FROM

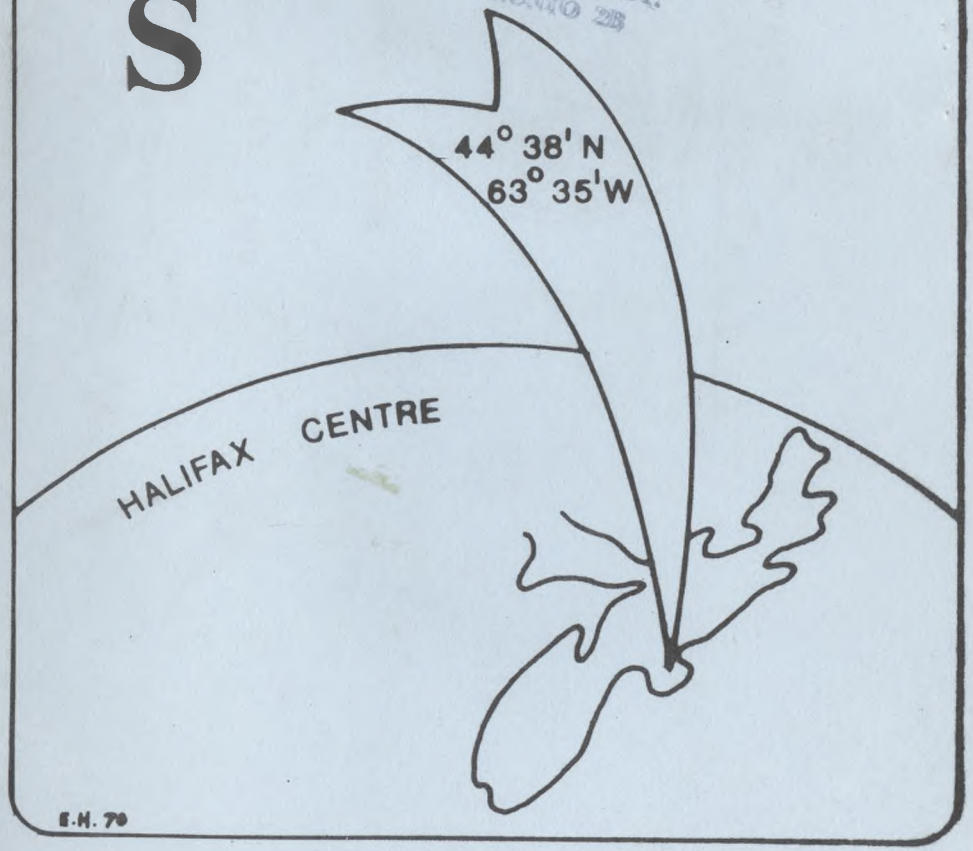
HALIFAX CENTRE R.A.S.C.
1747 SUMMER ST.
HALIFAX, N.S.

Feb 74

TO

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

NOVA NOTES



N O T I C E of M E E T I N G

HALIFAX CENTRE

R. A. S. C.

Date: February 15th, 1974

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

Time: 8:00 PM Sharp!

Topic: "Celestial Navigation
or
How to Fix upon a Star"

Speaker: Dr. E. W. Guptil
Dept. of Physics
Dalhousie University
Halifax, N.S.

All members and guests are most welcome!

Refreshments will be served?!

Nova Notes are printed, thanks to the goodwill of the Nova Scotia Museum.

Editor's Page

Boy! What a month!!! I have received some super terrific material this month and,yes,it's press time and they are still not sorted out. Keep this up and we will be able to compete with Sky and Telescope! So keep it up eh?

Our baby brother,the Junior Astronomy Club,is suffering growing pains and needs volunteers NOW. They meet where we meet, the Theatre of the Nova Scotia Museum,on the FIRST FRIDAY of the month,at 7:00 PM. Please contact Randall Brooks or John MacNeil at this month's meeting.

