NOVA NOTES

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JUNE 27-29

GENERAL ASSEMBLY
1975
HALIFAX

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Editor: Mr. Randall Brooks, Dept. of Astronomy Saint Mary's University, Halifax

NOVA NOTES are printed six times yearly (Jan., March, etc.) through the courtesy of the Nova Scotia Museum. Contributions on any aspect of astronomy are welcomed from non-members and members of the Halifax Centre. Closing date for the September issue will be Aug. 22.

CONTRIBUTORS: R. Bishop, D. Brooks, M. Cunningham, A. Edwards, W. Zukaukas, and me--I threw in some (useless , more useless ,most useless) trivia. And oh yes Perlo has made the scene and he thinks he is going to use his anonymity to make nasty comments on Nova Notes but let him be warned if he does I'll expose him by nominating him for editor in Oct.

UP COMING EVENT:

Star Nite In The Country--our annual trip to the wilderness to rediscover what we miss by inhabiting this sea of:(underline the appropriate items) fog, smoke, lights, salt spray, trees, plain old rain or any other of O'Shea's perils. (See note on pg. 80). The location for this and the date have not been arranged as yet but they may be announced at the Assembly and you will of course receive your usual notice of meeting giving details.
If interest is sufficient we may be able to arrange a rural location for the Perseids on Aug. 12th.

> "It is a pleasure to record that a new centre has been formed in the city of Halifax. For years it has been a matter of regret in the Council that the Society has never been represented in any city in the Maritime provinces so that the event is doubly welcome."

This was the introduction of the Halifax Centre to the RASC given in the JRASC, 76,49,1955. The Centre had previously been known as the Nova Scotia Astronomical Society and when they became affiliated with the RASC on 15 Jan. 1955 had 30 members. The original group had been in existance since 1951 and although I do not have substantiating information, I am sure that their Honorary President, Rev. M.W. Burke-Gaffney, had more than a little to do with the formation of the NSAS.

Astronomical interest in the Maritimes goes back a long time and in fact the first professional astronomer and first observatory were located in the region. Dr. Wm. Brydone Jack established an observatory on the campus of the University of New Brunswick in 1851 and by telegraph link with Harvard Univ.(then the 'prime meridian' for North America) determined the longitude of Fredericton and other places in New Brunswick-- the first time the method had been attempted. The observatory and transit instrument are still extant and for those who have driven to Halifax for the Assembly, you may wish to see the structure and instrument on the way home. J.E. Kennedy, now of the Univ. of Sask., was Director of the observatory in the 1950's and has written numerous articles on Jack and his observatory. These may be found in the JRASC.

Another astronomer of great note, Simon Newcomb was born and educated near Pugwash, N.S. However he determined at an early age (18) that Nova Scotia was no place for astronomical investigations and left for the US where he was to become Director of the US Naval Obs. for many years. He is of course well known for his mathematical solutions to many problems of motions of stars and planets. These are not the only two who have become astronomers from the Maritimes. One of the

Dominion Astronomers, C.S. Beals, came from Canso, N.S. and obtained his Bachelor's degree from Acadia Univ. Dr. Donald MacRae, Director of the David Dunlap Obs. and dept. head at Toronto, was born in Halifax.

The Halifax Centre has gone through 4 phases. The activities of the first four years as the NSAS are not known to the author except that they produced their own newsletter on their own equipment. The stimulus for the group came in great part from Fr. Burke-Gaffney and from several other active members.

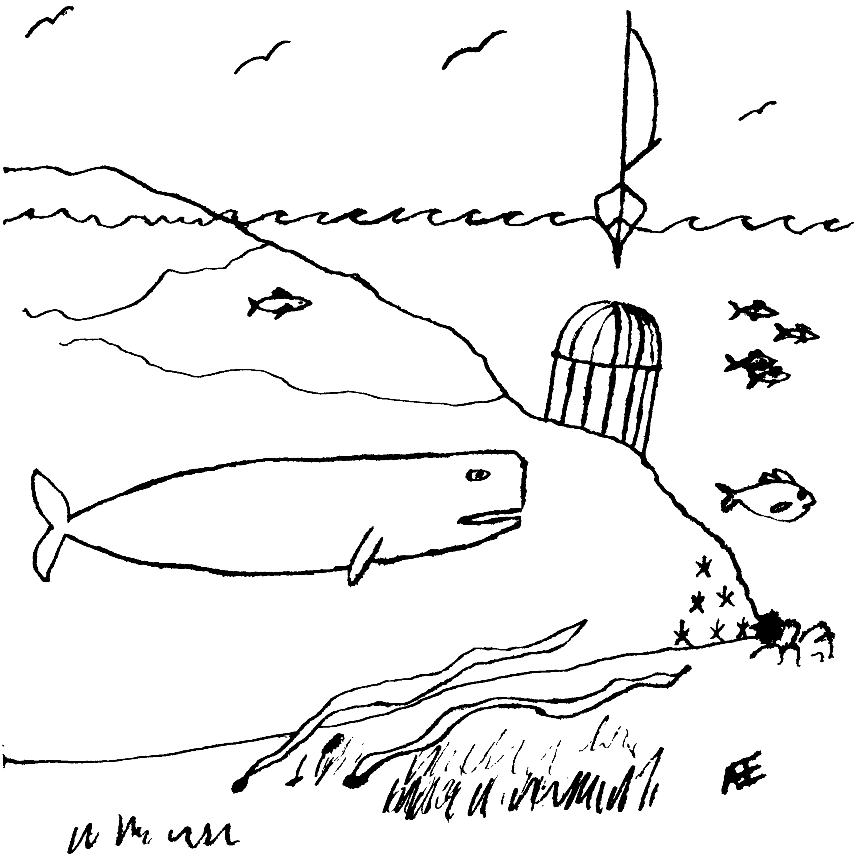
The second phase from 1955-65 corresponds with the operation of the planetarium of the Nova Scotia Museum of Science. It was the meeting place for the Society during this period and the planetarium sparked much interest in the general population (numerous people still enquire about it) which spilled over to the Centre in the form of more members and greater activity. Donald Crowdis was both the Museum Director and a councillor of the Centre and through his efforts the Dept. of Education purchased a Spitz Model A-1 complete with sun-moon-planet co-ordinates, meridian, and geocentric earth projectors. It can be said that this was the focal point of astonomical interest in Halifax for 10 years.

Unfortunately the Museum of Science was replaced by the Nova Scotia Museum and the new facility was neither equipped with space for the planetarium nor the interest in astronomy on the part of the people directing its operation. From 1965-69 the Halifax Centre ceased to exist--phase 3. By the way, to my, Fr. Burke-Gaffney's and other's chagrin, the planetarium is stored in a barn at Mount Uniacke--the infidels!

Fortunately Barry Mathews lived in Halifax at that time and as a result of his enthusiasm and energy, the Halifax Centre began its forth phase with renewed vigor. Barry's stay was short however--Ottawa being the lucky recipient of his talents--but the impetus given by him was sufficient to keep the Centre going. In Jan 1972 the Rev. M. W. Burke-Gaffney Obs. opened at Saint Mary's Univ. and our Centre is climbing in interest and numbers at least in part because of its existance. 5000 people had an opportunity to see and use the 16" Ealing telescope in the first year of operation. More than 1500 waited in line to catch a glimpse of Kohoutek. Which goes to show that the interest is definitely here. Late in 1973 the Halifax Junior Astronomy Club was formed by the Centre with an overwhelming response by the kids. And I guess the final touch thus far in phase 4 is your attendance at General Assembly 1975--our 20th year as a Centre Of the Royal Astronomical Society of Canada.

