THE ROYAL ASTRONOMICAL SOCIETY OF CANADA

SASKATOON CENTRE

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Editor: Greg Tomtego
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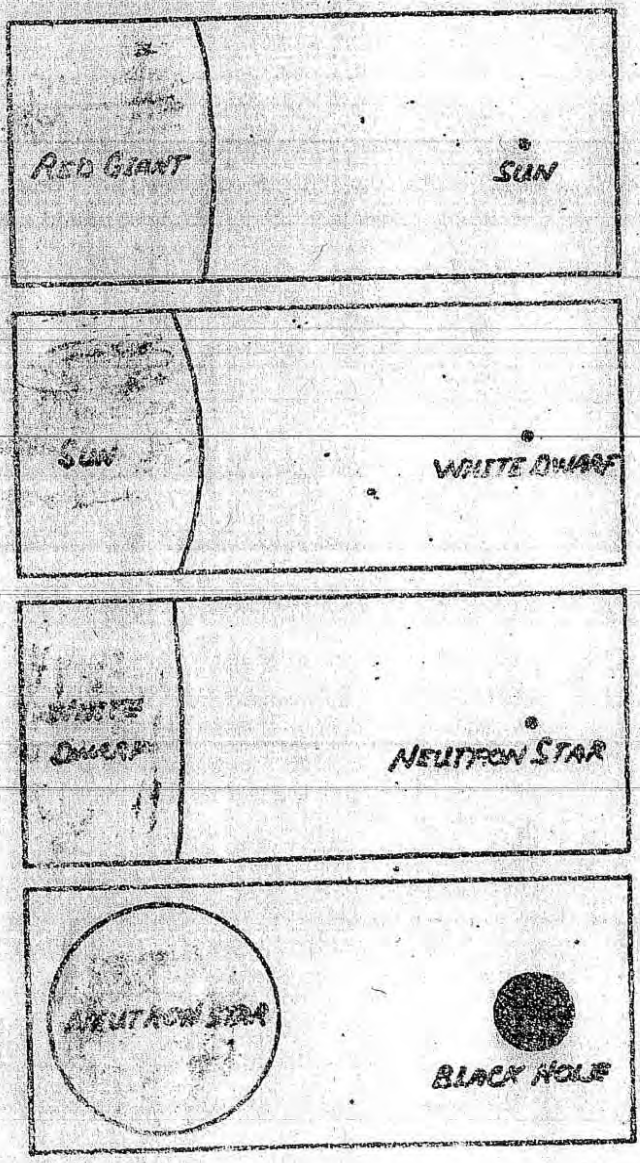
NEWSLETTER



COMPARATIVE SIZES of a red-giant star, the sun, a white-dwarf star, a neutron star and a black hole. The diameter of a white dwarf is roughly the same as the diameter of the earth.

UNIVERSITY OBSERVATORY

The attendance figures for 1975 are shown below and those for 1974 are given for comparison.

	1974	1975
Open House		
Wednesday Evenings	2164	1843
Sunday Afternoons and Evenings	3970	1812
TOTAL	6134	3655
Group Tours		
Total Tour Attendance	765	1174
Number of Tours	35	42
Average number per tour	22	24
RASC Functions	740	466
Astronomy 110 students	31	90
Total Signatures	7670	5385*

From the above figures, and by comparison with 1974, it is apparent that attendance at the Observatory has decreased. There is no immediate explanation for this decline but it should be pointed out that attendance increased rapidly over the previous three years and 1974 clearly marks the peak of this trend. However, another marked increase in attendance is expected next year due to the addition of the astronomy exhibits in the new display cases in the Observatory basement.

The members of the Saskatoon Centre, RASC, continue to use the Observatory although this has decreased considerably. The main reason for this is the transfer of activities to Mr. Patterson's telescope which is situated in a more favourable location on the edge of the city.

*At the David Dunlap Observatory, the attendance at mid-week and Saturday evening programs was 5500 for a comparable period.