This brings me to another point of interest,this month's meeting. Dr. Guptil,who was my first year Physics prof,has, what will prove to be,the most enjoyable lecture of the year. He gave this talk to one of the Astronomy classes at Dal this fall,and I can tell you,first hand,it's a goodie!

Dr. Wm. Silvert,our roving reporter,was on the newspaper beat around Christmas time and guess what he kicked up?!
On December 24, 1973, the following appeared in the Mail-Star....

> DOUBLE DOOM
> WINNIPEG (CP) - It was a bad time recently for the superstitious here. Winnipeggers scanning the skies for a glimpse of the comet Kahoutek also saw another traditional omen of doom-a partial eclipse of the moon.

....this is word for word,letter for letter.

Do you see anything wrong with it? Well,if you don't,you will have to start coming to more R.A.S.C. meetings! A partial eclipse of the moon isn't the traditional omen of doom,a total SOLAR eclipse is the omen. Further more,the eclipse occured in late afternoon. If you remember,Comet Kohoutek was in the early morning sky,setting over 5 hours before the partial lunar eclipse and not to rise for another

10 to 12 hours after it was all over!!! So there! Canadian Press.

Dr. DuPuy suggested I mention a letter he received a few days ago. A Mr.Gordon Brown,writing on behalf of the Association of Amateur Astronomers,would like to hear from interested members. If you would like to join Mr.Brown's group,drop him a line at...

181 Woodmount Avenue
Toronto 13, Ontario

He request the name of the Centre of which you are a member.

David Tindall of the Physics Department of Dalhousie U. sent not one but TWO letters along to us. Look for them in the "Letters to the Editor".

Pte. Denis Legault,our Halifax Member-at-large, sent us a Comet Kohoutek report from C.F.B. Esquimalt, B.C. You will find an abbreviated form in the "Letters to the Editor" section.

I want your Postal Code! How's that for coming to the point? I've been told that the Post Office provides a free service in "Post Card" form,for just this purpose,however I still have to look into this. If they do,I'll attach one to the back of this issue. Please fill it in and send it along (with an article for N.N.) to...

Peter Edwards
Editor,Nova Notes
P.O. Box 201
Bedford, N.S. B0N 1B0

If the P. O. doesn't provide this service,I still need your Postal Code. Without it you won't be able to blame me when Nova Notes arrives late. Ha! Now THERE IS an incentive!

Rember Nebulous? Well he was telling me that a new article maybe starting soon. John Shaw knows what Nebulous has up his sleeve....

Peter Edwards
The Editor

Minutes of the Meeting
January 18, 1974

Dr. Cunningham opened the meeting at eight o'clock. Among the twenty-six who braved the cold were Mary King, and Fr. Burke-Gaffney.

The response to the Junior Astronomy Club has been staggering, over a hundred participating in each of the December and January meetings. Randall Brooks made a plea for volunteer assistance with the Club members. He stressed the need to keep the member to volunteer ratio as small as possible. As many as ten volunteers are needed; please help.

Randall Brooks proposed that the Halifax Centre invite the national organization to hold its General Assembly in Halifax -- in 1975 if possible. The proposal was greeted enthusiastically and it will be forwarded to National Headquarters.

Needless to say, Comet Kohoutek came in for much discussion. Mary King reported her pre-perihelion observations, emphasising the possible loss-of-tail phenomenon. Dave Tindall and Chris Purcell, who took some of the earliest comet photos, exhibited their most recent effort, while Walter Zukauskas showed some slides of the Venus - Jupiter - Comet configuration of 8/9 January.

Dr. DuPuy introduced Fr. William Lonc who told us of his efforts at "Amateur Radio Astronomy". He told us about Jansky's initial discovery of cosmic radio waves, and of the their misidentification, and about Grote Reber's pioneering efforts with his backyard "water collector". Following a slide tour of a distinctly professional establishment, the National Radio Astronomy Observatory at Green Bank, West Virginia, we were introduced to the apparatus and problems of amateur radio astronomy. The problems include low resolving power, small fluxes, relatively small bandwidth, and much man-made interference. However, Fr. Lonc was able to show us his successful solar abservations, and he seemed confident that the galactic centre, Cas A, Cyg A, and Jupiter were on the horizon. We wish him well. Judging by the questioning following his talk, he may have some company on his journey.

