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THE NEWSLETTER OF THE HALIFAX CENTRE OF THE RASC
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NOVA NOTES, the newsletter of the ***Halifax Centre of the Royal Astronomical Society of Canada***, is published bi-monthly in February, April, June, August, October, and December. The opinions expressed herein are not necessarily those of the *Halifax Centre*. Material for the next issue should reach the editor by **July 22, 1994**. Articles on any aspect of astronomy will be considered for publication. "Letters to the Editor" or to our resident expert: *GAZER* are also most welcome. Contact the editor at:

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INSIDE THIS ISSUE...

EDITOR/PRESIDENT'S REPORT

You may be expecting a large report in this issue about the May 10th Annular Eclipse. Well, no one has written one yet! Pat Kelly has promised to write a full report, which he will publish in the next **Bulletin**.

Stuffed inside this issue you should find an invitation to our Pot Luck affair on June 17th. Please RSVP to me as soon as possible.

I'd also like to point out our three public observing sessions to be held at Dollar Lake Provincial Park this summer. See Page 10 for details.

If I don't see you over the summer, have a good summer, and see you in September! Ω

THE GREAT 1994 ANNULAR ECLIPSE PARTY

On May 10, perhaps 1000-2000 people throughout the afternoon, were able to view the annular eclipse in complete safety on the lawn of Saint Mary's University. This event was likely the greatest *RASC Halifax Centre* public event ever! Thanks to all those who helped out in any way!

LETTER TO THE EDITOR

[This letter is from one of our US members who lives in Rhode Island. He attended our general assembly last year and even a regular meeting a few years ago! - Ed.]

Dear Dave:

I saw the eclipse from the parking lot of Cranston East High School down here in Rhode Island. Used a C-90 with a Solar Skreen, three #14 welding glasses and a pinhole camera.

The morning was cloudy, but things cleared up more or less from about noon to 2pm, giving us good views of the first part. Unfortunately at a little past maximum we were socked in by a cloud bank, and only got a couple of glimpses after that. Used the #14's for those glimpses. In general, they seemed to be the most popular instruments for the public.

The school is located next door to City Hall, and down the parking lot from the firestation. In front of the latter there often were two or three firefighters in lawn chairs wearing full welding helmets. Our viewing public consisted of around 150 students, assorted teachers, well over a dozen City Hall employees, and at one point we had three police cars. One interested cop looked early on, and I told him to come back at the time of the maximum. Evidently word got around. I think that the school got some good will out of this, and the number of OH WOWS from the students looking through the telescope was very satisfying.

At the time of maximum (I say that, as we were somewhat south of the path of totality) the sky had a sort of metallic blue color to it. Not at all the greyish blue of an overcast day. Did not see Venus due to cloud cover over much of the sky. But when the sun was a thin crescent, the moon was not completely black. Rather it seemed to be ashen around the edge, and one had the distinct impression of surface detail, although at 38 power I could not make any details out clearly. Sort of like a deep lunar eclipse. Is this my imagination, or could one really see lunar surface detail during an eclipse like this?

Please let me know how things went up in Halifax. If this letter will serve as an observing report for the next newsletter I'd be honoured if you used it. Ω

John S. Wojtowicz
Rhode Island

MEETING REPORT: APRIL '94

by David Turner
Meeting Reporter (For-Life)

Friday, April 15th, 1994. Clear skies, no wind, and temperatures hovering between 20° and 25° C. This cannot be Nova Scotia in April. The Pinatubo influence must be over. We don't usually get weather this good even in our July "heat waves". With clear skies and a First Quarter Moon, what else would good RASCers be doing on a night like this but attending a monthly meeting of the Halifax Centre? Hummm? I'll leave that up to you. Fortunately, about 40 people decided that a good talk on astronomy was better than star-gazing, otherwise I wouldn't be writing this. I did ask someone if they would like to write the report for this evening's meeting, but only received another look of abject horror for my troubles. "Meeting Reporter for Life" eh? I really must remember to take that sign off my back.

After an exciting (?) executive meeting featuring the distribution of minutes (yes, actual minutes folks!) for several of the last few executive meetings, the formal meeting began with a short announcement from Supreme Dictator-for-Life Lane concerning the May 10th eclipse and the "stunning" eclipse viewers which are being distributed for this event. There were a few odd murmurs about the fluorescent colour scheme adopted for the viewers, although this should be of little concern for anyone who uses the Observer's Handbook on a regular basis! It should at least make them difficult to misplace. There was also the usual flogging of this month's sales items. Will someone PLEASE take those 1994 RASC calendars off our hands! Also, Mary Lou probably doesn't want to cart out those old Astronomy magazines for any more meetings.

