Journal of the

ORWELL ASTRONOMICAL SOCIETY (IPSWICH)

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What's Up?. The Solar system as seen from Ipswich, May, 1976.

SOLAR SECTION:

This month the Sun will be in the constellation of Aries and Taurus. Sunrise at the beginning of the month 04hrs 30m U.T. and sunset at 19hrs 30mU.T.

Synodic rotation number 1641 commenced April 30.53d
" " " 1642 commences May 27.75d.

Heliographic co-ordinates as at noon U.T.

	P.	Bo	Lo		P	Bo	Lo.
May 2nd	-24.0°	-4.0°	340.5°	May 17	-20.4°	-2.4°	142.2°
" 7th	-23.0°	-3.5°	274.4°	" 22	-18.9°	-1.8°	76.1°
" 12th	-21.8°	-3.0°	208.3°	" 27	-17.2°	-1.2°	9.9°

MERCURY is an evening star mag. -0.9 setting one and a half hours after the Sun at the beginning of the month. Inferior conjuction occurs on the 20th at 12hrs U.T.

VENUS is a morning object but owing to it's close proximity to the Sun will be unobservable this month.

MARS and SATURN are now drawing very close to one another on the boarder of the constellations of Gemini and Cancer. On the 12th at 02hrs U.T. an hour or so after Mars has set. Mars will pass 1°.3 north of Saturn. The Moon will be near Mars on the 4th and 5th.

JUPITER. is also a morning object too close to the Sun for observation this month.

SATURN as mentioned is very close to Mars, Saturn's magnitude is 0.4 and that of Mars is 1.6 so of the two planets Saturn will appear the brightest object. The Moon will be near Saturn on the evening of the 5th.

URANUS is an evening star in the constellation of Virgo, close to the star Gamma Virginis. The planet is just below naked eye visibility, to assist in finding the planetthe geocentric position is roughly R.A. 14hrs 10m. Dec. -12°30'.

LUNAR SECTION.

Moon phases for Lunation 660/661 *

New Moon	April 29th	10hrs 20m U.T.
First Quarter	May 7th	05hrs 17m U.T.
Full Moon	May 13th	20hrs 04m U.T.
Last Quarter	May 20th	21hrs 22m U.T.
* New Moon	May 29th	01hrs 47m U.T.

Perigee May 12th 17hrs U.T. Apogee May 25th 12hrs U.T.

Partial Eclipse of the Moon.

On May 13th a partial eclipse will take place visible in Australia, Asia, Europe and Africa. In Great Britain the Moon will be seen to rise about this time of mid-eclipse. Circumstances of the eclipse are as follows:-

Moon enters penumbra	17hrs 47m	Leaves	22hrs 02m
Moon enters umbra	19hrs 16m	"	20hrs 33m.
Middle of eclipse	19hrs 54m.		

Occultations.

May 3rd	ZC 943	Mag 6.2	D	21hrs 02.1m U.T.
" 17th	ZC 2715	" 6.5	R	01hrs 02.7m U.T.
" 27th	Jupiter	" -1.6	R	03hrs 26.5m U.T.

Note that with the occultation of Jupiter the planet rises at about 03hrs 10m U.T. Sunrise follows roughly 40 minutes later so observation of this phenomenon would appear difficult.

METEOR SECTION. by Mr. D. Barnard, Director Meteor Section.

There are no meteor showers this month excluding these two daylight streams discovered and exclusively observable to radio astronomers:

1. Upsilon Piscids max. May 13th ZHR of 16 Normal limits May 12-13th.
2. Omicron (Mira) Cetids max. May 15th, Normal limits May 14 -23. ZHR 16.

METEOR NOTES: Cont.

The ZHR figures are quoted for an observation by an average observer under normal conditions.

To the amateur, meteors offer an exceptionally fruitful field. Meteor observations are still to a fairly large extent in the hands of the amateur astronomers despite the work of radar observers, e.g. Jodrell Bank, and also Whipple's application of the Schmidt to meteor observation. Furthermore, the visual observation of meteors requires no costly equipment except for telescopic meteor and photographic meteor observing. To record a meteor when observing the detail required are Date and month, magnitude of faintest star in observing area.

2. magnitude of meteor.
3. Approx time U.T. *
4. shower or sporadic (If shower state which shower)
5. Any special features, i.e. colour, fragmentation, duration, train, etc

* When observing, one divides the period into, say, an hour or so, therefore noting all meteors observed in that period.

To record Fireballs.

A fireball is different to a meteor in that a fireball is a meteor brighter than mag -4.

1. The time should be given as accurately as possible in U.T.
2. Note any horizon features below the beginning and end points and the exact position from which the observation was made.
3. Duration of visibility.
4. Details of appearance and behaviour, colour, brightness, Explosions (if any) curvature or any other irregulations in the path, and any variations of angula velocity along path.
5. Train (if any)
6. Lat. and Long. of observing position
7. Any sounds or echoes.
8. Whether one or more bodies were seen.
9. sky conditions at time
10. Degree of accuracy of above items.