The meeting adjourned about ten o'clock.

W. Z.

Featured Constellation for February

We,the two sons of Jupiter are,
Tried to smoke his rubber cigars...
They were loaded,
And exploded!
Now we are traveling far...

Nebulous
(of course -ed.)

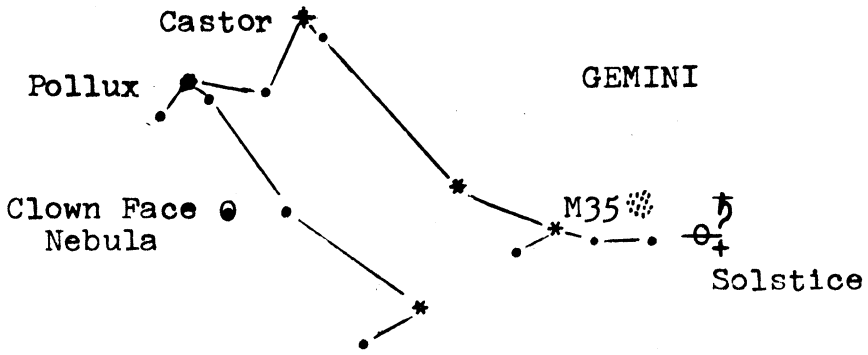
The constellation Gemini is high over head around 9:00 PM these nights. The dominent features are 1.6mag. Castor and 1.1mag. Pollux. These stars form the head of the Twins.

The myth behind this constellation is rather..."Hollywoodish"? Castor and Pollux were the sons of Jupiter and Cassiopeia. Castor was a mortal but Pollux,taking after his father,was immortal. It came to pass that during some sort of war Castor was killed. Pollux was so moved with his brother's death,that he asked his father,as king of the gods,if he wouldn't restore his brother to him as an immortal. (How's that for brotherly love?) Well,I imagine Jupiter must have granted Pollux's wish because today you can see them at the bull fights!*

Gemini is at the most northerly point of the ecliptic,the plane of our orbit,therefore,it is in this constellation that you fine the point of the summer solstice.

M35 is located in Gemini. This is an open cluster,best viewed at about 33X in any size telescope. Half way up Pollux,there is a super nova remnant. Although you need a 6" or larger telescope to see this object,it is worth the trouble. It is called the "Clown Face". This just what it looks like in good photos! Also,this year and next,Castor and Pollux are going to be playing "football" with Saturn!

*Taurus and Orion are battleing it out next to (south of) Gemini...
So how's that for a bull fight?!



P.E.

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Letters to the Editor

I have received three letters this month,all concerning Comet Kohoutek. I was thrilled to get these reports and in one case I even received a photo! I hope the printing process does not wash it out.

Pte. Denis Legault sent us a report from Victoria, B.C. On Jan. 8th Pte. Legault observed Kohoutek from Dunn's Head, C.F.B. Esquimalt,using 7X50 binoculars. He observed from 5:30 PM to 6:29 PM PST,under good to fair skies. Pte. Legault estimated Comet 1973f to be of magnitude +5,with an estimated length of 7°. He noted that the Comet,while approaching the Jupiter-Venus configuration,was in the Constellation Capricornus.

...Thanks Pte. Denis Legault

The following two letters come from Dr. David Tindall. The first,is that controversial topic,the magnitude of Comet Kohoutek. The second letter is a report of the sighting and PHOTOGRAPHING of Kohoutek. On the reverse side of the photo,I found a concealed message,which read as follows...

Comet Kohoutek 1973f; Tuesday January 8th 1974.; 2215 hrs. U.T. (1815 hrs. A.S.T.).; Altitude of Comet ≈ 5° .; Temperature 10°F.; Film: Ilford FP4 (ASA 125).; Exposure: 2mins, F/5.6 350 mm Soligor Telephoto Lens.; ((See rest of message under Photo))

...ed.