Following these announcements we were treated to a brief report from the Museum guard regarding that night's washroom arrangements (I kid you not!). [And I bet you thought that these meetings were dull!] At this point Paul Gray gave a report on the latest news for avid observers, namely another comet discovery by David Levy (ho hum), a supernova in M 51, Comet McNaught-Russell (how's that again, Nat, a comet isn't a comet unless it puts you in fear of your maker?), the Venus/Moon conjunction which was visible under clear skies locally, the opposition of Jupiter, the visibility of Pluto (did I hear that right?), the Lyrid and Eta Aquarid meteor showers (do I detect a bias on the part of the observing chairman?), and the May 10th annular eclipse (what else?). At this point Dave Lane welcomed Centre member Bob Hawkes from Mount Allison University to talk about *The Peekskill Meteorite.*

For uninformed readers, the Peekskill Meteorite was associated with a long-lived fireball that occurred during the early evening of October 9th, 1992, and which was visible from portions of Kentucky, Ohio, West Virginia, Pennsylvania, North Carolina, Virginia, etc. This appears to have been a 23-ton, Volkswagen-sized, chondritic asteroid chunk which streaked through the Earth's atmosphere on a rather flat trajectory (at about 11 km/s) over a time span of at least 40 seconds. The flight path calculated from various sighting reports and Camcorder reels places the entry point of the asteroid chunk over Kentucky and the end point (or points) in lower New York state near Peekskill, which lies between New York City and West Point. It was in Peekskill that the only recovered fragment made headlines by crashing through the trunk of a woman's used car, that was

subsequently sold for $10,000 U.S. — roughly a 10,000% profit! The bidding war on the meteorite fetched a further $59,000 U.S. (or more) from a private collector — not bad for one night's work, although admittedly far less remunerative than sitting on a Royal Commission.

Bob reported on the work of the Peekskill Fireball Group to determine an accurate trajectory for the fireball, which was used to establish the solar orbit of the asteroid fragment prior to its collision with Earth. The orbital parameters, a = 1.49 ±0.03 A.U., e = 0.41 ±0.01, T = 1.82 ±0.05 year, and q = 0.886 ±0.04 A.U., are those of an Apollo asteroid that just happened to catch up to the Earth on its way back out to the asteroid belt. As luck would have it, the event was recorded for posterity by several different people with Camcorders, most of whom were taking footage of night football games at the time. This begs the obvious question of why the major league baseball championship series were so unpopular that night? Oh well, a beautiful fireball was captured on film instead, one which fragmented into numerous pieces during its terminal stages. As many as 4 or 5 fragments with masses of a few hundred kilograms may have reached the ground according to Bob, compared to the few tens of kilograms for the one known fragment which landed in Peekskill. The flat trajectory of the fireball guarantees a very large size for the associated strewn field of this event, which may stretch through most of lower New York state. Happy hunting for all meteorite searchers!

The last part of the talk centred on the differences between Canadian and American laws regarding possession of space fragments, and the odds against the next such event. It turns out that there are something like 100 10-ton meteorites which can strike Earth each year, but the odds of one landing in early evening, under clear skies, and in the middle of a heavily populated region of the Earth are probably smaller, reducing the possibility to something like one every 100 years according to Bob Hawkes. Yet the audience had several other such witnessed events to describe, including one by this reporter in the fall of 1965 at an evening football match at the University of Waterloo (which was also somewhat more visually striking — you would have been impressed, Nat!). The Peekskill meteorite fireball lives on in some spectacular fireball photographs and videos, as well as in some very pricey pieces of asteroid grit which are being sold on the open market. Two of the latter were circulated during the meeting. I suspect that we would all like to find our own meteorite, although perhaps not after it had just demolished the rear end of our car.

The Handbook study for this meeting featured Shawn Mitchell discussing the section on the May 10th annular eclipse. I, for one, had trouble reading the one centimeter-high lettering on the projection screen from my seat 30 feet away *(Editor's Note: Getting old, Dave?).* Fortunately, I had already read that section of the Handbook, although clearly not as carefully as some others in the audience. This was a short, but timely, presentation, and was followed by a slide show from Mary Lou Whitehorne that provided travel publicity for Newfoundland's Avalon Peninsula and this year's General Assembly in St. John's. A few late announcements from El Presidente noted a forthcoming talk by David Levy at Acadia University and a reintroduction of Blair MacDonald as New Member Information Coordinator — sorry, but I can't think of a catchy description for that title! With a lineup like this, no one was grumbling about missing the sight of Venus in the early evening sky. ~~I could say something more on this latter topic, but I doubt that it would get by the editor's "delete" key~~.

Roy Bishop provided the trivia item for the evening by noting that the last annular eclipse visible from Nova Scotia occurred in 1831, and the next is not until 2251. Ω

PRINCIPLES OF ORBIT DETERMINATION:

by Larry Bogan

Have you ever wondered how to determine the orbit of a Solar System object. The complete methods are complicated and confusing, but the basic principles behind orbit determination are straight forward enough for most readers to understand. Only Newton's Laws and spherical geometry are required. Admittedly, the geometry in three dimensions can become very complicated. If, however, the geometry is restricted to two dimensions and circular orbits, then the orbit determination can be done without complicated mathematical manipulations.

Most observers are able to collect the data necessary to determine approximate orbits for a planet, asteroid, or comet. The minimum information needed are three positions (both right ascension and declination) and the times that they were measured. You can use photography to get reasonably accurate positions by measuring the images relative to the known coordinates of surrounding stars. Even visual observations are good enough; after all, that is the way it was done before photography became available in the mid-nineteenth century.