The Sporadic count held on March 27th was totally cloudy and only two other members turned up. The April Lyrids shower will be reported in the June Journal.

Next Meteor Count.

The next meteor count will be a Sporadic Meteor Count and will be held on Saturday 22nd May from 10p.m. At the April Lyrids meteor count we met at the entrance to Foxhall Stadium to find that the Foxhall Heath had been wired off so we had to find somewhere in a hurry. Up to going to press with the Journal we have not found anywhere equal to that of Foxhall Heath for Meteor observing so we will meet outside the Golf Hotel on Foxhall Road at 10p.m. and then will go to the new m~~eteor coun~~t site. Please do not be late because you might find that we have gone when you get there.

An astronomical puzzle by J. Deans.

1. The date - September 21st.
2. Time 03hrs 19m U.T.
3. At the zenith is the star Epsilon Cassiopiae.

Question: Where would you be and what would be the name of the nearest city? Answer in next month's Journal.

MR. Kevin Dye, assitant Lunar & Planetary Section Director.

As reported in last month's Journal Kevin had been promoted in his company to Sherringham but since then he has been promoted again to a bank in Bury St. Edmunds so he will be travelling to and from Bury every day and will continue as assistant director to the Lunar & Planetary Section on the Friday evenings at the observatory.

BACK NUMBERS OF JOURNALS.

If you would like any back numbers of Journals or any parts such as the History of Astronomy or the Photography articles please contact Mr. R.M. Cheesman, , Ipswich, IP4 5QA. who has a large supply (apart from that he want to empty his cupboards).

AMATEUR ASTRONOMICAL RESEARCH

by Charles Radley.

SOLAR ASTRONOMY.

There are a couple of things which I would like to mention as a follow on to the Solar Astronomy article which I wrote in a recent edition of the O.A.S.I. Journal.

There are two articles in the B.A.A. Journals which you might care to look up.

1. There is an interesting article about a home made gadget for photographing solar flars. That is, the February 1976 B.A.A. Journal. It mentions that hydrogen alpha sensitive photographic film is only available in the U.S.A. However, I spotted the following article in the April 1973 B.A.A. Journal.

FOR SALE: 103a-F 35mm Spectroscopic Pan Film, sensitive to red hydrogen alpha light and blue, fast, minimum reciprocity failure, ideal for nebulae, galaxies, etc; chance to try proffessional film. Lengths of 1.6m (36 exposures) with essential processing and other details, £1.00 post free from W.E. Pennel, Waddington House, Waddington, Lincoln.

Although this ad. is probably out of date, Mr. Pennel may be able to obtain some suitable film for use for solar astronomy with the long focal length Orwell Park telescope.

2. Mr. V. Barracas, Director of the B.A.A. Solar Section delivered a talk to a B.A.A. meeting a couple of months ago. The next B.A.A. Journal should contain a write up of his talk in the text of the minutes of that meeting. It is very interesting and well worth reading.

OCCULTATIONS.

What is a occultation?

Occultations are classified according to the object which is performing the occultation. An occultation is the hiding of a more distant and smaller celestail object by one closer and apparently larger. The most common sort of occultation is a Lunar occultation. As the Moon traverses the sky it frequently passes in front of stars hiding them for periods of time ranging from a few seconds to about an hour.

Planets can also be occulted by the Moon. The planets themselves very occasionaly occult stars, or even more rarely other planets. These phenomena are interesting, although I have never yet seen one. These are called planetary occultations. The rings of Saturn can occult stars, this can be interesting and useful to observe also. Artificial satellites can occult stars, but these are unpredicatable. Of astrophysical importance it is that stars can occult each other, but proper motions of stars are so slow that only one has been predicted to occur in our lifetimes.

This article will be divided into three parts:-

1. Lunar Occultations
2. Grazing Occultations
3. Other Occultations.

LUNAR OCCULTATIONS.

Visual Appearance:

Through a telescope the Moon can be seen to have a very well defined limb (edge or horizon) and the star, regardless of the telescope's magnification, appears as a point of light with no size. This means that Lunar occultations of stars are instantaneous. The stars move closer and closer to the edge and then suddenly without any fading at all disappears as an electical light does when turned off. This was one of the first pieces of observational evidence for the Moon having no atmosphere since if it had the star would fade as it was being seen through increasingly thick layers of gas and dust, possible even dissappearing from view before the actual instant of occultation. This does not happen.

Timing the event to an accuracy of one tenth of a second, or better if possible, is useful and should be sent to the B.A.A. Lunar Section, and as you improve they would [illegible] to Herstmonceux.

Note:

Graze predictions are not gospel. Uncertainties in the position of the star and Moon combine to make an error in the predicted position of the track across the Earth. The error can be as much as half a mile. The dimmer the Star the less well known its position is.

Also I refer you to the following article:- "Grazing Occultation 139 Tauri on March 21st"by L.V. Morrision in the B.A.A. Journal edition of June 1973, Vol 83 No. 4 Page 272. This is a good article of interest to grazing occultation observers.

GRAZING OCCULTATION IN SUFFOLK.

