

NOVA NOTES



Halifax Centre



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16-2

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5-21

NOTICE OF MEETINGS

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

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

Topic: Dr. Gary Welsh of the Saint Mary's University Astronomy Department will give a talk on charge coupled devices (CCD's). These sensitive detectors are providing new information in many areas of astronomy as they can supply information in a form ready made for computer analysis.

Date: Friday, April 19th : 8:00 P.M.

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

Speaker: Dr. Roy Bishop, National President of the R.A.S.C. and professor of physics at Acadia University will lecture on the 1985/86 appearance of Halley's Comet

REFRESHMENTS WILL FOLLOW BOTH MEETINGS !

About the cover: The cover this issue is of a 15th century woodcut depicting the ancient Chinese theory that solar eclipses were caused by a hungry dragon eating the sun. The entire populace would bang pots and make noise to scare away the dragon, and oddly enough this always worked !

REPORT OF THE TREASURER--1984

HALIFAX CENTRE, RASC

REVENUE	1983	1984
Membership Fees	2050.00	1577.50
Life Members Grant	152.00	152.00
Donations	---	---
Educational Activities	7.00	---
Interest and Dividends	71.89	121.79
Sales of Handbooks(net)	272.50	812.79
Advertising	---	---
General Assembly(incl. Travel Grant)	126.35	124.30
Miscellaneous	12.50	12.10
TOTAL REVENUES	2692.24	2800.50
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EXPENDITURES		
Fees Remitted to National Office	1216.50	1084.00
Library	9.00	111.80
Meetings and Newsletter	468.53	414.90
Annual Dinner(net)	12.70	15.00
General Assembly(incl. Travel Grant)	252.70	505.70
Equipment and Supplies	120.51	31.00
Office Administration	116.93	102.10
General Expenses and Audit	---	---
Educational Activities	---	---
Insurance	---	---
Awards and Donations	109.30	77.70
Operating Expenses(Observatory)	---	---
Miscellaneous	102.65	71.70
TOTAL EXPENDITURES	2408.86	2413.70
<hr style="border-top: 1px dashed black;"/>		
SURPLUS (or DEFICIT) ON OPERATIONS	283.38	386.80
BALANCE from 31 December, 1982/1983	1214.00	1497.00
BALANCE from 31 December, 1983/1984	1497.38	1884.00
Other Assets	2370.00	2125.00

Submitted 18 January 1985, R.C. Brooks, Treasurer

Notes on the Treasurer's Report:

The first point to make concerns the membership fees collected. Membership fees collected as of 31 December 1983 was abnormally high with a very high percentage of members paying for the 1984 year early--indeed last year saw the Halifax Centre grow to its largest ever with 105 members. Although fees collected this year are down, the number of paid up members is about average for the time of year.

Handbook sales were obviously good last year having been placed on a solid base by the efforts of David Tindall over the last few years. Cathy McLeod continues the contacts and some large orders have been received. However, we retain a small liability for unsold 1984 Handbooks which has been rolled over into the 1985 year in order to simplify transactions. To offset the liability, we have a credit note from the National Office for a number of returned Handbooks. Handbook sales are what have kept our heads above water this year and as suggested in last year's report help cushion unforeseen expenses, e.g. for the General Assembly. The expenditure for the GA was up this year since we accepted somewhat higher liability for costs incurred by our student representative. We can expect similar or higher GA costs this year with the Assembly being in Edmonton.

The Centre's accounts have recently been placed in a combined savings/chequing account with Central Trust thus proving better interest and dispensing with service charges for cheques. As of 31 December 1984, the Centre assets are as follows: bank account, \$1884.54; cash; credit note, \$100.00; unpaid invoice, \$212.50. Liabilities are: outstanding cheques, \$295.50; other debts, \$15.71 "Other assets" include mirror kits and accessories, mirror grinding machine, library books, unsold Handbooks and RASC crests and pins.