HISTORICAL BACKGROUND

Tycho Brahe collected all his data on the planets without a telescope. It was this data that Kepler pondered from 1601 to 1606 to fit geometrical curves to the orbital paths. He struggled to remove discrepancies as small as 8′ arc that circular geometries gave. In 1609, Kepler discovered that instead of circular orbits, the paths of the solar system bodies were ellipses. By 1619, Kepler had formulated the second and third of what we call "Kepler's Laws" of the planetary motion. The second law is really an early version of the law of conservation of angular

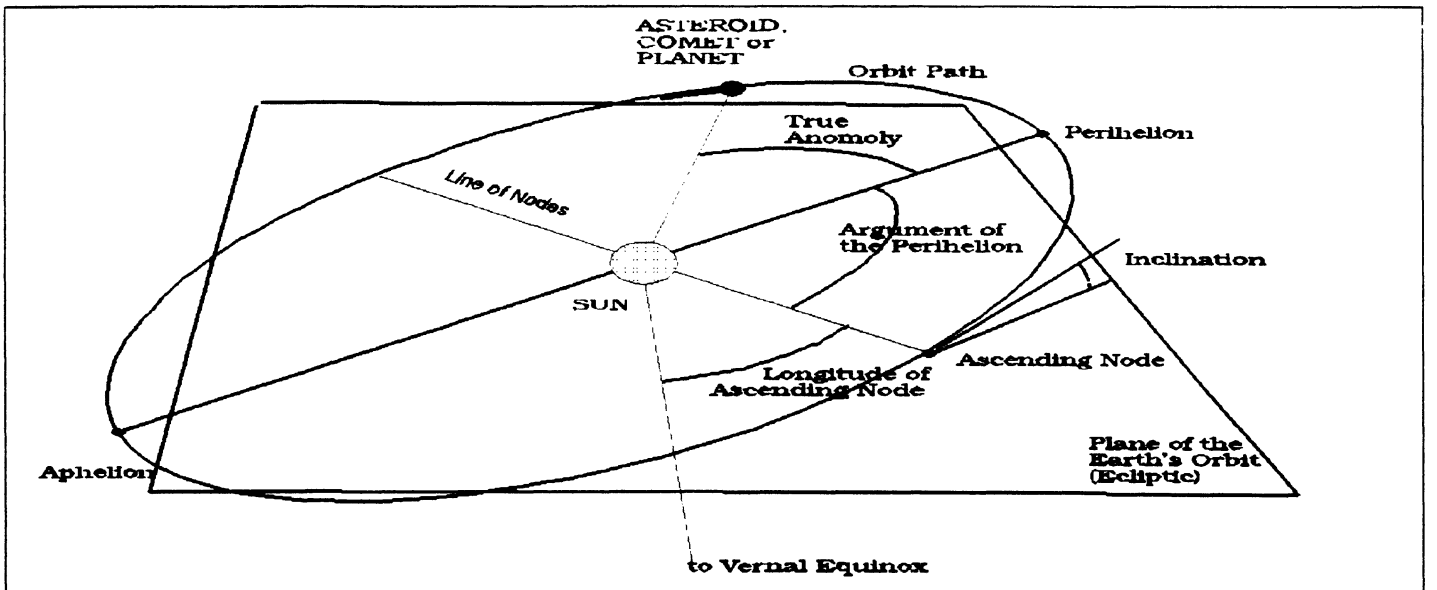

Figure 1

momentum and states that the radius vector from the Sun to a planet sweeps out equal areas in equal intervals anywhere in the orbit. The third law states that the orbital period squared is proportional to the cube of the planet's mean distance from the Sun. This law would later be derived by Newton from his second law (F = ma) and the law of gravitational attraction.

Astronomers, had to wait until Newton formulated his laws of motion, and the law of gravitational attraction before they established the foundation of the methods of orbit determination. In 1685, Edmund Halley learned that Newton had figured it all out 20 years earlier and had not published his deductions. Then, in 1705, Halley used Newton's laws to diligently work out the orbits of 24 comets sighted between 1337 and 1698. This resulted in the discovery that the comets in 1531,1607, and 1682 were all the same comet (Halley's comet). He then predicted its return in 1758.

Newton's method of orbit determination used a graphical method and successive approximation for parabolic orbits. The first algebraic method was developed by Euler in 1744 and extended to elliptical and hyperbolic orbits by Lambert in the 1760's. Lagrange, who had been influenced by the memoirs of Halley, perfected the theories of Euler and Lambert by 1780 and laid the foundations of the mathematical methods used at present. In Germany, Gauss developed a "least squares" method to use many observations to obtain higher accuracy for the orbits.

A SIMPLE EXAMPLE

Let's assume that you have the necessary data and want to calculate the orbit of the object. What does it take?

There are six parameters needed to completely define the position of an object in its orbit. Refer to Figure 1 for the geometry of the orbit.

1. **a**, *mean distance from the Sun*
2. **e**, *eccentricity of the elliptical orbit*
3. **i**, *inclination of the orbit to that of the earth*
4. Ω, *position of the ascending node of the orbit*
5. ω, *angle from the node to orbit perihelion*
6. *angular position from perihelion at epoch (called the mean anomaly). Epoch refers to the time for which all the elements apply.*

It is the inclination, and eccentricity of the orbit that complicates orbital determination. Let's simplify the problem and consider an asteroid with a circular orbit (e=0) and no inclination to the ecliptic (i=0). When this is the case, two of the other elements are not defined, the ascending node and the position of perihelion. (A circle has no perihelion or aphelion and an orbit in the reference plane intersects that plane everywhere.) That leaves only the radius and the mean anomaly to be determined. This can be done with only two angular position measurements along with their times of occurrence.