There will be a grazing occultation in Suffolk this Autumn. The last one was in the autumn of 1974 which some members will remember since we were wandering all over the Hadleigh and Raydon area for several nights practising for the great event, and when the day arrived it was cloudy.

However, weather permitting, conditions will be very good for the graze in November. Here are the first predictions taken from the B.A.A. Handbook.

The track passes from Poole and Luton to Norwich and out into the North Sea. The nearest it comes to Ipswich is Bury St. Edmunds. This is less than half an Hour's driveaway up the A45 since the new Stowmarket, Needham Market and Claydon bypass has been completed. I suggest that interested members write to Herstmonceux for a set of detailed predictions.

The star which will graze is Z.C.3199 also called -9° 5854. It is magnitude 6.8. The date of the event is Saturday 27th November, a good day of the week. The time is 18hrs 54m U.T.

Hopefully a group from the O.A.S.I. could be organised to observe this event. It is useless just turning up and expect to observe the event and go straight away home again. It's no cheap thrill. If you try to do it that way everything will go wrong. Nobody will be able to find the star, nobody will have any idea of the accuracy required. People will fool about until the last minute then wonder why they did not see anything. I suggest that the O.A.S.I. Lunar Section or other interested members who is fairly responsible organise an expedition to observe the graze and three or four dummy runs observing ordinary Lunar occultations from the Bury St. Edmunds site in the weeks leading up to the event.

Having condemned tape recorders, I suggest that if you have a portable cassette machine with empty cassette and microphone bring all three along, to the dummy runs. I suggest the organiser consults his B.A.A. Journal and select suitable Lunar occultations to observe as dummy runs. I suggest also that there be three briefing meetings up in the dome. One in August before all the action starts so that everything can beorganised and everybody knowns who is to do what. Then have another briefing to discuss the disastrous attempt at the first dummy run, analyse what went wrong and make new plans for the second dummy run. Hopefully everybody will be sufficiently experienced by the time the graze arrives. I guarantee that at least two of the dummy runs will be disasterous, one from organisation and one from the weather. So have three or four to make certain.

Other Occultations.

Other interesting occultations include: planetary, artificial satellites. Also the Moon occults radio sources which can occassionally be detected by amateurs. X-ray sources also can be occulted. These radio and X-ray occultations are very useful since the positions of X-ray and radio sources are not known as accurately as the positions of stars for example. Another occultation of interest to radio astronomers is the occultation of the Crab Nebula by the Solar Corona. This occurs every summer.

Planetary occultations are not common. An observer can only expect to observe one every two years or so.

In 1976 Mars occults a star. Full details can be found in the B.A.A. Handbook or the following reference "An Occultations of Epsilon Geminorum by Mars on April 8th 1976" by Gordon E. Taylor, Journal of the B.A.A. Vol 86, No. 1. December 1975 page 33.

Unfortunately by the time this article goes to press we will probably have missed this rare event. But here are the predictions anyway.

From Britain this event is a graze, visible at 01hrs U.T. exactly, almost. The star Epsilon Geminorum is marked in Norton's star Atlas and is mag. 3.2. Mars will be mag 1.2 at that,time, with a semi-diameter of 3".2. Epsilon Geminorum has a ninth magnitude companion which will be occulted $1\frac{1}{2}$hours after Epsilon itself. Unfortunately the planet will be quite low down above the horizon for the event, but I think it is worth cracking the Dome that night to try to catch it.

Mars will be setting at the time of the event.

The rings of Saturn and the planet Saturn itself ocassionally occult stars. The precedure for observing planetary occultations is almost the same as the Moon. Then note the relative durations of any fades and brightenings due to the planetary

Factors affecting the time of an occultation.

Geographical three dimensional co-ordinates of observer, i.e. latitude and longitude and height above mean sea level of the observer. These three can be determined very accurately by means of Ordinance Survey maps, and are regarded as known quantities.

Two other factors affect the time, the position of the Moon and the position of the star. The position of the observer can be measured directly, so can be determined to a high degree of accuracy. The position of the Moon at any one time cannot be measured directly, there is no tape measure one quarter of a million miles long, so we must rely on other methods.

Our knowledge of our own position is much more accurately known than that of the stars or Moon (relative to the centre of the Earth) so we call the positions of the stars and Moon UNKNOWNS, or UNKNOWN **quantities.** The object of any scientific investigation is to investigate the unknowns and improve our knowledge of the unknowns.

Therefore by obtaining an accurate timing of an occultation you are providing data which will enable professional astronomers to determine accurately the position of the Moon and the stars which it occults.

The Apollo spacecraft left several laser mirrors on the Moon which enable experimenters to accurately measure the distances and changes in the distance of the Moon. Occultations enable us to accurately measure the celestial sphere (Right Ascention and Declination) and the third dimention (distance) enable us to obtain the more accurate our predictions will become.

Methods of Observation.

An observer must first locate and identify the star. This must be done at least a few minutes before the event. Then he must observe the occultation stopping a stopwatch at the instant of occultation. The limiting factor for accuracy therefore is the reaction time of the human observer.