RASC Halifax Centre Library

We would like to encourage members of the RASC Halifax Centre to visit the Centre's Library, which is located in the short corridor through the doors at the left of the lecture hall. The holdings consist at present of several dozen books on astronomy and related fields, back issues of the RASC Journal and Sky and Telescope, and other publications. Selected books will be brought out for display after the main speaker, along with a Circulation Log which must be filled out if a book is borrowed. Books will normally be loaned for one month, after which the borrower may be asked by the Librarian to return the book for another reader. For this purpose, we ask that borrowers include their telephone number in the Circulation Log. For out-of-town members, we will send books to you by mail, but you must bear the cost of returning them. We will send any member a listing of the books who contacts us for a copy.

A recent inventory of the Library revealed several books which have been loaned for a long period of time or are not accounted for. Please peruse the following list and return any book that belongs to the Library if it is in your possession:

- Moore, Shirley, SCIENCE PROJECTS HANDBOOK
- Fishlock, David, A GUIDE TO EARTH SATELLITES
- Sagan, Carl (Ed.), COMMUNICATION WITH
EXTRATERRESTRIAL INTELLIGENCE
- Ronan, Colin A., GALILEO
- Norton, Arthur P., NORTON'S STAR ATLAS (2 copies)
- ASTRO-CARDS, SETS I and II
- Newton, Jack, DEEP SKY OBJECTS
- Serviss, Garrett P., ASTRONOMY WITH AN OPERA GLASS
- Kolin, Alexander, PHYSICS: ITS LAWS, IDEAS AND METHODS
- Fillmore, W. I., CONSTRUCTION OF A MAKUTOV TELESCOPE
- Howard, N.E., STANDARD HANDBOOK FOR TELESCOPE MAKING
- Texereau, Jean., HOW TO MAKE A TELESCOPE

The Centre will be expanding its holdings in the upcoming year, so please feel free to make suggestions for purchases. Also, we would be obliged

to anyone who makes a donation to the Library,
especially items that are not so easy to acquire.

The Library has recently acquired several new
items which may be of interest:

INTERNATIONAL HALLEY WATCH HANDBOOK, Vols. 1 & 2

These books, donated by Roy Bishop, are a must
for anyone planning a serious observation program for
Comet Halley. They include an ephemeris, detailed
charts, a description of observing and photographic
techniques, and standard forms for the reporting of
observations.

THE COMET IS COMING by Nigel Calder

This book is an excellent popular account of
the history of Comet Halley and of comets and comet
observers in general. It is filled with fascinating
facts, figures and photos. It is a good read for
anyone from the general interested reader to the
professional astronomer.

THE CAMBRIDGE DEEP SKY ATLAS by Newton and Teece

The colour photographs in this atlas were all
taken by the celebrated Canadian astrophotographer
Jack Newton from an amateur observatory near Victoria,
B.C. The objects were selected from the Messier and
NGC Catalogues. Although the pictures do not have the
brightness and resolution of those taken with the
large professional telescopes, they provide a good
feel for what a dedicated amateur can achieve. One
feature that is especially useful for observers is
that the pictures all have the same scale and
identical exposure times, so the relative size and
visibility of the objects is easily gauged.

Happy Reading!
Dave Chapman
Halifax Centre Librarian

(H) (B)

***** METEORITES IN BRIDGEWATER

As announced in the previous issue of NOVA NOTES, the Lunenburg County Astronomy Club will be hosting an exhibit of meteorites at the Desbrisay Museum in Bridgewater.

This exhibit was created by the Provincial Museum of Alberta and is being circulated in Nova Scotia by the Nova Scotia Museum as part of the National Museums Program.

"Meteorites" will be in Bridgewater during the months of May and June, and should be set up by the end of the first week in May.

The LCAC has invited the Halifax Centre to hold their May meeting in Bridgewater on Saturday, May 18th at 7:00 pm. Hopefully we will have someone to give a brief lecture on our visiting "extraterrestrial immigrants" before viewing the display. There will be eleven meteorites, and fifteen specimens and artifacts among the display. If the weather permits there will be an observation session following the meeting, so bring your telescope or binoculars too!