Asteroid #214 has nearly zero eccentricity and inclination so I will use it as an example of simple orbit determination. Its positions on two dates are:

Asteroid 214

Time and Date (1994) 0 hr UT	Geocentric Longitude
April 1	59.3°
May 1	71.3°

(Geocentric longitude is measured eastward from the vernal equinox along the ecliptic)

The asteroid's position was determined from our moving Earth and we wish to determine its position relative to the Sun so we must know the position of the Earth at the times of observation. From the *Observer's Handbook* (page 129) you will obtain

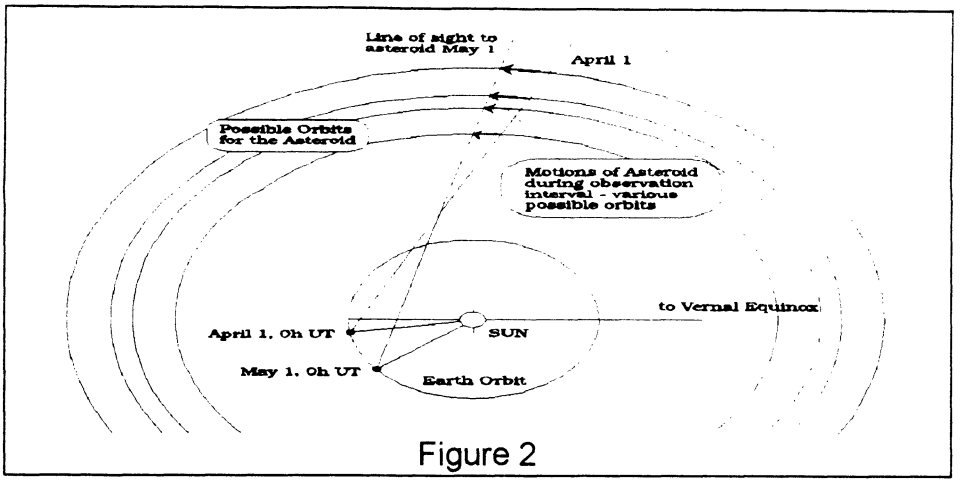

Figure 2

the Earth's heliocentric longitudes of 191 and 220 degrees respectively. We now have enough information to get the radius of 214's orbit and its mean anomaly.

Figure 2 shows the geometry of the Earth, the Sun, and the direction to the asteroid for the two observations. (its position is unknown since the radius of the asteroid's orbit is unknown). Orbit determination must use the fact that we know the orbit is circular and that the rate of motion in its orbit is related to the radius through Kepler's third law. We know that it takes exactly 30.0 days for the asteroid to go from the first to second position, but we do not know the period of the orbit to determine its change in longitude. As you may see, this is a sort of a chicken and egg problem; if we don't have one we can not get the other.

The solution is to guess at the radius of the orbit and then determine the interval between observations for that radius. If the calculated interval is longer than the actual one, the radius must be decreased. It must be increased if the calculated interval is shorter. We must then continue to adjust the radius until the result matches the measurements.

The easiest way to perform the above calculations is the same way Newton used: graphical methods. In Figure 3, I have drawn the Earth-Sun-asteroid system to scale for the observations, then drawn three circles to represent possible orbit radii of 2.0, 3.0, and 4.0 AU for the asteroid.

1. Calculate the orbital periods for each radius using Kepler's third law: *period(yrs) = radius(AU)^1.5*
2. Measure the angular motion of the asteroid along each orbit with the sun as centre.
3. Use Kepler's second law for a circular orbit to obtain the interval time: *interval(yrs) = angle/360*period*

The results of your calculation should be as shown in the following table:

Orbit Radius	Orbit Period	Angular Motion	Interval (yr)	Interval (days)
2.0	2.828	5.5	0.0432	15.8
3.0	5.196	7.5	0.1083	39.6
4.0	8.000	8.7	0.1956	71.4

From the last column we see that the radius needs to be between 2.0 and 3.0 AU in order to get an interval of 30 days. If one does a simple interpolation to get the correct interval, the radius is about 2.6 AU. Not bad compared to the actual radius of 2.61 AU. The corresponding period of the asteroids orbit is 4.192 years (1531 days).

To determine the Mean Anomaly of the Epoch, measure the longitude of the asteroid for one of the sightings. On April 1, 0hr UT, (214) had a heliocentric longitude of 76 degrees. The mean motion of the asteroid is 0.2341 degrees per day (360 degrees/period in days). The

