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OTTAWA ASTRONOTES

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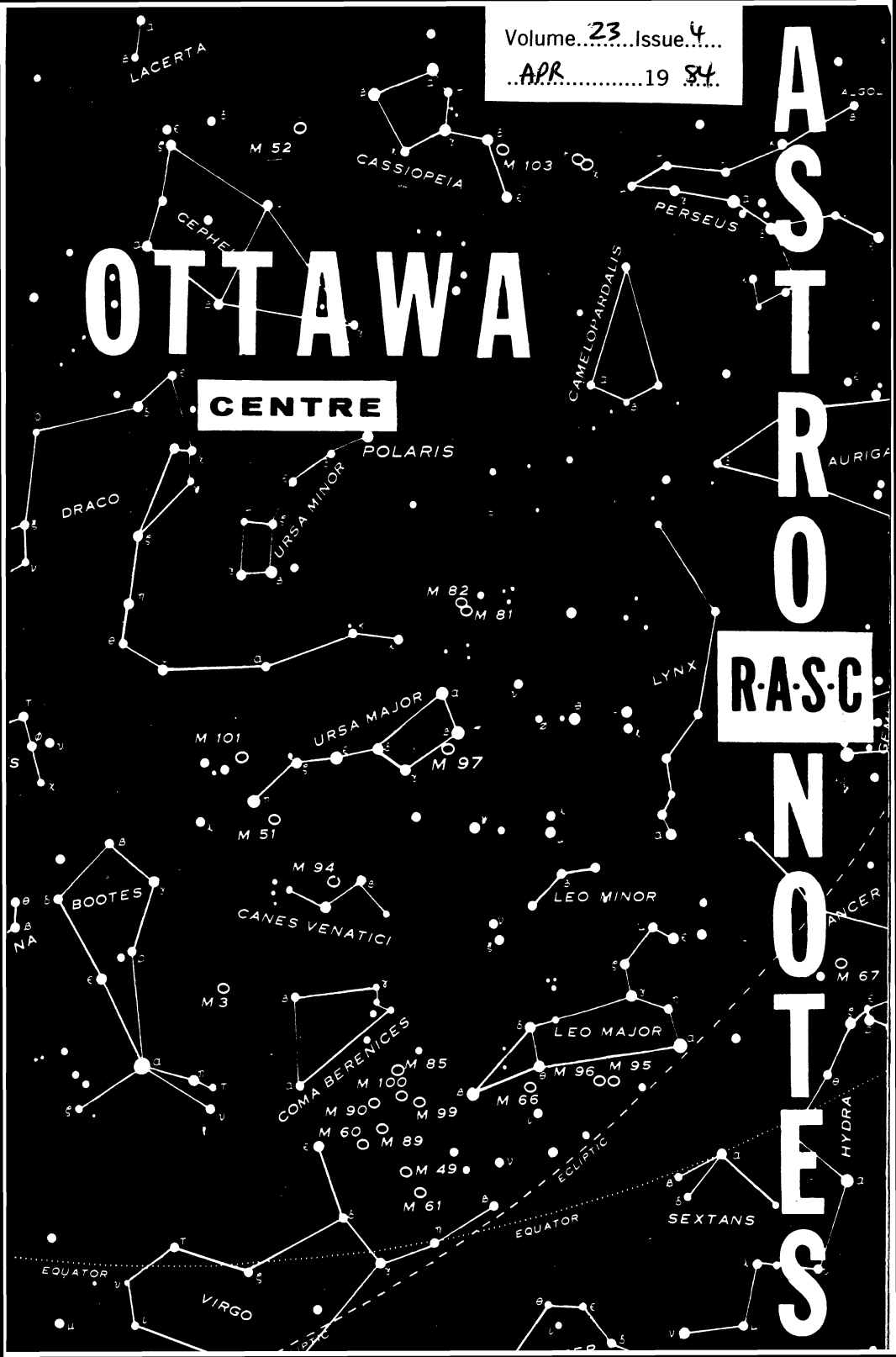

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DR. VARSHNI ON QUASARS

Dr. Varshni of the University of Ottawa spoke to the Centre on Wednesday, March 21, about the subject of quasars. Dr. Varshni pointed to significant evidence which indicates that quasars are, in fact, nearby objects, quite faint, within our own galaxy. They are too faint to be seen in external galaxies. The main phenomenon which accounts for the spectral lines of quasars is a laser effect, which is producing radiation as a result of a rapidly-cooling plasma, such as would be produced by a star during the production, say, of a planetary nebula. Depending on the consituent elements of the star, the temperature of the plasma, the rate of expansion, and other effects, a large number of spectral lines may be produced. It is thus very easy to confuse these lines with red-shifted lines of other elements, such as the hydrogen line. Dr. Varshni showed examples of several quasar spectra, which actually showed several coincident lines, which were not red-shifted, but corresponded to lines which may also be found in planetary nebulae. The broadenning of spectral lines of quasars is due to the rapid expansion of the plasma which produces the laser effect, this expansion taking place in all directions. Also shown were measurements of the proper motions of quasars, which is much harder to explain if they were distant objects. It is suggested that the new space telescope be used to study the proper motions of quasars more closely, and this would resolve the issue. It was also noted that more search should be made for quasars along the galactic axis. If quasars really are distant, they should not be visible here, but this area has not been studied for quasars.