Of course, if you can't make it, your welcome to view the display during regular museum hours through May and June. For any details please contact me at any meeting of the Halifax Centre... ...Darrin Parker

DOUBLE STARS WITH CONTRASTING COLORS

For many years I have wanted a list for some public nights of double stars that are colorful, besides the well known crowd pleaser Alberio (Beta Cygni). Such a list has long been needed for some public nights because of the long twilight of summer, light pollution, at times a lack of bright planets, or a full moon which severely dims the view of practically all celestial objects. Under those conditions, the most interesting objects to show are double stars, but if both of the stars that form a double star are the same color, the public thinks that they are plain white and all look the same and they soon become bored with doubles. If a double has a nice color contrasting companion, they find double stars interesting and notice the beautiful colors.

In late November 1983, I asked our local double star experts Rowland Rupp and Shaun Hardy to see if they knew of any such listing of stars, but unfortunately they did not. After giving an observation report about a double star at the December Buffalo Astronomical Association, I asked the audience if anyone was aware of a listing of color contrasting doubles, but again no luck. In the January 1984 issue of our club newsletter, THE SPECTRUM, Rowland Rupp wrote an article on the subject which included a short list of double stars from some reference material. Soon afterward came letters responding to that article from several amateur astronomers from New York, Florida and as far away as Japan, all with little or no luck.

Reading SKY & TELESCOPE and ASTRONOMY magazines for more than 10 years, I have never seen a list of color contrasting doubles or come across one looking through some older issues. The same is true of THE OBSERVER'S HANDBOOK, NORTON'S STAR ATLAS, BURNHAM'S and the WEBB SOCIETY HANDBOOKS. Over the months I have compiled a list of seventy-four (74) doubles with contrasting colors which should help popularize "double stars" such as the Messier Catalogue has done for the deep-sky objects.

The columns below contain the following information on double stars with contrasting colors: From left to right; the star's name (more than one designation may appear), the magnitude and color of the primary star (if the star is variable, upper and lower limits are given), the separation of the two stars in arcseconds, the magnitude and color of the secondary star, the right ascension of the stars in hours and minutes and the declination in degrees and minutes. The following abbreviations are used for the colors: b=blue w=white g=gold y=yellow o=orange r=red.

Σ3053 Cas	6	g	15	7.5	b	00 00	+65 49
55 Psc	5.5	g	7	8	w	00 37	+21 10
π Cas	3.6	y	11	7.2	r	00 46	+57 33
γ Cas Σ100	4.2	w	23	5.3	y	01 11	+07 19
φ Cas	5.0	w	134	7	b	01 17	+57 58
Σ163 Cas	6.5	o	35	8.5	w	01 47	+64 36
λ Ari	4.8	w	37	7.4	y	01 55	+23 21
h647 Psc	9	r	26	9.5	w	02 00	+07 27
γ And Σ205	2.2	y	10	5.4	b	02 08	+42 06
ε Tri Σ227	5.4	y	4	7.0	w	02 10	+03 04
Q2826 Cas	6.5	b	63	7	y	02 16	+59 48
ι Cas	4.7	y	2.3	7.0	b	02 25	+67 11
η Per	3.9	g	28	8.6	b	02 47	+55 41
Σ336 Per	6.5	y	9	8	w	02 50	+32 13
Σ320 Cep	6.5	r	5	9.5	y	02 59	+79 13
π Com	6	o	55	8.5	b	03 39	+59 49
Q267 Cam	5	o	1.7	8.5	b	03 53	+60 58
32 Eri	5.0	y	7	6.3	w	03 53	-03 06
β87 Eri	6.2	o	1.8	9.3	b	04 17	+20 35
Σ644 Aur	6.5	b	1.5	7	g	05 07	+37 14
h3752 Lep	5.5	y	3.1	6.5	b	05 20	-24 49
χ Lep	3.5	y	95	6	o	05 42	-17 53
η Gem	3.3	r	1.6	6.5	g	06 12	+22 31
38 Gem	5.5	w	7	7.5	y	06 52	+13 15
h3934 CMa	7	b	14	8.5	w	07 09	-21 43
h3945 CMa	5	r	27	7	w	07 16	-23 13
δ Gem	3.5	w	6	8	o	07 17	+22 05
β584 Cnc	6.9	b	93	7.7	g	08 37	+19 44
Σ1254 Cnc	6.5	g	63	8	y	08 38	+19 51
ε Cnc	4.5	g	31	6.5	b	08 44	+20 57
ε Hya Σ1273	3.5	y	3.1	6.9	w	08 44	+63 06
α Leb Regulus	1.4	w	177	7.9	g	10 06	+12 13
88 Leo Σ1547	6.5	y	16	8.5	o	11 29	+14 39
Σ1561 UMa	6.3	y	10	8.6	g	11 36	+45 23