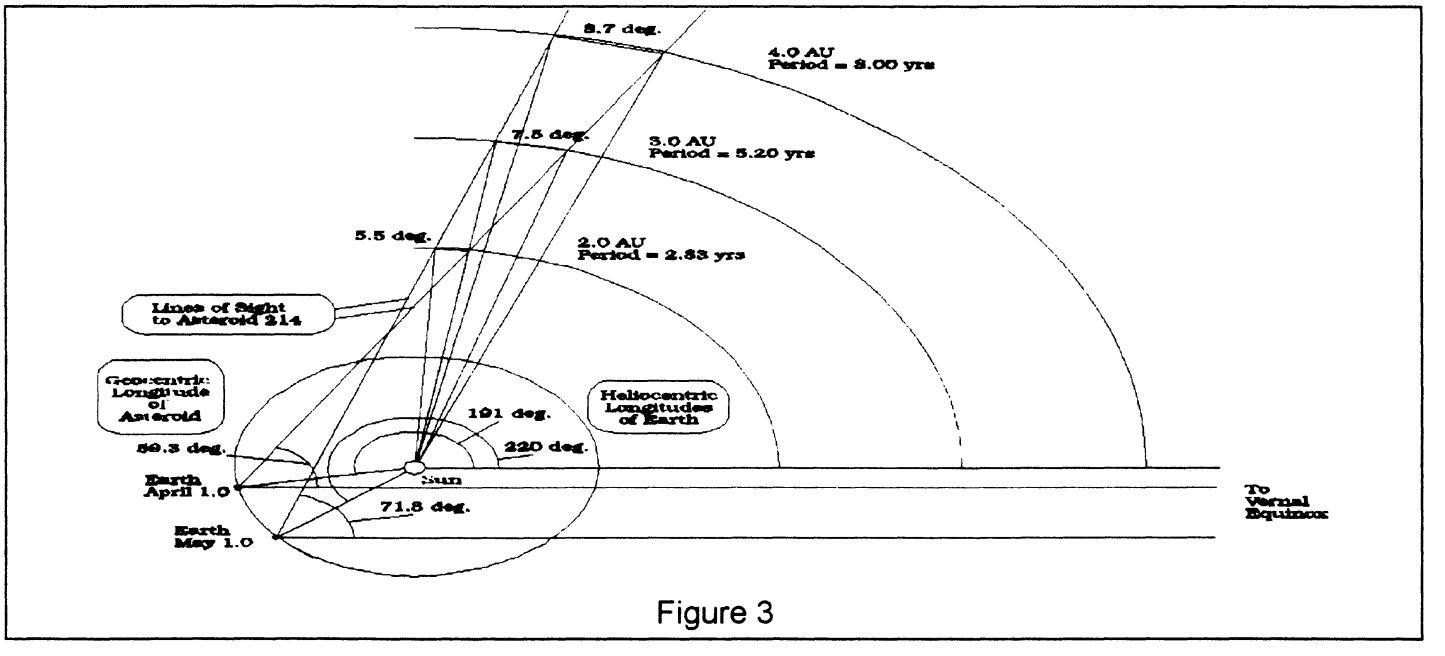

Figure 3

asteroids position can be calculated at any particular epoch. If the epoch is Jan 1, 1994 at 0 hr UT then its position was 90 days or 21.1 degrees earlier in its orbit. The Mean anomaly is the longitude of the asteroid at the epoch which would have been 76 - 21 = 55 degrees.

COMPUTER METHOD

The orbital determination is best done with a computer program, since the computer can easily repeat calculations until the correct results are obtained. The geometrical angle measuring is replaced with trigonometry formulas and the interpolation is replaced with a simple iterative procedure. I have written such a program for circular orbit solutions but the geometrical explanation above is easier to understand. If anyone wishes copy of the program, let me know.

MORE GENERAL ORBITS

In general, the eccentricity and inclination of an orbit can not be assumed to be zero. As a result, much more complicated geometrical procedures must be used to obtain the parameters of the orbit. A computer program is a must in the general orbit determination. However, the basic ideas of the orbit determination are still the same as the above simple example for asteroid 214.

REFERENCE

"Fundamentals of Astrodynamics" by Roger R. Bate, Donald D. Mueller, and Jerry E. White (Dover Publications 1971) Ω

THE GREAT COMET CRASH: DAVID LEVY AT ACADIA UNIVERSITY (26 APRIL 1994)

by David M. F. Chapman

Twenty-five years ago, a group of physics students at Acadia University knocked on Professor Roy Bishop's office door looking for advanced instruction in astronomy. One of those students was David H. Levy, who has become one of the most successful comet-hunters of all time. On the night of Tuesday, 26 April 1994, David Levy returned to Acadia to speak about the most peculiar of the 21 comets that he has discovered (or co-discovered) to date. He squeezed the Acadia visit in between two lectures, one in Tucson and another in Miami, all in the same week! The lecture hall was filled to overflowing with an audience eager to hear the latest word on Periodic Comet Shoemaker-Levy 9, also known as the String-of-Pearls Comet or the Kamikaze Comet. Members of the *RASC Halifax Centre* were observed throughout the hall, the most conspicuous being our own Roy Bishop, who introduced David (and whom we should thank for making the evening possible, I wager).

David Levy has a unique approach to the night sky.

David Levy has a unique approach to the night sky. Where a traditional astronomer would prepare the telescope and say "Let's look at the Moon" or "Let's have a peek at the Andromeda Galaxy", David Levy likes to gaze up at the sky and say "OK Sky, its your game ... make my night. What do have to offer me tonight?" This philosophical view emerged from the countless hours spent methodically scanning the sky, searching for comets, but instead re-discovering star clusters, nebulae, double stars, and other celestial wonders. He is an amateur in the truest sense of the word: not a "second-rate" astronomer, but someone who loves astronomy. He especially loves comets: looking for them, studying them, writing about them, talking about them.

And talk he did. Although the content of the talk had much in common with his Hogg lecture (given last year at the GA), David Levy managed to make it all sound fresh. David, who studied English Literature in university — not science — provides a cultural perspective to the history of comets: he spoke about the influence of comets as portents of evil in ancient times (I'm not sure the world has actually progressed much on this score.); he quoted Shakespeare ("The heavens themselves blaze forth the death of princes." from Julius Caesar); he played taped music to a slide show of astronomical art depicting the imagined end of S-L 9. This reflection of astronomy in a cultural mirror sets David Levy apart from other astronomical lecturers, in my opinion.