DALHOUSIE UNIVERSITY
HALIFAX, N. S.
CANADA

DEPARTMENT OF PHYSICS

15 th January 1974

To the Editor:

I enclose a plot of the brightness of Comet Kohoutek 1973f fitted to the following curve:

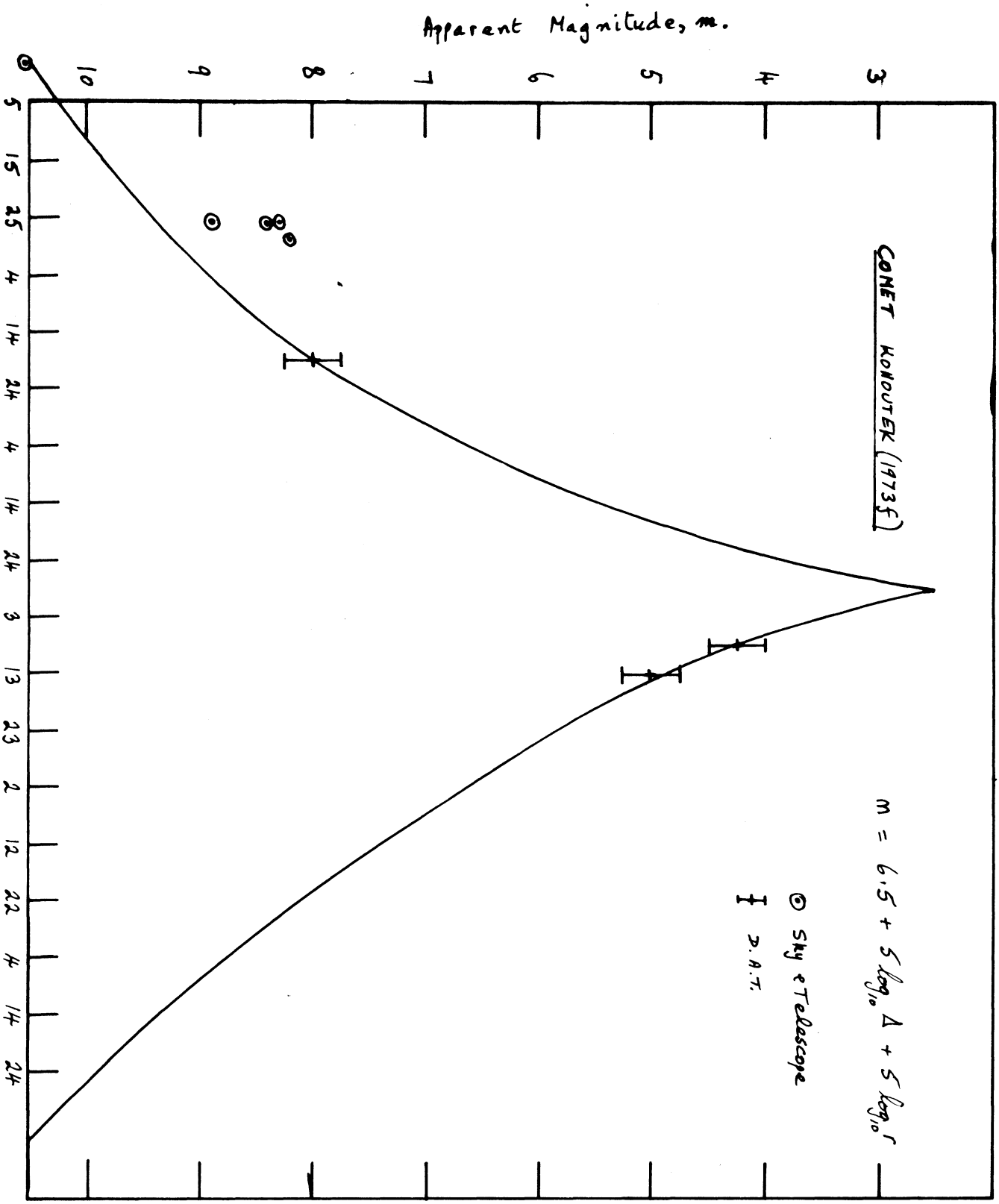
$$m = 6.5 + 5 \log_{10}\Delta + 5 \log_{10} r$$