2 CVn Σ 1622	5.5	r	11	8	y	12 14	+40 56
δ Crv	3.1	b	24	8.4	g	12 28	-16 14
24 Com	5.2	q	20	6.7	b	12 33	+18 39
32&33 Com Σ 123	6	r	195	6.5	y	12 50	+19 27
35 Com	5	q	29	9	w	12 51	+21 31
Σ 1764 Vir	7	g	16	8.5	w	13 35	+02 38
ϵ Boo Σ 1877	2.5	q	2.9	5	b	14 43	+27 17
ξ Boo Σ 1888	4.8	y	7	6.9	d	14 49	+19 18
Hh457 Lib P2121	6	a	22	7.5	r	14 55	-21 11
18 Lib Σ 1894	6	g	20	9.5	y	14 56	-10 57
μ Boo	4.3	w	108	6.5	y	15 22	+37 33
κ Her Σ 2010	5.3	y	28	6.5	g	16 06	+17 11
α Her	3-4	r	5	5.4	y	17 12	+14 27
δ Her	3.2	b	9	8.8	y	17 13	+24 54
σ Oph	6	g	11	7	w	17 15	-24 14
Σ 2194 Her	6	g	16	8.5	w	17 39	+24 32
μ Her Σ 2220	3.5	y	34	9.3	r	17 45	+27 45
8694 Oph	6.5	q	82	7	b	17 50	+01 08
95 Her	5.1	w	7	5.2	y	17 59	+21 36
θ Dra Σ 2420	4.5	g	34	7.5	b	18 51	+59 20
δ Lyr	4.3	r	620	5.6	b	18 52	+36 54
Ω 525 Lyr	6	y	45	7.5	b	18 53	+33 54
S711 Sgr	7	y	45	8.5	b	19 05	-26 55
Ω 178 Aql	5.5	y	90	7.5	b	19 13	+15 00
Σ 2521 Vul	6	r	71	9.5	w	19 24	+19 48
β Cyg Alberio	3.1	g	34	5.1	b	19 29	+27 52
84 Sge HN	6.5	r	28	8.5	w	19 37	+16 27
AX Cyg Ω 391	9	b	19	9-11	r	19 56	+44 08
β Cap	3.1	y	205	6.0	b	20 18	-14 56
γ Del Σ 2727	4.5	q	10	5.5	y	20 44	+15 57
52 Cyg	4.5	b	7	9.5	g	20 44	+30 32
12 Aqr Σ 2745	5.8	y	2.9	7.9	b	21 01	-06 01
β Cep Σ 2806	3.5	b	14	8	w	21 28	+70 20
ξ Cep	4.6	w	8	6.6	y	22 02	+64 23
41 Aqr Hh753	6	g	5	7.5	y	22 12	+21 19
Σ 2849 Lac	6	b	16	8	w	22 17	+37 31
δ Cep	3.5-4.3	y	41	6.2	b	22 27	+58 10
θ Cep Σ 3001	5.5	g	3.2	8	y	23 16	+67 50
94 Aqr	5	y	13	7	g	23 17	-13 44
WZ Cas Ω 2254	7.5	w	58	7.4-10	r	23 59	+60 05

Carl Milazzo
reprinted from "ORBIT"
Hamilton Centre

THE ORIGIN OF THE UNIVERSE

In the beginning God created the heaven and the earth.
And the earth was without form, and void;
and darkness was upon the face of the deep.

