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JOURNAL OF THE JUNIOR ASTRONOMICAL SOCIETY

The Whirlpool Galaxy, M 51

See page 145

Photograph courtesy Mt. Wilson and Palomar Observatories

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comment

Congratulations to all those of you who entered our speculative art contest, *Man Reaches Mars*. The overall standard was remarkably high, and all entrants showed a most pleasing enthusiasm for their subject.

The winner, with a striking and bold colour painting, was R. Burch of Benfleet, Essex, who wins our splendid book prize. Highly commended were: Martin Cailes and Robert Webber. Commended was Paul Hartley. Unfortunately, it is not possible to reproduce the winning entry for technical reasons, but I hope as many of you as possible will be at the next Caxton Hall meeting for the official prize-giving.

For those of you with a more literary bent, I am pleased to announce another of our popular essay competitions. A book prize will be presented to the author of the best article inspired by **your** favourite *Hermes* photograph. For instance, if you particularly like Dr. Roberts' photograph of the Pleiades (January issue), why not write an article about this famous star group. Or if you are struck by the recent Moon-probe photographs, you might write about how these space-craft came to reach their destination. The possibilities are endless; they rely on your ingenuity.

Entries should be between 750-1,000 words, typed if possible. Age will be taken into account when judging, so please let us know how old you are. Try and be as original as possible; and don't copy material directly out of books and magazines. The closing date is December 23, and the winning entry will appear in the April *Hermes*. Good luck to you all—can we expect a record entry for this contest?

IAN RIDPATH

from the p.r.o.

More helpers are urgently required to act as DISTRICT PUBLIC RELATION OFFICERS for the JAS. With an immediate target of 2,000 members, these representatives will have an extremely important job to perform.

It is possible that you have an interest in this subject and can help *your* Society by informing local organisations, educational centres and local journals about the activities of the JAS. Please don't hesitate, therefore, to get in touch with me at 73 Sanger Avenue, Chessington, Surrey, and I will post on to you further details. I shall be particularly interested to receive your views on ways in which the Society membership may be increased, and in future it is hoped that some of these comments will be printed in *Hermes*.

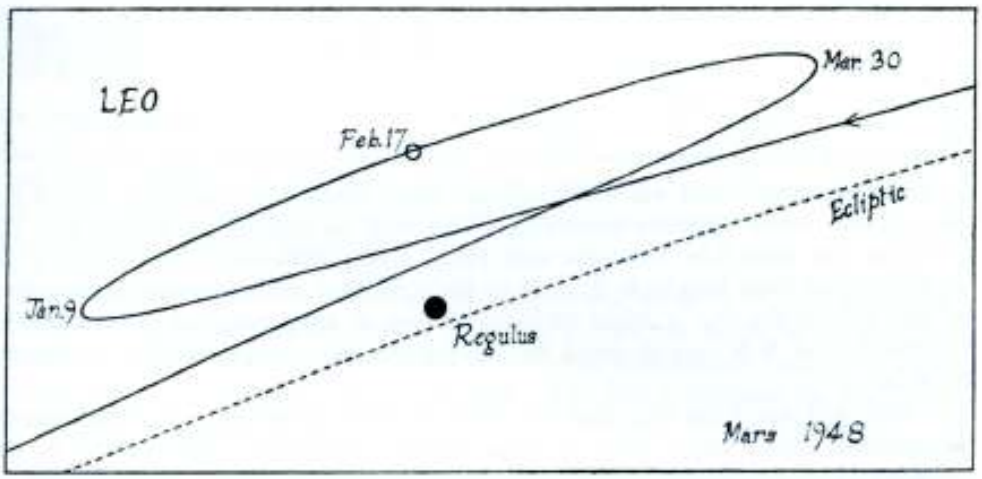
Every one of you can act as a P.R.O. for the JAS! Let us attempt to achieve a membership of 2,000 and above by Christmas of this year—and we have not far to go. Remember, increased Society membership means increased Society facilities for JAS members, such as that exciting new-look *Hermes* we are all hoping to produce. Your job is therefore of vital importance; can I hear from you this week?

GEORGE TEIDEMAN

in opposition

by J. G. Porter, B.Sc., Phd. FRAS.

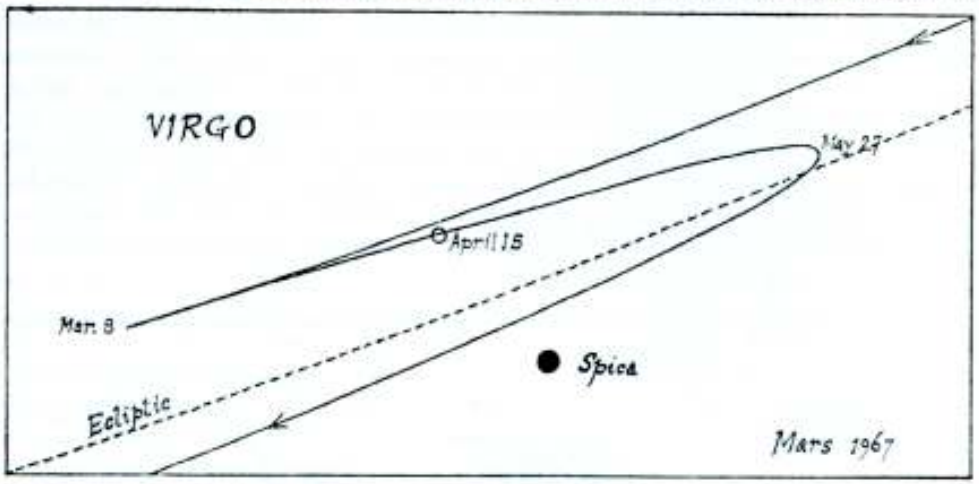
Mars is now low in the south-west at sunset, and not very conspicuous, but I wonder if you observed it at the time of opposition in April last, and noticed the peculiar shape of its apparent path among the stars of Virgo? The whole subject of the shape of the apparent path of a planet or comet is quite a fascinating one, but most text-books are rather cagey about it because it can become very complicated. If a planet were to travel in the plane of the Earth's orbit, then we should see it always in the ecliptic, shuttling backwards and forwards along this great circle in the sky. But the planetary orbits are all inclined to the ecliptic, and so we see them pass north or south of this great circle, crossing it only at the two nodes. If the planet were to come to opposition at its most northerly point (90° in longitude from the ascending node) then its latitude is changing very slowly, and the apparent path forms a loop, which is merely the effect of perspective due to the changing distance and angles from the Earth. The opposition of Mars in February 1948 is a good illustration of this.



On the other hand, if the planet is at opposition at a node its latitude is changing most rapidly, so that it moves north (or south) so quickly that the apparent path does not fold back on itself but is drawn out into an S-shaped curve. The opposition of Mars in November 1958 was of this kind; in this case the planet was at the node on November 9 and came to opposition only a week later. We can now see that at the opposition in April of this year the conditions were between these two extremes, the planet crossing the node 50 days after opposition. The loop is still there, but it has shrunk so much that it cannot be shown on the scale of the diagram. Calculations show that the loop was only 2·4° long and about 76 seconds wide, but it is interesting to note that Mars was apparently moving so slowly that it took about 40 days to traverse this small loop.

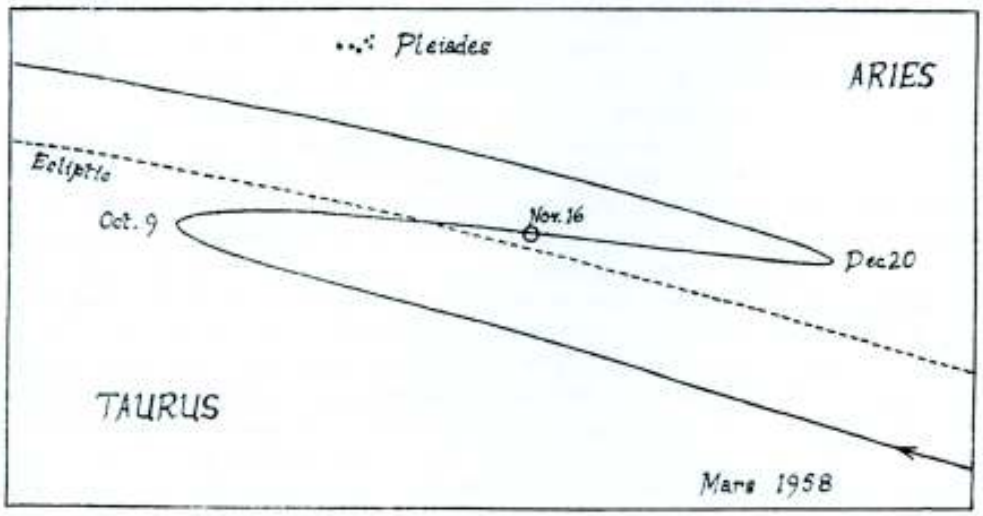
When a loop is formed in this way there is always a double point where the apparent path crosses over itself, and you will see that this double point always lies nearer to the ecliptic than the point of opposition, which occurs somewhere near the middle of the retrograde part of the curve. The dates of opposition are those on which the longitudes of the Sun and of the planet differ by 180°; note that it is the longitude, not the right ascension, that is used, for there can be a

very big difference between the two. It all depends on the inclination of the planet's orbit, for if the planet is well north of the ecliptic, its longitude and R.A. may differ considerably. Thus in 1967 Pluto was in opposition in longitude on March 10, but opposition in R.A. did not occur until a week later. This is not a very extreme case, but with very large inclinations the planet can wander into very high latitudes, perhaps right up to the pole of the ecliptic, or even farther north. It may then be seen in that curious part of the sky between the



pole of the ecliptic and the north celestial pole, where the longitudes and R.A.s can actually be in opposite quadrants. This may be difficult to realise, but, for example, the stars Chi Draconis and Delta Ursae Minoris both lie near R.A. 18 hours, but their longitude is close to 90°. So if a comet or planet were seen in this part of the sky, it might be in opposition in longitude, but it would be in conjunction in R.A.—or it could be moving direct in longitude, but retrograde in R.A.

