Kelly

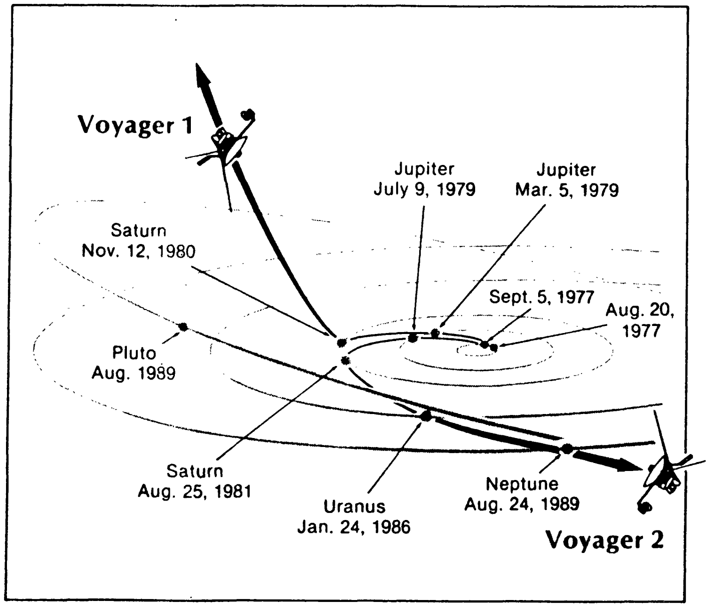


Figure 1

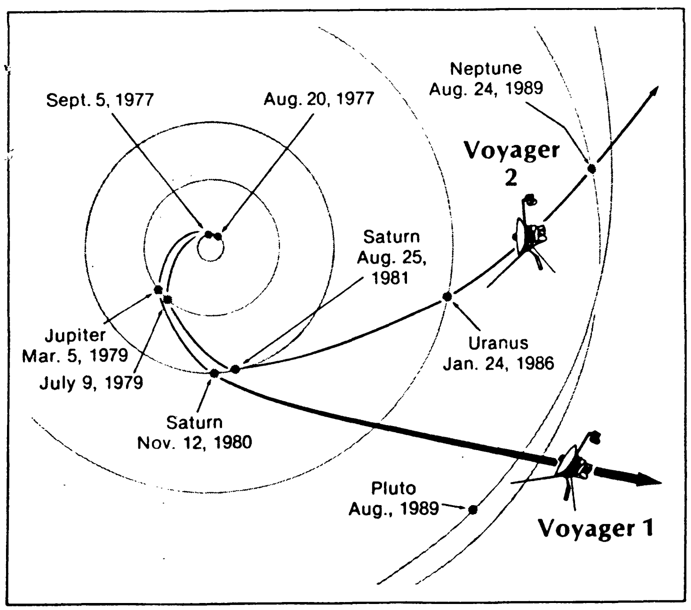


Figure 2

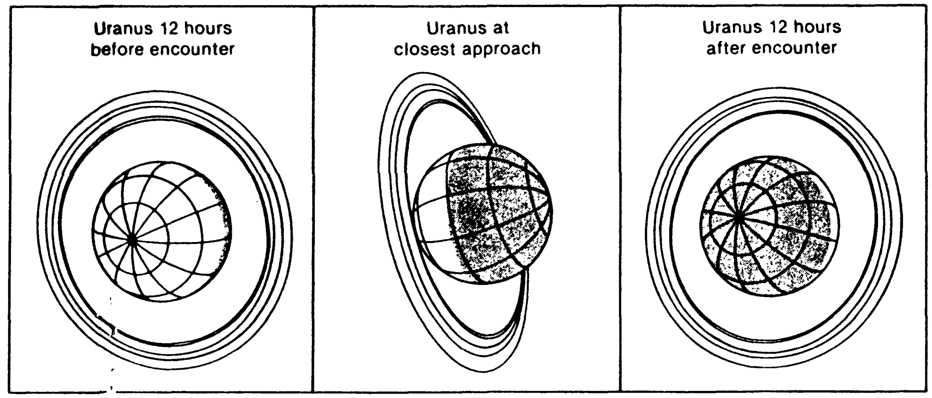


Figure 3

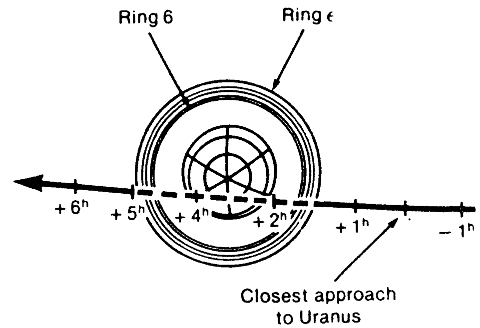


Figure 4

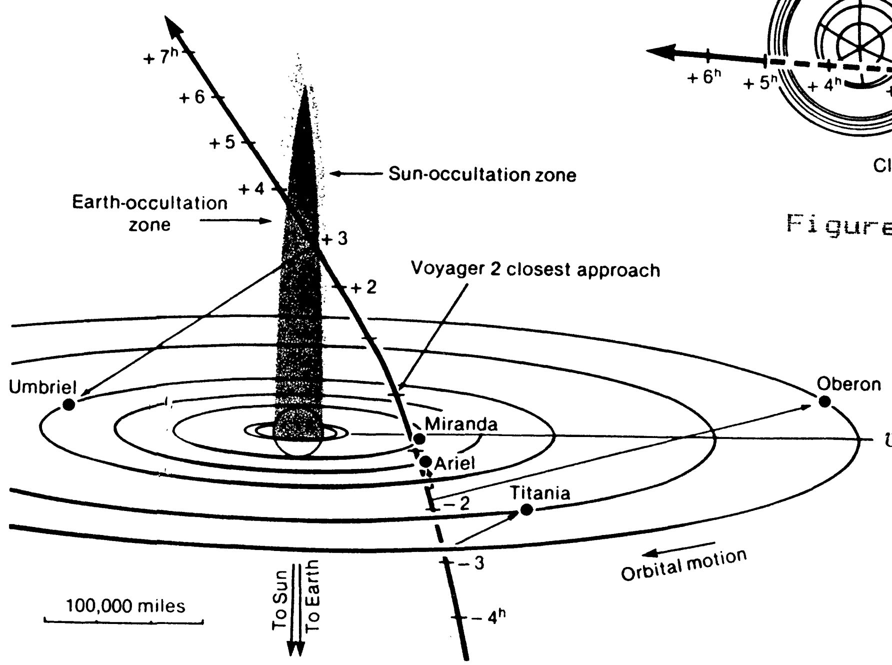


Figure 5

ANOTHER INTERPLANETARY VISITOR

With all the hype surrounding the interplanetary interloper which visits us from the far reaches of the solar system every 76 years, it appears that another interplanetary visitor is paying a visit to the outer realms of the gas giants. It is a coincidence that it is paying its visit around the same time as Halley's Comet is making its transient trip through the inner solar system.

Of course, I am talking about the little man-made object known as Voyager 2; that intrepid explorer that along with its sister ship Voyager 1 has virtually rewritten astronomy books covering the Jovian giants Jupiter and Saturn. But now, Voyager 2 is about to open up a whole new chapter in our astronomy books that never really existed before now.

On January 24, 1986 , after traveling some 4.8 billion kilometres, Voyager 2 will pass 107 000 km above the cloud tops of Uranus, providing us with the first close-up views of a new world. The spacecraft will send back approximately 300 images along with other data before continuing on its voyage outward to Neptune and beyond. It will eventually become another mechanical interstellar ambassador for all of mankind, carrying with it all of the sights and sounds of its home world. Hopefully, this will provide any spacefaring civilization with information about the creatures that built and launched this little bottle with a message into the great ocean of space.

But first, the mission at hand. Hopefully, without further glitches in its boom which carries its array of cameras and instruments, Voyager will be able to complete its itinerary through the Uranian system and attempt to answer the many questions that have plagued astronomers since that planets discovery over 200 years ago by an amateur astronomer named William Herschel.

