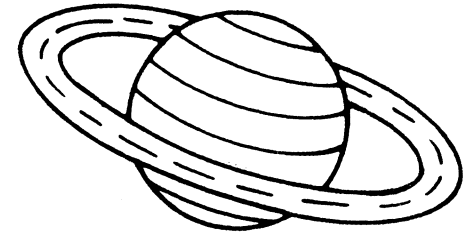
FROM

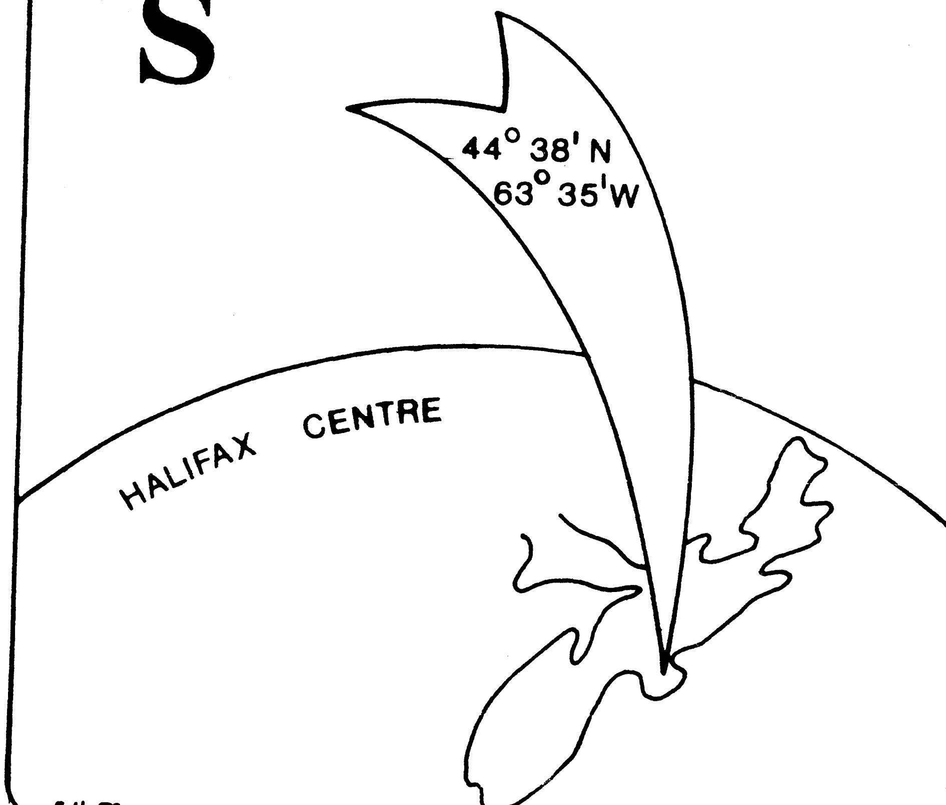
HALIFAX CENTRE R.A.S.C.
1747 SUMMER ST.
HALIFAX, N.S.

TO

ROYAL ASTRONOMICAL SOCIETY,
252 COLLEGE ST.,
TORONTO, ONTARIO.

NOVA NOTES





NOTICE of MEETING

Halifax Centre

R.A.S.C.

Date: October 19th 1973

Place: The Theatre
Nova Scotia Museum
1747 Summer St.
Halifax, N.S.

Time: 8:00 P.M. Sharp!

Topic: The Copernican Revolution

Speaker: Dr. W.L.Silvert
Department of Physics
Dalhousie University
Halifax, N.S.

All members and guests are most welcome!

Nova Notes are printed, thanks to the kindness of

Dr. D.L.DuPuy and St. Mary's University.

Editor's Page

No one wants to send any letters to the editor it seems. You know,you can get pretty lonely sitting by your typewriter without a "Letters to the Editor" to read...Well? How about it?? Have you seen the Comet yet? Maybe Nova Notes came postage due last month. Is there a new or old feature you would like to see in Nova Notes?