The Holy Bible

Whatever our religious beliefs may be, all cultures share a "creation" of sorts and in most cases this creation arose out of nothing. So it is also with the latest concepts of science as researchers attempt to explain the extraordinary beginnings of our universe.

I have used the word "extraordinary" because we have to imagine in our mind a situation that is extremely difficult to comprehend. In the beginning there was truly nothing at all. Those of us who have heard of the "Big Bang" assume that some form of matter must have been present to expend energy in an explosion that took place at a certain point in space and time. Our mental image may allow us to imagine a supernova explosion magnified by a great deal but that is not at all what may actually have happened.

What we have to understand is that before the Big Bang there was no existence of anything. There was no empty space in which the explosion could conceivably originate. As well, there was no space into which the universe could explode into. Space, time, matter and energy did not exist before the Big Bang.

All that we understand and everything that exists was created at the instant of that "explosion". The universe as we know it today, one moment did not exist and the next it was there. All of the empty space for it to expand into was suddenly present. For myself, the whole thing is so abstract and remote that I will leave it to others to fathom it out. In the early part of this century someone made a very good start at it.

Albert Einstein developed a revolutionary new theory of the dynamics of the universe. In Einstein's view two things were possible. One was that matter and energy were essentially the same thing. What differed was their manifestation. The other aspect of the theory was the unification of space and time.

The final outcome of this theory is that space-time becomes the basic fabric of the structure of the universe. Within this framework energy and matter are allowed to interact with space-time by means of gravitational forces.

Everything then began with the Big Bang. Not only matter and energy but also space-time. Since there was theoretically nothing before the Big Bang we can only wonder and speculate just what might have preceded the Big Bang. For the present time the future of the ever expanding universe is sufficient to hold our interest.

Peter Steffin

The Halifax Centre Executive has approved a scheme whereby members outside the Halifax area will be able to arrange a lecture on astronomy at the Centre's expense. There are some guidelines which are given below. The intent is to fulfill one of the objectives of the Society, i.e. to promote the dissemination of astronomical knowledge. To this end, we will supply the names of several Halifax members who are prepared to go to your community and to present a lecture on an astronomical topic. First, the lecture must be held more than 100 km from Halifax and before a lecture can be approved, we need you to do some of the footwork. A site for the lecture must be found which is free (or very cheap to rent). You must also be prepared to arrange for publicity through public service announcements in local papers, radio and TV stations. Once a site is found and some potential dates determined, you should write the Halifax Centre President with the proposed dates. He will then forward a list of the members and lecture titles so you can choose the speaker and topic. We will then attempt to set a mutually convenient time for the lecture. It may require more time to set up lectures further from Halifax but we will try to meet your time requirements as best we can. The Centre will pick up the cost of transportation for the speaker, cost of goodies after the lecture and any other costs which the Executive approve.

This is a trial project, but we hope it will prove popular and successful. Drop a note or phone Dr. Scrimser if you are interested in helping us arrange one of this series of talks.

UPDATE - UPDATE - UPDATE

In the May/June 84 issue of Nova Notes I published an article that was titled DATING WITH ASTRONOMY and in it reported on the possible and not so possible astronomical significance of the great pyramids in Egypt. My data was based on historical references and left open the question of the true reason for the particular alignment of the pyramids. The following information is obtained from the CBC radio program "Quirks & Quarks" dated 1 Feb. 85 and goes some way in answering that question.

An astronomer at the U.S. Naval Observatory in Flagstaff, Arizona carrying out some research on the possible astronomical orientation of the great pyramids in Egypt has published some new findings that confirm more recent theories. Dick Walker, using the most modern theories of the movement of the earth's axis, has meticulously calculated where the pole star at the time of the building of the pyramid of Cheops would have been. If early findings are correct then the pole star of 2600 BC would have been aligned with the entrance on the north face of the pyramid. At that time the pole star was Thuban and it was widely believed that because the pyramids had the same orientation as the compass, the entrance passages must have also been built with the same affiliation in mind. Walker believes that nothing could be further from the truth and his calculations seem bear him out.