where Δ is the distance from the comet to the earth and r is its distance from the Sun. The choice of multiplier for $\log_{10}\Delta$ is governed by the inverse square law: if Δ increases by 10 one would expect the comet to decrease in brightness by a factor of 100, which corresponds to an increase of 5 in m. Since proximity to the earth presumably has no influence on the comet's inherent properties the coefficient of $\log_{10}\Delta$ must always be 5. However close approach to the Sun can drastically alter the physical properties of the comet and in practice the variation with r goes as anything from $r^{-1.8}$ to r^{-10}, depending on the comet. Most commonly r^{-4} and r^{-6} are used, giving $10 \log_{10} r$ and $15 \log_{10} r$ respectively: these were the formulae used for Kohoutek and it was the rapid variation of r^{-6} which gave the over-optimistic predictions.

It would appear from my observations that $5 \log_{10} r$ is close to the correct value; this is what we would get from a planet or other body whose physical properties are relatively unchanged by close proximity to the Sun. I made my observations with 7X50 binoculars, and photographically, by comparison with neighbouring stars and the magnitudes quoted are for the head only. On Tuesday 8th January the tail was about 3 - 4 degrees long but by last Sunday (13th) it had shrunk to around $\frac{1}{2}^{o}$ (as seen in the same binoculars).

I should be very interested to hear from anyone who has made other estimates of brightness of Kohoutek.

David A. Tindall, Physics Dept., Dalhousie.


Apparent Magnitude, m.
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COMET KOHOUTEK (1973f)
m = 6,5 + 5 log10 Δ + 5 log10 r
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Its distance is 2.2 million light years ; diameter is 200,000 light years ; mass is $3x10^{11}$ solar masses. The outer arms of Andromeda galaxy can be resolved into individual stars. A great number of Cepheid variable stars as well as over 100 novae have been observed in this galaxy. In addition, this stellar system contains dark and bright nebulae, open and globular star clusters. The Andromeda galaxy is accompanied by two elliptical galaxies, M32 and NGC205. It also provides a fairly good picture of the appearance of our own Galaxy.

M31 is also NGC224, its position is; R.A. 00H:40.0MIN.(1950) Dec. +41 00', its size is 160' x 40' , it has a magnitude of 4 and is of the sprial type of nebula.

Michael Edwards

Sources: Collins Concise Encyclopedia of Astronomy
The Penguin Dictionary of Astronomy
Photograph: Enlargement of a Celestron slide using a 225mm f1.65 @20min. Celestron Schmidt Camera. Slide by Celestron Pacific Inc.

HAVE YOU READ ?

There are some goodies in the recent scientific literature that could be recommended to our membership. I would like to know how many of you go to the library to look them up- it might surprise even the younger members how much is to be learned in these articles.

SCIENCE Dec.14 1973 pl089 Cygnus X-3 is surely one of the most fascinating stellar objects. It gives off x-rays, infrared, light, radio and cosmic rays! and all of these in fluctuating flux energies. We will have a talk on radio astronomy soon and this article gives a view of the riches of non-visual astronomy.

NATURE Dec.14 P.400 In case you have still some interest in comets there is a good review article on Kohoutek and the many research projects that we now know might have been !

SCIENCEDec.28th pl346 Jupiter's great red spot and other observations on the atmosphere of this giant of our system.