As you see from the notice of meeting,Dr. Silvert of Dal. U. is our speaker. It sounds like a very interesting talk and a great way to round off Copernicus' Anniversary. Here is a brief preamble...

"The Copernican Revolution"
William Silvert
Associate Professor of Physics
Dalhousie University

How did the Copernican revolution,the replacement of the geocentric model of the universe by the heliocentric model, come about? It is not true,as often stated in elementary texts, that the Copernican system was accepted because it was a much simpler model. It won out over the Ptolemaic system on the grounds of clear scientific evidence,only some of which was known to Copernicus and his colleagues. The evidence for and against the Copernican model will be presented,with a discussion of the social and philosophical framework in which the revolution occurred.

...Don't miss it!

Membership fees are due now. See last month's issue for your "Handy-Dandy" price list.

According to the constitution of the R.A.S.C., Centre elections of officers are to be held at or before the November meeting. Nominations for ALL officers are currantly being accepted. All paid members are eligible to hold office.

Peter Edwards
The Editor

Minutes of September Meeting

The September meeting was opened by Dr. Peter Reynolds, Vice-president of the Centre, who introduced the speaker for the evening, Dr. David L. DuPuy. The topic was the QSO problem, and one (drastic?) solution to the problem. Basically, the "QSO problem" is that, if the quasi-stellar objects are at the distances implied by their Doppler shifts (a standard method of estimating distances to galaxies), then several almost insurmountable difficulties arise, including huge luminosities, variability in timescales less than the dimensions of the QSO's (in light-days, for example).

One possible solution to this problem has been proposed by Dr. H. Arp of the Hale Observatories. He suggests that the QSO's might be clumps of galactic material hurled from nearby galaxies at great speed. As wild as this seems, he attempts to back it up with photographs which clearly show hugh luminous material being thrown out of nearby galaxies. The most serious objection to Arp's proposal is that we almost never see material thrown out towards us, but away from us. Arp's theory is vigorously opposed by many astronomers!

After the meeting, refreshments were served. About 28 people attended, and the meeting broke up around 10 p.m.

Quasars

When you look up into the sky at night, many objects confront you (unless it is cloudy). Among these are the planets, an occasional comet, meteors, stars, nebulae, galaxies, etc. Of all the objects that we can see, the closest is our companion the moon, but what is the object most distant from us that we can see? It appears today as if it would be a Quasar, or Quasi-Stellar Object.

"But what," you ask, "is a Quasar?" Well, some of its properties are:

1) they are starlike objects which are often identified with radio sources*;
2) they are variable in radiation output;
3) they usually have a large ultraviolet output and a bluish appearance;
4) they have broad emission lines in their spectra, and absorption lines are sometimes also present;
5) their spectral lines have large redshifts;
6) the radio sources, when present, are often extremely powerful and are often double and separated by the order of 50 kiloparsecs.

"Whooppeeee!" you say, "What does all this tell me though?"

Well to start with, the redshift can be intrepreted according to the Hubble law to give distances and velocities for an excess of those of the most distant galaxies (See Table 1). In fact, though Quasars were discovered around 1960 it was about four years before their spectra were able to be intrepreted due to their very large redshifts.

I might note here that the redshift has also been intrepreted other ways to give smaller distances to the Quasars, but they have their own problems and for the most part are disregarded.