That is the simplest method of observation. There are two other methods which involve electronic equipment.

1. The tape recorder plus button operated buzzer, where the buzzer is held and in effect replaces the stopwatch.

2. Photomultiplier plus tape recorder. This is an advanced device, cheap enough and simple enough only for the enthusiastic and intelligent observer. It is in fact an automatic and extremely accurate occultation observing machine. There is no need for an observer at all. All it needs is a man to operate the equipment. A photomultiplier is a very sensitive light detecting device.It produces an emf proportional to the amount of light falling on it's sensitive end. This emf can be measured. The photomultiplier is attached to the telescope. When the star is occulted the emf drops. The emf can be recorded on a pen chart recorder or electronically processed and recorded on a tape recorder. I will not dwell on this methods. A good knowledge of electronics is needed and must be aquired if you wish to persue this technique. EMI produce a range of photomultipliers cheap enough for the amateur pocket. Photomultipliers are widely used by professional astronomers and other scientists.

Returning to the simpler methods now.

All occultation observers need an accurate time fix to work from as a starting point, all observations made relative to this datum. There are three methods accurate enough for occultation observation, but I will start by listing some of the methods which are hopelessly inaccurate, many times less accurate than the original calculated predictions.

Television clock, radio disc jockeys, Big Ben and the Town Hall Clock.

The perfect instrument for fixing time is an atomic clock, but not many amateurs possess these since they are not on the market. The amateur can, however, obtain:-

The announcements and pips of the telephone speaking clock, the time pips of radio, and quartz crystal clocks.

I have in fact thought up a fourth method, a piece of electronic digital apparatus combining the advantages of the last two mentioned pieces of apparatus, but I have not started designing it yet. I am not prepared to discuss my idea, and by the time I perfect it, somebody will probably beat me to it. Suffice it to say that scope for amateur experimentation exists in this field, particularly using the new integrated circuits which which are now available quite cheaply.

By the way, is anybody interested in electronics, with a faily well equipped workshop. If so please get in contact with me and we could exchange ideas.

Method 1. requires a MAINS operated tape recorder, battery operated portable machines are not really accurate enough. The method involves taping the speaking clock for a minimum of twenty-five seconds, then performing the observation WITHOUT STOPPING THE TAPE then immediately after the event recording the speaking clock again for another twenty-five seconds. This enables the machine to be callibrated for inaccuracies.

The observer then can retire to the comfort of his own living room and run the tape using a stopwatch to calibrate the tape and eventually obtain an absolute value for the Greenwich Mean Time of the occultation which he then can record on an observing logbook and observation form.

Where to obtain predictions.

Predictions for Lunar occultations are widely available. Three or four books can be used: Whitakers Alamanac, Reeds Nautical Almanac, The Astronomical Ephemeris, the B.A.A. Handbook and of course these predictions are published in our own Journal for the following month. I should mention here that SAO stands for Smithsonian Astrophysical Observatory and ZC for Zodiacal Catalogue. Both abreviations are widely used for naming stars, as an alternative to the more common system of Greek or Roman letters followed by the constellation.

Grazing Lunar Occultations.

These are very interesting phenomena. They occur when the edge of the Moon touches a star. With a telescope it is readily noticed that the Moon is not a perfectly round sphere, but has a serated edge due to mountains and valleys on the Lunar surface. Thus the star can disappear behind mountain crests and reappear in valleys and disappear again behind the next mountain. When a mountain top itself touches the star you can obtain a sort of grazing-grazing-occultation since the mountain top itself is not smooth, and rocks, and craters of the order of a few feet or metres in size can hide the star for a fraction of a second.

By timing these events (accurately) a good picture of the Lunar profile can be built up, and very accurate fixes on the position of the Moon and the star can be made.

Method of Observation.

The best method of observing grazes involves having teams of two or three observers with a portable telescope and stopwatch or tape recorder.

Grazes (like total eclipses) can only be observed in a narrow strip a few miles wide. The observers should be deployed at 50 or 100 metres intervals in a fairly straight line across the graze track. The position of each observer must well be determined using a suitable Ordanance Survey Map. It is worth purchasing a 1:25,000 map for this. Also purchase the relevant 1:50,0000 map. Then obtain a set of predictions for a graze passing through Suffolk. The predictions will give the latitude and longitude of the two graze tracks, one called "Delta Sigma=zero", and the other called " Delta Sigma=-1 one. Take a large piece of graph paper. Examine the 1:50,000 scale OS map closely. You will see that it has a grid of lines superimposed on it, this grid is called the National Grid. Each line is numbered as you will see. Around the perimeter of the map you will see the latitude and the longitude also on the map. Compare the latitude and the longitude markings at the top and the bottom of the map. You will see that the latitude and longitude lines are not parallel to the National Grid Lines. It is necessary to use graph paper to compensate for this since the predictions for the graze are given in **latitude and longitudei** You will notice in the key to your map that **intersections** between lines of latitude and longitude are marked by a cross on the OS map at 5' intervals.