R.C. Brooks

FROM THE LITTLE OBSERVATORY BY THE SEA



"WELL! HIGGINS, AFTER THAT STORM OTTAWA WILL KNOW WHY WE WANTED WATERPROOF PAINT. BUT, MAYBE WE CAN OBSERVE STARFISH."

HAVE YOU READ?

Science, May 2nd pages 445-476
This long series of reports give all the data on Pioneer 11 in its encounter with Jupiter. There are no photographs but many diagrams. Jupiter is not a star.

Nature Mar 27th
Page 282-The opportunities in Astronomy in the near future look bleak. Try teaching. Page 295-The power source of Seyfert galaxies and QSO's. Ah hah of course it is monstrous Black Holes. Not one of your ordinary black holes that sucks in gas, but a Big one that reaches the mass M_c. All hell breakes loose then but the black hole at our galactic centre will not reach this size for another 10^{10} yrs.

Scientific American May 1975
Page 80-The search for Extraterrestrial Intelligence. Look at the drawing of the 1,500 dish antennaes each 100 meters in diameter.
If this subject interests you turn to page 117 for the book review of; the Galactic Club: Intelligent Life in Outer Space by Bracewell. All your answers there.

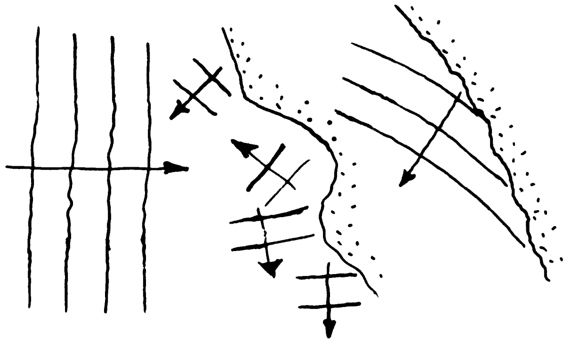
Murry Cunningham

MIRROR OPTICS

"In the reflecting telescope the mirror's the thing"
(R.W. Porter, ATM I,1)

Mirror surface must be smooth to:

$1/10\lambda$
$= 1/10 \times (0.5 \times 10^{-6})$
$= 50\text{nm}$
$= 1/500 \times 10^{-3}$ in.
(10^{-3} = good machining tolerance.)

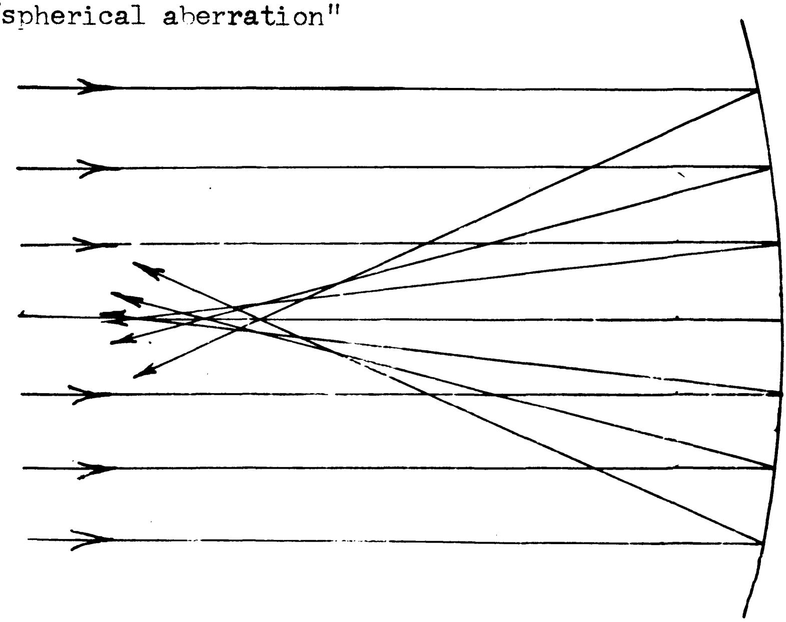


TO ACHIEVE

Rub two blocks of glass together at random with finer and finer abrasives--spherical surface is automatically produced. (All bumps departing from a surface of constant radius are worn off.)

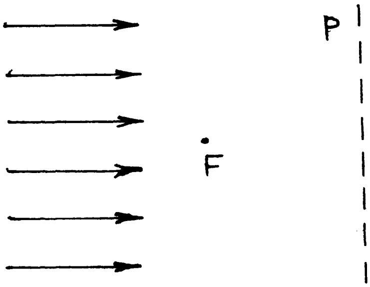
SPHERICAL SURFACE AND LIGHT FROM A STAR

The light rays do not form a sharp image of the star--"spherical aberration"



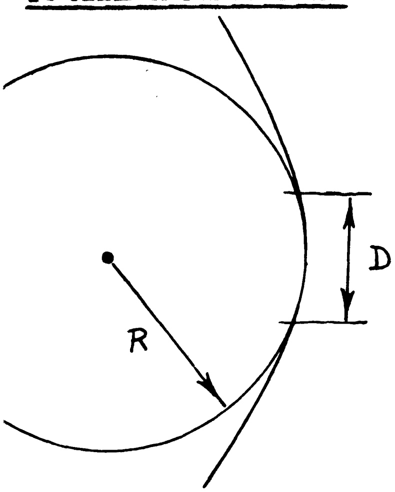
CONDITION FOR A GOOD FOCUS (F)

All rays of light must take the same time to reach F—
Fermat's principle.



Light rays will reach a plane (P) at 90° to their motion in the same time. Hence, in order to be deviated by one reflection to arrive at F in the same time, the reflecting surface must be equidistant from F & P (the definition of a paraboloid).

TO MAKE A PARABOLOID



Since a telescope mirror is usually only a small central portion of a paraboloid, it deviates only slightly from a sphere.

(R/D~8 to 20)

Hence one uses the random grinding technique to make an equivalent spherical mirror, and then uses selective polishing to alter it to a paraboloid.

CONTROL OF THE SELECTIVE POLISHING

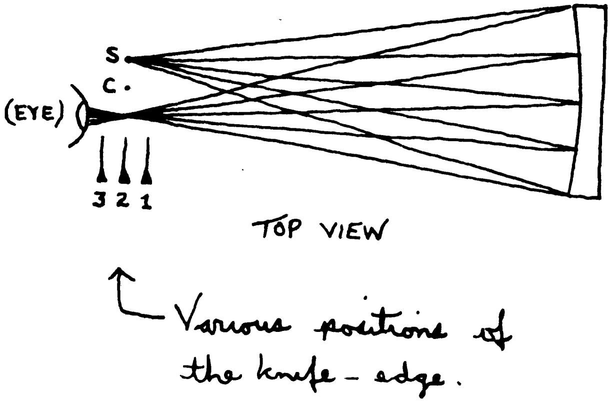
Foucault knife-edge technique (1858);

Prior to 1858 the production of an acceptable paraboloid was a trial and error process—ie. an art.