SCIENCE Dec. 21st This is the first place you can see it. The FIRST but not we hope the last photograph of Jupiter taken from Pioneer went by recently. The bands , red spot and the shadow of Io. There will be more pictures later. That is on page 1235

For the real amateur who would like to build something different the January issue of SCIENTIFIC AMERICAN has on p. 96 The Astrolabe- a fascinating article on the ancient astronomical instrument. It can tell the time by day or night. It can latitude and the time as sidereal and mean solar. A really good modern instrument could be made of Lucite with stellar positions accurately marked and and optical alidade. While you are at it a series of climates could be constructed and the almucantars and the rete of cunning modern design. Good luck !

If that is not your bag then turn to Page 114 and start building your weather satellite recorder. That's right - get your own weather maps straight from the satellite printed on what looks like a rolling pin.

Why don't more of us just stick to grinding telescopes.

Murray Cunningham

PRESENT IDEAS ON BETA LYRAE - PART 1 R.C. Brooks

In recent years much has been learned about the eclipsing binary β Lyrae through both spectroscopic and photometric observations. These have led to continuously changing models with the most recent incorporating a black hole secondary to explain some of the observed features.

β Lyrae was discovered to undergo periodic changes in brightness by John Goodricke, a deaf-mute from York, Eng., in 1784. He found after a series of observations that it varied with a period of $6^d.5$. Soon after, he found that alternate minima were of unequal depth and he correctly concluded the period to be actually $12^d\ 22^h\ 25^m$. The maximum visual mag. is $3^m.38$; at primary eclipse (PE) it is $4^m.36$; and at secondary eclipse (SE) it is $3^m.9$. The spectrum of this supergiant is listed as B8 pe and indicates T = 12,000°k. There is no observed spectrum due to the secondary but it is usually classed as F from other considerations.

Otto Struve's 1957 model is based on spectroscopic work done in 1955 at Mount Wilson by himself and Jorge Sahade. Each of the 200 spectra obtained was enlarged and then lined up in order in the $12^d.9$ cycle. (Unfortunately this series cannot be reproduced properly for this article, but they may be found in the July 1957 S & T. It is well worth the effort to look at these because of the multiplicity of effects one can observe in them.)

By lining up the interstellar calcium H & K lines, which are unaffected by β Lyrae, one immediately detects displacements of the absorption lines due to the orbital motion (180 km s^{-1}) of β Lyr. As well one sees emission bands undergoing similiar orbital motion but with a much higher velocity than β Lyr itself. These emission lines are due to an expanding (100 km s^{-1}) shell of gas about the system. We conclude that, since the shell's velocity is greater than the B8* 's, it is not coupled to it. The question arises whether the shell is moving with the centre of gravity or the invisible component. From the analysis of the velocity curve (Fig. 1) the radial velocity of the secondary is found to be 270 km s^{-1} but the H γ & HeII lines of the shell are not attached to that component either. By lining up the absorption lines in the spectra the shell lines are seen to be in the opposite phase to the B8* . The shell must undergo very complicated orbital motion independant of the two stars.

A second problem arises at phase φ 0.5, ie. at secondary eclipse. The lines of Fe, Mg, Si and Ca become more intense and the lines at λλ 4233 Å, 4303 Å and 4352 Å due to ionized Fe appear while He does not appear brighter or become ionized. Eclipses of the F* have the opposite effect. There are three possible solutions to this. 1) The spectral type may not be the same about the star, ie. the hemisphere seen at φ 0.5 is cooler than seen at PE. 2) The opacity of the shell may vary when

observed in projection against the B8* at different phases. 3) There may be a cool stream of gas (velocity 140-200 km s^{-1}) (Fig. 3)eminating from the secondary component which flows along the following hemisphere of the B8* . This would have the effect of producing an accumulation of metalic atoms in front of it at ϕ 0.5. This stream can be seen displaced to the red as absorption features between ϕ = .9586 - .9814.

The more dense stream (Fig. 3) having a velocity of 80 - 360 km s^{-1} can be seen in the spectra between ϕ = .0419 - .0999 as broad absorption features. This hot stream of atoms leaves the B8* and flows around the F* . From ϕ = .0999 - .1232 the stream is no longer in front of the B8* but is seen projected on the F* and the space between the two. The result is emission features displaced to the blue.