Take the graph paper and number suitably chosen lines on the paper to correspond with the national grid. Then superimpose the latitude and longitude by hand and eye them up square onto the replica national grid you have made. Plot the latitude and longitude co-ordinates of the two graze tracks onto the graph paper. The transfer the graze track (in pencil) onto your Ordinance Survey Map. Then select geographically suitable observing positions. They must be accessible by road and suitable for placing a telescope tripod, and parking your car. The situation must also be close to a telephone kiosk for recording the speaking clock. All these features are marked on Ordnance Survey Maps.

Obtaining your Predicitons:-

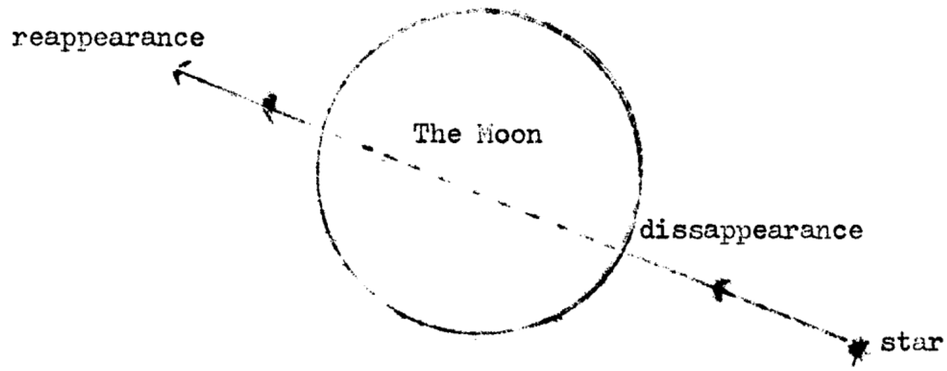
The B.A.A. Handbook contains a map showing the approximate routes of graze tracks. Select any that are in within striking distance from Ipswich, then write off to Herstmonseax for a set of predictions. The address is given in the B.A.A. Handbook. Herstmonceux will then send you a set of predictions plus detailed explanitory notes and forms on which to record your observations.

Further information;

I refer you to the Lunar Section of the B.A.A. They have an occultation sub-section. If you are not a member of the B.A.A. I suggest that you join. Then send a set of a doxen or more S.A.E.s to Miss Rosa Atwell in Burlington House, London. You will then receive the B.A.A. Lunar Section's monthly circulars which keep you up to date.

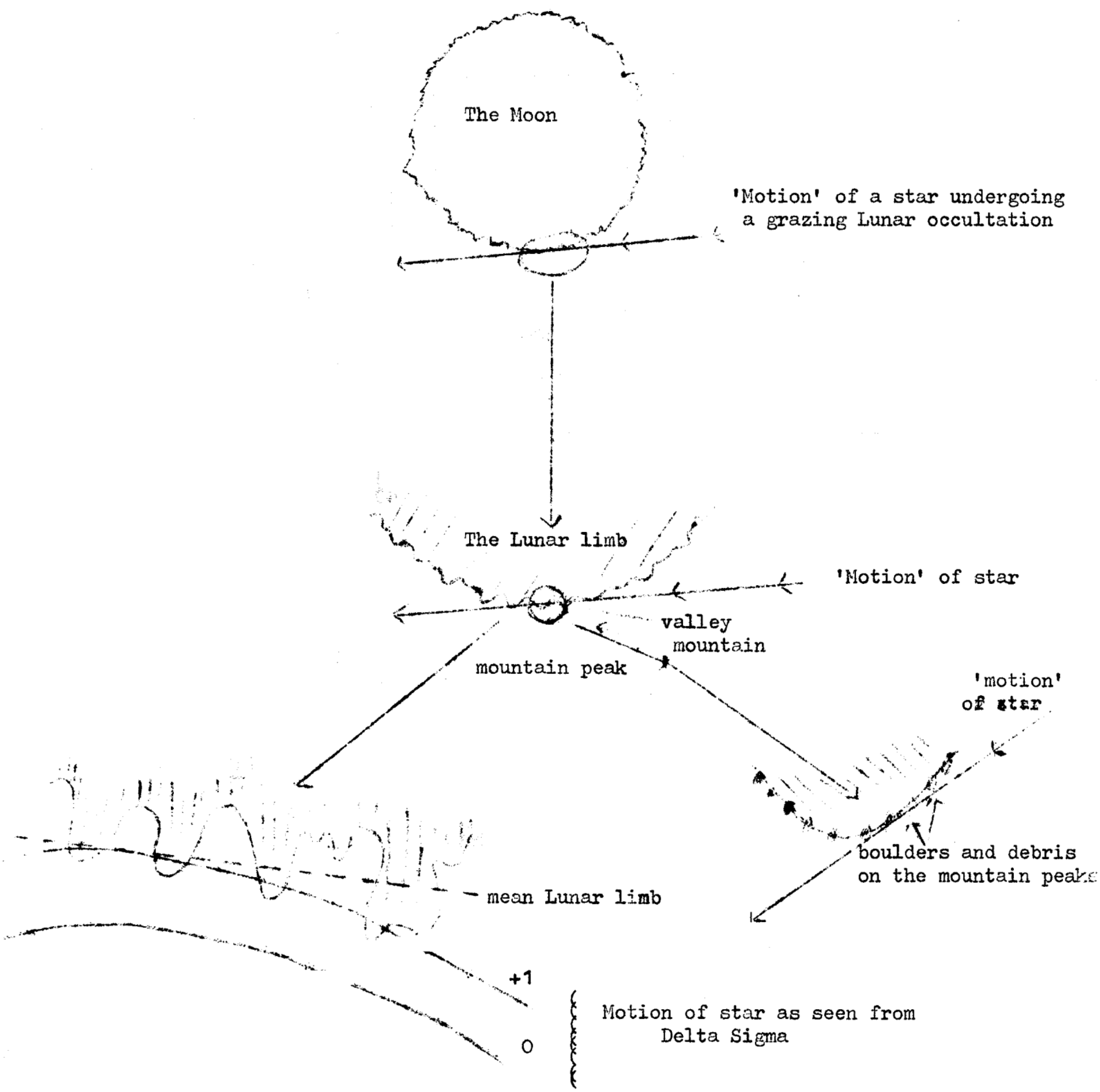
The B.A.A. Lunar Section also publishes a leaflet, copies of which should be in the Observatory. If not ask the Librarian. It's title is "Observing the Moon" (I think). Copies can be ordered from the B.A.A. and cost a few shillings.