Periodic Comet Shoemaker-Levy 9 — discovered in March 1993 and destined for a catastrophic impact with the planet Jupiter in July 1994 — nearly eluded the comet-hunting team of Carolyn Shoemaker, Eugene Shoemaker, and David Levy. After a long string of cloudy nights at Mount Palomar, the team's first clear night turned out to be a disaster: someone had mistakenly exposed their box of photographic film to a bright light and their telescopic exposures turned out to be totally black when developed! The next night was partly cloudy and not ideal for quality work, but David wanted to press on, despite Eugene's fatherly admonitions to be patient. The two negotiated a compromise: they dug down deep in the box of damaged film and exposed some sheets that were spoiled only at the edge. They took the discovery photographs of S-L 9 on 23 March 1993, but Carolyn did not inspect them until 2 days later. She had been discouraged about the team's lack of progress and then, while peering through the stereo microscope used to detect the motion of asteroids and comets against the background stars, she saw something that really shook her. "I don't know what this is but it looks like a squashed comet."

The initial surprise of finding a comet that had been drawn apart by Jupiter's "differential gravity" during a very close passage gave way to a second surprise: S-L 9 had actually been captured by Jupiter's gravity and was in orbit around the planet! Then came the third surprise: the various bits and pieces of the comet are destined to crash into Jupiter over the period 16-22 July 1994. (The full

story of S-L 9 and this remarkable event can be read in the pages of recent issues of *Sky & Telescope* and *Astronomy* magazines.) Carolyn Shoemaker and David Levy initially felt a kind of sadness over the predicted loss of "their" comet. By coincidence, the CBC Radio programme *Quirks&Quarks* broadcast a partial interview with Carolyn Shoemaker on the Saturday before Levy's talk at Acadia. In this interview, she remarked on the fate of S-L 9: "My first reaction when I found out that it was going to impact Jupiter was 'Oh no! I don't want to lose one of my comets' and then I thought 'Well if I'm going to lose one I'd like it to go out with fireworks.' "

Eugene Shoemaker had a different reaction. A pioneer of the field of astro-geology, he has spent a career investigating the impact of asteroids and comets on planets of the solar system. (It is his research programme, in fact, that has resulted in the recent string of S-L comets, among other discoveries.) His PhD thesis was devoted to proving that the large crater near Flagstaff, Arizona is in fact the result of a small asteroid impact. He regards the Jovian demise of S-L 9 as a rare opportunity to observe one of these events as it unfolds, "and it's not going to be here!"

David Levy spent some time discussing the theory that comet or asteroid impacts on Earth had a role to play in the evolution of life on Earth. "Impacts reset the dice of the development of life," he says. "They keep things interesting."

David Levy has just published his 9th book. Those waiting for the promised publication of "Terrible Swift Swords" must content themselves with "The Quest for Comets", which is the same book with a more prosaic title cooked up by the publishers, Plenum Press. (The book is — or was — available at the Acadia bookstore.)

The discovery of this remarkable comet has completely transformed the lives of the Shoemaker-Levy team. David seems somewhat bewildered by all the attention he has been receiving these days, but despite his grueling schedule of speaking engagements, he took time to answer each and every question put to him by his enthusiastic listeners, paying particular attention to the young. His grateful hosts were compelled to drag him away from the podium so that the audience could return home at a respectable hour! He eagerly awaits the demise of his most peculiar comet, not only to learn more about what makes comets tick, but also for the opportunity to relax a little and to return to visual comet hunting at his own telescope. He plans to write a book about S-L 9 and then he wants "a little quiet". Ω

"Amateur astronomy means you do it from the heart. There's something magical about it. It's almost like being kidnapped — you have to do it. Astronomy connects you, heart and soul, to the sky. Anybody can be an amateur astronomer — even a professional astronomer."

- *David H. Levy*, reprinted from Mercury (July/August '93)

THE EARTH IS ONE PLANET OF ONE STAR OF 100 BILLION STARS:

by Bill Lucas of the Nova Central Astronomy Club (reprinted from *The N.C.A.C. Coordinate*)

So I enter the store, proceed towards the gentleman at the counter and I ask him: "Do you have any astronomy programs in stock?" To which he replies: "Why yes we do, follow me, here they are". He hands me a program with the big bold letters on the front of the box "Astrology". Well, what are you going to do? I grumble something nasty under my breath and hand it back. "Astrology, astronomy, what's the difference?" he says. Oh boy.

So I begin, "Well you are one person right? in one town, in one province, in one country, on one continent, on one planet orbiting one star of 100 billion stars."

"Whoa whoa, I see where you're coming from — so what's the difference?"

Oh sure, I know the answer, but I hate this conversation already so I say, "A hell of a lot!" and I leave the store.

Amateur astronomers grow weary of this type of encounter very early on because it is extremely common. What is most upsetting for me is you never seem to get much beyond the 100 billion stars part before you are shut down and this is just about the time it's beginning to get really interesting. Thank goodness for the NCAC Newsletter. I can occasionally write to my fellow club members and ask questions, give answers, ponder, complain, yell, rant and rave! and of course, expect the same in return. Now if our friend at the store had shown any signs of being truly interested in discovering the difference between astrology and astronomy, our conversation may have continued something like this:

"Oh I see, so what's beyond those 100 billion stars?"

The Magellanic Clouds orbit the 100 billion stars at a distance of 50,000 parsecs (160,000 light years) for the LMC and 57,000 parsecs (185,000 ly) for the SMC. These satellite galaxies are very young and contain untapped reservoirs of gas. Some time in the distant future the Milky Way will deplete its star forming materials.

The Magellanics will enter the old star fields to refuel and replenish the Galaxy and prolong its lifetime. The Local Group of galaxies is our next beyond and is contained within a diameter of 1 million parsecs (3 million ly). There are about 20 members involved in the system. It is made up of three large spiral galaxies: our Galaxy, the Milky Way; M33, the Pinwheel Galaxy; and M31, The Great Andromeda Galaxy. An assortment of small ellipticals and irregulars make up the balance. Some of these miniature island universes are so loose in structure the difficulty in detecting them suggests that many low mass galaxies remain to be discovered.