These large distances however imply large energy output to enable the objects to be seen. From the distance

*sometimes they are galactic type objects and sometimes nothing is visible in the optical spectrum.

magnitude relation their Hubble distances and apparent magnitudes one gets an absolute magnitude (magnitude if at 10 parsecs) of approximately -25.5 on the average. This gives us an energy output of $10^{12} - 10^{13}$ times that of the sun of 10^{47} erg/sec. This is also approximately $10^2 - 10^3$ times the peak output of a supernovae! There is also reason to believe that this energy output goes on for at least 10^6 years which implies an output of <u>at least</u> 10^{60} ergs converted by Einstein's mass-energy equivalency we get a mass of 10^{34} grams which means that in order to get this amount of energy we would have to totally convert 10^{39} grams of matter into energy! However as no process (except the matter-antimatter annihilation, and this is somewhat unlikely) is known which can convert matter entirely into energy we assume a 1 % efficiency which gives us an object which posesses at least 10^{41} grams. (This, by the way, is approximately 10^8 solar masses)

Various energy sources have been put forward to help explain how quasars work but either they can't explain where that much energy comes from, they can't explain its distribution along the spectrum or both.

The fluxuations which occur in two types; the first ranges over a few days to a coupld of months and is irregular in pattern and the second, which is more regular and has a period of one to several years. The short scale variations are believed (in certain quarters anyway) to be regional type fluxuations on the object's surface. The longer ones however are believed to be a simultaneous event over the entire surface of the object. This then implies the size of the Quasars and it has been calculated by certain groups that they (the QSOs) have a radius not much in excess of one light year.

This adds further problems to the energy question for now besides being very bright we find that the object is very small and rather dense and hence we have even more trouble visualizing just what it looks like and where in heck all the energy is coming from.

I won't dwell long on the spectral lines though much can be learned from them. The main point of information one may derive from them is that Quasars are apparently some sort of nucleus surrounded by shells of gases of density $10^4 - 10^7$ particles/cm^3 (the earth's atmosphere has 10^{19} particles/cm^3) expanding outward from them at different rates some of which are quite high.

The double radio source of some quasars bears remarkable resemblance to the radio sources of the types known as Seyfert and N-type galaxies. "Hurrah!", you say, "So what?" Well if one looks at 16 quasars in the optical region of the spectra and has a very high resolution telescope one <u>may</u> see some structure which resembles galaxies. Plus it appears we may in fact have something which is a galactic phenomenon. It has been suggested that due to their distance and the finite velocity of light that what we see is a very early stage of galactic phenomenon.

Anyway to get back to the original question "What is a quasar?" Well it's some sort of galactic phenomenon almost certainly in the nucleus as the spiral structures of these are totally dominated by the energy output of the centre. There is an extremely high energy output and gas clouds surrounding the nucleus , then the whole affair is incredibly far away and going like a bat out of hades! However no one knows what it is at all which is certainly something to think about for your ideas on the subject are probably just about as good as mine. Maybe better . . .

Table I

QSO	Redshift %	Recessional Velocity	Distance (LY)
3C 273	16	15	2×10^9
3C 48	37	30	4×10^9
3C 295	46	36	5×10^9
3C 345	59	43	6×10^9
3C 446	149	70	9×10^9
3C 9	200	80	10×10^9

The table on the previous page give represenative values; the recessional velocity is given as a percentage of the speed of light. Redshifts are defined by the relation

$$z = \frac{\Delta\lambda}{\lambda} = \left(\frac{\sqrt{1 + v/c}}{\sqrt{1 - v/c}}\right) - 1$$

where z = redshift, λ = wavelength of a spectral line of a body at rest with respect to the observer, $\Delta\lambda$ = the change of wavelength of this line due to relative velocity between source and observer, c = speed of light in a vacuum, and v = velocity of object relative to observer.

Hubble Law: $V_r = Hr$
where V_r = velocity of object with respect to observer, r = separation of observer and moving object, and H = Hubble constant which has a value of about 100 km sec^{-1} Mpc^{-1} (± 25 %).

Einstein mass-energy equivalency: $E = mc^2$
where E = energy equivalent to mass of the body in question, m = mass of body in question, and c = speed of light in a vacuum.