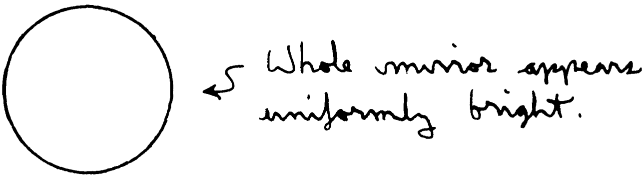
R.W. Porter has referred to the Faucault test as:

"One of the most delicate and beautiful tests to be found in the realm of physics."

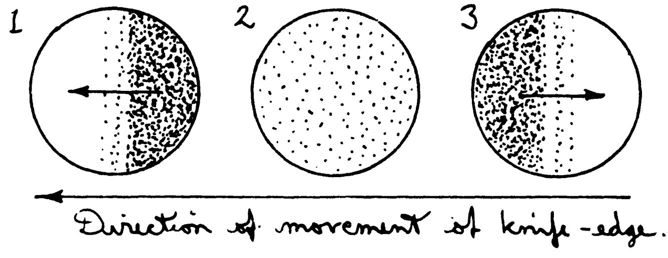
<u>Spherical mirror</u> with a point light source S near its centre of curvature C produces a point image on the other side of C. An opaque baffle, a'knife-edge', is moved sideways into the light rays near the image, and the result is viewed with the eye just behind the knife-edge.



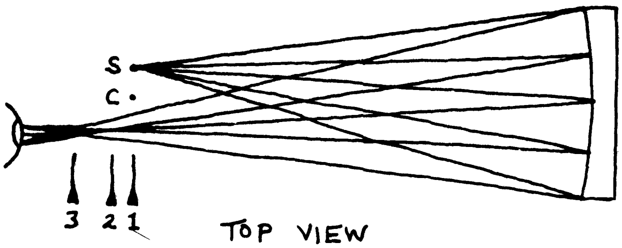
Without the knife-edge:



With the knife-edge:

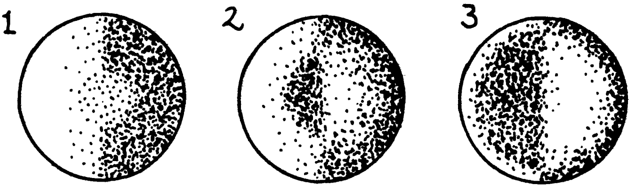


Now use <u>paraboloidal mirror</u>. Let C be the centre of curvature of the central part of the mirror. Since a paraboloid is 'flatter' toward the edges than a spherical mirror, marginal rays come to a focus beyond the image point formed by rays near the axis--ie. there is aberration in the image.



Without the knife-edge, the mirror appears uniformly bright as before.

With the knife-edge:



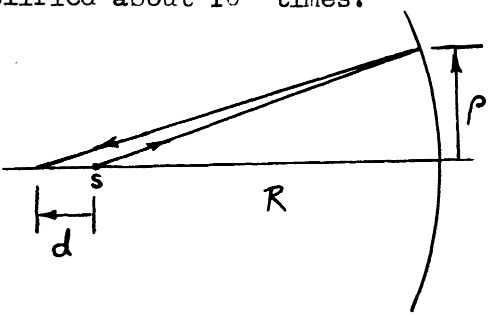
Note that the circular zone at the image point of which the knife-edge is located appears uniformly dimmed. The position of the knife-edge is thereby related through the shadow pattern to the actual shape of the mirror. Qualitatively one can think of the shadow pattern as if one were viewing a lunar dome or crater illuminated by grazing light coming in from the side opposite to the knife-edge. The relief pattern then represents the deviation of the mirror surface from a reference sphere whose image of S is at the position of the knife-edge. One appears to see the deviations in true relief, as though the surface were illuminated by grazing light and the deviations were amplified about 10^5 times!

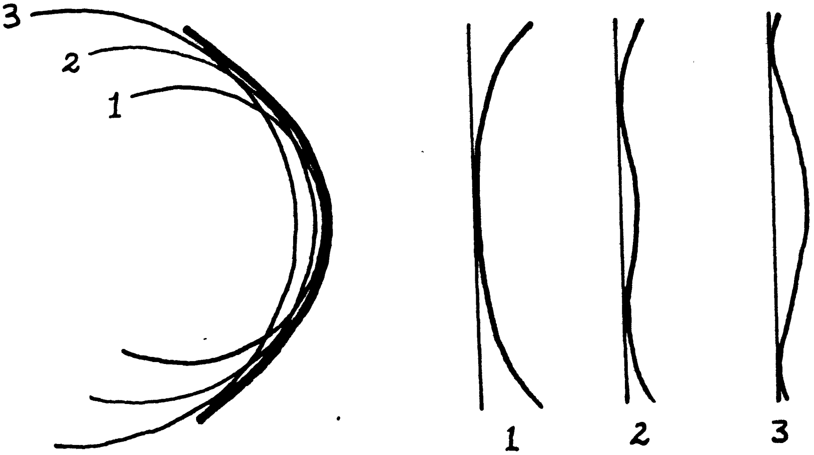
Quantative treatment

For various zones of radius ρ, the shift in the knife-edge position is* (easily Shown):

$$d \cong \rho^2/R$$

*(for a paraboloid)

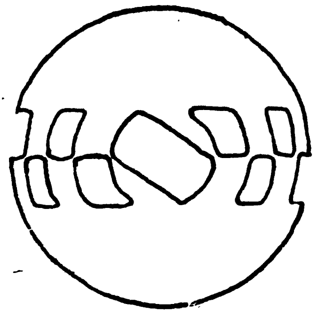


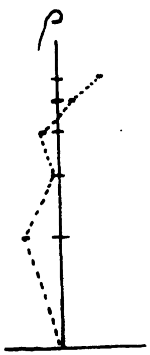


Deviation of the mirror surface from the three reference spheres corresponding to the three positions of the knife-edge indicated above. (greatly exaggerated)

Various zones of the mirror can be selected by means of a mask designed to expose two portions of the same zone at opposite sides of the axis. For each zone the knife-edge is adjusted to make the brightness of the two apertures equal.

Mask for 5 zones



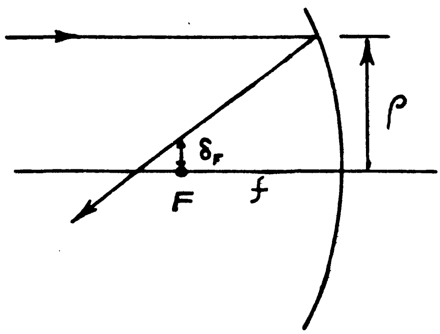


Since any real mirror is not a perfect paraboloid, the actul position of the knife-edge (d') will be different from the value $d=\rho^2/R$.

$\delta \equiv d' - d + \epsilon$ (where ϵ is an adjustable constant)

If ϵ is chosen so that the δ's are scattered about zero (+ & −), and the δ's are plotted as slopes vs ρ across the various zones, one thereby obtains a rough idea of the mirror profile relative to a paraboloid and is thus able to proceed with selective polishing to bring the surface closer to a paraboloid.

ACCURACY OF THE FINISHED MIRROR



As used in a telescope, the mirror accepts parallel light. Hence the transverse aberration δ_F is required. Simple geometric arguments give:

$$\delta_F = \frac{\rho}{4f}\,\delta$$

If $\delta_F \ll$ radius of the diffraction disc $(=1.22(f/=)\lambda)$, then the mirror is effectively a perfect paraboloid.