Dick Walker's calculations show that at no time could Thuban be seen from the descending passage on the north face of the pyramid. After checking and rechecking his data, including many refinements, he still came up with the same answer that had the line of sight of the passage off by 2 degrees. That means the alignment was off by 4 diameters of the moon and that is just too great an error to reconcile, especially when compared to the miniscule 2.5 minutes of arc error in the compass alignment of the pyramid itself. The pyramid alignment demonstrated that the Egyptians had the capacity to correctly align structures so that there must have been some other reason for the construction of the passage.

Another puzzle to solve was the 26.5 degree descent angle of the passage. Why would the Egyptians use that particular angle? Using borrowed toombstones made of different materials Walker let them slip down a home made ramp set at an angle of 26.5 degrees and after many trials came to a simple conclusion. This angle was steep enough to allow the stones to slide down easily but not so that they would gather speed and get away. The reason for the huge stones that block the passage was of course to stop thieves from entering the pyramid after it was sealed. Researching ancient documents, to see what kind of astronomers the pyramid builders were, led Dick Walker to conclude that they were not mathematicians being barely able to handle fractions. They also never recorded an eclipse, they never recorded the passage of a comet and they never recorded a meteor shower yet they recorded everything else. The builders of the pyramids had more earthly thoughts on their minds than the pursuit of astronomy.

Peter Steffin

UPDATE * UPDATE * UPDATE

You may recall that the cover of a recent issue of NOVA NOTES showed a figure which was said to have been a priest observing the sky with the aid of a pair of crossed sticks. However, a note in the current issue of SKY & TELESCOPE shows that this is not the case. A careful linguistic analysis of many examples of the crossed stick form has shown that this symbol is equivalent to the word 'visible' and when combined with the eye and face becomes 'clearly seen' or 'sharp-eyed'. This shows the caution needed in studying images at face value without taking into account the language and culture behind them.

WHEN IS A PLANET NOT A PLANET ?

As most of us are probably aware, large gas giant planets such as Jupiter or Saturn give off more heat than they receive from their sun because they are still slowly shrinking, which releases gravitational energy as heat. These planets are also very hot at their cores but because they are not massive enough they cannot produce enough heat and pressure at their cores to start the fusion process which is the power source of stars. Because of this, these gas giants are sometimes referred to as "failed stars". However, as the mass of a gas giant is increased, its central temperature and pressure continues to increase and more and more energy is released until the object becomes a very faint red dwarf star usually referred to as a "brown dwarf". The long standing debate over the dividing line between planet and star has taken on new meaning with the recent discovery of a substellar object orbiting the star Van Biesbroeck 8, which is a red dwarf located in the constellation of Ophiuchus at a distance of about 7 parsecs (21 light-years).

Van Biesbroeck 8 (VB 8) was being observed as part of a continuing study by astronomers Donald McCarthy and Frank Low of the University of Arizona and Ronald Probst of Kitt Peak National Observatory. The study was an attempt to detect companion objects of nearby stars including those for which classical astrometric observations indicated an unseen companion. Their interest in VB 8 increased after a paper published in July of 1983 indicated that an unknown object was in orbit around VB 8 and the upper limit on its mass was 10 times the mass of Jupiter.

McCarthy and his co-workers were using a technique known as infrared speckle interferometry. Speckle interferometry is a procedure normally used for separating close binary stars and attempts to avoid the turbulence of the Earth's atmosphere by combining many very short exposures. For each short exposure, the air moves so little that a clear image is obtained although with correspondingly less light gathered. When these

are combined, their interference pattern can be used to determine the separation of the objects. For their work, however, the main star would outshine its dim companion by about 12 magnitudes in visible light as opposed to only 3 magnitudes in the infrared, and thus infrared speckle interferometry was used.