Magnitude distance relationship: $m - M = 5 (\log_{10} r) - 5$
where m = visual magnitude of object, M = absolute magnitude of object (magnitude if at 10 pc), and r = distance to body from observer. $\log_{10} x$ is a relation defined by $y = \log_{10} x$ if $x = 10^y$.

Gerald Diamond

Watch Out for Kohoutek!

Comet Kohoutek is now (Oct 5) only 171 million miles from the sun, and approaching at an ever increasing speed. At perihelion on December 28, it will be traveling at about 250,000 miles per hour and will be only 13 million miles from the sun -- not as close as the "sun-grazing" comets, but close enough to produce spectacular results.

New predicted positions and magnitudes for Kohoutek have just been received from the I.A.U. Central Bureau for Astronomical Telegrams:

	α (1950)		δ		mag.
Oct 5	10^h	36^m	-1°	$25'$	$9^m.9$
Oct 15	10	55	- 3	29	9.0
Oct 25	11	17	- 5	55	8.0
Nov 4	11	42	- 8	49	6.9
Nov 14	12	14	-12	18	5.7
Nov 19	12	34	-14	18	-
Nov 24	12	57	-16	28	4.3
Nov 29	13	23	-18	47	-
Dec 4	13	56	-21	10	2.6
Dec 9	14	35	-23	26	-
Dec 14	15	22	-25	14	0.3

I will have a detailed star chart at the October meeting, with Kohoutek's path plotted on it. See me if you would like to have a copy. Note that the positions mean getting up for pre-dawn observing between now and Christmas! After about January 5, the comet will be placed for comfortable observing just after sunset.

David L. DuPuy

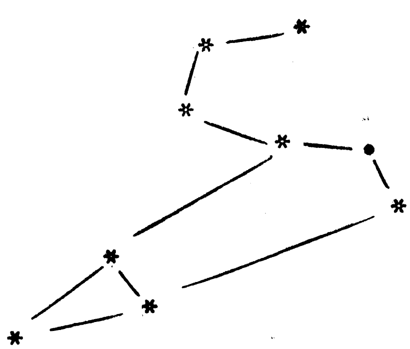
Apparent Magnitudes of the Stars (Part 2)

Last month I briefly described a simple "photometer" to give magnitudes to an accuracy of $0^{m}.1$ for a person with sharp eyesight. Now I shall describe how the instrument works and some observations that can be made with it.

First cover the prism completely with the sliding scale and observe a bright star. The image will appear in a normal way but if the telescope is out of focus you will perceive two images formed by the two bundles of light rays. Now pull the metal strip back slowly and you will see a second fainter image displaced approximately 10' from the first. The intensity ratio is determined by the ratio of areas contributing to each image, i.e. is equal area of unobstructed objective/area of exposed prism - say a/b.

Now that you have an idea of how it works cover the prism and turn to Mizar and Alcor in U Ma and adjust your focus as carefully as possible. Slowly slide the strip so the accessory images (image due to prism) of the double appear. Try to make the accessory image of Mizar equal to the main image of Alcor. If necessary rotate the photometer head in front of the objective such that the accessory image is close to the primary image to which it is being compared. You will quickly see reaching equality is not easy. For one thing, the prism acts as a diaphram over the objective which results in the suppresion of some aberrations which thus makes the accessory image sharper than the main image. This is minimized if the two stars being compared are of about the same spectral type and hence same colour. Also try moving you head and observe the influences. Take several independant readings of b. Find the average $\bar{b}$. Calculate: $\Delta m = 2.5 \log (a/\bar{b})$. Compare Δmag. from that obtained from the Observer's Handbook. What is your error?

Using Norton's Star Atlas, map 5 insert, try measuring the Δmag. of several stars in the Pleides. Again what are your person errors? Try measuring Algol with its comparison stars as given in the back of the Handbook. Is the accuracy any better -- especially if you compare it with several other of known mag.? Now from your measurements can you calculate the brightness ratio k we used in Part 1? Any ideas why $k \neq 100$? i.e. what are the sources of error contributing to the fact you did not get exact equality of image brightness?