The major astronomical event of 1975 visible from Saskatoon was the total lunar eclipse of Saturday May 24th. This attracted a crowd of more than 200 people to the Observatory. We would certainly have had a greater attendance except that the sky clouded over a few minutes after the moon entered the penumbra and, by totality, it was pouring with rain.

Three groups of girl guides were given instruction for their astronomy badge during the winter months by Mrs. Paulson.

Because of an increase in the demand for group tours, several extra tours were held on Sunday and Thursday evenings, with a few daytime tours as well. By December, 1975, all Friday evening tours were booked until June, 1976.

P.A. Hardie

THE ROYAL ASTRONOMICAL SOCIETY 1968
SASKATOON CENTRE

MEETING NOTICE

Place Rm B110, Health Sciences Bldg. U of S

Date Tuesday, 15 June 1976

Time 8:00 p.m.

Purpose June General Meeting

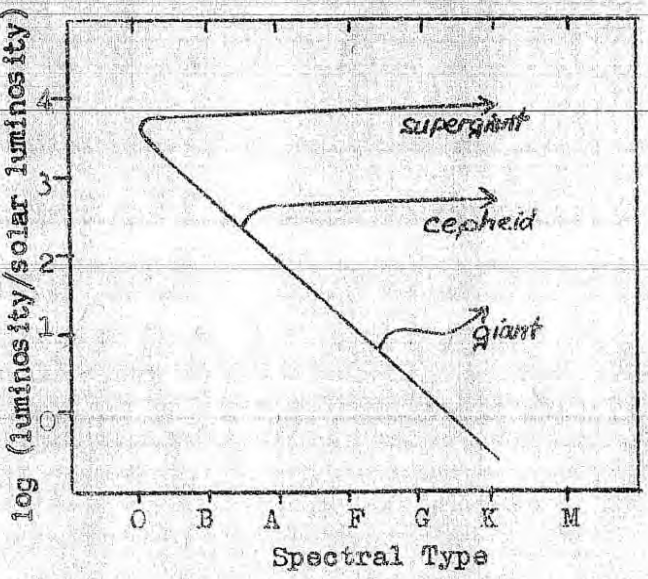
Gerald Borrownand "Manned Space Flight" (with emphasis on the Russian Program) + Calgary Exhibits

BLACK HOLES Michael Wesolowski, Saskatoon Centre, RASC

The Author - Michael is 14 years old and in grade 9 at Holy Cross High School in Saskatoon. He joined the Centre in October 1975 and has been interested in astronomy for about two years. He is a very enthusiastic member and a regular attender of Saturday night meetings at G.N. Patterson's.

A black hole is a region of space into which a star (or collection of stars) has collapsed. The intense gravitational field prevents any light from escaping. The prediction of their existence came about as a result of Einstein's general theory of relativity. A century earlier in 1798, however, Pierre Simon de Laplace predicted that bodies might exist with gravitational fields so intense that even light would not escape.

Black Hole Formation Normal stars spend most of their lives on the main sequence of the Hertzprung-Russell diagram. When most of the hydrogen is used up in thermonuclear reactions, the star collapses, heating up as it does so. When the core temperature exceeds 200 million degrees, reaction involving helium may take place. Thermal pressure forces the star outward and the star moves to the right on the H-R diagram.