You will see from this that the (very ancient) definitions of opposition or conjunction really apply only to those planets which stay fairly close to the ecliptic. You can hardly apply these rules to a minor planet or comet which comes right inside the Earth's orbit. Such a body could be in opposition or



superior conjunction when it is outside the Earth's orbit, but when it comes inside, it could be in inferior conjunction as well as superior conjunction—and it might even transit across the face of the Sun. The shape of the apparent path in such a case as this becomes extremely complicated. Even if the body had quite a small inclination to the ecliptic, it could cross the Earth's orbit at a point quite close to the Earth, and would then be seen high up near the pole. This happens, for example, with the little planet Icarus in 1968, whose orbit is inclined at about 23° and has its perihelion well inside the orbit of Mercury. In June of next year Icarus approaches the Earth within 4 million miles and it will move very rapidly from Perseus through Ursa Minor (quite close to Polaris) then through Ursa Major and down to Libra—all this in about 16 days. This will give astronomers the opportunity to make more accurate measurements of the scale of the solar system, the mass of Mercury and a number of other quantities which are not yet known with sufficient accuracy. But I doubt if you will be able to observe this interesting close approach, for at its brightest Icarus will only reach the 13th magnitude. Rather a pity, I think.

novae

by Graham Gough

The word *nova*, from *nova stella*, means 'new star'. Before telescopes came into wide use, the appearance of one of these dramatic objects, a bright star blazing down from where none had previously been seen, were quite logically thought of as new. But in actual fact a nova is not a new star at all—rather, a very old one, as modern theories see it.

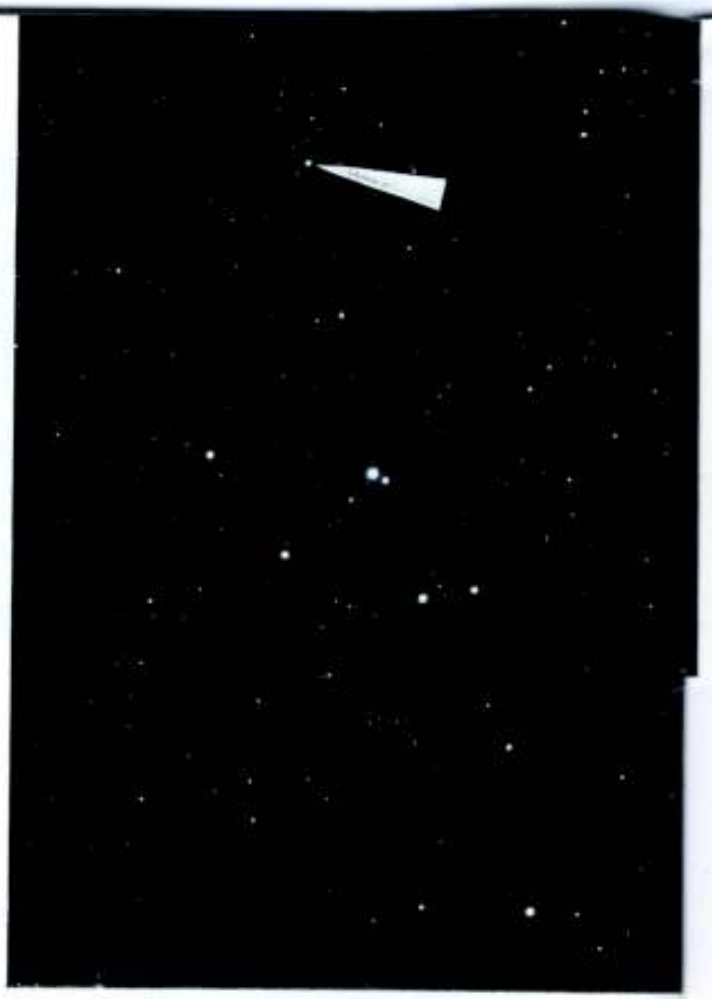
A nova, according to astrophysicists, starts out as an O- or B-type star, burning hydrogen by nuclear fusion reactions. At some point in its life, the hydrogen is almost used up, and the star becomes imbalanced, causing a rapid temperature rise inside the body of the star. The star undergoes an explosion, and we see its magnitude rise.

An ordinary nova dies down to leave the star at about the same brightness as before the explosion. In some cases, such as that of T Coronae Borealis, the star has flared up again after its first decline (see article by P. Lancaster Brown, July *Hermes*). When the explosion is over, the star may possibly be what is known as a white dwarf star. We also believe that the matter expelled can be seen around the nova, forming a planetary nebula.

The average nova has a maximum absolute magnitude of about −6, this being the magnitude it would appear to have from a distance of 10 parsecs.

But occasionally there occurs a nova which reaches an absolute magnitude of about −15. This is a supernova, and it is rather different from the average new star. After the explosion, there is no star left—just the exploded remains. Examples of this are the well-known Crab Nebula, which was seen by the Chinese in A.D. 1054, and of which there can be now seen only the shattered fragments, and the Veil Nebula in Cygnus—now a huge tenuous shell of gas.

Another famous supernova was that noted by Tycho Brahe in A.D. 1572, found in the constellation of Cassiopeia. His detailed descriptions of that star are in *De Nova Stella*, a work of his.



Nova Delphini 1967 *(arrowed) Photograph by Colin Hunt, Aylesbury, on July 9. Exposure ½ hr., f5·6, on Ilford Zenith plate.*

A classic example of a nova in recent times is Nova Aquilae. This, on June 7, 1918, experienced an internal explosion that shot its magnitude from 10·5 to 6·2 in one evening. By June 8 it had risen to mag. 1·2, and by the 9th, the maximum magnitude of −1·44. This only lasted a few hours and by the following night its magnitude had fallen to 0·0. This means that the star's luminosity must have risen to about 70,000 times above normal in a few days.

By the end of that June the magnitude had decreased to 5·8, and from then it went down very slowly. In 1925 it had sunk back to magnitude 10·5, varying irregularly by about 0·5 magnitude.

Of course, we have recently been treated to a nova of our own. Discovered by George Alcock on July 8 this year, Nova Delphini 1967 can still be seen. This is a slow nova, having risen from about mag. 11·9 to mag. 5·4. The surprise here is that it was visible to the whole world for many days before the assiduous sky sweeping by George Alcock picked it up.

Details of the discovery and the nova have already been given in JAS Circular No. 8, and in the *New Scientist*, July 20. Full accounts are not yet in, since it will be a long time before the full story is known and all patrol plates have been scanned for pre-discovery magnitudes.

The essential point about Alcock's discovery is that it was made with a simple pair of binoculars, of aperture 80 mm. and magnification 11 times. Although his discovery was aided by his intimate knowledge of the sky, it is still true that any amateur can discover a nova. Furthermore, it is centuries since a supernova appeared in our own galaxy, and one is long overdue. Perhaps a JAS member will be the first to find it?

the great discoverers

by B.Stevens

Percival Lowell will take his place in the astronomical Hall of Fame as the brilliant mathematician, writer and lecturer whose dedicated and painstaking calculations led to the tracking down of Pluto by Lowell's observatory assistant, Clyde Tombaugh, some fourteen years after Lowell's death. However, Lowell is more closely associated in the popular mind with the canals of Mars, a subject on which his views were revolutionary, if not fantastic.

PERCIVAL LOWELL (1855-1916)

Percival Lowell was born on March 13, 1855, in Boston. After being educated at Harvard and some time spent in the Far East (during which time he wrote several books dealing with Japan, a then unfamiliar country, and was at one period American Counsellor to Korea) Lowell decided to devote his life to astronomy with special emphasis on Mars. Realising that the only way to study Mars in detail was to use a large telescope under clear dust-free skies, Lowell founded his own observatory at Flagstaff in Arizona, where he could carry out his work under good seeing conditions, and equipped it first with an 18-inch and then a 24-inch refractor. With the support of many eminent men who joined it at various times, Flagstaff began in 1895 a stream of valuable scientific work which has continued up to the present time.

Lowell first became interested in the possibility of a trans-Neptunian planet at the turn of the century. In December 1902 he gave a series of lectures, entitled *The Solar System*, which were published in book form. He deals with the apparent comet families associated with each of the giant planets, noting the existence of two aphelion groupings beyond the orbit of Neptune, and adds:

"This can hardly be accident; and if not chance, it means a planet out there as yet unseen by man, but certain sometime to be detected and added to the others. Thus not only are comets as a part of our solar system now recognised, but they act as finger-posts to planets not yet known."

This thought of a planet beyond the one for which he was in search was still with him many years later. In his 100-page *Memoir on a Trans-Neptunian Planet* of 1915 he writes: "The solutions indicate the place of the perturbing matter supposing it is represented by a single body which is the only practical and workable supposition. For though other bodies doubtless exist beyond, their effect is not likely, owing to distance, to be such as seriously to modify the primary solution."

The Flagstaff observatory began a search for this unknown planet in 1906, and continued it through twenty-four years. Lowell continually re-worked and refined his calculations until he was sure he had obtained the best prediction possible for the position of Planet X. Towards the end, as if foreseeing death, he worked feverishly. From his office in Boston he would telegraph out the latest data, revising the prediction and urging that the telescopes be immediately turned on this new area. If results were not rapidly forthcoming, he would telegraph again to Arizona demanding, "Hurry!"

Through all this time, Lowell was still heartily engaged in writing, travelling, furthering his opinions on the planet Mars, and even in June 1908, succumbing to marriage. The most significant result of Lowell's observations at his observatory was the publication in 1906 of his book *Mars and its Canals*, which gave rise to an unprecedented argument.