Randall Brooks

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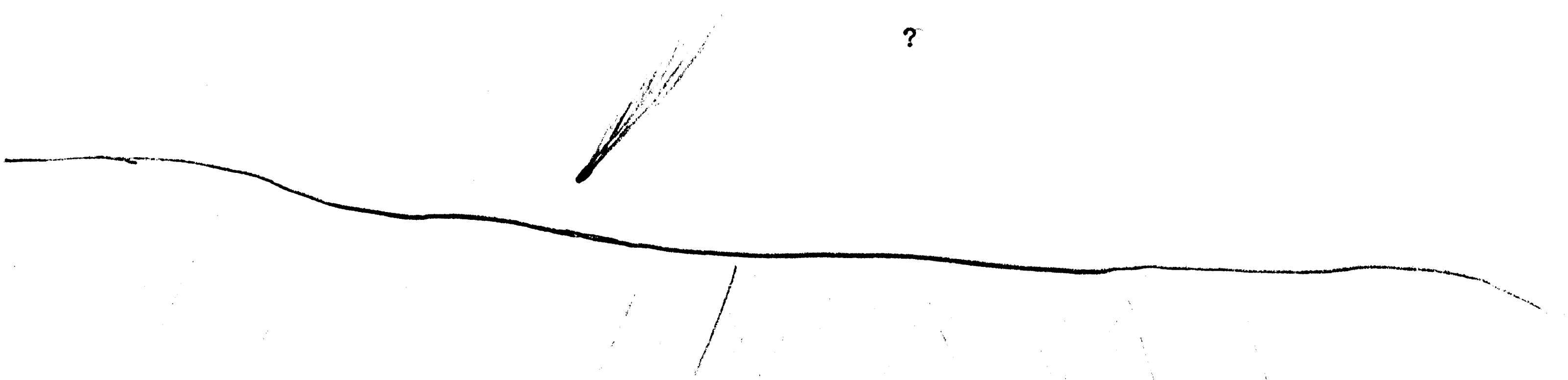


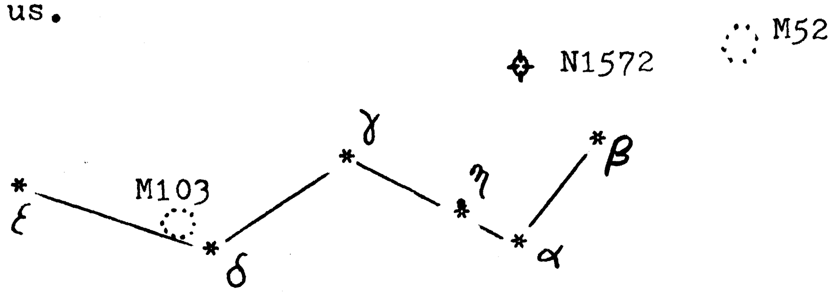
Featured Constellation for October

Sitting high in the North-east,Cassiopeia dominates the night time sky. The entire constellation is circumpolar at our latitude,and marks the northern limit of the Milky Way. Cassiopeia is that big "W" in the sky. Mythology has tagged this constellation as a throne or chair. Those who wrote the mythological annals were even so bold as to place the queen or lady in the chair!!

In 1572,Tycho Brahe discovered a bright supernova, Casiopeia B. It couldn't have been very hard though...it out shone Venus.

Cassiopeia is the home of two Messier Objects and a nice double star. Both M52 and M103 are Open Clusters. η Cassiopeiae has a separation of 10 seconds of arc. The 7.2 mag. companion takes about 500 years to orbit its 3.5 mag. primary.

Just below,in the evening,Cassiopeia,in Perseus,is the famous Double Cluster. This Cluster is some 7000 light years away from us.



CASSIOPEIA

Double
Perseus
Cluster

P.E.