Little is known about this strange and mysterious world that appears as a little green orb set in the blackness of space when viewed through even the largest ground based telescopes. Even such basics as size, period of rotation and density are all estimates. We do know that Uranus lies on its side, with its equator tipped 98 degrees with respect to its orbital plane, and only speculation has arisen to explain this planetary oddity. The leading hypothesis postulates a catastrophic collision with an asteroid, but such a devastating collision should have disrupted the orderliness of its retinue of tiny moons. However, Uranus has the most orderly of all moon systems known to date.

None of the five known moons are more than half the size of the moons of the Galilean group orbiting Jupiter. Their sizes are estimates based on their brightnesses and assumptions of their surface reflectivity. The results of their infrared spectra indicate that they have surfaces of water ice. Because the planet is oriented in such a peculiar way, the south pole is bathed in constant sunlight, with the planet and its rings appearing as a huge bulls-eye to the approaching spacecraft. Due to this, Voyager 2 will be unable to travel near near the plane of the satellites, focusing its cameras on them one at a time as it did during its Jupiter and Saturn encounters. Instead, Voyager must plunge through the satellite plane and will essentially encounter all of the satellites at once rather than individually. Therefore, Voyager will give us a view of some of the satellites from a greater distance than we would like. Despite this disadvantage, the spacecraft will provide us with accurate determinations of their diameters, densities and albedos, giving each of these points of light a personality of sorts not known before.

As you can see, this naked eye object has remained slightly out of reach of modern day instruments and astronomers have had to work long and hard to glean any information about the mysteries of this planet. With a little luck, scientists have made some startling discoveries. For instance, on the night of March 10, 1977 a very serendipitous discovery was made. While observing an occultation of a star by Uranus, some unexpected dimmings of the star took place prior to and after the occultation. At first, the scientists thought these dimmings were caused by a malfunction in their equipment or weather conditions. After examining the results of the observation, they found the dimmings to be uniform on either side of the planet. The hypothesis that arose from their data pointed to only one logical cause: rings. Yes, they had discovered the third known ring system in our solar system, this time around the planet Uranus. This discovery was made completely by accident, since the original intent of the observations was to refine the measurement of Uranus' diameter.

It is now known that Uranus has at least nine rings girdling it. The question now is: Are they similar in structure to those of the Saturnian system or are they of different composition and dynamics? These questions and others may be answered by Voyager 2. The rings have a low albedo and recent spectroscopic measurements indicate that they are not icy in composition, which is an unexpected result, considering that ice is a common constituent of the outer solar system. It also appears that their general structure is very puzzling. For example, the outermost ring has more mass than all of the others combined and yet has a large orbital eccentricity. On top of that, its width varies greatly, from 20 km at periapsis to 96 km at apoapsis. Perhaps, the spacecraft will discover "shepherd" satellites holding the entire structure of the ring system together, similar to the ones tending the narrow F ring of Saturn.

Through Voyager's eyes we may see belts, zones and raging storms roiling amid the Uranian atmosphere. Then again, it may be boring and bland. We may see braided and kinky rings and solve the mystery of what holds the rings together - or deepen the mystery. There are many questions about the Uranian system that require answers and Voyager 2's close encounter with this enigmatic planet will surely help in answering those questions. This could very well turn out to be one of the major highlights of the Voyager 2 mission.

We have to remember that nothing is guaranteed. Questions will be answered but as in the past, Voyager will provide us with new vistas to contemplate and new questions to ponder and hypothesize. We must expect the unexpected.