Lowell's observations greatly increased the number of canals first mapped by Schiaparelli in 1877. This in itself does not account for the controversy aroused by the book, for the argument over the actual existence of the canals had already gathered weight. Lowell deduced that the geometrical network of lines was an artificial structure designed to capture and utilize as well as possible the meagre aquatic sources of this arid world. In other words, he believed there were present on Mars beings with a civilisation more or less comparable with that achieved by the human race. Lowell stated, firmly and uncompromisingly, "That Mars is inhabited by beings of some sort or other we may consider as certain as it is uncertain what these beings may be." (*Mars and its Canals*, p. 376.) He drew attention to the fact that when two canals crossed, as they frequently did, there was a blob or oasis, which was presumably a centre of population.

Lowell's conclusions aroused tremendous public interest, but were vigorously disputed by several astronomers, notably Antoniadi, who made many observations from 1909 onwards with the 33-inch refractor at Meudon Observatory, and emphatically concluded that the lines observed by Lowell did not exist; they were, he said, merely an optical illusion. Probably Lowell was annoyed at the abuse and ridicule hurled at his head—for the fact remains that he was a great astronomer, who did much for science, and his faith was not shaken for one moment.

He continued his work at Flagstaff, mapping over seven hundred canals. Most of these can still be recorded today, although it is now generally accepted that Antoniadi's conclusion was correct. Although remorseful at his failure to find Planet X, Percival Lowell remained active to the last. He died in November, 1916, with the words: I did not know it would be so soon.

galaxies and nebulae

M.J.Hendrie, FRAS

The photograph (*cover*) shows the well known spiral galaxy NGC 5194 (M 51) and the associated galaxy NGC 5195. This galaxy deserves its descriptive name "Whirlpool" galaxy and is a very fine example of spiral structure in a galaxy seen almost face on, with its plane at right angles to the line of sight.

Becvar's *Atlas Coeli II Katalog* gives the following information about these objects:

	RA(1950·0)	Dec(1950·0)	Mag(vis)	Mag(phot)	App. Size	Type
NGC 5195	13h 27·9m	+47° 31′	8·4	11·1	2·0′ × 1·5′	I
NGC 5194 (M 51)	13h 27·8m	+47° 27′	8·1	10·1	12·0′ × 6·0′	Sc

Abetti, in his book *Nebulae and Galaxies* (Faber 1963), gives the distance as 18 million parsecs (60 million light years). The galaxy M51 is shown in *Norton's Star Atlas* about 4 degrees south preceding η Ursae Majoris, although M 51 itself is over the border in the constellation Canes Venatici.

This galaxy is interesting because it shows so well the bright nuclear regions, spiral structure, bright condensations in the arms and the widespread presence of dark obscuring matter. The bridge joining this galaxy to its satellite NGC 5195 which is classed as an irregular type of galaxy, almost devoid of organised structure, looks more like a gaseous nebula of the type found in the Milky Way, rather than a system of stars like M 51. However it is too far away for individual stars to be seen so that appearances are deceptive.

It is also interesting that this galaxy was probably the first to reveal its spiral structure; Lord Rosse noted it about 1850 with the 72-inch aperture reflector he built at Parsonstown in Ireland.

In *Outlines of Astronomy* Sir John Herschel describes the appearance of these objects on page 607 of the 1850 edition:

> "The 51st Nebula of Messier, viewed through an 18-inch reflector, presents the appearance of a large and bright globular nebula surrounded by a ring at a considerable distance from the globe, very unequal in brightness in its different parts, and subdivided through about two-fifths of its circumference as if in two laminae, one of which appears as if turned up towards the eye out of the plane of the rest. Near it (at about a radius of the ring distant) is a small bright round nebula. Viewed through the 6-feet reflector of Lord Rosse the aspect is much altered. The interior, or what appeared the upturned portion of the ring, assumes the aspect of a nebulous coil or convolution tending in a spiral form towards the centre, and a general tendency to a spiroid arrangement of the streaks of nebula connecting the ring and central mass which this power brings into view, becomes apparent, and forms a very striking feature. The outlying nebula is also perceived to be connected by a narrow, curved band of nebulous light with the ring, and the whole, if not clearly resolved into stars, has a 'resolvable' character which evidently indicates its composition."

The spiral nature of this and other nebulae was confirmed when photography was applied to faint objects, especially by Isaac Roberts in England about 1890. Even as late as 1920 there was still great argument as to whether these nebulae were a part of the Milky Way system or were external systems of stars comparable in scale with our own Galaxy.

Looking at the front page photograph of the "Whirlpool" galaxy taken with the 200-inch Hale reflector, Lord Rosse's description can be seen to be surprisingly accurate—which is all the more remarkable when one remembers that his 72-inch telescope had no modern mounting, was situated in a generally unfavourable climate and required frequent refiguring and polishing. Finding M 51 with such a telescope would tax the patience of most observers.

observing the constellations

by P. Lancaster Brown, FRAS

Although the constellation of Cepheus is a relatively inconspicuous configuration to the naked eye, with even the simplest optical aid the area is revealed strewn with glorious star fields. The main part of the constellation lies within the borders of the Milky Way and it can easily be found lying in the triangular area formed by the Pole Star, Cassiopeia and Cygnus. Another method to locate it is by projecting a line from Alpha Persei (Marfak) to Alpha Lyrae (Vega); half way between these two stars can be found the brighter members which form the traditional figure. In the latitudes of the British Isles the entire constellation is circumpolar so that at different times one sees the complete inversion of the group, a fact which may cause some confusion to the beginner.

The origin of the constellation is controversial. Some ancients declared that the group of stars was placed in the heavens in memory of Cepheus, a king of Ethiopia, father of Andromeda by Cassiope. Another story is that he was one of the Argonauts who sailed in the ship Argo to obtain possession of the Golden Fleece, and was changed into a constellation at his death. Still another story links Cepheus with Cheops the builder of the Great Pyramid in Egypt.

Compared with other constellations Cepheus makes a fairly presentable (and convincing) human figure showing both feet, waist and shoulders to advantage; and some fainter stars between the shoulders and above are suggestive of a crowned head, called by Ptolemy the Tiara.

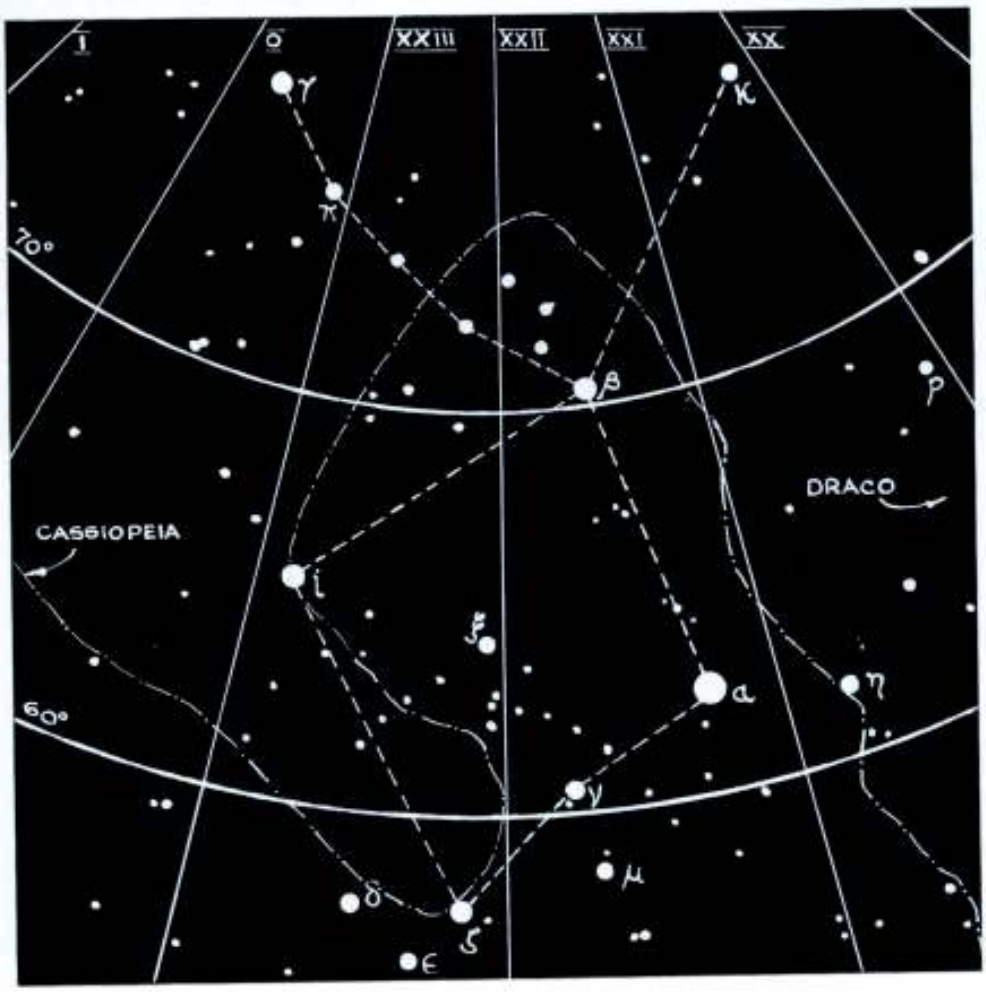
But to the nomadic Arabs, the constellation had a pastoral meaning and depicted a shepherd attended by his dog keeping watch in a fold or field. Some authorities are of the opinion that in the period 21,000-19,000 B.C. when the stars Alpha Cephei and Gamma Cephei were each respectively pole stars, it represented the Ape god, Kapi.

The brightest member in the group is the white star **Alpha Cephei** or Alderamin, magnitude 2·6, which means right arm—now marking what is considered the right shoulder of Cepheus. It was the pole star in 21,000 B.C. and will be Polaris again in the year A.D. 7,500. It is of interest that midway between Alderamin and Alpha Cygni (Deneb) lies the north pole point of Mars.

Beta Cephei or Alfirk meaning 'a flock' marks the waist of Cepheus. It is an optical double star, magnitudes 3·3 and 8·0, distance 13·7 seconds and a fairly easy object with a 2-inch O.G. The primary star is also a variable (of the classical Cepheid type—range 3·32 to 3·73). In addition it is also a spectroscopic binary system with a period of revolution of only 0·190 days.