Now our group of galaxies is in no way unique, other than the fact that our world is hiding within this 3

million ly sphere. In fact the Local Group, compared to other galaxy groups, has few galaxies, with the majority being of small mass. So is that anything to complain about? I think not. As a matter of fact, our Galaxy, our 100 billion stars, is probably all we'll ever have to know when it comes to getting around, but this shouldn't prevent us from looking. We've gone far enough, let's return to our neighborhood and take a look at the next closest star to the Sun.

Approximately 1.3 parsecs or 40 million million kilometres away is the dwarf star Proxima Centauri, the smallest and faintest member of the Alpha Centauri three star system. We came, we conquered, we explored our Solar System, but to traverse the next star system requires a knowledge we can only conceive. We know somehow in some way it requires the secret of light which travels at 186,282.397 miles per second. One day in the not too distant future residents of our world will travel to this system, if un-manned probes prove the trip is worth taking. Who knows, the residents of the Alpha Centauri system may travel to Epsilon Eri.

Well, do you think my friend at the store would still be with me? Let's face it, the Earth is one planet of one star of 100 billion stars and one thing is definitely certain, amateur astronomers sure love to travel and there's a long road ahead. Ω

CENTRE LIBRARY BOOK REVIEW: *"MISSION TO MARS, AN ASTRONAUT'S VISION OF OUR FUTURE IN SPACE"*

by Mary Lou Whitehorne

We have a new book in the Centre library and it's a great read for all you space enthusiasts! I absolutely enjoyed the book and I recommend it to anybody who has even the slightest interest in space flight. I'll tease you with a pithy quote that I certainly identified with. You probably will too. For me it embodied the spirit of the whole book:

"Call it genes, character, culture, spirit, ethos: by whatever name, it is within us to look up into the night sky and be curious, within us to commit our bodies to following our eyes."

Written by Apollo astronaut Michael Collins (he's the guy who orbited Moon in the command module while Armstrong and Aldrin made the first famous footprints in the Lunar soil), "Mission to Mars, An Astronaut's Vision of Our Future in Space" is a thoroughly enjoyable look at the prospects for a manned mission to the Red Planet. Collins writes with an easy, familiar style which blessedly avoids techno-jargon and the dreaded TLA's (three letter acronyms) that normally pepper any publication even remotely associated with NASA.

> ... "Mission to Mars" takes a candid look at the present state of Earth's space capability ...

In the space of 292 pages, "Mission to Mars" takes a candid look at the present state of Earth's space capability and makes a few predictions about what technology will have to be developed in order to make a manned Mars expedition possible. Along with a good look at the technical challenges involved in a manned flight to Mars, there is also a very engaging discussion of the greater hurdle of keeping the crew healthy and happy (maintaining the crew's psychological stability) over the duration of such a long and risky space flight. There is also a pragmatic discussion of the three big sticky places in a major project such as this would be: costs, politics and international cooperation.

The book is four years old, having been published in 1990, so political and economic situations are slightly different now than they were at the time of writing, but this detracts from the value of the book not one whit. The same physical, technical and psychological demands must be met. We still must deal with problems like radiation hazard, adequate and efficient propulsion, the effects of long-term weightlessness, and whether or not both sexes should fly the mission.

The final few chapters bring the enormity and complexity of a manned mission to Mars into perspective by describing an imaginary flight. It is a very engaging description of crew selection and training, construction of the interplanetary vehicle, and finally the mission itself. This part of the story could be accused of being oversimplified and unrealistic (things just go a little too smoothly), but it gets the message across nevertheless. It is written for the average Earth citizen and there is no need to go into excessive detail. The purpose of the book, in which it easily succeeds, is to make the point that a manned mission to Mars is desirable, affordable, and most importantly, it is doable. This book is entertaining, it's educational, and it's thought provoking. It will leave you wondering at our collective political myopia but it is also optimistic for the future. You can't help but be infected with Collins' contagious enthusiasm:

" What will the first explorers find? Is there life on Mars? Maybe not, but there will be." Ω

WHAT'S UP:

by Bill Lucas of the Nova Central Astronomy Club (reprinted from *The N.C.A.C. Coordinate*)

[Editor's Note: Since Joe's column was not available in time for this issue I have substituted one of Bill Lucas' wonderful articles]

Giants In the Sky

Hydra, Virgo, Ursa Major, Hercules, Draco, and Centaurus grace our skies at this time of year, and are among the largest constellations in the heavens.

All are within the top ten in size and all display easily distinguishable patterns. There is however, another giant rising in the east this time of year, a most spectacular figure standing 45 degrees tall and spanning 4 hours of right ascension. Ophiuchus, the Serpent Bearer is the 11th largest constellation containing 948 square degrees. The Greeks new him as Asclepius, the god of medicine. He was the son of Apollo and Coronis and during his earthly years as a doctor he was able to heal lepers and bring the dead back to life. In the sky, he holds the serpent which to this day is the symbol of western medicine.