Hertzprung-Russell Diagram

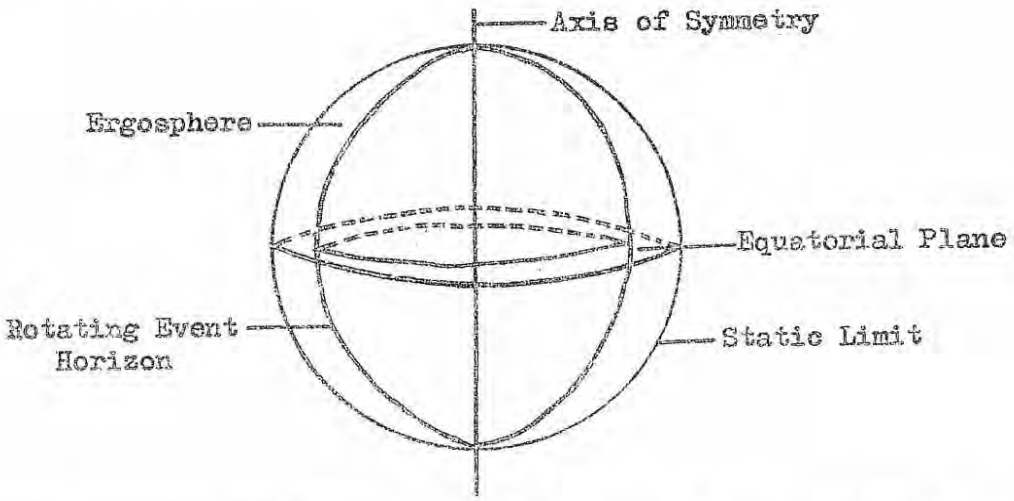
Eventually, however, a star will cool down and collapse. If the star has a mass greater than 1.2 suns, it will be unstable as a white dwarf. Similarly, a neutron star will not be stable if it has a mass greater than 3.2 suns. It is possible, however, for a very massive star to go nova or supernova, thereby blowing off enough mass to make it possible to become a neutron star. This happened once in 1054 AD, with the appearance of a "guest" star in Taurus. Today we observe the results of that explosion as the Crab nebula.

What happens to a massive star that doesn't go supernova? Until it collapses to what is called the "gravitational radius", collapse may stop at any time. Once the gravitational radius is reached, nothing will halt the total collapse to a black hole. The gravitational radius of a non-rotating Schwarzschild black hole is determined by the equation $2GM/c^2$, where "M" is the star's mass in grams, "G" is the universal constant of gravitation (6.67×10^{-8} CGS units) and "c" is the speed of light (2.998×10^{8} meters/sec.).

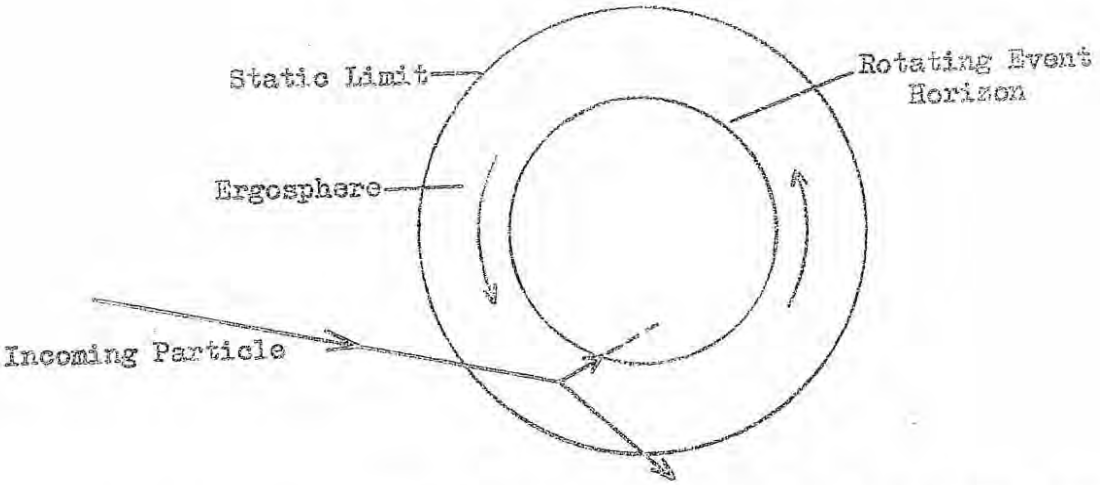
The gravitational radius is now the surface of the black hole and is called the "event horizon". Signals emitted from within the event horizon do not escape because the escape velocity is greater than the speed of light. The gravitational radius, or the size a body would have to be to be a black hole, is 2.95 km. for the sun and 0.89 cm. for the earth! They would be this size but would contain the same mass as they originally did. Imagine holding the earth in the palm of your hand!