Michael Grace

****

MATERIALS DONATED TO ARCHIVES

At the request of the Public Archives, we have donated all of the Halifax Centre's old issues of NOVA NOTES, general correspondance, minutes of meetings, General Assembly reports, etc. to the Public Archives of Nova Scotia. Anyone interested in accessing this material can ask for it at the Public Archives Building which is located at the corner of Robie Street and University Avenue in Halifax. The refernce number given to our material is MG 20 Volume 1585

****

NEW COMET SIGHTED

As reported in the November issue of Sky and Telescope magazine, a new comet has been just discovered by two astronomers who detected found it on a plate taken with the U.K. Schmidt Telescope in Australia. Comet Hartley-Good is well placed in the southwest at dusk and is passing through the constellation of Aquila. At about 7th magnitude it is about the same brightness as Halley's Comet. The following ephemeris (2000.0 co-ordinates)

Nov 6	18h 50min	+ 7.0 degrees
Nov 16	18h 20min	+11.5 degrees
Nov 26	17h 54min	+14.5 degrees

The reason that I chose to review the book "DISCOVER THE STARS: How to Use a Telescope" was because from the title I expected that this was an introductory book on the use of astronomical telescopes. In fact, the subtitle actually refers to only one of the eleven chapters in the book. Instead of explaining how to use a telescope, this little volume attempts to explain the night sky at a very elementary level.

The first four chapters are devoted to explaining the night sky and how we perceive it both in terms of the star patterns that we see and also in the manner in which the sky appears to "spin" over the course of a night and from season to season. This is done with the help of several aids for visualizing the sky. One of these aids is with the use of an old umbrella. Instructions are given on how to place the stars on the inside of an old umbrella with a piece of chalk, and then turn the umbrella with its shaft inclined at the proper angle to simulate the stars' movements. The entire sphere of the sky is also shown as being similar to a spherical flask and the reader is shown how to construct a model planetarium from such a flask. The portion of sky visible is even simulated by half filling the flask with a water-ink solution, which blocks out the correct portion of the sky when the flask is held at the appropriate angle.

The book then goes on to explain how the earth's rotation makes the sky appear to turn. The reader is shown several ways of using the stars to tell time, both from hour to hour and from season to season. The next subject to be covered is the constellations. The figures used to depict them are quite crude if one compares them with other similar introductory books. As well, the shapes of the constellations even though they follow the traditional forms, are quite hard to make out. I still prefer the constellations as drawn by H.A. Rey in his book "Find the Constellations" as he actually draws them so that they look like the objects they are supposed to represent.