For each zone the average slope of the mirror surface relative to an ideal paraboloid is $\sim\frac{1}{2}\,\delta_F/f \equiv \sigma$. If $\rho\sigma$ is plotted versus ρ across the various zones, a rough half-profile of the actual mirror surface relative to a paraboloid is obtained (ϵ is adjusted to make this as level as possible--ie. the best 'reference paraboloid' is chosen as when focusing the telescope). Deviations from a paraboloid can be read directly off of the diagram. If they are $\lesssim 1/10\lambda$, the mirror is effectively a perfect paraboloid.

Roy L. Bishop

Ed. note: The foregoing article was taken from notes used by Dr. Bishop in his part of the May meeting of the Halifax Centre. It is reproduced because of several requests by members attending the talks. The second half of the meeting was devoted to an amusing demonstration of pitch lap preparation by Peter Edwards. I'm sure Peter violates the prime rule of mirror grinding (cleanliness is next to godliness) by using that 30 year old salt herring barrel. And that apron--it looked like he had just come from Frankenstein's dissection laboratory. Jewelers rouge is very messy stuff, isn't it Peter!

WATER ON JUPITER

"It has been customary to dismiss instantly the possibility of life on Jupiter with a reference to poisonous gases and freezing temperatures. But the Jovian atmosphere, let us recall, are far from unambiguously poisonous; indeed, they are just components of the primitive atmosphere in which life arose on Earth...With an atmosphere of hydrogen methane, ammonia and water, an abundance of energy sources, and equable temperatures, we have exactly the conditions used in experiments on the origin of life on Earth."**

Written almost ten years ago, this passage seems for us almost matter of fact. Perhaps "Jupiter As The Abode Of Life" still strikes us as a strange notion, but the factual material leaves us little to quibble with. Yet is both surprising and sobering to realize just how many of Carl Sagan's facts were in fact, hunches and spectulations. The equable temperatures of which he speakes were unproved in 1966. It was not until 1973 that infrared techniques first showed signs of small, discrete "hot spots" having quite comfortable earth-like temperatures of 25°C. Although methane and ammonia had long been known, the presence of hydrogen, in the form of H_2 molecules, had been verified only in 1960 and water had not been detected at all.

Sagan's confidence that Jupiter's atmosphere contains water vapor seems well founded however. Water being quite common here on Earth, Having been detected in the solar atmosphere, in the atmospheres of Mira type variable stars, and even being commonly observed in the harsh conditions of interstellar space. So although it had not actually been seen, water was a sure-bet constituent of the Jovian atmosphere.

**

I.S. Shklovskii & Carl Sagan. Intelligent Life In The Universe, 1966, p. 328

GENERAL ASSEMBLY 1975

PROGRAM

Friday, 27 June

Time:	1400-2200	Registration, Residence Colonnade
	1500-1730	RASC Council Meeting, AC 163
	1600-2200	Displays, AC 160
	1600-1800	Cafeteria open
	2000-2200	Wine and Cheese Party, Art Gallery hosted by Saint Mary's Univ.
	2100-2400	Burke-Gaffney Observatory open
	2200-2400	Members Slide Show AC ~~159~~ 162

Saturday, 28 June

Time:	0800-0900	Cafeteria open for breakfast
	0830-0900	Registration, Residence Colonnade
	0900-1600	Displays, AC 160
	0900-1200	Paper Session I, AC 172. Dr. Gingerich will open with a paper entitled: "Astronomy 300 Years Ago—A Salute to the Greenwich Tercertenary"
	1030-1045	Group photograph
	1045-1100	Coffee break, Colonnade
	1200-1300	Lunch in Cafeteria

Cont'd.....

PROGRAM CONTINUED

Saturday, 28 June

Time: 1330-1630	Paper Session II, AC 172. Dr. Chris Garrett, Dept. of Oceanography, Dalhousie University, will open the session with a paper entitled: "Tides, Tidal Power and Cosmology"
1400-1630	City Bus Tour--leaves from parking lot by football stadium.
1500-1530	Coffee break
1630-1730	RASC Annual Business Meeting, AC 172
1730-1830	RASC Council Meeting, AC 163
1900	Buses leave for Province of Nova Scotia Banquet at Chateau Halifax. Meet near parking lot by football stadium.
1915-2300	Reception and Banquet followed by address by Dr. Gingerich
2330	Buses return to Saint Mary's Residences

Sunday, 29 June

Time: 0800-0900	Breakfast, Cafeteria
0900	Buses depart for Peggy's Cove
1200-1300	Lunch, Cafeteria
1330	Buses leave for Bluenose and Haligonian.
1400-1630	Haligonian cruise
1400-1800	Bluenose cruise
1900	Buffet supper, SMU Cafeteria. Dr. MacRae speaks on: Canada-France-Hawaii Telescope

GENERAL ASSEMBLY 1975

Abstracts

Sat, 28 June;

0900 Dr. W.A. Bridgeo, Dean of Science, SMU.
Welcome on behalf of the University.

0905 Dr. Owen Gingerich, Smithsonian Astrophysical Observatory.
--Astronomy 300 Years Ago--A Salute to the Greenwich Tercentenary

0935 William Silvert, Department of Physics, Dalhousie University, and Halifax Centre.
--Rotation of the Sun: an Elementary Science Experiment.

To supplement a study of Galilean astronomy in a history-of-science class, a series of solar observations with a 6cm. refractor and sun-screen were carried out during class time. The experiment greatly stimulated student interest. It also provided a modest amount of practical experience in telescope operation and in the observation of the motion and evolution of sunspots. Most important, analysis of the data in order to determine the rotation period led to a number of challenging and sometimes unexpected problems in scientific methodology, which will be discussed.

0950 Robert Pike, Toronto Centre, Chairman of the centre's Observations Committee.
--Image Quality in Amateur Instruments

Using a moderately simple computer programme, a series of ray traces were made of paraboloidal mirrors and two-lens achromats of various focal ratios at 0, 1, 2 and 5 degrees off the optical axis. Evaluations of the image qualities in the instruments are given, particularly with respect to correction for on-axis aberrations and coma. The suitability of the systems to visual and photographic work is discussed and reference made to a catadioptric system for comparison with the more common designs.

1100 B. Paton and C. Purcell, Department of Physics Dalhousie University, and Halifax Centre
—Photometry for the Amateur

Due to the high cost of equipment, amateur astronomers tend to leave photometric measurements to the professionals or the large institutions. However, the cost of solid state light sensors has fallen dramatically to the point where a sensitive photometer can be constructed for a modest investment in components. We shall discuss photometry from the ground up; starting with a $2.00 phototransistor and a 75¢ "op amp", plus hardware to yield a useful instrument for under $5.00. As we seek out fainter objects in the sky we will show you how to improve the sensitivity with better detectors and more sophisticated techniques such as chopping the light and employing synchronous detection or photon counting with a photomultiplier tube.

We will show the apparatus constructed by "amateur" students at Dalhousie and the results they obtained. Some of the experiments they attempted included measurements of the shadow bands at the July 10, 1972 solar eclipse, intensity profiles of the lunar halo, photometry of Comet Kohoutek and analysis of the light pollution in the night sky over Halifax.