Solution to the Energy Crisis? At this point I should mention that because stars do rotate, it is likely that black holes also rotate. Black holes can give up this rotational energy in a process proposed by and named after Roger Penrose of Birbeck College, London.

First, note that the gravitational field of a star causes a redshift in its light(a slight change in wavelength due to loss of energy). All black holes have infinite redshifts, but the point at which the redshift is infinite differs between rotating and non-rotating black holes. In the case of non-rotating ones, the event horizon and surface of infinite redshift, or "static limit", coincide. The static limit and event horizon are separate in rotating black holes.



The region between the event horizon and static limit is called the "ergosphere". If a particle is sent by someone to within the ergosphere, it is possible for the particle to split into two; one half falling into the black hole and the other half escaping with more energy than it originally had.



Such energy extraction could continue until all rotational energy is gone. Once the black hole stops rotating, it is termed a "dead" Schwarzchild non-rotating black hole. The Penrose process is not very efficient, however, and would probably never be used. Another method of getting energy is the merging of two holes. Emmission of "gravity waves" would result in a high total energy output. (Being curious about what gravity waves were, I did some reading on the subject. Apparently, they radiate from a source like light does, carrying energy and causing fluctuations in surfaces they encounter.)

Stellar Collapse Consider the optical appearance of a star that is collapsing to $2GM/c^2$. To an observer standing on the surface of the star, the collapse to the gravitational radius would take place in a finite period of time. To an observer watching from a distance, the star would appear "frozen" in the middle of the collapse. The reason for this lies in the increasing gravitational field.

Until a star collapses to 1.5X the gravitational radius or $3GM/c^2$, the first critical stage, all photons emitted by the star escape, although the trajectories are curved by the gravitational field. When the star reaches this stage, the photons are bent into orbits, forming a spherical cloud from which the photons will slowly escape. This is the "frozen star" we observe. The photons emitted at $2GM/c^2$ (second critical stage) form another cloud with a large redshift because the photons lose more energy in escaping. The third critical stage is when the star is crushed to zero volume, the "singularity".

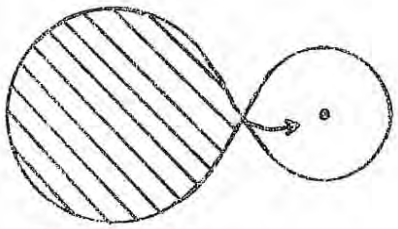
Detection of Black Holes Because most of the stars we observe are part of binary or multiple star systems, the chances are that we will detect black holes by means of their influence on nearby stars.

The easiest method is to search for oscillations in a star's motion where there isn't a companion visible, although it would appear to have a high mass. In another method, the gas and dust surrounding the star is observed as it collapses inward. This dust forms a large disc and radiates in the infrared due to the mild heat generated by the collapse.

A.G.W. Cameron of Yeshiva University believes that the invisible companion of Epsilon Aurigae system is a black hole. Every 27.1 years, the primary, which is 35 times more massive than the sun, is eclipsed by another large invisible body, with a mass 23 times that of our sun. For 330 days, Epsilon shines at 48% of the uneclipsed value. ". . . as if a giant, semitransparent disc with a diameter 2500 times that of the sun passed in front of the primary star."

If the primary is a giant or supergiant star, accretion of matter from the star to the hole becomes possible. The matter, spiralling into the star (black hole), heats up due to compression and turbulence. It also emits X-rays. Because of this, X-ray emitting objects are good candidates for black holes. In addition, the objects would have to be variable. (remember that we are talking about a binary system)

In 1970, a small satellite was launched from Kenya. It was named Uhuru, and carried two X-ray detectors. Over a period of three years it catalogued 161 X-ray objects.



X-ray Star (possible black hole draining matter from supergiant)

Supergiant

The following table lists those objects which show periodic variations in X-ray brightness.