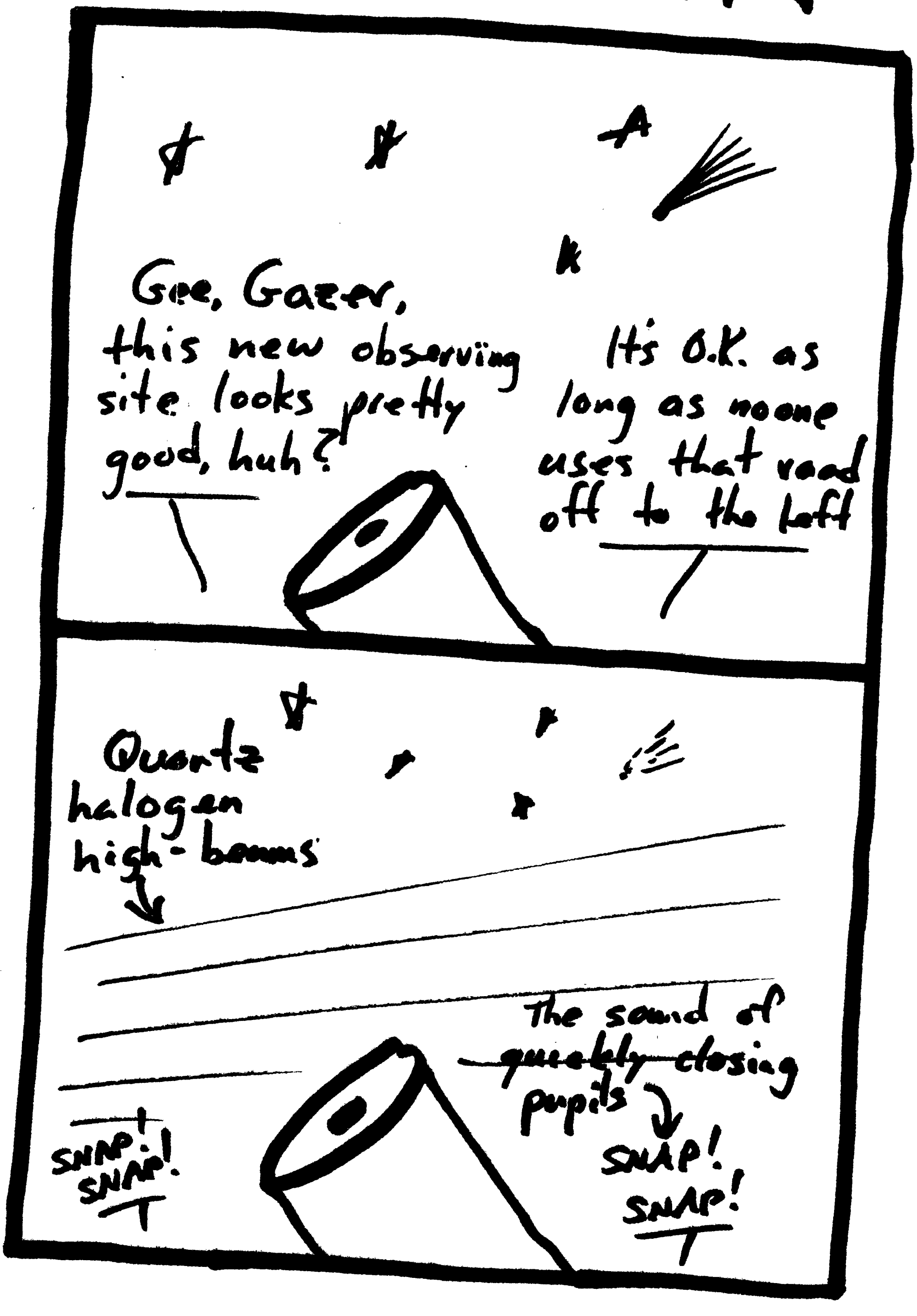
Any serious attempt to explain the sky could not be complete without a section on planets and this book is no exception. The section starts by looking at the odd motions of the planets as viewed from the Earth and follows the various theories put forth to explain them. Once showing that Copernicus had the right idea, the book again shows how to build a simple device to help explain both the movements of inferior and superior planets. Also included in this section are a very brief description of meteors and meteor showers.

The moon is also treated in a separate section and once again, the charts used for showing the moons major features leave much to be desired. The movements of the moon are well covered, including a rather interesting section explaining how the angle of the moon's orbit with respect to the horizon causes the Harvest and Hunter's Moons. Eclipses and tides are also covered reasonably well. We now have a small section showing how to find about a dozen other types of celestial objects that can be seen with opera glasses or small binoculars. The list includes such old standbys as the Andromeda and Orion nebulas; Alcor and Mizar; the Pleiades, Hyades and Double clusters and several variable stars.

The last section of the book covers small instruments explains how refracting and reflecting telescopes work, as well as how to test them for their visual accuracy. The reader is also shown how to build a simple refractor (simple meaning cardboard tubes) but also a clinometer for measuring angles and a passable sextant. Although this book gives even treatment to a lot of different subjects, its lack of both appendixes and index as well as the poor quality of the drawings force me not to recommend this book as introduction to astronomy. To put it simply, there are many other books around which are much better.

Pat Kelly

GA*ZER



Gee, Gazer, this new observing site looks pretty good, huh?
It's O.K. as long as noone uses that road off to the left
Quartz halogen high-beams
The sound of ~~quickly~~ closing pupils
SNAP! SNAP!
SNAP! SNAP!