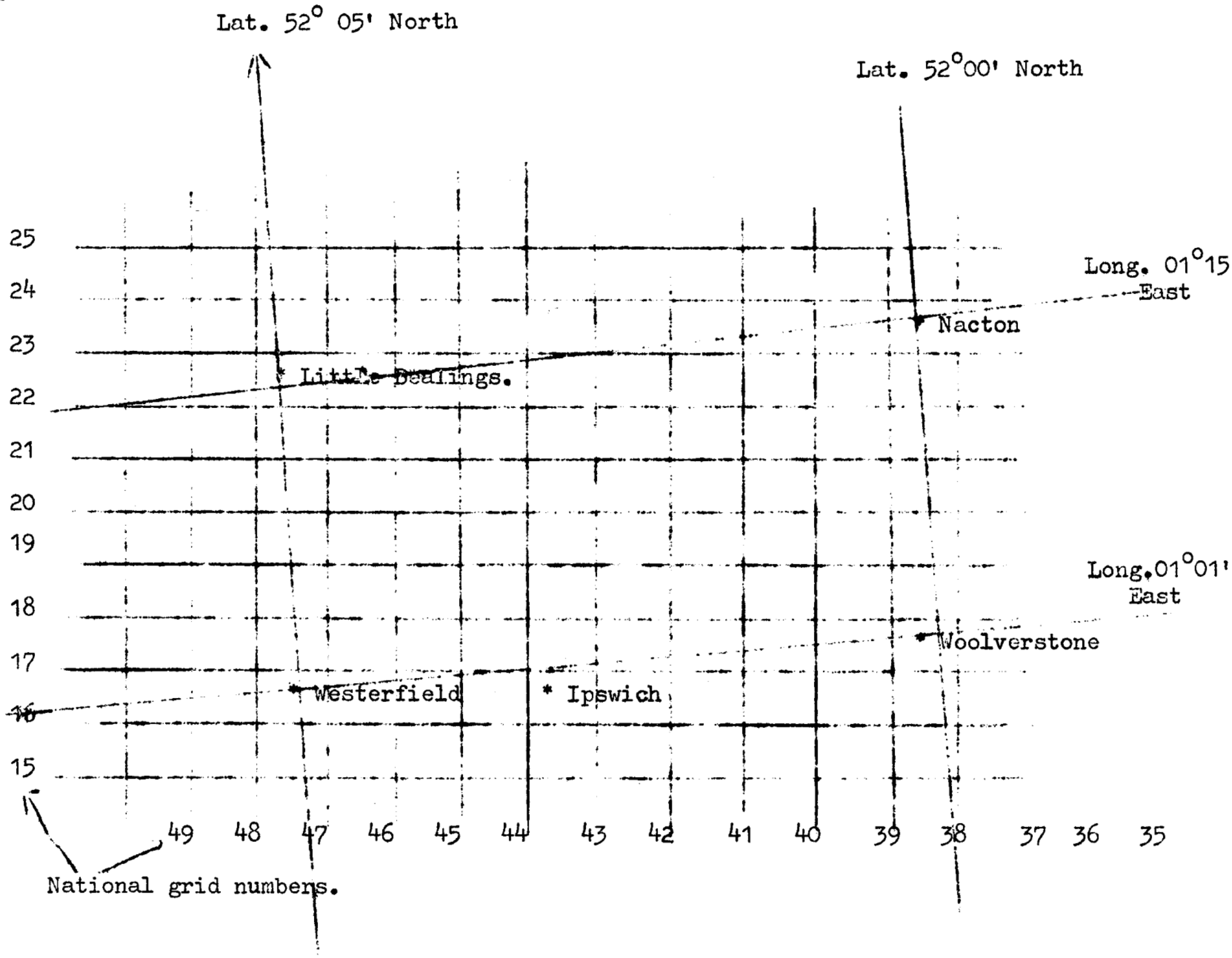
OCCULTATIONS.