1130 F.John Howell, Calgary Centre

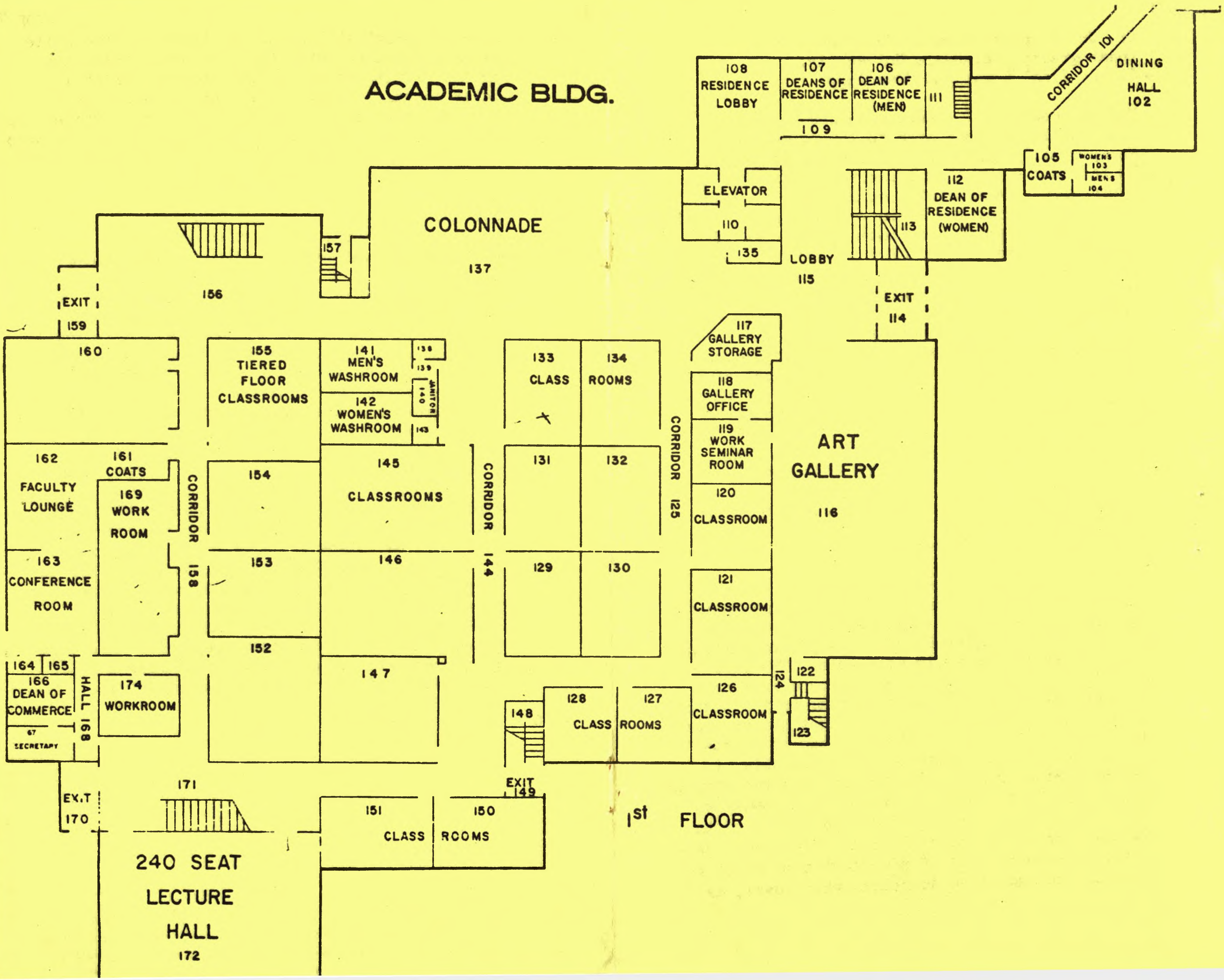
—Where and When Did It Fall?

After more than a century of wandering, one of Canada's largest iron meteorites, sacred to all Indian tribes in the West, has at last been returned to the Province of Alberta where it originally fell. A history of the white man's involvement with the Iron Creek Meteorite or the "Manito Stone" as the Indians called it, makes dismal reading. This paper deals with a project for possible dating of the fall, the events which led up to its return to Alberta, and the hope that its orginal fall location will be found and custody returned to native leaders.

1145 Randall C. Brooks, Dept. of Astronomy, Saint Mary's University, and Halifax Centre.
—A Suggested Experiment for Colour Astrophotography

Some recent experience with Anscochrome Gaf 500 colour slide film indicates that significant gains in results can be achieved over the more commonly used High Speed Ektachrome film especially in the area of deep sky objects. Experience has also indicated that a process used by professional astronomers might be useful with this film to extend the limiting magnitude in shorter exposure times, and it is this which is suggested as a possible experiment. Although not widely used, the process of pre-flashing photographic films has been known for many years as a method of cutting down exposure times by subjecting the film to a flash of low intensity light prior to exposure at the telescope. For the professionals this is very tricky as their photographs are intended for precise intensity measurements, but for the amateur this is not a worry and simplifies the procedure. The basic requirements for this type of process will be discussed, including a brief description of the theory of the process.

1200 Break for lunch.


ACADEMIC BLDG.
108 RESIDENCE LOBBY
107 DEANS OF RESIDENCE
106 DEAN OF RESIDENCE (MEN)
111
109
CORRIDOR 101
DINING HALL 102
105 COATS
WOMEN'S 103
MEN'S 104
ELEVATOR
110
135
LOBBY 115
112 DEAN OF RESIDENCE (WOMEN)
113
EXIT 114
COLONNADE 137
157
156
EXIT 159
160
155 TIERED FLOOR CLASSROOMS
141 MEN'S WASHROOM
138
139
JANITOR 140
142 WOMEN'S WASHROOM
143
133 CLASS
134 ROOMS
117 GALLERY STORAGE
118 GALLERY OFFICE
119 WORK SEMINAR ROOM
ART GALLERY 116
CORRIDOR 125
131
132
162 FACULTY LOUNGE
161 COATS
169 WORK ROOM
CORRIDOR 158
154
145 CLASSROOMS
CORRIDOR 144
120 CLASSROOM
163 CONFERENCE ROOM
153
146
129
130
121 CLASSROOM
164
165
166 DEAN OF COMMERCE
HALL 168
67 SECRETARY
174 WORKROOM
152
147
122
124
148
128 CLASS
127 ROOMS
126 CLASSROOM
123
EXIT 170
171
EXIT 149
151 CLASS
150 ROOMS
240 SEAT LECTURE HALL 172
1st FLOOR

1330 Dr. Christopher Garrett, Department of Oceanography, Dalhousie University.
—Tides, Tidal Power and Cosmology

Modern theories of ocean tides are outlined, with particular reference to the cause of the exceptionally high tides of the Bay of Fundy. It is now thought that exploiting these for the generation of electricity could cause increased tidal ranges over the whole Gulf of Maine. Tidal energy is presently dissipated in the Bay of Fundy at a rate of about 2×10^{10} watts, roughly 1% of the worldwide total. The source of this energy, and also of any extra tidal power extracted by man, is the rotational energy of the earth (which is non-renewable!). The total dissipation of tidal energy in the earth-moon system is supposedly known from the acceleration of the moon. Estimates of this on atomic time differ from earlier estimates with respect to ephemeris time, possibly because of changes in G. Perhaps further work on ocean tides can help discriminate between different cosmologies.