P. Kelly / D. Pitcairn

NOVA NOTES INDEX

November - December 1985 Volume 16/Number 6

NOVA NOTES is published bi-monthly by the Halifax Centre of the Royal Astronomical Society of Canada in January, March, May, July, September and November. Articles for the next issue should reach the editor by DECEMBER 20th 1985. Articles on any aspect of astronomy will be considered for publication. The editor is:

Patrick Kelly
2 Arvida Avenue
Halifax, Nova Scotia
B3R 1K6
477-8720

NOVA NOTES is printed courtesy of the Nova Scotia Museum

R. A. S. C. - HALIFAX CENTRE 1986 CALENDAR OF EVENTS

January 1986

S	M	T	W	Th	F	S
			1	2	3	4
5	6	7	8	9	10	**11**
12	13	14	15	16	**17**	*18*
19	20	21	22	23	24	25
26	27	28	29	30	31	

February 1986

S	M	T	W	Th	F	S
						1
2	3	4	5	6	7	**8**
9	10	11	12	13	14	*15*
16	17	18	19	20	**21**	22
23	24	25	26	27	28	

March 1986

S	M	T	W	Th	F	S
						1
2	3	4	5	6	7	**8**
9	10	11	12	13	14	*15*
16	17	18	19	20	**21**	22
23	24	25	26	27	28	29
30	31					

April 1986

S	M	T	W	Th	F	S
		1	2	3	4	5
6	7	8	9	10	11	**12**
13	14	15	16	17	**18**	*19*
20	21	22	23	24	25	26
27	28	29	30			

May 1986

S	M	T	W	Th	F	S
				1	2	3
4	5	6	7	8	9	**10**
11	12	13	14	15	16	*17*
18	19	20	21	22	23	24
25	26	27	28	29	30	31

June 1986

S	M	T	W	Th	F	S
1	2	3	4	5	6	**7**
8	9	10	11	12	13	*14*
15	16	17	18	19	20	21
22	23	24	25	26	27	28
29	30					

July 1986

S	M	T	W	Th	F	S
		1	2	3	4	**5**
6	7	8	9	10	11	*12*
13	14	15	16	17	18	19
20	21	22	23	24	25	26
27	28	29	30	31		

August 1986

S	M	T	W	Th	F	S
					1	**2**
3	**4**	5	6	7	8	9
10	**11**	12	13	14	15	16
17	18	19	20	21	22	23
24	25	26	27	28	29	30
31						

September 1986

S	M	T	W	Th	F	S
	1	2	3	4	5	**6**
7	8	9	10	11	12	*13*
14	15	16	17	18	**19**	20
21	22	23	24	25	26	27
28	29	30				

October 1986

S	M	T	W	Th	F	S
			1	2	3	**4**
5	6	7	8	9	10	*11*
12	13	14	15	16	**17**	18
19	20	21	22	23	24	25
26	27	28	29	30	31	

November 1986

S	M	T	W	Th	F	S
						1
2	3	4	5	6	7	*8*
9	10	11	12	13	14	15
16	17	18	19	20	**21**	22
23	24	25	26	27	28	**29**
30						

December 1986

S	M	T	W	Th	F	S
	1	2	3	4	5	*6*
7	8	9	10	11	**12**	13
14	15	16	17	18	19	20
21	22	23	24	25	26	27
28	29	30	31			

Key to calendars:

Meetings: **outlined**

Observing sessions: **bold and underlined**

Observing session alternates: *italics and underlined*

Additional Observing sessions:

August 1,2,3,4 camping observing weekend

Meteor Showers:

August 11 is the Perseids (6-day old moon)
November 16 is the Leonids (full moon)
December 14 is the Geminids (12-day old moon)

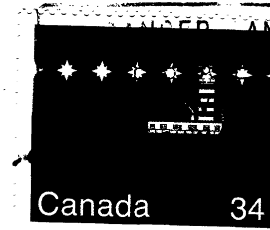
Meetings:

The 3rd Friday of each month at the N.S. Museum.

Banquet will be on a Friday in May - yet to be announced - watch for it!

October 1 - 1987 Memberships due.

Halifax Centre
Royal Astronomical Society of Canada
c/o 1747 Summer Street
HALIFAX, Nova Scotia
Canada
B3H 3A6



ROYAL ASTRONOMICAL SOC OF CAN,
136 DUPONT ST,
TORONTO ONT,
M5R 1V2