The main stars of Ophiuchus form a large oval with little visible to the unaided eye in the central region. This is but a deception. Of the 100+ globular clusters around our Milky Way, 22 globular clusters can be found in Ophiuchus. To name a few, M9 is 9.3' in size (diameter) with a magnitude of 7.9; M10 is 15.1', mag 6.6; M12 is 14.5', mag 6.6; M14 is 11.7', mag 7.6; M19 is 13.5', mag 7.0; M62 is 14.1', mag 6.6; and M107 is 8.5' in diameter with a magnitude of 8.2.

Beside the globulars there is no scarcity of planetary nebula — NGC6572 is the brightest planetary in Ophiuchus, 8" in size at 9th magnitude, located on the giant's shoulder forming an isosceles triangle with α and β Ophiuchus. Also NGC6369, resembling M57 only smaller, with an apparent size of 28" and a magnitude of 10.4. This planetary is located near the star 44 Ophiuchus and a little east of B72, Barnard's "S" shaped nebula. Another Barnard discovery is Barnard's Star, a magnitude 9.0 red dwarf with the largest proper motion of any known star in the sky. It is the second closest star (after the Alpha Centauri system) to our solar system at a distance of 5.9 light years.

Many astro-photos have been taken of σ Ophiuchus and Antares in Scorpius. Both stars lie in the glowing dust and gas nebula IC4604. On a clear dark evening at the Camden site (south of Truro), I was able to make out much of the nebula surrounding these stars and with a pair of 7X50 binoculars. Many of the globulars can actually be seen as well, so don't forget to bring your binoculars along on our next observing run.

Focus - The Pipe Nebula

The arrival of Ophiuchus brings with it some of the strangest and most exotic regions of the night sky. With the return of Ophiuchus, we know the summer constellations are not far behind. In the southern portion of the giant we find a very rich star field bordering the centre of the Galaxy and throughout this sector some very curious dark regions. The most famous of these is the Pipe Nebula, visible to the unaided eye with a length of 7 degrees. The bowl of the pipe is Barnard's Cloud B78 and the stem includes B59, B65, B66 and B67. The Pipe Nebula is a foreground extension of the Great Rift, the massive complex of dust and gas that hides the central region of our Galaxy from view, 30,000 ly away. Just north of the bowl you can find Barnard 72, the "S" nebula which makes up part of the pipe's smoke.

This Way To Centaurus A!

There is nothing about amateur astronomy that could ever be considered routine. If you have set up your telescope a thousand times, then you have never experienced the same procedure twice. If you have written a passage in your logbook as often, then you have never experienced the same emotions twice. Astronomy is full of surprises and every time you look through the eyepiece you can rest assure the experience will be a new one and the event forever etched in your memory.

There are always those events that may stand out a little more than others and on Saturday, May 7, 1994 members of the *RASC Halifax Centre*, and the NCAC Truro club had such an event. At the suggestion of the RASC Observing Chairman Paul Gray, two telescopes were trained on the southern horizon only 1.5 degrees above the tree tops to the south of the Camden Site, located at 45 degrees north latitude and 600 ft. above sea level. The objective was to observe the southern hemisphere galaxy and radio source: NGC5128, better known as Centaurus A. This is by no means an easy task when you consider its declination is -42° 53'. The galaxy is listed as one of the brightest in the sky with a magnitude of 7.0, but its glow is spread over an 18' by 14' area.

... NGC5128, better known as Centaurus A. This is by no means an easy task when you consider its declination is -42° 53'.

At exactly 11:45pm, the galaxy was observed as a barely discernible, feeble haze. What I did see, was a delicate half circle with a faintly straight and slightly sharper edge lying closest to the horizon and running almost parallel with the horizon line above the tree tops. Both Dave Lane and Paul Gray were able to identify and confirm the galaxy as well, as we had spent a half hour zeroing in on its precise position. Centaurus A is definitely worth another look because on this particular evening, the sky to the south had a transparency of 6/10!

On a clear night, a good 6 inch telescope should be able to pick up this elusive galaxy. As trophies go, I've got Paul to thank for this one. Ω

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Halifax Centre

"Pot Luck Dinner"

You (and a guest) are cordially invited to attend a Pot Luck dinner (in place of the regular June meeting) in Room MM310, McNally Building Saint Mary's University 923 Robie St, Halifax, N.S.

Please RSVP to David Lane
Phone: 443-5989 (evenings) 420-5633 (days)

"Don't forget to bring your pot!"

NOTICE OF MEETINGS AND EVENTS

Date: **Special Meeting - Friday, June 17th at 7pm**
Place: **Saint Mary's University, McNally Building, Room MM310.**
Event: **Pot Luck Banquet. Tickets are free, but you must RSVP to David Lane** (Phone **443-5989** evenings or **420-5633** days). If you would like to buy something, rather than make something, please call; we have a list! There will be no main speaker, but there will be awards presented and a tour of the Astronomy and Physics Department and the Observatory. Dress — informal.

Event: On **July 15th** (July 16th, if clouds) and **August 5th** (August 6th, if clouds) there will be **Public Observing Sessions** at Dollar Lake Provincial Park. Please come out and help us show the wonders of the sky to the public. These events are part of the **Parks are for People** program.

Event: On **August 12th** there will be public **Perseid Meteor Session** at Dollar Lake Provincial Park. Please come out and help us show the wonders of the sky to the public.

PUBLIC HALIFAX PLANETARIUM SHOWS ALL SUMMER!

The Halifax Planetarium, located in the Dunn Building at Dalhousie University, provides shows each week on Thursday evenings at 7pm. Contact the *Nova Scotia Museum of Natural History* at 424-7353 for show information.

1994 HALIFAX CENTRE EXECUTIVE

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