The observations were made between May and July of 1984 and at both wavelengths used, VB 8 resolved into two components separated by roughly 1 arc second, which at their proximity corresponds to a distance of 6 A.U. This compares with Jupiter's distance from the sun of 5 A.U. These observations allowed several of the new objects properties to be deduced. Combining the now known separation and the previous astrometrical data the mass of VB 8B was found to be about 5 times the mass of Jupiter although this figure is far from certain. Its luminosity is .003 % of the sun's, which is one tenth that of the dimmest known star, and it has an effective surface temperature of only 1 400 K.

As the minimal requirements for a "true" star are usually taken to be a luminosity of about .05 % of the sun and a temperature of 2 750 K it is easy to see why many astronomers are referring to this newly discovered object as the first known planet outside of our solar system. However, even more interesting is the case of the star VB 10. The same group who initially published data on the mass of the companion of VB 8 also determined that VB 10 has a companion and its mass is less than the mass of VB 8B. Attempts by McCarthy's group to resolve VB 10 have failed so far, however we do know that if Jupiter were placed 5 A.U.'s from VB 10 we would not be able to detect it. As a result this actually seems to improve the chances that VB 10's companion is similar to one of the gas giants of our own solar system.

Patrick Kelly

BOOK WATCH

To coincide with David Chapman's report on the state of the centre library, I thought it might be a good time to start what I hope will become a regular feature of NOVA NOTES, namely a book review column. Having had a chance at the last meeting to look over some of the literary works put on display by David, I was hard pressed to choose only one book to take home. At this point I must confess that the idea for this column had not even entered my head. The book that I chose was WATCHERS OF THE STARS by the well-known British author and astronomer Patrick Moore. It is published by G.P. Putnam's Sons, 200 Madison Avenue, New York, N.Y. 10016

In this book the author relates the tale of what he considers to be the greatest scientific revolution of the last two millenia, namely the demise of the view that the Earth is the center of the universe and the rise and eventual triumph of the heliocentric model of the solar system. He accomplishes this by looking at "the five great pioneers of the revolution - Copernicus of Poland, Tycho Brahe of Denmark, Kepler of Germany, Galileo Galilei of Italy, and Sir Isaac Newton of England". Starting with the theories of antiquity and leading up to the Greeks and Ptolemy, Moore quickly begins a detailed look at the five main characters previously mentioned. He explains not only their accomplishments, strengths and weaknesses but also gives an interesting look at their backgrounds, how they related to the world around them and their part in the establishment of the heliocentric theory.

Moore has done a considerable amount of research for this book and always manages to throw in some interesting tidbits of information such as Copernicus' excellent effort as a military organizer and Kepler's treatise on a method for determining the amount of wine left in a cask! When needed, Moore includes current astronomical knowledge and understanding to make a point more understandable in its historical context. In addition to being very easy to read, the book

is full of excellent illustrations and includes 24 beautiful color plates (although the captions on two of them have been mistakenly switched). These range from painting of the main figures of the book, to historical star atlases, to a view of the Earth from space. An appendix gives a list of books for further (and more detailed) reading as well as a time line for each of the characters showing how their life spans were related and the major points in each of their lives. If I have any complaint about the book, it would be that I found it so engrossing that I took it to read on several bus trips and ended up with a few headaches for my effort. !

If anyone else would like to submit a review of a book which they feel would be of interest to other members, please feel free to send it to me. Please include the address of the publisher so that others can order it if they wish.

Patrick Kelly

"If this is true, and if they are suns having the same nature as our sun, why do not these suns collectively outdistance our sun in brilliance ?"

- Kepler, 'Conversations with
the Starry Messenger'

Kepler's argument that the universe could not be infinite was based on his observation of a dark sky at night. This puzzle later became known as Olber's paradox.