Gamma Cephei, magnitude 3·4, a yellow star called Errai (the shepherd) marks the left knee of the figure. It will be Polaris in approximately 2,600 years' time.

Delta Cephei is a variable star and probably one of the most famous stars in the entire Northern skies. It was from this star that the Cepheid variables were so named and this was the first example of its type to be recognised. It is also an optical double with a companion star of magnitude 7·0 about 40 seconds away; the yellow and blue combination of these two stars is reminiscent of Beta Cygni (Albireo). The primary star varies in magnitude from 3·90 to 5·00 in a period of 5·3663 days. The Cepheid variables have been of interest to astronomers ever since the light changes were discovered in 1784 by the English amateur John Goodricke, a deaf mute who was one of the earliest and most successful discoverers of variable stars. He died tragically at the early age of 22 years.



The light variations of this star and the other Cepheid variables proceed with clockwork regularity. The periods are usually measured in days, but they are unlike the short period eclipsing Algol type variables and their light variations are due to periodic pulsations. A peculiar relationship was discovered between the length of period and the luminosity when many others of these stars were found. The longer the period the more luminous the star. This period-luminosity relationship has been of the greatest value in furnishing us with another method of determination of stellar distances within our own galaxy, in the globular clusters and even the nearby galaxies. It is only necessary to measure the period of a Cepheid in order to deduce its intrinsic brightness, and when this brightness is compared with its observed brightness the distance can be deduced. Today several thousand Cepheid type variables are known.

Nearby Delta is a remarkable double known by its catalogue name of **Krueger 60**—a very faint and insignificant but interesting double star of magnitudes 9·0 and 9·2. The orbital period is only 44·52 years and it is one of the closest situated binary system to the Solar System, with a parallax of 0·257 seconds (about 14 light years). Yet although so close it is well beyond the range of naked eye visibility. Both stars are members of a class of star known as red dwarfs. The brighter star is only one-fifth of the sun's mass while the fainter one is just in excess of one-sixth. This fainter star is one of the least luminous stars known to us at the present time.

Two other bright stars that help form the familiar configuration are **Iota Cephei,** magnitude 3·7 and **Zeta Cephei,** magnitude 3·6.

Among the other fainter stars is **Mu Cephei,** the celebrated red star nicknamed the 'Garnet Sidus' by Sir William Herschel. In 1848 it was discovered to be an irregular variable star by the famous English amateur J. R. Hind who eventually rose to become the Superintendent of the Nautical Almanac Office. The magnitude variations, 3·6—5·1, can be followed entirely with the naked eye, but it often takes between 5 and 6 years to complete one cycle. In binoculars or small telescopes the star is very striking in appearance, especially immediately after looking at the brilliant whiteness of Alpha Cephei.

A variable that can be followed through its entire light fluctuation with binoculars is **U Cephei** (an eclipsing Algol type variable discovered by the Russian Ceraski in 1880) with a magnitude range of 6·74—9·81 in a period of 59 hours 50 minutes. In 4½ hours it falls in brightness, remains there for 2 hours and then rises slowly back to maximum again.

The constellation of Cepheus although strewn with rich star fields has little to offer in the way of star clusters and nebulae for those equipped with small instruments, and although this writer has observed some of them with as little as 2—2½-inch aperture they require a 4-inch refractor or a 6-inch reflector to make more than a nodding acquaintance. However, if opportunity occurs to view this region on a dark, moonless winter's night through a 'Richest Field Telescope' such as 10 x 80 binoculars, one is rewarded with a view of the diffuse gaseous and dark obscuring nebulae (known as Coalsacks) that makes the venture into the winter cold a worthwhile and unforgettable experience.

time . . . its measurement and importance

Summary of a talk given by Dr. L. Essen, OBE, FRS, DSc, AMIEE, at the JAS meeting of July 29, 1967

The astronomical standard of time serves two purposes: giving the time of day, required for civil and navigational applications, and also the unit of time interval required for physics. In order to make this unit as constant as possible, various different time scales called UT0, UT1 and UT2 have been used. All of them depart considerably from the time of day. The most uniform of these time scales provides a unit which is thought to have varied by 7 parts in 10^8 during the last 200 years, and which, with the help of good quartz clocks, can be determined with an accuracy of about 1 part in 10^8. This accuracy falls short of present day requirements. More precise measurements are needed for radio applications and in particular for navigational systems.

The atomic standard is based on the fact that some spectral lines have a frequency within the radio frequency range. This means that the vibrations can in effect be counted—a prerequisite for any time standard. The particular transition which has proved most useful is the hyperfine transition of the hydrogen or alkali atoms. This is accompanied by magnetic properties which facilitate its detection and enable it to be defined with an accuracy of 1 part in 10^{11}. Most standard frequency and time services throughout the world are now controlled by atomic clocks, which have thus completely revolutionised the measurement of time.

Ref. *Keeping Atomic Time* by Dr. L. Essen—*New Scientist*, July 20, 1967, page 148.

amateur astronomy

Summary of a talk given by E. A. Beet at the JAS meeting of July 29, 1967.

An amateur astronomer is one by choice; he (or she, of course) "does" astronomy because he cannot help it, and without thought of any reward; it is "science for its own sake".* If the interest is primarily practical observation there must still be some serious reading, for observation without understanding brings no satisfaction. If the branch of astronomy being studied is in itself outside an amateur observer's reach, making the student a desk-chair astronomer, he must still get outside and make himself thoroughly familiar with what can be seen, for reality cannot be wholly realised at a desk. In either case the amateur astronomer must be patient and persevering, *dedicated* to the task undertaken. Most of the work is done for personal satisfaction only, but if it is done well and methodically recorded some of it someday might be of value to a research worker. One of the things which amateur Societies do is to collate and preserve members' work for such an eventuality, *provided that it is good enough*.

Although the amateur astronomer is really a "do it yourself" person, joining a Society makes possible the exchange of ideas with others of like interest; the observer can become a better observer and the student can make more rapid progress. Membership is a two-way business. The "what do I get out of it" person is not welcome, for Societies depend on what its members can put in, not only by subscription but by knowledge, experience and leadership. The JAS is intended for beginners, but it includes many competent amateurs as well —they put in their experience to train beginners to become competent in their turn. The advanced amateur who wants wider facilities than the JAS can offer joins the British Astronomical Association. Professional astronomers join it too; the knowledge and experience they bring in is invaluable to the amateurs. Compared with the JAS, the B.A.A. has more sections, more meetings, more publications, an extensive library—and of course a higher subscription. The Royal Astronomical Society is largely professional, and provides for the discussion and publication of original research. Some amateurs become fellows, and thereby make a financial contribution (and a few gifted ones an intellectual contribution too) to the advancement of astronomy. These three national Societies are not rivals: they are complementary, each with *its own contribution* to make to "astronomy for its own sake".

*Sir Edward Appleton, Pres. Brit. Ass. for Adv. of Sci., 1953.

from the president

One of the most healthy signs about any Society is an active interest by the Members in its running. To judge by the number of letters and comments reaching me, the JAS is very fit, and now the outward sign of vigour is shown by active competition for vacancies on Council. Now is your chance to vote for the Council YOU want by the postal ballot. Everybody, or every Society receiving a copy of *Hermes* by subscription is entitled to use the ballot paper and vote for up to 4 candidates of their choice. Although a vote for more than 4 candidates will invalidate your paper, a vote for 1, 2 or 3 only will not.

Also with the ballot paper is a questionnaire. It is not necessary for us to have your name or number on the questionnaire, as it is just the overall statistics we need. Please read carefully the instructions on the back of both of these papers before completing them. I do hope you will complete and post both right away. The third portion of these centre pages is your subscription renewal form. If you have not already paid for the coming 12 months, would you please detach that portion of the page, and post it together with a cheque or postal order, payable to the JAS, to Mr. Tibbott. If you could help us in this way, you will be making a very substantial saving to our funds as we normally have to spend a lot of time and money in chasing overdue subscriptions. The more money we can save in this way, the more we have to provide you with a better Society.

I hope to see as many of you as possible at the AGM, where you will have an opportunity of hearing how the JAS has fared in the last year. The two excellent speakers are shown in the Programme.

MICHAEL J. de FAUBERT MAUNDER

September 1, 1967

Voting Paper

Please return this Voting Paper to the JAS Secretary,

Mr. D. B. P. Beglan,
17 Chanctonbury Chase,
REDHILL,
Surrey.

NOT LATER than 12 Noon, on Friday, October 27, 1967.

No communication, other than the Questionnaire, must be returned in the same envelope. Any clue to your identity will invalidate your votes.
The Scrutineers (appointed at the A.G.M.) will disqualify your votes unless the envelope returning your ballot paper is

SEALED; Marked VOTING PAPER; and marked with your MEMBERSHIP NUMBER.

This renewal form should be detached from the Ballot Paper, and Questionnaire. It must not be returned with them, but to

The Assistant Secretary of the JAS,
Mr. V. Tibbott,
58 Vaughan Gardens,
ILFORD,
Essex.

Please remember that the Asst. Sec., like all other members of Council, is a voluntary worker. We ask you to allow at least 3 weeks for your receipt, at this very busy time.

JUNIOR ASTRONOMICAL SOCIETY

VOTING PAPER

You have 4 votes. Please record your votes by crosses against 4 candidates of your choice, from the alphabetical list below.

☐	G. LAKE	Responsible for distribution of Beginners' Notes. Area Representative.
☐	P. S. LITTON	Past President, 1962-1964. Council Member.
☐	G. TEIDEMAN	Public Relations Officer. Editor, 1964-1967.
☐	M. D. WAGHORN	Artwork for *Hermes*, since July issue 1967. Committee member of Croydon Astronomical Society.
☐	H. N. D. WRIGHT	Director of the Occultation Section. Council Member.

Detach this Portion

To: The Assistant Secretary of the JAS,
58 Vaughan Gardens, ILFORD, Essex.

PLEASE FIND ENCLOSED 15/- Cheque/Postal Order (made payable to The Junior Astronomical Society) as my subscription until September 21, 1968.
I also enclose a further 5/- for the purpose of receiving JAS Circulars until October, 1968.