A third problem arises when one determines the size of the B8 component. The light curve (Fig. 2) gives a value for the radius of 70 $R_\odot$. Normally in close binary systems it is quite reasonable to assume the period of axial rotation is equal to the period of orbital revolution, ie. synchronization. For a star of 70 $R_\odot$ this implies a rotational velocity, V_{rot}, of 300 km s^{-1} but the absorption lines are only slightly broadened by rotation and suggests a V_{rot} of only 50 km s^{-1}. Either the size is 1/6 of 70 $R_\odot$ (12 $R_\odot$) or it does not have synchronous orbital motion. Gaposhkin suggests making M_{B8} = 1/2 M_F. To avoid violation of the Mass - Luminosity relation, he says the F is hidden by gas streams. If the B8 has a mass of 1.9 $M_\odot$ and if one assumes synchronization, then V_{rot} = 80 km s^{-1}. This is still large but not a serious discrepancy. However, there are other problems such as why hide only the F* ? what happens to the F* 's energy in the gas streams? ie. why is no re-emission observed? and more importantly why assume the B8 component obeys the M - L relation or is in synchronous orbit when the observations contradict such assumptions? For instance, the mass loss from the B8* which results in slowing of the period results in much more rapid evolution of the star (observed through spectrum anomalies) and under such circumstances the star may well deviate from the M - L relation. This mass transfer explains the lengthening of the period since it means that

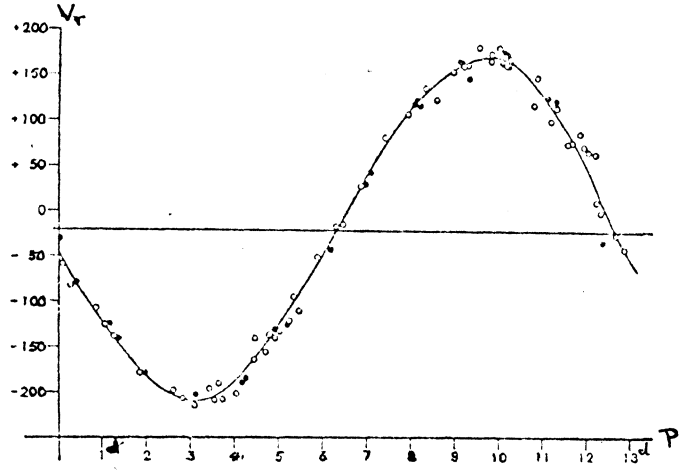

Fig.1--Velocity curve

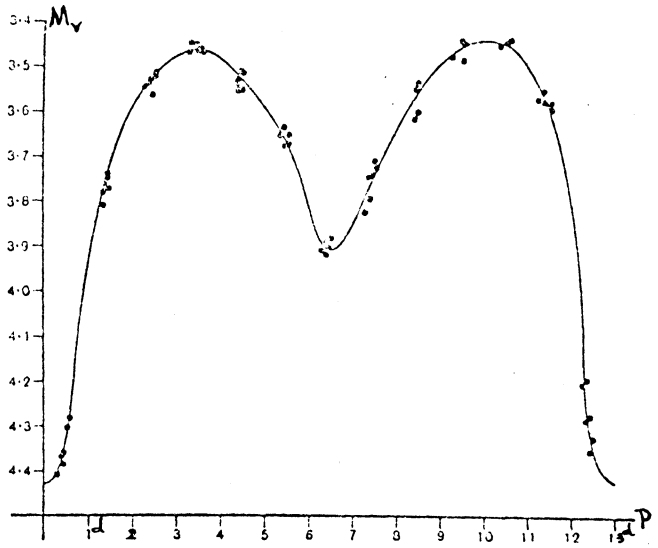

Fig.2--Light curve

the F* must decelerate its rotational velocity which in turn means its axial rotation must accelerate. As the spectrum of the B8 companion is unseen, this cannot be confirmed observationally.