Source	Per. (yrs.)	Optical
3U0900-40	8.97	HD 77581
3U1700-37	3.41	HD 153919
SMC X-1	3.89	Sanduleak 160
Cyg X-1	5.60	HDE 226868
Cen X-3	2.09	Krzeminski's star
Her X-1	1.70	Hz Her
Cyg X-3	0.18	?
Cir X-1	12.3 ?	?

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TWILIGHT

Unfortunately, Saskatoon is now in a period of permanent twilight which means that it never gets totally dark at night. This will continue until about 23 July. After this, conditions will slowly improve as darkness periods during the night lengthen. The reason for continuous twilight is that the sun never gets down to 18° below the horizon, which is the depth it must get to in

THE 1976 GENERAL ASSEMBLY

The 1976 General Assembly, hosted by the Calgary Centre, has come and gone and, once again, the Saskatoon Centre left its impre ssion on the Assembly, bringing home an engraved plaque declaring them as the "Winning Centre of the 1976 National Observing Competition". An award of $100.00 went along with the plaque.

The entrants from the Centre and their entries were as follows:

Kevin Atchison	- 4 drawings of Globular Clusters	- 1st Prize
Douglas Beck	- 4 photos of Open Clusters	- 1st Prize
	- 1 photo of thin Lunar Crescent	- 2nd Prize
Gordon Patterson	- 4 photos of Open Clusters	- 3rd Prize
	- 1 photo of thin Lunar Crescent	- 3rd Prize
	- 3 Colored Slides	
Gregory Towstego	- 3 drawings of binocular views	- 1st Prize
	- 3 Colored Slides	- 3rd Prize
Lillia Wilcox	- 3 Lunar Crater Drawings	- 1st Prize
	- Open Category, Comet 1975h	- 1st Prize (shared)
Jim Young	- Open Category - Lunar Crater Photo	- 3rd Prize

In addition to the Observing exhibits, the Saskatoon Centre gave two of the ten papers presented, one by Professor Kennedy on the 1979 Solar Eclipse, and one by Mr Patterson on his new Astrophotography Exposure Guide.

Two other members, Merlyn Melby and Dave Pristupa rounded out the total Centre representation.

While the Centre members are justifiably proud of their achievement, they are all aware that this was primarily due because they took the Observing Competition seriously, and submitted entries, something that many of the other Centres failed to do. In at least two of the categories, Saskatoon had the only entries, hence an automatic first prize.

All entries, with the exception of the colored slides, and the awards ribbons will be on display in the Observatory for other Centre members and the general public to view. This should prove that some members of the Saskatoon Centre are active, and may encourage others to try their hand at this rewarding hobby.

Disregarding the competitive aspect, all Centre members attending the Calgary General Assembly felt that it was a very worth-while and informative meeting. Many friendships were established with members from other Centres, and the cross-exchange of ideas and information was probably the real value of this Assembly, and will outlast any of the glamour of the awards.

The Calgary Centre is to be highly commended for the magnificient job they did in hosting this General Assembly, their innovative approach to competitive observing, and for the additional attractions such as the banquet at Heritage Park, the RASC Banquet at the Calgary University, the trip to Banff and the Cosmic Ray Laboratory followed with the Western Barbeque in the evening - truly a tremendous organizational achievement. Hats off to Calgary, or should we say Stetsons, and the sincere thanks of the Saskatoon Centre.

To our own Centre members, can we do it again? We should be able to if only we can get the cooperation of more of the members - let's face it - the other Centres are not going to let us have it quite so easy next time. We may not make it in Toronto next year simply because of the distance, but Edmonton, look out. We'll be there in force in 1978.

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RASC GENERAL ASSEMBLY - CALGARY 1976 - A PERSONAL VIEW Kevin P. Atchison

The Author - Kevin is 18 years old and in grade 12 at City Park Collegiate in Saskatoon. He came to us from Toronto and joined the Centre in February of this year. Immediately after joining, he became actively involved in all activities of the Saskatoon Centre. He now stands out as one of our most active members and is a real asset to us. He owns a two inch refracting telescope and it gets well used. His interest in astronomy dates back to his early elementary school years. His future plans are to take Pre-med at the U of S in Saskatoon.