THE ORIGIN OF THE MOON

Of all of the objects visible in the night sky, the one with which the vast majority of people through history were probably the most familiar is the moon. Despite the fact that it has been studied from antiquity to modern times with increasingly sophisticated equipment, there is one main question about the moon which has still gone unanswered: Where did the moon come from? There have been many attempts to answer this question but the first plausible explanation came after it was discovered in the 1800's that the length of the day was slowly getting longer and that the moon was moving further away from the Earth at about one inch per year. In the late 1800's George Darwin (one of Charles Darwin's sons) traced this process back and found that 50 million years ago the moon had been only 9 000 km from the Earth and the day was only 5 hours long! Utilizing these erroneous conclusions he thought that the young molten Earth had been made to wobble by the sun's gravity. This had resulted in the Earth being distorted to the point that a piece of it broke off, went into Earth orbit, and solidified to form the moon. This fission theory was eventually dropped as there was no way to account for the fact that the Earth now spins so slowly compared to how quickly it would have had to spin in order for a piece of it to be flung off.

However, as Darwin's theory was being debated there arose two new theories, usually known as the capture theory and the nebular theory. In the capture theory, the moon was formed in another part of the solar system and had a highly elliptical orbit. It was later captured by the Earth on one of its passes through the inner solar system. The nebular hypothesis is based on LaPlace's nebular theory that the entire solar system formed from a large cloud of gas and dust and states that the Earth and moon were formed as a binary system at the time that the solar system formed from the solar nebula. Over the years, favor for both competing theories rose and fell. It had been hoped that the rocks brought back from the

Apollo missions would have settled the problem once and for all, because the capture theory implied that since the Earth and moon formed in separate parts of the solar system, their chemical compositions should be different whereas the nebular theory implied that they should have the same composition.

Analysis of the moon rocks showed that although the moon's composition was similar to Earth's, it also had some differences which were hard to explain. This information further discredited the capture theory which had been on shaky legs ever since computer models done several years earlier indicated that the Earth could not have captured such a large object without shattering it in the process. The nebular theory also had trouble accounting for the fact that the moon contained far fewer volatile materials than the Earth. It was about time for a new theory and one was proposed in 1976 although it has been mostly ignored up until the last few years.

This theory is usually known as the impact theory although it has also been given the nickname of the "Big Whack" theory which describes its basic premise quite nicely. According to this theory, when the Earth was about 100 million years old, it was struck by another planetesimal left over from the formation of the solar system. This object would have been about the size of Mars, and would have struck the Earth a glancing blow as it swept in from the outermost regions of the solar system. The intruding object was shattered and continued on its way but a huge region of the Earth's crust and outer mantle were vaporized along with most of the outermost layers of the planetesimal. This very hot gas would have exploded away from the Earth but in the same general direction as that of the planetesimal. The total mass of the gas would have been about twice the mass of the moon. A lot of it would have fallen back to Earth, but within a few hours a ring would have formed, girdling the Earth. After about 100 years, the ring would have expanded outwards into the region where the Earth's tidal forces could no longer prevent the accretion of solid bodies.

Over the next thousand years, larger and larger particles condensed from the cooling gas and eventually the moon was formed.

This theory accounts for the similarity between the compositions of the Earth and moon, for most of the volatile materials would have been boiled away from the heat of the explosion. There are still two problems with this theory which must be resolved. The first is the amount of iron on the moon. Compared to other rocky bodies, it should have about four times as much iron as it has, and in any type of collision not only should a large amount of iron been present, but it should not have been volatile enough to boil away. The other problem is with the concentration ratios of three oxygen isotopes which acts as a fingerprint in locating where in the solar system an object was formed. These ratios for the moon are so similar to Earth's that they imply a local origin for the moon. However, recent refinements have shown that the colliding object could have originated from a region near the Earth as opposed to the outer solar system with much the same results. More research is now under way which will employ a supercomputer in an attempt to model the behavior of the materials involved in the collision. It is hoped that it will be possible to determine whether the composition could change in such a way as to produce rocks like those in the moon. Another factor in favor of the Big Whack theory is that information gathered over the last twenty years shows that the rate of meteor bombardment early in the life of the solar system was higher than previously thought. This seems to make the Big Whack theory easier to swallow than it would have been in the past. In relation to this, the low possibility of such a collision may explain why our moon is such a unique object in the solar system. It seems that at long last, we may finally be able to give a fairly accurate answer to the question of where the moon came from.

Pat Kelly

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