Motion of occulted star

GRAZING OCCULTATION





Check the above replica national grid with an ordnance survey map of the Ipswich area. When making your own version of the above make sure the lines of latitude and londitude are properly perpendicular and parallel to and with each other.

The Application of Photography in Astronomy part 3.

by Mark Howe.

There are basically two methods of photography through a telescope: photography at the focus (focal method) and photography by projection (projection method) In the following discussion of their relative merits I shall assume that the reader does not have any form of automatic telescope drive but has to rely on other means to follow the apparent daily motion of the celestial sphere.

The best camera to use is one of the single-lens-reflex type with interchangeable lens facility. Indeed, the focal method is impossible without this facility and nearly so if you do not own a SLR. However, some rangefinder cameras, such as the Zorki 4K and the Leica Series 'M' cameras, do have interchangeable lenses, and so focal photography is feasible with these cameras.

In employing the focal method you are, in effect, using the telescope objective as a telephoto lens. The telescope eye-piece and the standard camera lens are both removed and the camera, minus the lens, is attached to the eyepiece mount. If an SLR camera is being used, correct focus is achieved by simply adjusting the eyepiece focussing mount until a clear, sharp image can be seen through the viewfinder of the camera. If the camera is one of the rangefinder-focussing type, the only solution I can offer is to measure the distance from the telescope objective to the film plate, which should equal the objective focal length. Any slight error will not amount to much, especially if the objective lens has a f-fatio.

The problem of following the object being photographed does not arise when it is the Sun, or the Moon if a film of 50 ASA or faster is being used, in which case the exposure will be about 1/15 second. If the subject is a planet, it must be followed through the guide telescope <u>very accurately</u> (however, I would not advise the focal method for photographing planets; see below)

The advantage of this method is that fairly short exposures are possible becaus of the high brightness of the image. The exposure for the Sun is about one millisecond and that for the Moon is approximately 1/15 second. Alternatively, the length of the exposure can be more greater and the film speed degreased to, say 12 ASA, giving finer grain and thus more detail.

When the focal length of the objective is F, and the angular diameter of the subject in minutes of arc is D, the size of he image I (in the same units as F) will be given by:-

$$I = \frac{FD}{3000}$$

Thus it will be seen that, even for the most conspicuous planet, Venus, the size of the negitive image as photographed through a 1000mm focal length objective will not be more than 1/3mm. across. So this method of photographing planets is best left to owners of long focal length telescopes; the effective focal length of the objective can be increased by the use of a Barlow lens, but personally I am not at all fond of these contraptions unless they are of the very highest quality.

One of the projection methods is akin to the method of projecting an image of the Sun onto a piece of paper to plot sunspots; the camera lens is not used (this is called eyepiece projection). However, this requires the use of an SLR with interchangeable lenses, and a simpler projection method is available.

In the second type of projection method, the telescope is first of all focussed by eye on the subject to be photographed. Then the camera, with its lens set on infinity, is attached to the eyepiece. If the telescope is focussed properly (don't forget if you are short or long sighted, the beam of light from the eyepiece will not be parallel, so you must focus with your glasses on or by some other means) there will be no other complications.

One drawback of the projection method is that following is essential for all subjects bar the Sun. This is due to the faintness of the image as compared with that obtained using the focal method, which necessitates longer exposures. An exposure of about 5 - 10 seconds is about right for photographing planets with 25 ASA film, 3 - 5 seconds for the Moon, and as little as 1/250th second for the Sun.

The great advantage of the projection method lies in the image it produces. This enables the amateur astronomer to photograph planets without too much difficulty. However, the images are still rather small and so fairly fine grain film must be used.

As noted before, the telescope best suited to focal photography is the long-focus sort. This means that refractors are quite well suited to this type of astro-photography. But the problem of false colour is accentuated in photography; this is why camera lenses often have six or more components. Because modern photographic films are more sensitive to blue than red, the effect of chromatic aberration can be reduced by the use of a yellow filter which filters out the bluer, unfoccused components of the light. A word of warning, however, a yellow filter will block out some of the incoming light, and you will have to double the exposure time.

On the other hand, a reflecting telescope is, or should be, completely free from any colour problems. Perhaps the best telescope for photography would be a long-focus reflector, such as a Cassegrain focus optical system.

From the above discussion it would seem that the best equipment for astro-photography is a Cassegrain combined with an SLR. But this does not mean that astrophotography cannot be attempted by someone with less perfect equipment: it depends much on your own ingenuity and determination.

NEW PLANETS

Not including the earth, the five brightest planets had been known since antiquity. The discovery of unknown planets was something no one had contemplated.