I enclose a further 4/- for the purpose of receiving 4 issues of "SELEN", the official bulletin of the JAS Observing Sections.

NAME (Block Letters) .....

ADDRESS .....

.....

.....

MEMBERSHIP NUMBER .....

If your Subscription has been paid in advance, or up to March, 1968, please ignore this notice.

Delete where not applicable.

JUNIOR ASTRONOMICAL SOCIETY

QUESTIONNAIRE

The Council exists to help all JAS members in any practicable way, but it can only do so if it has some knowledge about you, or your comments. Please help us by completing the following short questionnaire.

Please tick appropriate boxes

1. GENERAL PERSONAL. Male / Female ☑☐
   (a) Age— less than 10 / 10-15 / 15-21 / over 21 ☐☑☐☐
   (b) Area of residence— London / SE / West / Midlands / Other ☐☐☐☑ Other
   (c) JAS member for— less than 1 year / 1-3 yrs. / over 3 yrs. ☐☑☐
   (d) Also Member of— RAS / BAA / BIS / Local Society ☐☐☐☐
   (e) Is astronomy your main hobby?— Yes / No ☐☑

2. METHOD OF JOINING. Did you join through mention by:—
   Friend already a member / Book / Magazine / T.V. / School ☑☐☐☐☐

3. "HERMES". Do you consider it to be:—
   Just right / Too advanced / Too simple ☑☐☐
   Have you written anything for it— Yes / No ☐☑
   or "SELEN" Yes / No ☐☑

4. OBSERVATIONS. Are you an 'armchair' astronomer?— Yes / No ☐☐
   Please indicate how many of the following you possess:—
   (a) Binoculars or field glasses ☐
   (b) Refractor(s) of less than 3 inches aperture ☑
   (c) Refractor(s) of more than 3 ,, ,, ☐
   (d) Reflector(s) of less than 6 ,, ,, ☐
   (e) Reflector(s) of more than 6 ,, ,, ☐
   (f) Other unspecified equipment, e.g. cameras, spectroscopes, &c. ☑
   (g) Access to other people's equipment ☑

5. CAXTON HALL MEETINGS. Do you consider them to be:—
   Just right / Too advanced / Too simple / or never attended ☐☐☐☑

6. SUBSCRIPTIONS. It would help us to know if the following applies:—
   (a) First subscription was paid for you ☐
   (b) Subsequent subscriptions were paid for you ☐

FOR THOSE OVER 15 YEARS OLD

7. EDUCATION. Are you currently at:—
   School / C.F.E. / Tech. Coll. / University / Private study ☐☐☐☐☐

8. OCCUPATION. Astronomer ☐
   or— Self-employed / Salaried / Wage earning ☐☐☐

One final question:—

9. While at school, did any of your teachers express an interest in astronomy Yes / No ☐☐

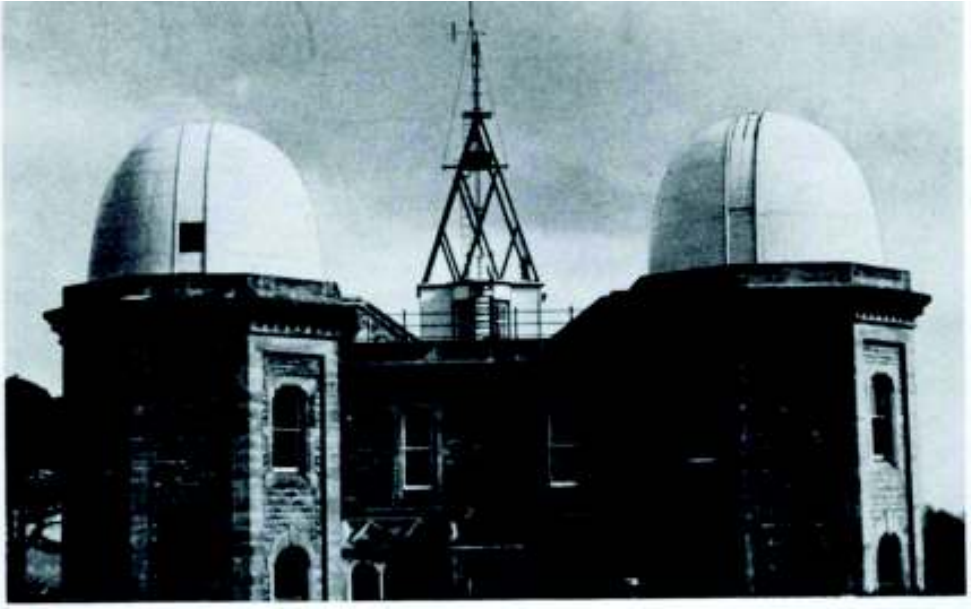
Now is your opportunity to make your

COMMENTS

This Questionnaire should be returned as soon as possible to the JAS Secretary,

Mr. D. B. P. Beglan,
17 Chanctonbury Chase,
REDHILL,
Surrey.

It may be returned with the ballot form, provided no clue to identity is given.



the liverpool equatorial

by Keith Hindley, BSc, FRAS

In 1960, when the University of Liverpool Astronomical Society was rapidly gaining an interest in observational matters, the Society's committee heard that there was a telescope in a disused condition at the University's Tidal Institute and Meteorological Observatory at Bidston. The Observatory stands on a hill-top at 200 feet altitude, in the centre of the Wirral Peninsula, some four miles west of Liverpool, on the opposite bank of the River Mersey.

Inspection showed that the Observatory consisted of two large domes, set in the roof of a spacious and solidly built two-storey building. The Observatory is now used as a meteorological station, and the basements contain some of the most accurate tide-level computers in the world. The Eastern dome was empty, but the stone pillars going down through the floor indicated that a very accurate transit instrument once stood there. The Western dome was found to contain an 8½-inch f17 refractor, mounted on a most elaborate equatorial mounting. The telescope is equipped with a fine selection of eyepieces, micrometers and other items including a spectroscope. Unfortunately, the instrument had clearly been disused for many years, and many layers of thick paint now covered the once proud brasswork. A search was made in the Observatory's Publications, and a fascinating story of a most remarkable telescope emerged.

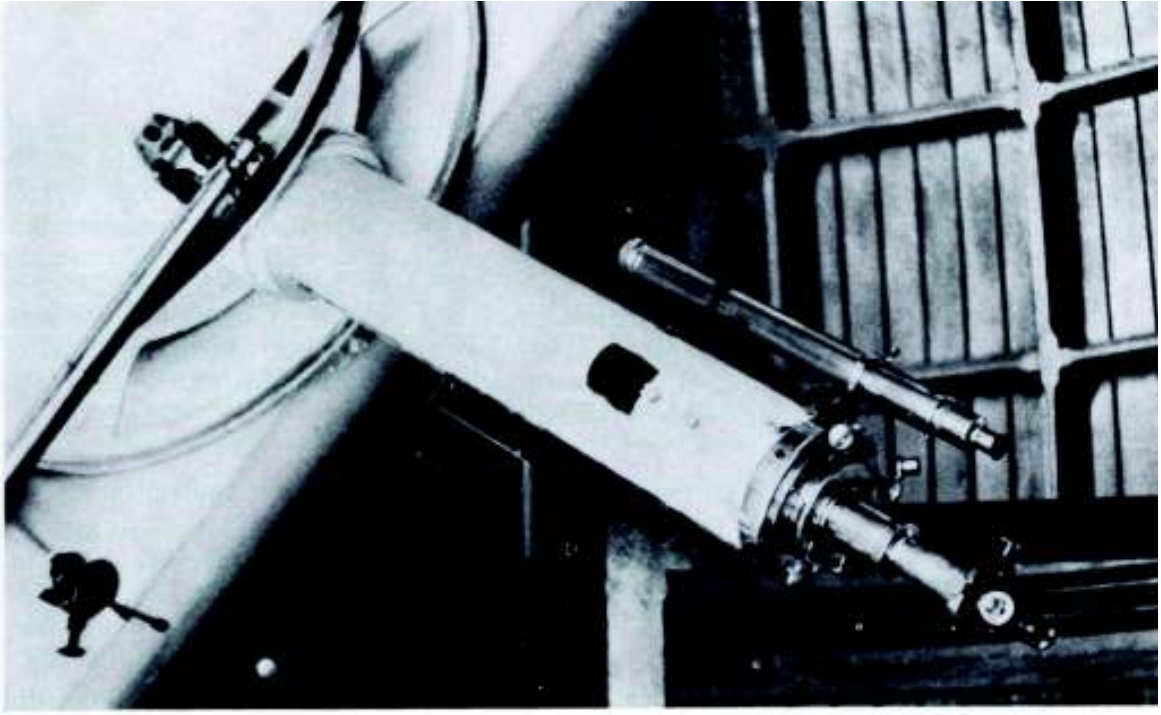
In the mid-1840's, the only reliable method of navigation was to make use of a chronometer, to compare G.M.T. with local time to deduce the longitude of the ship. Liverpool at this time had become a thriving port, with ships leaving daily for all parts of the world, and especially America. A local astronomical observatory was essential to check and regulate chronometers whilst ships were in port. In 1843, the Liverpool Observatory was built at the Waterloo Dock Pierhead. The flash from the muzzle of a cannon fired on the Observatory lawn at noon was the last time-check a navigating officer had as he left Liverpool. The following description of the astronomical instruments installed at the original Observatory has been extracted from "A Report on the Liverpool Observatory, Addressed by the Astronomer to the Observatory Committee of the Town Council," dated February 2, 1849.