1415 Norman Sperling, Duncan Planetarium, Princeton Day School, New Jersy
—Henry Fitz Jr. (1808-1863)

Fitz was America's first commercial telescope maker. He invented three proprietary processes for grinding achromats that made them superior to the European telescopes of his period and much cheaper and more readily available. The first, in 1845, was local polishing, which allowed him to compensate for the imperfections in the optical glass then available and make a lens better than the glass in it. The following year he started using the thinnest possible flint elements, to reduce striae. And in 1847 he used a glass annulus around his lens blanks to prevent a turned-down edge. A number of his instruments were used in Canada, including one at McGill. His career generally preceeded that of the Clark's by about a decade. He made five achromats which were, as far as I can tell, the largest made outside Europe at those times (1845-60) and no Clark record-breaking telescope was made till after Fitz's death.

1430 J.E. Kennedy, Department of Physics, University of Saskatchewan and Saskatoon Centre
—William Brydon Jack

1445 R.M. Cunningham, Halifax Centre
—The Philately of Nicholas Copernicus

The number of stamps issued is quite large and the complete collection is in the display area. This brief presentation will show some of the highlights in slides with some background to some of the stamps. It makes an interesting world picture: small poor nations with grand ideas of modern rockets, countries emphasizing their own scientific history, and some faint traces of propaganda. On the whole it is a happy prospect of the world and the place of astronomy in it.

1530 A.E. Covington, Herzberg Institute of Astrophysics and Ottawa Centre
—Goth Hill Radio Observatory, 1948-1971

A radio telescope was designed in late 1945 by the Division of Physics and Electrical Engineering of the National Research Council, using components from radar sets available at the Radio Field Station. The operating wavelength of 10.7 cm was determined by a Dicke switch used for testing silicon crystals, and reflects the impetus given to radar technology by the high-powered 10 cm cavity magnetron brought to Canada and the United States by the Tizard Mission in 1940. The objective with the 4 ft (1.2m) reflector was the detection of Cosmic Radio Noise, which had hitherto been observed only at longer wavelenghts. On July 26, 1946, solar signals were observed, confirming qualitatively Southworth's earlier work. During the following evenings an unsuccessful search for cosmic noise was conducted. Radio observations of the partial solar eclipse of Nov. 23, 1946, studied in association with optical photographs made at the Dominion Observatory, showed an intense source of radio emission associated with a large sunspot group. The temperature of 1.5 x 10^6 suggested that the energy originated from the corona; and in view of the solar control of the ionosphere through x-uv radiation, the potential usefulness of a radio index of these emissions was recognized. After patrol observations started in Feb. 1947, the onsets of radio bursts were found to coincide with sudden ionospheric disturbances, hence solar flares. Interference from nearby radar sets was intense, and in Sept. 1948, the quiet site at Goth Hill was established ten miles south of Ottawa. The patrol continued there until similar observations were undertaken at Algonquin Radio Observatory in 1962. From the beginning a variety of programs were undertaken, the last being a re-determination of the absolute solar flux in 1969-70, as recommended by URSI.

1550 Douglas R. Gies, Toronto Centre
—Astronomical Allignments of the Nine Ladies Stone Circle

Last summer while touring Britain, a map was made of the standing stones known as the Nine Ladies Stone Circle ($1^\circ.48$ W, $56^\circ.163$ N) on Stanton Moor in Derbyshire, England. This thirty foot Bronze Age stone circle (built about 1500 BC) has a fine eastern horizon, being located on a ridge dominating the region. Using the plotted stone positions a computer analysis was made of all the allignments and corresponding azimuths, to compare with the extreme lunar and solar rising and setting points (determined with respect to the effective horizon altitude). Within the error from stone mapping, the results show several good solar allignments (including both solstices and equinox) and a number of possible lunar allignments.

1605 Mary W. Grey, National Museum of Science and Technology and Ottawa Centre.
—Reincarnation of the 15-inch Equatorial from the Dominion Observatory to National Museum of Science and Technology

1615 Walter P. Zukaukas, Department of Astronomy, Saint Mary's University and Halifax Centre
—Reanalysis of W Corvi

A previously published light curve of W Corvi is reanalysed in an attempt to determine if the quoted errors are due to intrinsic variations in the curve. The errors on the photometric quantities published with the analysis of this important close β Lyrae eclipsing binary, appear larger than one would expect from the errors of the individual observations. Hence a reanalysis is attempted in order to determine if further information can be extracted from the data.

NOTES

NOTES

With the great number of sure-bet predictions falling by the wayside nowadays, it is most satisfying to read where water has just been discovered on Jupiter. To make that discovery took an extraordinary effort and some of the most modern of astronomical apparatus. The astronomers Larson, Fink, Treffers & Gautier report their findings in the May 1, 1975 number of <u>Astrophys. Journal Letters</u>.

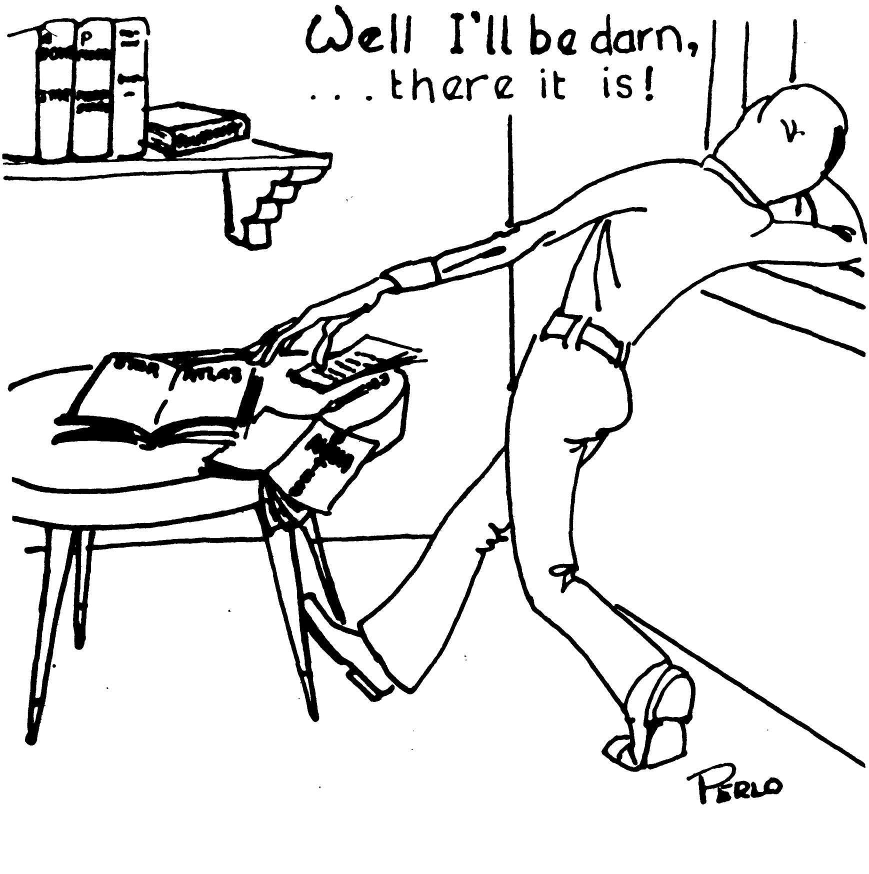
To detect the Jovian water, two problems had to be avoided. The spectrum of Jupiter is dominated at visible wavelengths by strong absorptions due to methane and ammonia, absorptions which could swamp any weaker absorptions due to water. Fortunately, water absorbs quite well in the middle infrared, a wavelength region where ammonia and methane have much less effect. Thus, they chose to observe Jupiter at 5μm = .005 mm = .0002 inch. The earth itself has a large amount of water vapor whose absorptions could frustrate efforts to see Jovian water. The scientists took all their apparatus in a cargo aircraft and lifted it above most of the earth's water vapor to an altitude of some 40,000 feet. The apparatus consisted of a 36" diameter telescope, a tracking device to ensure that Jupiter's image was always centered in the field of view, a Fourier spectrometer which would ultimately produce the Jovian spectrum and an infrared detector cooled to the temperature of liquid nitrogen.