William Herschel and Uranus

William Herschel was born in Hanover, Germany, in 1738. His family contained many musicians. He was also a musician, playing an oboe in the Band of the Hanoverian Foot Guards. During a visit to England with the Guards, in 1755, Herschel decided he would like to stay there some time in the future. He returned to the continent, but after the German defeat at Hastenbeck, Herschel resigned from the Army and came back to England, finally settling in Bath.

For the first few years in Bath, Herschel taught music. In his free time his interest in astronomy grew. At the start he hired some telescopes for his observations. He was not satisfied with these hired telescopes, so eventually he constructed his own. His interest in astronomy began to take up so much of his time that he reduced the number of students in his music classes to about seven a day.

On Tuesday, 13th March, 1781 Herschel, using a telescope of his own construction, noticed an unusual object which he considered to be either a nebulous star or perhaps a comet. On observing the area four nights later he commented "I looked for the Comet or Nebulous Star and found that it is a Comet for it has changed its place". Herschel continued observing the object until enough information for its orbit could be calculated. During April he announced this discovery to the Royal Society. The Astronomer Royal at this time was Nevil Maskelyne who, after observing the object for sometime noticed that it was behaving more like a planet than a comet.

When sufficient information on its action was available, three Continental mathematicians, Simon Laplace and Jean Bochart de Sarron in France and Anders Lexell in Russia, worked out the object's orbit. They proved that this new object had an almost circular orbit at a distance of about double that of Saturn from the sun. The planet was subsequently names Uranus after a classical god. Herschel would have liked it named Georgium Sidus, after George III.

Uranus was observed some time before its true nature was known. John Flamsteed had recorded it as a fixed star of magnitude six. During 1768-9 Lemonnier had made eight observations of it. Its position was accurately recorded by Tobias Mayer at the beginning of 1756.

The discovery of Uranus brought Herschel's name to the attention of other astronomers. George III who was himself interested in astronomy and had an observatory built at Kew, asked to see Herschel and instructed him to bring his telescope to Greenwich. The 5.7" reflecting telescope with which the discovery of Uranus was made aroused much interest in other astronomers when it was set up at Greenwich. Every person familiar with astronomical telescopes thought that it was the highest quality telescope they had ever seen. It had a much higher magnifying power than existing telescopes. On taking the telescope to Windsor for examination by the Royal Family, George III offered to make Herschel independent of music, and gave him a salary of £250 a year, and an observatory site at Datchet.

Herschel was a prestigious maker of telescopes throughout his life. He constructed about 400 mirrors of various sizes and sold about 69 telescopes. One of the mirrors he made was the largest ever, up to that time. After beginning his full-time astronomical work at Datchet, Herschel managed to obtain £4,000 from the privy purse for its construction. The telescope had a mirror some 48 inches in diameter, and was constructed at Slough. Though it was used during the first two years after completion, it proved to be too cumbersome for constant use and gradually became obsolete.

With smaller instruments, Herschel made many more important discoveries during the next thirty years. He produced a catalogue of about 2,500 nebulae and similar objects. He made many series of measurements on double and variable stars. After his discovery of Uranus his most important work was on the distribution of stars in, and the shape of the Galaxy. For this he undertook star counts in about 3,400 selected areas of the sky. Herschel thought that the Galaxy was shaped like a rectangular box that was split open at one end. From a point within this box the stars would appear as a luminous band across the sky, just like the Milky W ay.

Herschel discovered infra red radiation by means of a thermometer held at the red end of a spectrum produced by a prism.

ORWELL ASTRONOMICAL SOCIETY (IPSWICH)

at Orwell Park Observatory,
Nacton, Nr. Ipswich.

Programme for May, 1976.

MONDAYS: from 8.30p.m. General Observations Section.
Director. Mr. N. Gage, [redacted], Felixstowe, 'Phone Felixstowe [redacted]
and Mr. S. Flory, [redacted], Ipswich, 'Phone [redacted]

May 10th
" 17th
" 24th

WEDNESDAYS: from 7p.m. Solar, Lunar & Planetary Section.
Director. Mr. R.M. Cheesman, [redacted], Ipswich.

May 5th
" 19th
" 26th

THURSDAYS: from 8.p.m. Double Stars Section.
Director Mr. D. Bearcroft, [redacted], Ipswich, 'Phone [redacted]

May 6th
" 20th

FRIDAYS from 8.30p.m. Lunar & Planetary Section.
Director. Mr. J. Deans, [redacted], Capel St. Mary, 'Phone GT. WENHAM [redacted]
and Mr. K. Dye, [redacted], Ipswich 'Phone [redacted]

May 7th
" 21st.

FRIDAYS from 8.30p.m. Nebula and Faint Objects Section.
Director, Mr. M. Stow, [redacted], Ipswich
and Mr. R. Hazelwood, [redacted], Ipswich, 'Phone [redacted]

May 14th
" 28th

METEOR SECTION
Director Mr. D. Barnard, [redacted], Ipswich, 'Phone [redacted]

Sporadic Meteor Count Saturday 22nd May
Meet OUTSIDE The Golf Hotel, Foxhall Road, Ipswich, at 10p.m.