Let's face it, solar observing without proper equipment (ie full aperture filter) just isn't satisfying. With closed, short-tube catadioptric telescopes now available, projection is not the best to say the least. A small-aperture refractor, on the other hand, is ideally suited to projection. But you just can't beat a full-aperture filter for rewarding observations. If you have the money, I'd recommend it above all.

Whatever your preferred method, let's start our journey into the solar realm.

When you look at the solar disk, you are seeing the photosphere, the sun's visible surface. Under excellent conditions, ie clear and steady skies, the photosphere may appear grainy. The graininess, or granulation, as it is called, is due to the small convective cells, which are 800 to 1600 km across (1 to 2 arc-seconds) and are detectable with a 3-inch telescope.

Sunspots appear on the disk almost every day, except at solar minimum when, most frustrating to you, spots do not show at all. The sunspots are magnetically disturbed areas of the sun about a thousand degrees cooler than the rest of the surface. Although they appear dark, they would appear white hot if seen by themselves. They range in size from 1600 km to more than 160,000 km across. You will notice some of the spots, usually the larger ones, have a dark or gray outline around them. This is called the penumbra. The umbra is the dark inner spot itself. A cluster of the spots is called a group. Two main spots, a leader and a follower, with a smattering of smaller ones nearby is generally considered to be a group. The sun takes about 25 days for one rotation, and thus a particular spot or large group can, if it survives, be observed for as long as about 12 days. Some may "live" long enough for 3 or 4 rotations.

The sun is only 37% as bright at the limb as at the centre of the disk. This is due to the solar rays being absorbed by a greater amount of photosphere, which the light must penetrate as it surges upward. Because of this you can detect the bright streaky or vein-like areas known as faculae. These markings appear mainly near the limb, before or after sunspot occurrences.

Light bridges are also observable with a small-aperture telescope. They are intensely bright areas found upon the sun's umbra and penumbra. (I myself have

not yet observed them.) In a large spot, you may find several of them.

A practiced observer will see a "depressed" appearance of a sunspot. Usually large and ciruclar spots give this impression. This phenomenon is known as the "Wilson Effect". Dr. Alexander Wilson, in 1769, found that as a large sunspot approached the preceeding limb (the west side, when north is at the bottom), the penumbra closest to the sun's centre became narrower. He concluded that the spot must have been saucer-shaped with the umbra at the bottom and the penumbra representing sloping sides. The same was observed with spots coming over the following limb.

Up to this point I only want to cover what is easily observed when you are viewing the sun.

Further morphology includes pores, which are filled-in grains. Remember, the photosphere is made up of granules, giving it the mottled or grainy apperance. Pores can dissolve and form in minutes, and range is size from 1 to 5 seconds (800 to 4000 km). Large pores, like large sunspots, will have a better chance of lasting longer. Disturbances between pores consist of dark lanes between them or changes in the appearance of the granulation.

Going back to the penumbra, when it is large and well-developed, it will form dark filaments around the umbra. Overlapping the filaments and grains are dark, shadowy, semi-transparent fibrils. Now, you would need high-resolution indeed in order to distinguish these features of the sun.

Oh yes, one other relatively rare event to watch for is white-light flares. They will suddenly appear in or very near a sunspot group. They can reach a peak brightness in a few minutes, last as long as a few minutes, and then return to the normal level of the photosphere. One observer actually observed this event for as long as 50 minutes.

The close-up diagram of some features appears on the next page.

Observing the sun is a fascinating project for study. If you wish more information, please see me after the meeting. I'll be the one with the sunny disposition!

* * *

The moon swung away from the earth on March 2 to its most distant point since 1750, a feat that won't be repeated until about 2100, a distance of 252,719 miles.


UMBRA
PENUMBRA
filaments
grains
granules
small pore
0 1 2 3 4 5 6
arc seconds

RH/3-83

HOW OLD IS THIS ROCK CALLED EARTH? David Lauzon

Introduction

It's hard to imagine that when you look at the Great Nebula in Andromeda, you are looking back into the past by about 2 million years. The light seen now was emitted during an epoch on the earth's history known as the Pliocene, in the Tertiary period. This seems like a long time, but it is just a fraction of the time the earth has been around.