The Royal Astronomical Society of Canada - consisting of 18 centres across Canada - is an organization dedicated to the advancement of astronomy. In order to fulfil such a purpose, several essential ingredients are required. One prime ingredient is accomplishment - the actual getting out and doing of astronomy, for without this there would be no RASC. The existence of active members who are willing to get out and explore the heavens with whatever equipment and methods available is what provides the all important nucleus for each centre. Among these members there must also be a certain degree of organization and cooperation; between centres there should be communication so that discussion can take place, preferably on a social level. These are the basic ingredients required to make the RASC work, and at the recent General Assembly in Calgary, I noticed that some of these ingredients were present in varying degrees.

As a new member in the society, the General Assembly was my first and I found it to be both an entertaining and educational experience. Most of all, it played a prime role in shaping my ideas on how the RASC might function more efficiently.

Centre solidarity is a must if it is ever to be succesful in helping to fulfil the purpose of the society. To achieve such solidarity, a certain amount of respect must exist between the members, and such respect was generated between those of us who attended the assembly. It was in Calgary that we travelled together, dined together, won together, and it was there that I first felt that I really belonged to the centre.

We are the only centre that went to Calgary as a centre, and we came out being even more of a team. We have learned that group cooperation is rewarding and that in order to maintain such a winning reputation, we are going to have to become an even more organized and diligent group in the coming year. What made our centre such a special one was the observing competition where six of our members entered their projects together as a block. Each one won a prize, including five firsts. Consequently, we also won the award for the most active all-round centre, winning over larger centres such as Toronto, Vancouver, Montreal and Ottawa. It would appear that many centres did not take the competition as seriously as we did. Many of those who did participate did so on

an individual basis without much identification with their centres. It is my opinion that such an attitude is contrary to the idea of organized, cooperative centres, the type of which are needed to better fulfil the purpose of the RASC.

A centre whose members are willing to share their knowledge with one another and divide up the work load among members so that all observing categories will be covered will meet with more success than a centre made up of loners. This does not mean that individualism should be abolished, but rather that certain skilled individuals share their knowledge with their fellow members in order to improve the quality of that centre. Such techniques, coupled with a sincere desire to explore the heavens can lead to rewarding experiences at General Assemblies.

The whole purpose behind an observing competition, however, is not just to win awards, but also to provide opportunity for centres from all over the nation to display their observational reports and explain to others how they were carried out. There was also a papers session which was a series of talks given by members concerning a wide variety of topics. These two events blended together well to make up one of the main purposes of the assembly - the exchange of knowledge among members. One can mingle with and talk to members from other centres about topics ranging from observing techniques to centre governments, or one may even choose to debate with a Toronto delegate on the definition of astronomy. All this allows for the important communication between members.

In some cases, decisions arrived at may affect the RASC as a whole. An example of this would be the subject of the $185,000 that headquarters now has and might be willing to distribute portions of among centres who sincerely need it. Topics like this one were discussed in detail at the general meeting.

To top off the convention, there was a trip to Banff which allowed us to become more aquainted on a relaxed, more social level. As a whole, the General Assembly was a rewarding experience in that we made many new friends, shared ideas and became a little closer as a centre. Above all, we learned that an organized, cooperative centre concept, along with the sharing of information with other centres allows for maximum achievement of the society's purpose - the advancement of astronomy, even if it be at an amateur level.

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MINUTES OF A GENERAL MEETING, SASKATOON CENTRE, RASC,

HELD IN ROOM B-110, HEALTH SCIENCES BUILDING, U of S, 8:00 PM, 18 MAY, 1976

Present:

Halyna Kornuta..... President	Lillia Wilcox..... Secretary
Mr Jim Young..... Vice President	Mr Merlyn Melby.... Activities
Mr G.N. Patterson..... Centre Rep.	Doug Beck..... Sub-councillor
Mr Hugh Hunter..... Librarian	Greg Towstego..... Editor

Absent:

Mr Alan Blackwell..... Treasurer

Minute	Subject	Action
82.	Meeting called to order at 8:00 pm.	H. Kornuta
83.	Moved that the March minutes be adopted as published. Carried	M. Wesolowski G.N. Patterson
84.	Halyna Kornuta has handed mail key over to G.N. Patterson as she will not be able to pick up the mail during the summer months.	H. Kornuta
85.	Astronomy magazine can be taken out from the Observatory library.	H. Kornuta
86.	Observatory attendance figures received, showing a reduction of signatures mainly due to Astrophotography classes being held at G.N. Patterson's.	H. Kornuta
87.	Solar eclipse trip to Africa discussed.	H. Kornuta
88.	Mr. Gerald Borrowmand of Saskatoon has volunteered to speak at our June General meeting. His topic will be "Manned Space Flight" with emphasis on the Russian Program.	H. Kornuta
89.	G.N. Patterson talked briefly on the trip to Calgary. To date eight members will be going.	G.N. Patterson
90.	The new Ash Dome is now installed at the U of S Observatory.	G.N. Patterson
91.	The Ash Manufacturing Co. of Plainfield, Illinois, USA would like to produce G.N. Patterson's Astrophotography Computer.	G.N. Patterson
92.	Transparencies to be used in talk at Calgary on Astrophotography Computer were shown.	G.N. Patterson
93.	Suggested that at Calgary meeting, it be asked that future General Assemblies be held on 1st July weekend.	J. Young
94.	The 1978 General Assembly will be held in Edmonton, Alberta.	G.N. Patterson
95.	The operation of the new dome was discussed and NO ONE is to operate it unless previously informed as to its proper use.	G.N. Patterson
96.	Saskatoon Centre exhibits for General Assembly will be posted in Observatory when brought back	
97.	Summer activities will be reviewed at September General Meeting.	G. Towstego
98.	Meeting adjourned to Observatory - 8:30 pm.	Robert McAllister M. Wesolowski

MINUTES OF AN EXECUTIVE MEETING, SASKATOON CENTRE, RASC,

HELD IN ROOM B-110, HEALTH SCIENCES BUILDING, U of S, 8:35 PM, 18 MAY, 1976

Present:

Halyna Kornuta.....	President	Lillia Wilcox.....	Secretary
Mr Jim Young.....	Vice President	Mr Merlyn Melby.....	Activities
Mr G.N. Patterson.....	Centre Rep.	Doug Beck.....	Councillor
Mr Hugh Hunter.....	Librarian	Greg Towstego.....	Editor

Absent:

Mr Alan Blackwell..... Treasurer

Minute	Subject	Action
99.	Meeting called to order at 8:35 pm.	H. Kornuta
100.	Possible observing site on Pike Lake Road to be investigated.	G.N. Patterson
101.	Annual Wiener Roast and Star Night at Diefenbaker Park will be held on Friday 30 July or if cloudy on Saturday 31 July.	H. Kornuta
102.	Annual Field Outing will be held on Saturday 28 August, 1976.	G.N. Patterson
103.	Meeting adjourned to Observatory at 8:45 pm.	J. Young

Minutes prepared by: Lillia Wilcox,
Secretary,
Saskatoon Centre, RASC

DRAPER CLASSIFICATION OF STELLAR SPECTRA

CLASS	EXAMPLE	ELEMENTS PRESENT	TEMP (°K)	COLOR
W	γ Velorum	H, He		
O	λ Orionis	ionized He, He, H	50,000	Blue-white
B	β, δ, ϵ Orionis	H, He, Si, O, Mg	25,000	Blue
A	Sirius, Vega	Ca, H	11,000	Blue-white
F-H	Canopus, Procyon	Ca, neutral metals	8,000	White
G	Sun, Capella	H, Fe & other metals	6,000	Yellow
K	Arcturus, Aldebaran	neutral metals strong, H diminishing	4,500	Orange
M	Betelgeuse, Antares	TiO	3,500	Red
R	Invisible to eye		3,000	
N	19 Piscium	carbon compounds	3,000	Very red
S		zirconium oxide, titanium oxide	3,000	Very red