From this work the four concluded that water vapor exists on Jupiter and has now been detected. The water vapor seen here is probably at deeper levels than the absorbing ammonia and methane gases, and may be confined to the hot spots. Studies of the intensities and bredths of the water vapor lines indicate they are formed at about 20 atmospheres pressure and at a temperature of about 25°C. Under such conditions it is not likely, they conclude, that liquid water clouds or icecrystal clouds exist.

How much water vapor is there? The conclusion the astronomers draw is for each million H_2 molecules, there is one H_2O molecule. There may be more if liquid water or ice can somehow be formed. It may not seem much, but recall that compared to oxygen and nitrogen, water vapor is a minor constituent of the earth's atmosphere.

If we picture the formation of life as taking place in a thin soup with water as the solvent, and the complex organic molecules as a thin solute, then the Jovian situation seems all backwards. But at least we know the water is there, and perhaps we are just seeing the steam from that soup.

Walter Zukauskas



TELESCOPE RAMBLINGS

One of the many strange traits of the astronomer is that while evolution has provided him with two eyes, he usually stares at the Universe with one. Since the optics of a telescope form an enlarged image of the observer's eye pupil at the objective (the exit pupil and entrance pupil are conjugate images), the astronomer confronts the Universe as a curious Cyclops, with an immense eye affixed to a relatively feeble body.

The main purpose of two eyes is to provide the immense computer behind with parallax information. The two, dissimilar, two-dimensional images are processed to yield a single, three-dimensional image before the signals are presented to the consciousness of the owner.(Incidentally, the former are also inverted and colorless, while the latter is upright and, provided light intensities are adequate, colored; however, this article will be limited to a few comments on binocular vision.)

In turning but one eye on the Universe, the astronomer is short-changing himself in two respects. Firstly, although parallax effects are not appreciable for distances beyond a few hundred meters, images of distant objects as perceived by two eyes have a sense of reality which is missing in monocular vision. Last month I had a one-eyed view of the eclipsed Moon against the stars of Scorpius. It was pretty, but there was no sensation of distance —— it was simply before me as if spread on an indefinite canvas. In binoculars however, two new aspects appeared. Although the relative distances of the Moon and the stars were not apparent, there was a strong sensation that I was here and the Moon and stars were out there. In addition the images seemed more substantial, as if with two eyes operating, the images were no longer absent for half the time.

Secondly, as was experimentally established near the beginning of this century, one of the things the brain does to obtain as much information as possible when light levels are low is to switch the visual system into a summation mode. In daylight, images seen by one eye are just as bright as when seen by two; however, when the visual system is dark-adapted, the perceived image is approximately twice as bright when seen by two eyes as by one. Thus for night-time use the effective aperture of binoculars is $\sqrt{2}$ times that of a monocular telescope of the same nominal aperture. (The light grasp varies as the area of the objective and hence as the square of the aperture).

In one of the classic ATM volumes is a photo of an admirable individual peering into his home-made binocular consisting of, I recall, two 6 inch Newtonians. In addition to being the equivalent of an 8½ inch telescope for light grasp, the images obtained would have a sense of space and reality that is absent in a single instrument.

Roy L. Bishop

Question corner????

I received a report from John MacNeil of the sighting of roughly a dozen small, fast,"sparkler" meteors during the eclipse. This number included 3 or 4 brighter meteors all radiating from a position 10° west of the moon. Any other observers? Is anyone aware of a shower on that date?

Bk

FROM THE LITTLE OBSERVATORY BY THE SEA.

"HEY, HIGGINS, OUR SUMMER STUDENT THOUGHT HE FOUND A NEW PULSAR"

A slightly different look at the development of astronomical knowledge this month. The problem presented here is old enough that the solution is well known and few of us have ever had strong ideas in conflict with the present solution. Therefore it is a good scientific and psychological study.

"What are galaxies? No one knew before 1900. Very few people knew in 1920. All astronomers knew after 1924. Galaxies are the largest single aggregates of stars in the universe. They are to astronomy what atoms are to Physics" (pg.1, Hubble Atlas of Galaxies by Sandage)

Most amateur astronomers are probably aware of the speculations of such philosophers as Kant, Wright and Swedenborg regarding the nature of these nebulous objects. The Herschel's (Wm. & John) catalogued more than 5000 nebulous objects between 1786-1864 and were followed by J.L.E. Dreyer who catalogued the 15,000 objects found in the NGC and Index Catalogues.

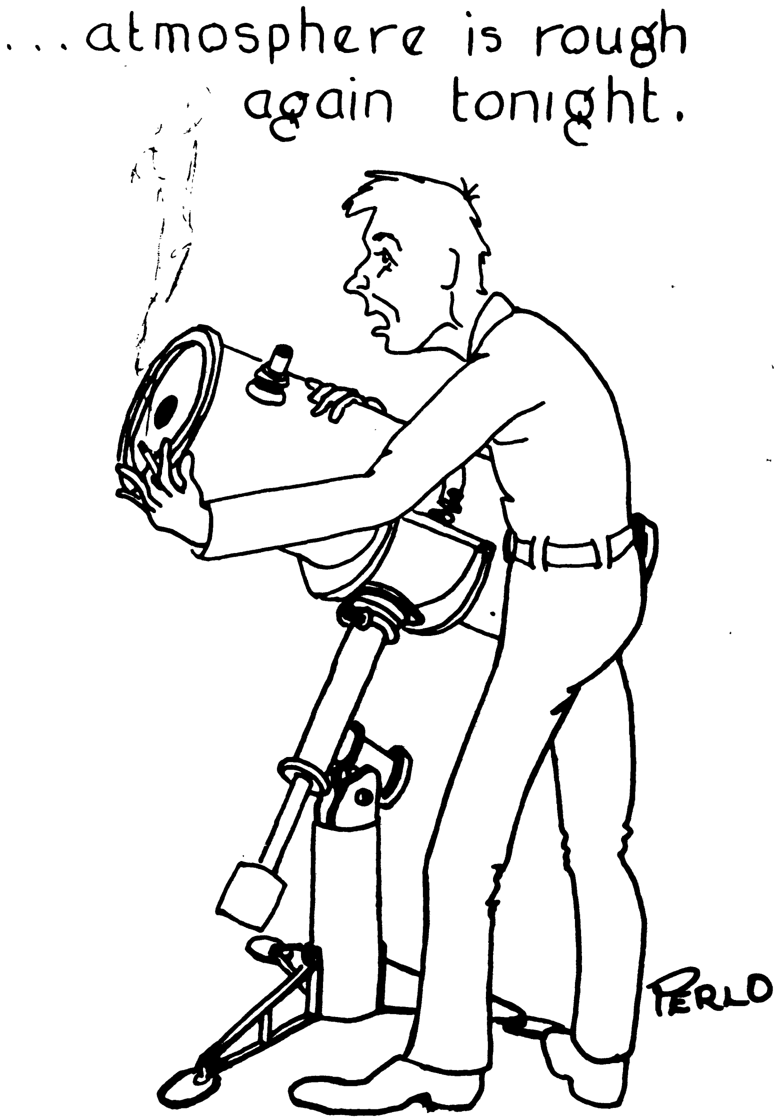
The solution of the problem of the true nature of these objects was delayed until the 60" Mount Wilson telescope came into operation in 1908. Ritchey working in 1917 discovered a nova in NGC 6946. He, by checking old 60" plates and H.D. Curtis by checking 36" Lick plates discovered 5 additional nova. More searching by others netted 11 nova with four in M31. 26 nova were known in our galaxy and by using these Harlow Shapley determined the distance to M31 as 10^6 ly. His discussion of the implications of finding for the island-universe is found in PASP 29,213,1917. Shapley did not believe his determination but Curtis did--and the controversy as to whether the nebulae were intra or extragalactic was on and was to last until Dec. 1924.