The geologist's best estimate of the age of the earth is about 4.6 billion years. But how do they know? Hopefully, I will try to explain this, but let's first take a look at the history which led up to this.

The Age of the Earth

To start things off, I would like to briefly explain the differences between relative an absolute time. Relative time is a representation of the sequence of geological events, which are determined by laws. One such law is the law of superposition, which states that if beds of rock have not been overturned, the age of the rocks would increase with depth. Unfortunately, this only tells the story of what happened, and dosen't tell how long. Absolute time, however, answers this question. This gives the actual age of a rock by evaluating radioactive decay rates.

With these tools, scientists can calculate the age of the earth.

Mankind first estimated the age of the earth at 6000 years, based of the interpretation of the Old Testament in the Bible. Before evolution was accepted, the changes in fossil records (ie extinctions) were explained by "The Great Flood".

In 1899, John Joly calculated the age of the earth to be 90 million years. He did this by dividing the total salt content in the oceans by the amount of salt annually delivered. Another calculation, based on the settling times of rocks, gave 100 million years.

Due to the lack of precision in the last calculation, the famous Lord Kelvin calculated the age of the earth to be between 20 and 40 million years. He used the laws of thermodynamics and the rate at which the earth cooled. When radioactivity was found to produce energy (heat), he

threw his calculations out the window.

in 1896, the discovery of radioactivity by Becquerel gave Rutherford and Soddy a chance to see the forgotten science of alchemy in action. It was observed that radioactive decay sometimes caused one element to be transformed into another.

Later, an equation was developed to calculate the time taken for a decay to occur, if the decay constant, the amount of parent product, and the amount of daughter product are known. This equation is:

$$t = 1/\lambda \times \ln(1 + D/P)$$

where t = time
lambda = decay constant
D = number of daughter product atoms
P = number of parent product atoms

Present methods of measuring the age of the earth, such as radiometric decay, give a result of about 5000 million years. But the earth was made from second-generation star stuff, and these elements were created earlier. Therefore this figure is an upper limit. Rocks found in the Canadian Shield are the oldest known, at 3800 million years. So we now have a lower limit, too. If we assume that the earth formed within these two boundaries, we could possibly find something else to give us a better estimate. Fortunately, meteorites formed at about the same time as the earth. The oldest meteorite found was about 4550 million years old.

In conclusion, the age of the earth can be stated as about 4.6 billion years. This is a very long time, considering that mankind only goes back about a million years or so. This is insignificant compared to the age of the universe.

One important thing that did occur within our life time (the earth's that is) was that the planet quickly flourished with life after the crust cooled, some 3500 million years ago. Since then, life evolved, diversified, and soon enough looked up into the starry sky and wondered why it all started. Are you curious?

References

General Geology; Foster; Charles E. Merrill Publishing Co., 1983; pp 326-342

BOK AWARDS IN ASTRONOMY FOR H.S. STUDENTS Paul Feldman

A recent issue of **Sky and Telescope** announced the 1984 North-America-wide high-school competition for the Priscilla and Bart Bok Awards for projects in astronomy. Until 1984, these cash awards were given annually by the Department of Astronomy at Boston University. Starting this year, they will be sponsored by the American Astronomical Society. What is required is a 5 to 10-page scientific report of the project, which may be observational, theoretical, or equipmental. By the time you read this, it will probably be too late for the 1984 competition (closing date April 1, 1984), but prospective entrants from the Ottawa Centre might be interested in planning their 1985 projects now. It is not too soon. Report of projects for next year's awards are due approximately March 1, 1985 (the final date has not been set).

Of special interest to Ottawa Centre members is that the 1983 First Prize winner ($200) was fellow member Michael Buckthought of Sir Robert Borden High School in Nepean. His project, titled "The Origin of the Inner Planets", was a computational exercise in testing the accretion hypothesis for the origin of the terrestrial planets. Winning awards is not unusual for Michael, who has several science fair and many music prizes (in Spanish and classical guitar) to his credit. This accomplished young man, who was barely 16 when he won the Bok award, is currently a first-year student at the University of Waterloo. I understand that he is considering a career in astronomy despite the astronomically poor job prospects.

To give Centre members an idea of what other Bok Award winners submitted as projects, second prize for 1983 went to a girl from Lisle, Illinois, for "Experiments for the Space Shuttle", and third prize went to a boy in Pensacola, Florida, for "A Two-Year Analysis of the Relationship between the Erratic Behaviour of Periodic Comet Schwassmann-Wachmann I and Solar Activity".