The masses pose another problem. Since the secondary is the more massive, why is it underluminous and why should the primary, which is smaller and should have evolved slower, have reached the giant stage? One suggestion has been that the material from which the F* condensed was extremely large thereby retarding contraction of the star and thereby one can postulate an initial lag time in the star's evolution. Indeed the rotating disc surrounding the system may be the remains of the prestellar matter. As you well know, more massive stars evolve more rapidly. This suggests a second solution where the F* has evolved very rapidly and may have passed the giant and supergiant stages and now lies below the main sequence in the H - R diagram (perhaps it is even a black hole).

A third solution may be one in which the primary was once the more massive component. In such a system the B8* would have evolved to the giant and supergiant phases and matter was then ejected through the Lagrangian point. The secondary, being the recipient of this material, becomes larger and hence the distance between the components becomes smaller. This in turn shrinks the equipotential lobe around the primary causing an increasing rate of mass ejection. This process would be extremely rapid compared to the lifetime of the system and may explain the small number of variables like β Lyr.

Next month the photometric observations will be reviewed and the models that the observations suggest will be discussed. Recent arguements for a black hole secondary will be included as well.

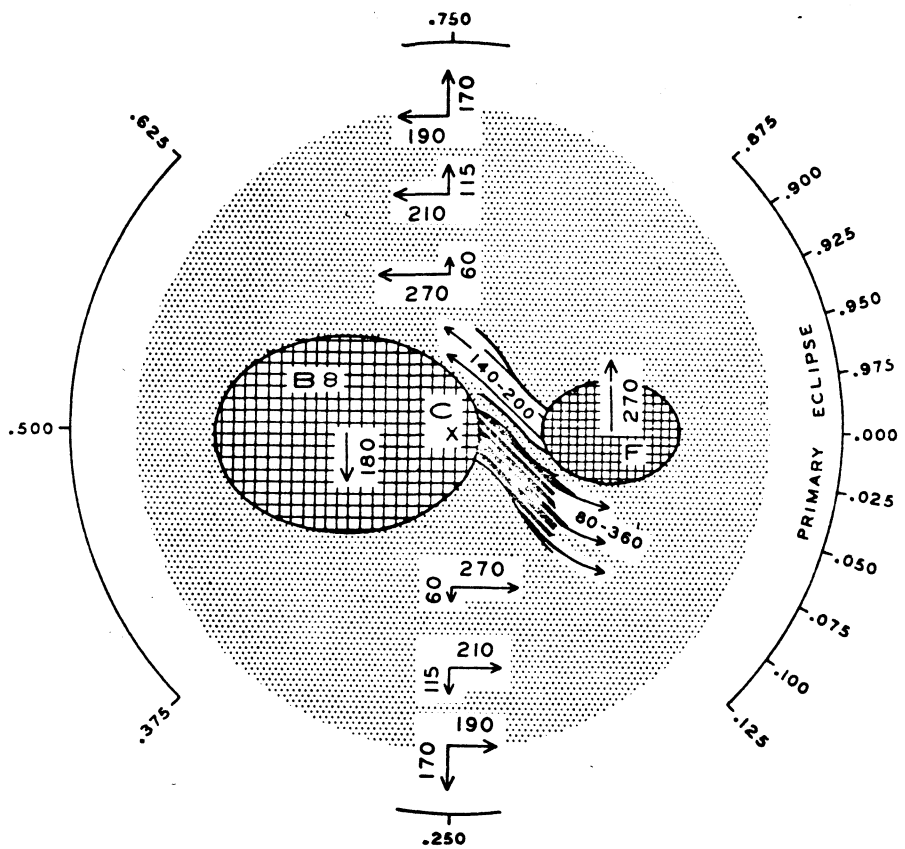

Fig.3--Schematic model of Beta Lyrae. Velocities are in km s^{-1} and the numbers around are the phases and show the oeientation as viewed from the sun. This model is due to Struve.