"The Astronomical Instruments—a Transit Instrument of five-feet focal length, and four inches aperture, by Messrs. TROUGHTON & SIMMS—An Equatoreal of twelve-feet focal length, having an object Glass of 8½ inches aperture. This latter instrument was constructed under the direction of the ASTRONOMER ROYAL [then Sir George Airy]. The Object-glass is by MERTZ of Munich and is of first-rate excellence. The heavier parts of the mounting were executed by Messrs. MAUDESLEY & FIELD, Engineers, and the graduations and all the finer parts by Messrs. TROUGHTON & SIMMS. To extend our knowledge of the system of the Universe, it is necessary that we repeatedly observe the position, of the heavenly bodies, and compare the observed position with places calculated from theory. For all objects bright enough to be seen in daylight on the meridian, there are no better instruments so good as the meridian telescope for determining their position. For Comets and Asteroids however, one can rarely use a meridian, and one must have recourse to the Equatoreal. One serious objection to the ordinary equatoreal is a want of firmness in its mounting. With a view to lessen this defect, the Astronomer Royal has, in the construction of this instrument, availed himself of means never before, so far as I know, had recourse to in the mounting of an Equatoreal. The result is, that an Equatoreal has been produced, which I believe it to be no exaggeration to say, is not to be equalled in the whole world for strength and firmness. The Observations that I have made, show clearly that the telescope will measure differences in Right Ascension and Declination, almost, if not altogether as well as can be expected from the best meridian instruments."

A further description of the telescope's function has been published in the Proceedings of the Royal Astronomical Society for December 8, 1848. "The Right Ascension Circle and Declination Circle are each four feet in diameter, and when properly adjusted, the instrument reads off Right Ascension at once. This contrivance is peculiar to the Equatoreals of Liverpool and Cambridge, and in some researches is of great convenience. The Polar Axis, which is of wrought-iron plate, is very massive and stiff. The weight of the whole moving instrument is 70 to 80 hundredweights. The Liverpool Equatoreal is thus intended to measure *by its circles* intervals of up to several degrees, with as much accuracy as the average stars of our extensive catalogues possess, and thus give us excellent positions by reference to well known stars."

The telescope has a huge yoke-mounting, and enormous circles. The Right Ascension circle is made of brass with two fine lines inlet in silver. These lines are divided to one second of arc, and smaller differences are read by micrometer microscopes, twelve hours apart. The Declination circles are likewise constructed and are read by micrometer telescopes, one reading each of the two circles between which the telescope is mounted. The telescope was used for many years and produced regular positions of difficult objects to 1/10th second of arc. The Pierhead evidently became too busy with traffic and general disturbances for accurate observations, and the Observatory was moved to its present site in 1859. Inevitably, with the advent of radio time signals, the Observatory lost its *raison d'être*, and the telescopes fell into disuse. The old transit instrument is now on display in a Liverpool Museum.

As the years went by the telescope became more and more derelict and the whole mounting and telescope was in a sorry state when we came to "re-discover" it in 1960. The University Astronomical Society was given permission to use



The 8½-inch telescope, showing solid yoke mounting and R.A. circles. A bifilar micrometer is attached to the eyepiece end.

the telescope, if they brought it into working order and maintained it. Many trips were made to the Observatory on afternoons off, and the dome was brought into a habitable state. The University Fabric Department weatherproofed the dome, and recovered the floor. The Society hired an engineer to go over the mechanism of the mounting, and the drive. The object glass was thoroughly cleaned and repolished by D. G. E. Martin, of the University Optics Department. Martin also completely overhauled all the optical instruments, and dissolved off the paint from brasswork and varnished it. A builder was employed to weather-proof the dome, and he duly arrived and decided to use putty for the numerous holes in it. (At the local shooting range nearby, the enthusiasts take pot-shots at the Golden Domes atop the hill.) To his horror he found two parallel vertical cracks going right up the dome—"this must be where all the rain was coming in," he said. He filled the cracks with putty, and of course, next time we used the Observatory, we couldn't open the slit, as it had set solid. The poor builder had to come back and chip all his putty away again.

The telescope is now completely operational again. The Mertz lens is a rather fine example of the Munich optician's work. On the best nights, 6th magnitude star images are well defined, and the Airy disc with three or four diffraction rings is clearly visible at x800 to x1100. The mounting of the telescope on two four-feet granite pillars going down through two floors and two basements to the rock face, makes the telescope a dream to use. The motions are smooth and one cannot detect a slightest tremor with several people energetically kicking the granite mounting.

Observations of the planets have been regularly made. The recent passage through the Saturn ring-plane was followed and regular observations of the Moon, Mercury, Venus and Mars, as well as Jupiter, are made. Photography has been tried, and here the twelve foot focus is useful, with some excellent results. The keener members of the Society, and especially the mathematically minded ones, hope to make use of the instrument's high positional potential, to derive accurate comet and asteroid positions, as well as to measure double stars. The spectroscope is useful, and we hope to add comet spectrography to our observing programme. It is certainly satisfying to know that such a remarkable instrument is being regularly used again.

society notices jas

15th Anniversary Celebration Meeting. March 30-31, 1968, at Keele University, Staffordshire. Full board from lunch Saturday to tea Sunday inclusive of celebration wine and cheese party Saturday evening: £3 12s. 6d., but only £3 7s. 6d. to JAS members. Accommodation is limited; the first fifty to send a deposit of £1 made payable to the Junior Astronomical Society to Miss E. R. Atwell at 10 Moreton Road, South Croydon, Surrey, CR2 7DL by December 1 will be assured of a place. (Note experimental postal code in the above address.)

Details for those not Resident will be given in the January *Hermes*. It is regretted that the University regulations do not permit us to accept anyone under the age of sixteen on March 31, 1968.

Speakers at the meeting will include Dr. R. Maddison, Mr. E. Duggan, MA, BSc, and Cmdr. H. Hatfield.

Book Scheme. Owing to the resignation of Brian Stevens, this is now being handled by Mrs. V. G. Longman, 65 Speer Road, Thames Ditton, Surrey. All forms of payment may be sent to her, made out to the Junior Astronomical Society. JAS members may receive *Sky and Telescope* for only £2 13s. 0d. per annum through this scheme. Further books and magazines will soon be available through this scheme with maximum savings for JAS members.

Beginners' Notes. A copy of the script of the Beginners' Session for each Caxton Hall meeting will be available free, one month after the meeting, by sending a stamped self-addressed 9 × 4 envelope to Geoffrey Lake, Daisy Bank, Frodsham Street, Kelsall, Cheshire. N.B.—as this is a free service, the Notes cannot be dispatched without the s.a.e.

JAS Circulars still provide the best astronomical News service in Britain, and still for only 5/- a year. All subscriptions and renewals *must* be sent to the Assistant Secretary, and *not* to the Circulars Editor. Use the subscription order form on the centre pages of this issue if you wish.

Penpal addresses. Will all those members who wish their names to be placed on this page for penpals please note that we cannot print their addresses if they are still minors unless written permission is included from their parents or legal guardians.

libration

by H. R. Hatfield (*British Astronomical Association*)

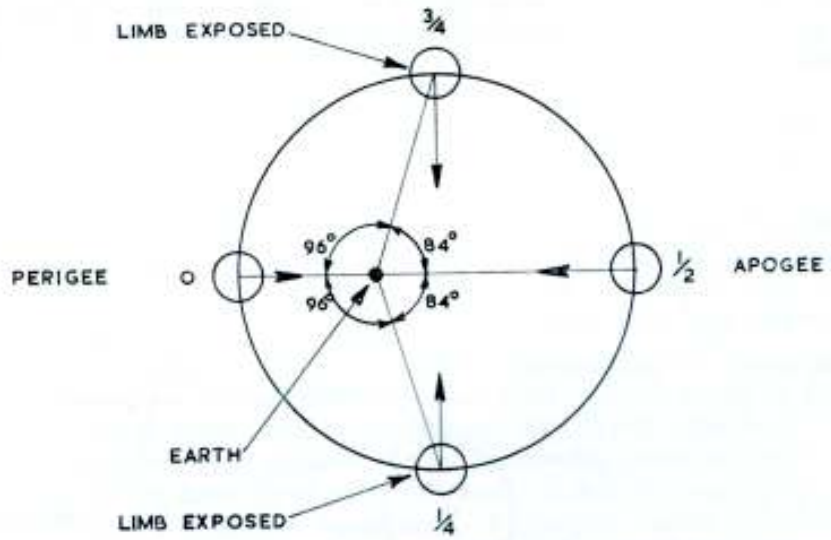
Imagine that the Moon is held in place by an invisible giant. He is rocking it gently to and fro. He may rock it as much as 11° from a mean position, in any direction he chooses; he will complete one cycle in about one lunar month, and never again repeat it exactly.

To an observer on the Earth this rocking means that at various times areas of the Moon which are invisible at "mean libration" will come into view. During his lifetime he may see about 60% of the surface area if he is lucky.

Tables given by the B.A.A. list, for each lunation, the times when the giant is pushing the Moon in the cardinal and half cardinal directions (N, NE, E, etc.); they indicate the amount of tilt in degrees, and the limb exposed. Thus a libration of 8·5° SE means that the tilt is 8·5° (quite a good one, since 11° is the absolute maximum) and the SE limb is exposed.

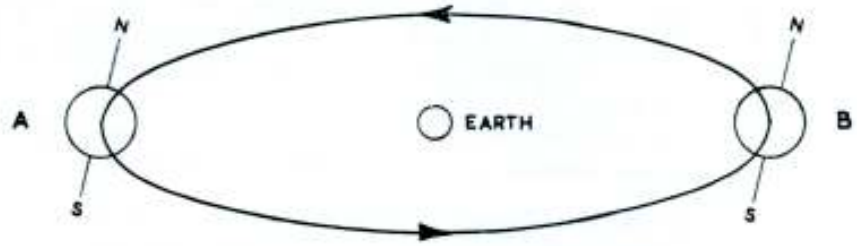
In order to make it easier to calculate the libration at any time the professional astronomer breaks it down into its component parts, and deals with each separately. These components are explained below.

OPTICAL LIBRATION IN LONGITUDE. The Moon's rotational speed on its axis is assumed to be constant (it isn't quite); its speed in orbit varies, being greatest at perigee and least at apogee.