Reports should be sent to either:

Dr. Michael D. Papagiannis, Dept. of Astronomy,
Boston University,
725 Commonwealth Avenue,
Boston, MA 02215 USA
(Tel 617-353-2626)

or:

Dr. Harry L. Shipman, Physics Dept.,
University of Delaware,
Sharp Laboratory
Newark DE 19711 USA
(Tel 302-738-2986, X2661)

I strongly recommend that entries be sent to Dr. Papagiannis by registered mail, if there is time (remember that registered mail goes more slowly than ordinary mail). If there is little time (eg you decide to write up your pet project now for arrival in Boston on Monday, April 2, 1984), send it by Priority Post.

I won't guarantee that late 1984 entries will be accepted. But Dr. Shipman told me that due to the changeover in sponsorship, the competition was publicized late, and hence the closing date was moved forward from February 15 to April 1, 1984. Few entries have been received to date, so tit is possible that your report will be accepted if received in the early part of April. If you have any question in this regard, call Dr. Papagiannis first.

* * *

TWO MORE GRAZES Brian Burke

The grazing season got off to a shaky start with the first graze being blown in the wind. Last month's graze expedition had to be cancelled due to very strong winds which were gusting from 40 to 70 kmh. The driving conditions were also bad because the drifting snow was causing white-outs on area highways. However, to make up for last month's loss, I have lined up two more grazes.

Graze 1

date: Wednesday, April 18
time: 00:28 EST
star: ZC 2282
magnitude: 5.9
limb: south, dark
moon: 92% sunlit
type: marginal
location: 1 km south of Casselman, Ontario

The lunar profile for this graze shows a mountain

reaching up over the surrounding limb by more than 3 km. It will be interesting to try getting a profile of the mountain but we need many observers to accomplish this. We will meet at the St. Laurent Shopping Centre beside the Dominion Store at 22:30 EST on the night of Tuesday, April 17. The drive from St. Laurent will be 40 minutes to the graze site. All driving, except for the last few km, will be on highway 17. Although there are two other locations closer than Casselman, I have not yet had the opportunity to look at these sites. However, I suspect that they will not be desirable because they are on major highways. I will inform you at the meeting of any changes or give me a call.

Graze 2

date: Sunday, May 6
time: 23:27 EDT
star: ZC 1225
magnitude: 8.5
limb: north, dark
moon: 35% sunlit
type: marginal
location: 3 km southwest of Kanata

We will meet beside the K-Mart store on Moodie Drive in Bell's Corners at 22:00 EDT. The drive from there to the graze site on Richardson Side Road will be 15 minutes.

If you would like to participate in these graze expeditions, let me know at the meeting or call me at 521-8856. If you can lend equipment such as telescopes, cassette recorders, or short-wave radios, it would be appreciated.

* * *

SPRING METEORS - THE APRIL LYRIDS David Lauzon

After two months of rather non-activity, it is time to pull out those old sleeping bags again. Yes, that's right! It's meteor time again, and this month it is the April Lyrids. If, as you read this article, you think that it won't be a good shower, think again. April is a good

meteor observing time due to an increase of much-needed heat, and the low level of mosquitos. Equilibrium achieved! So there are absolutely no excuses this time.

This year the Lyrids are somewhat favourable, being a day before the last quarter moon. The weather is hard to predict, but when it is clear, it should be good.

Details of this shower and the Eta Aquarids is below:

shower	date	UT	moon	RA	DEC	HR	speed	duration
Lyrids	Apr 22	04	LQ	18h 16m	+34	15	65 kmh	3 days
Aquarids	May 4	07	NM	22h 24m	00	20	41 kmh	7 days

More details will be given at he meeting, concerning the observing site and time. If you can't make it to the meeting, give me a call at 745-7962 and we will see if arrangements can be made.

* * *

ASTRONOMICAL TRIVIA

Here are the answers to last month's quiz:

1) Newton
2) the BD
3) S147
4) 3.2 minutes
5) VB10
6) neutrinos
7) Sirius B
8) Venus
9) anomolistic
10) Neptune

and 10 more questions:

1) Who discovered Uranus?
2) Who was the first woman to discover a comet?
3) Who discovered the absorption lines in the solar spectrum?
4) Who's calculations led to the discovery of Neptune?
5) Who discovered Janus?
6) Who "predicted" the existence of Phobos and Deimos before they were discovered by Hall?
7) Who has discovered more comets than anyone else?
8) Who discovered "canals" on Mars?
9) Who discovered sunspots?
10) Who discovered the rings of Saturn?

* * *

ASTRO NOTES

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