Shapley did not believe his results for two reasons;
1)S And, a nova discovered in 1885, would have to be very much brighter than other novae in the nebula and
2)proper motions of the spiral arms of nebulae by van Maanen showed large values which combined with the 10^6ly distance gave angular velocities greater than the velocity of light. The statements of the two were published in 1919 in thePASP31,261(Shapley) and the Journal of the

Washington Academy of Science 9,217(Curtis). Although Shapley used correct arguments, he came to an incorrect conclusion, but on the other hand Curtis reached the correct conclusion from incorrect or weak arguments. If it had not been for van Maanen's observations the matter might have been resolved by 1919. As it turned out van Maanen had reduced the observations incorrectly resulting in the positive rotation results. Knut Lundmark (remember that beautiful composite photograph of our galaxy) had discovered 22 nova in 2 years in M31 and he analysed them assuming they were similar to those in our system. An absolute magnitude of -4 was assigned these and the distance determined to be 650,000ly. In the analysis he had omitted S And and concluded that an 'upper' and 'lower' class existed among the novae (we now make the distinction as supernova and nova). One might ask at this point why nebulae would not be considered island-universes especially if you look at a 100" plate of M31. It is clearly resolved into stars. However astronomers of the day did not really consider this possible--they said the 'nebulous stars' had 'softer' images and were not images of individual objects.

A debate between the two before the National Academy of Sciences in 1920 culminated the argument. The papers are published in the Bull. of the National Research Council 2, pt 3, May 1921 and Shapley concluded stating: "It seems to me the evidence, other than the admittedly critical tests depending on the size of the galaxy, is opposed to the view that the spiral are galaxies of stars comparable with our own. In fact, there appears as yet no reason for modifying the tentative hypothesis that the spirals are not composed of typical stars at all, but are truly nebulous objects. Three very recent results are, I believe, distinctly serious for the theory that spiral nebulae are comparable galaxies--1)Sear s' deduction that none of the known spiral nebulae has a surface brightness as small as that of our galaxy; 2)Reynolds' study of the distribution of light and color in typical spirals, from which he concludes they cannot be stellar systems; and 3) van Maanen's recent measures of rotation in the spiral M33, corroborating his earlier work on M81 and M101, and indicating that these bright spirals cannot reasonably be the excessively distant objects required by theory."

The Cosmological problem became more exciting when the correct solution became obvious during the meeting of the American Astronomical Society, Dec 30,1924-Jan1,1025 in Washington. A paper prepared by Edwin Hubble was read to the Society disclosing the discovery and analysis of bright cephid variables in M31, M33 and NGC 6822. The detailed analysis and interpretation may be found in: Astrophysical Journals 62,409,1925; 63,236,1926; and 69,103,1929. End of debate--and everyone knew it. Astronomers now had a large segment of the Universe to contemplate.



The Hubble Atlas of Galaxies was compiled by Allan Sandage from notes, papers and from conversations with Edwin Hubble. This classification system of galaxies, was prepared between 1936 and 1950. It includes two new types, S0 and SB0, to cover galaxies between E7 and spirals, as well as a finer subdivision of spirals. There are detailed descriptions of elliptical, S0, Sa, Sb, Sc, irregular and the barred spirals, SB0, SBa, SBb, SBc and their corresponding irregular galaxies.

In the introduction to the Atlas a history of the postwar controversy of the status of nebulae as existing within or without our galaxy and the island-universe hypothesis are given. The Shapley-Curtis debate is developed (see Steady State Astronomy for their arguments for and against the island-universe theory) and its resolution in 1924 by Hubble's work on the cepheid variables in M31 and M33 follows. The description of galactic types and the reasoning behind the selected divisions conclude the introduction.

Most of the volume is composed of the illustrations of the 176 featured galaxies, the illustration plates being supplied by the Mount Wilson and Palomar Observatories. A table of data lists all illustrated galaxies by their NGC number; Hubble type, enlargement factors and plate scales are given. Beside each photo the NGC and Messier numbers, north/west orientation, date and exposure time, filters and emulsion, and brief description are included. Some plates include the negative in an insert to illustrate particularly faint features which would be lost in production of the positive prints. The photographs range in size from approximately $4\frac{1}{2}$" x 4" to $12\frac{1}{2}$" x $9\frac{1}{2}$".

The Hubble Atlas of Galaxies offers useful material for both experienced specialist and the avid amateur. Although much finer 3 dimensional classification systems have been developed, the Hubble Atlas remains the primary reference for galactic classification. It is a fascinating book to peruse on those cloudy evenings. The Atlas is available from Academic Press for $12.50.

Diane Brooks

OBSERVING REMINDERS

Fri. 4 July--Mercury at greatest western elongation will be 22° from the sun but only 12° above the horizon at sunrise. Not the most favorable time to catch a glimpse of the elusive 7th brightest object in the sky. Mag. +0.7

Mon. 7 July--Mercury will be occulted by the moon albeit during daylight hours but even the short sighted should be able to make a timing of this event--assuming O'Shea's* law does not interfere. Mercury will disappear at 9 09.7 ADT behind the bright limb and reappear at 10 34.1 from behind the dark limb. The moon will be approaching full phase.

Sat. 19 July--Appulse of the asteroid Ceres with the star SAO 93633 which is near the Pleides. Ceres does not reach opposition until Dec. 1 when it will be mag. 6.7, so on the 19th you can expect to see a very faint object.

Tues.29 July--Delta Aquarids. This shower is under a last quarter moon and reaches max. at 15hr. ADT. 20 meteors/hr have a velocity of 40km/sec. Very short duration.

Tues.12 Aug.--Perseid meteor shower--usually the best of the year. Last time round we (5 people) counted 125 meteors in an hour and a half. Average hourly rate is 50 and these are very fast moving (60kms^{-1}). Max. is reached at 20hr ADT. Anybody for a party?

Thurs 28 Aug--Appulse of Mars and SA076625 as in the case of the Ceres appulse is visible late in the night ie. after 3 or so.

Aug-Dec --Vesta is highest in the sky in the summer reaching opposition on Sept 18 when its mag. will be 6.1. This is another object for the early birds for the next couple of months. See pg. 71 of Hdbk for position. If you see anything spectacular, wake me up--in the morning.

*O'Shea's Law--Murphy was an optomist.

FROM:
RASC
1747 SUMMER ST
HALIFAX NS

Apr Aug 75

TO:

ROYAL ASTRONOMICAL SOC OF CAN,
252 COLLEGE ST,
TORONTO,
ONT