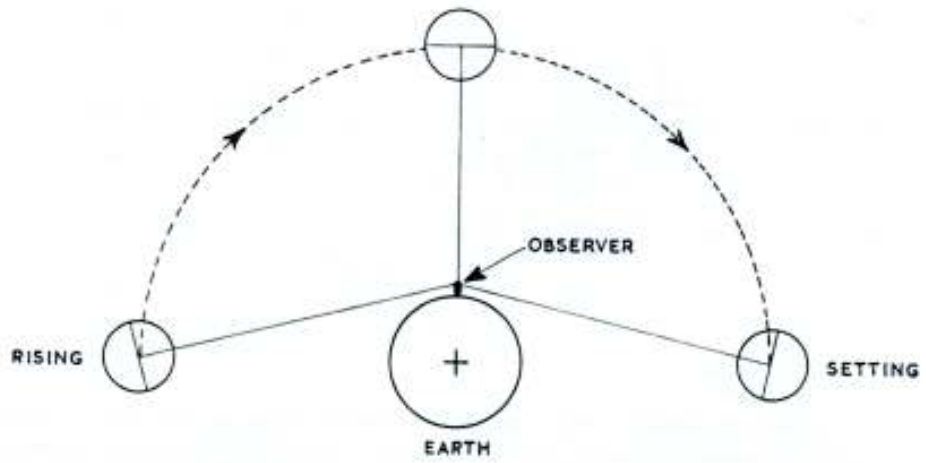
In the figure the Moon covers about 96° of its orbit in the first ¼ period from perigee. During this time it rotates only 90°; it is running early. It reaches apogee at exactly half time, when it has rotated through 180°. At the ¾ point it has covered about 264° in its orbit, but rotated 260°; it is running late. This effect is called the optical libration in longitude. One cycle takes about a lunar month; maximum values in individual cycles vary over a period of several years, and can be as much as ±7¾°.

OPTICAL LIBRATION IN LATITUDE. The polar axis of the Moon is not perpendicular to its orbital plane. When the Moon is at A in the figure an observer on the Earth will see beyond the north pole. When it is at B, after half a revolution,



he will see beyond the south pole. One cycle of optical libration in latitude takes about a lunar month, but NOT the same time as a cycle of optical libration in longitude. Maximum values in individual cycles vary over a period of several years, and can be as much as $\pm 6\frac{1}{4}^{\circ}$.

DIURNAL LIBRATION. The optical librations referred to above are calculated on the assumption that the observer is at the centre of the Earth. If the Moon is in the observer's zenith, he will be in line with its centre and that of the Earth, and this assumption will be valid (see figure). If the Moon is anywhere but in the zenith the observer will see "over the top of it" by an amount which is called the diurnal libration. The effect will be greatest at rising or setting, when it may amount to about 1°. It will always reveal the parts of the Moon nearest the zenith.



The optical librations are tabulated in the Astronomical Ephemeris, and (in a slightly different form) in the B.A.A. Handbook and the B.A.A. Lunar Section Circulars. Diurnal librations cannot be tabulated, since they vary from place to place.

The Moon's rotational speed is not quite regular; neither does its polar axis remain absolutely fixed relative to the ecliptic. To allow for these facts "Physical Librations" must be superimposed on the optical librations described above. They are very small, and may be neglected by most amateurs.

If a sphere is close an observer will not quite see half of it; if it is at infinity he will see exactly half. This effect applies to the Moon, which is sometimes close (perigee) and sometimes further off (apogee). "Parallactic Libration" is very small, but it can affect the shape of the limb. In most cases it may be neglected by the amateur.

space exploration

b/ Robin S. Scagell

THAT OLD DEVIL MOON

American Moon-probe launchings are at the moment almost too numerous to keep up with. After the success of *Lunar Orbiter IV* (*see photographs on following pages*), *Lunar Orbiter V* was dispatched on August 2 to extend coverage of the Moon's far and near sides.

Hidden-side photography has at present covered 60% of the surface. *Orbiter V* was expected to cover an additional 35%, as well as taking a close-up look at craters Copernicus, Alphonsus, Aristarchus and volcanic areas in Oceanus Procellarum. Pictures coming through at the time of going to press show this *Orbiter* to be continuing the high standard set by previous probes.

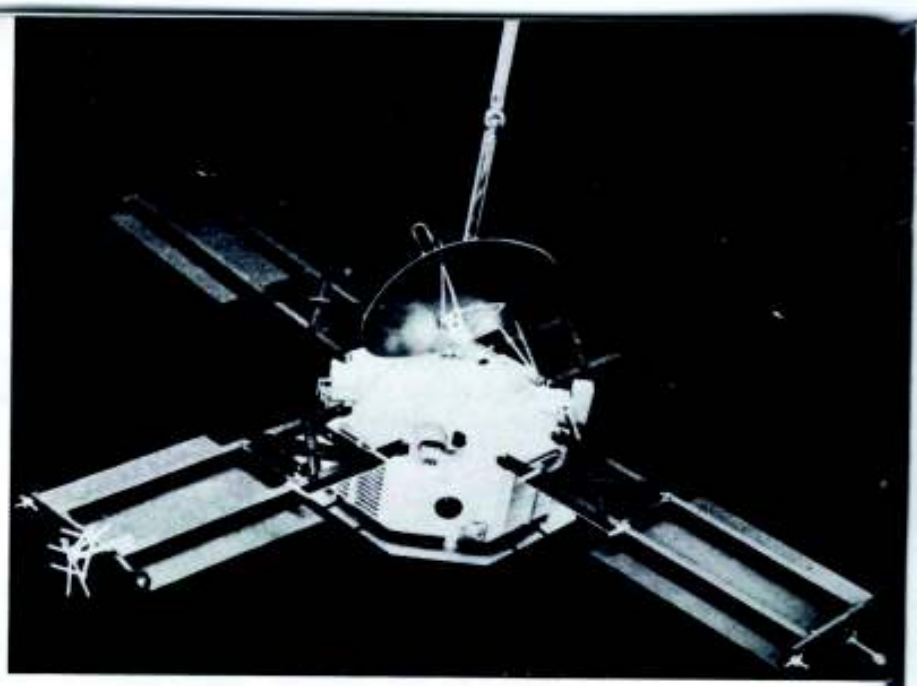
Orbiter V joins *Explorer*-35, which is taking radiation measures from Moon-orbit. Further details on these probes will be given in the next *Hermes*.

VENUS HERE WE COME

June's 'launch window' for the sending of probes to Venus saw two stations on their way to our closest neighbour among the planets. The next occasion on which the 14-day window presents itself will not be until the very end of next year, so both the U.S. and the Soviet Union made good their opportunity.

America's contribution to interplanetary understanding is shown in this artist's impression. It is planned to fly within 2,000 miles of Venus on October 19, some ten times closer than its predecessor, *Mariner-II*. *Mariner-V* is not equipped to take television pictures of the planet—this would probably reveal little, because of the dense cloud cover of Venus. It will carry instead an ultra-violet photometer, occultation experiments, a trapped radiation detector, a magnetometer and a plasma probe. These will also be gathering information on the conditions existing in interplanetary space during this time of increasing solar activity.

One problem which it may solve is that of whether or not Venus has a magnetic field. So far, instruments have detected no traces of magnetic fields around the Moon, Venus or Mars. Why, then, does the Earth have a substantial field?



The American Venus Probe, Mariner-V.

NASA photograph.

Evidence provided by the magnetometer and the trapped radiation detector —which will detect radiation in conditions similar to the Van Allen belts surrounding the Earth—will prove or disprove the negative findings of *Mariner-II* in December 1962.

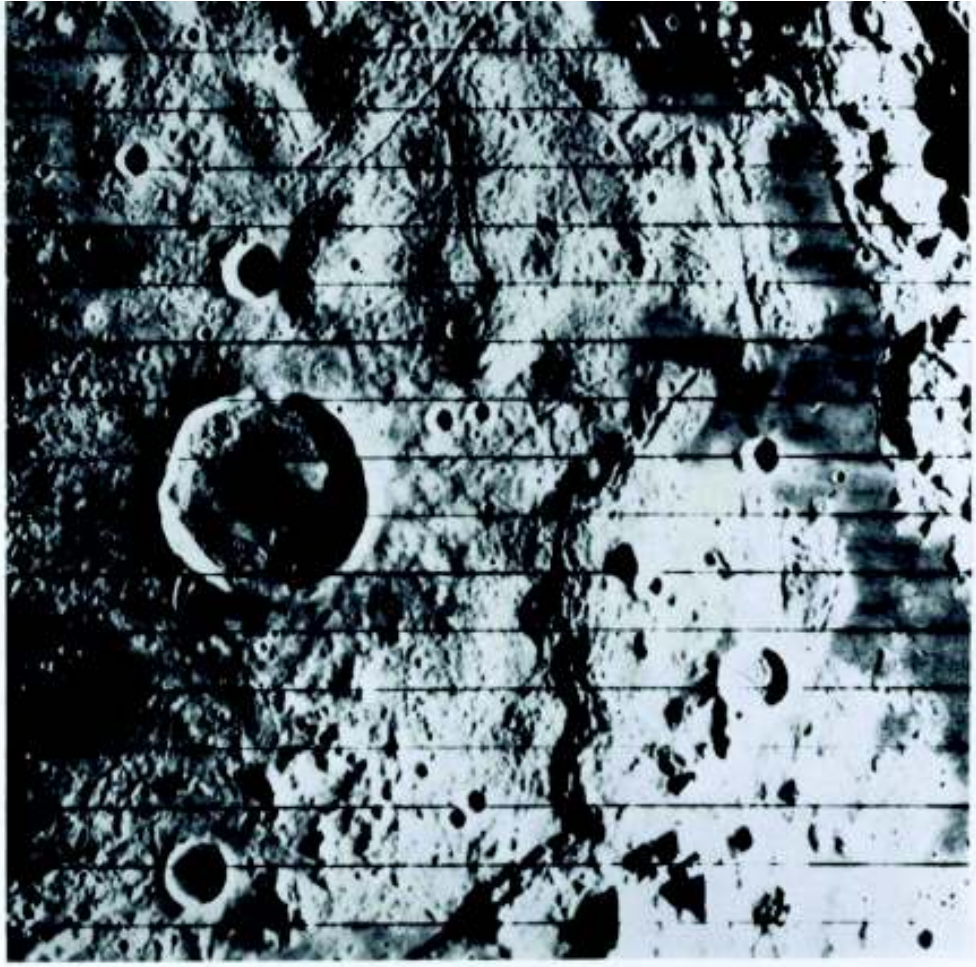
Latest reports say that *Mariner-V* is on a near-perfect course. If the successes of *Mariner-II* and *Mariner-IV* are anything to go by, the results should be worthwhile. *Mariner-IV*, which flew by Mars in July 1965 and sent back those excellent pictures of the Martian surface, is still orbiting the Sun. Signals were received from it at a distance of 219 million miles. *Mariner-V* has been modified from the back-up probe which would have gone to Mars had *Mariner-IV* been unsatisfactory.

Venus-4, the Soviet ship, was launched on June 12. This should reach the vicinity of Venus at about the same time as the American spacecraft. It too is sending back telemetry giving details of the conditions between Venus and the Earth. Apart from announcing that the probe is on a trajectory close to that planned, the Russians are not revealing whether the probe is scheduled to hit the planet or just to fly by. A previous Soviet probe to Venus did in fact hit the planet, carrying a Soviet pennant. At the moment, the Soviet Union is playing safe by saying nothing.

WHAT GOES ON BEHIND THE SUN?

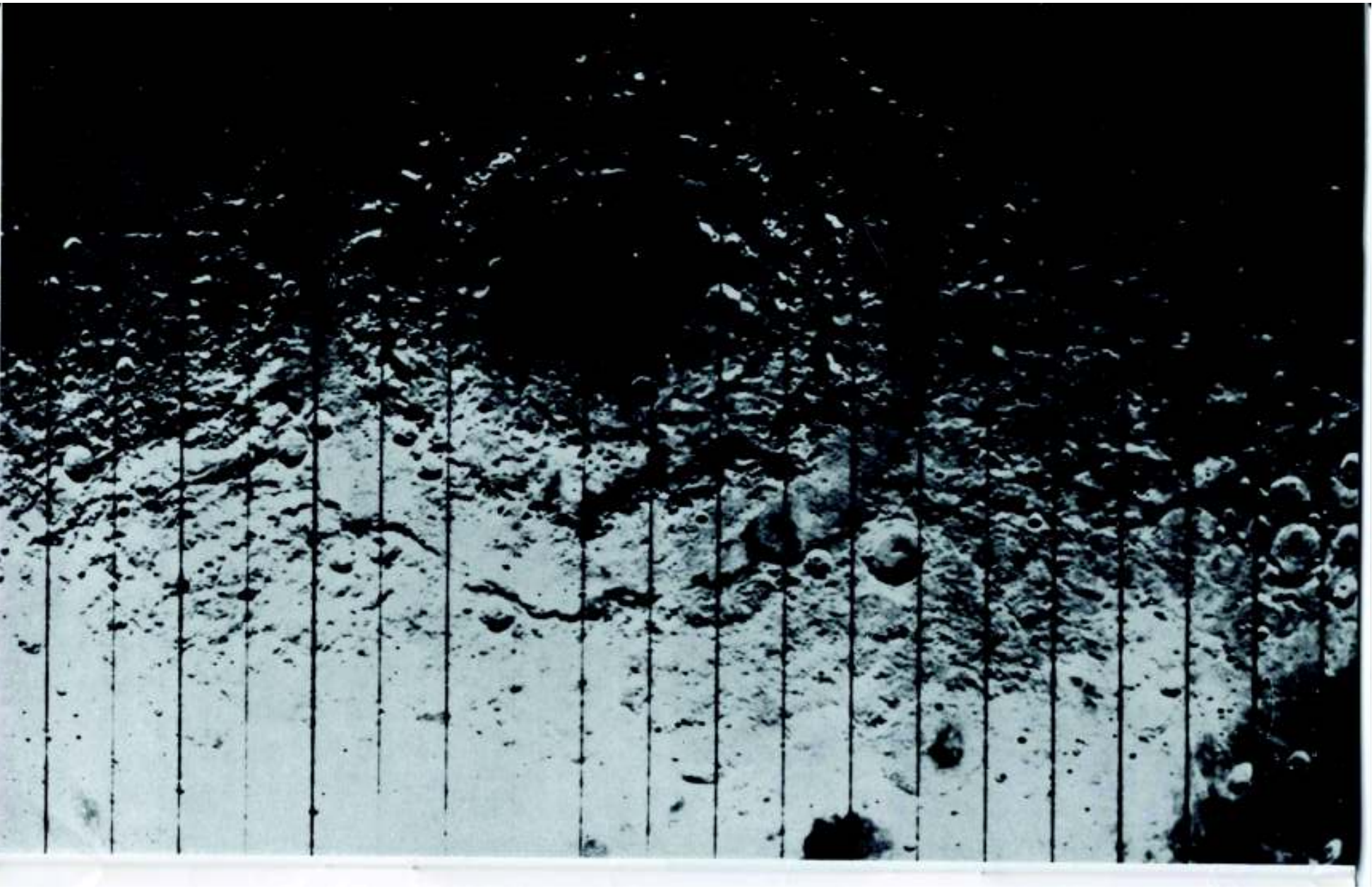
Two little-known space-probes are giving us the first comprehensive view of the Sun. With their help, improved weather forecasting may be on the way.

Pioneer-6 and 7 are monitoring solar radiation far out in space. They are in almost the same solar orbit as the Earth, and are gradually moving further and further away from us. *Pioneer-6*, launched in 1965, is at present one-third of an orbit ahead of Earth. *Pioneer-7*, launched last year, is one-tenth of an orbit behind the Earth. Together with the frontal view from Earth, it is now possible to see all round the Sun. Big storms on the Sun are swamping the sensitive instruments on board the spacecraft, but nevertheless they are doing a good job. It is now possible to predict solar flares up to 13 days before they erupt. The solar flares have a profound influence on communications, and also jolt the Earth's magnetosphere, which may well affect world weather systems.



ABOVE—The north eastern portion of Mare Orientale through Orbiter IV's telephoto lens. Showing a complicated pattern of highland, lowland and faults, this photo was snapped from an altitude of 1,700 miles above the Moon. On the right are the Rook Mountains, with Mare Veris at their foot. Part of the concentric walls of Mare Orientale show characteristics typical of Earth-like fissure volcanoes.

RIGHT—Limb-crater Inghirami, 57 miles across, is shown from above for the first time in this Orbiter IV telephoto shot. The unusual striations point towards Mare Orientale, and show many characteristics reminiscent of terrestrial lava flows. Note how the complex ridges seem to pass undisturbed right through the crater wall and join with concentric elements within Inghirami. Ridges and troughs also run tangentially to the main crater in other directions.



spectrum

by Joslyn Darby

PIRATE WAVES GOODBYE. *The Marine Broadcasting (Offences) Act has seen the end of a job for at least one JAS member.*

One-time Jupiter Section Director Alan Fossey worked on Red Sands fort as Programme Planner for the popular light music station Radio 390. Listeners in the south-east may know him better by the name of Stephen West.

Alan joined the JAS in 1962 at the age of 20. His most active period was in 1963-4, when he shared the Jupiter Section with Richard Kirby, and he was a familiar face at Croydon's fortnightly meetings.

His radical ideas of an international Society took him to the Casual Astronomers. Never able to settle down, he worked at various jobs before becoming a d.j., leaving astronomy and changing his name.

Bearded Alan is now back in his home town of Morden, Surrey, relaxing and playing music whilst his next move in the entertainment world is awaited with interest.

LEFT—The Orientale Basin, taken from Lunar Orbiter IV near the end of its mission. Maximum diameter of this basin is over 600 miles, with radial striations extending away for another 600 miles all round. At the top of the frame shows the famous crater Caramuel (Hermes, vol. 13, no. 3). The only craft in a polar Moon-orbit, Orbiter IV is extending high-quality photographic coverage to large areas of the Moon's near and far sides not known in detail.

ON THE EDGE OF SPACE. At New Mexico State University Observatory they've been busy getting a new 24-inch Cassegrain in operation for a planetary patrol. Clyde Tombaugh took time off from this work to answer some questions prompted by Brian Stevens' article on page 143 of this issue.

During the Lowell Observatory search for Planet X, not all the hundreds of plates taken were examined under the blink microscope. Could a new planet have escaped this process of 'blinking,' solving the problems of enigmatic Pluto?

"The unblinked plates mentioned have never been blinked for planetary suspects as far as I know," said Professor Tombaugh. "Since these lie in high ecliptic latitude, the prospect of any unknown planets seems extremely unlikely.

"However, all the thirty-year-old plates are being blinked with recent ones for proper motions of stars. This work under the direction of Henry Giclas is approaching completion with a very fruitful harvest of proper motion stars.

"My planet search would have permitted the detection of a planet Neptune's size and albedo at about seven times Neptune's distance from the Sun. Within that distance in all heliocentric longitudes I feel confident that no Neptune-like planets exist.

"The intersection of Pluto's orbit with Neptune's, and the photoelectric measurements of Pluto giving a 6·3 Earth-days rotation, convince me that Pluto is an escaped satellite of Neptune," continued Prof. Tombaugh.

"Bodies as small as the Earth would have been detected out to a distance of 100 a.u. from the Sun. In view of these facts, I think the prospect of more remote planets is rather poor.

"It would be interesting to see what the 48-inch Palomar Schmidt might reveal, but the great increase in the number of stars to review, especially in or near the Milky Way, is most forbidding."

UNIDENTIFIED FLYING ASHTRAYS? "Flying saucers—a load of claptrap," says *Hermes* Editor Ian Ridpath.

"I've seen photographs of models, clouds, and even a time exposure of the Moon and Venus setting passed off as genuine UFO pictures. The answer to a lot of other puzzlers lies on the negatives themselves," he asserts.

This year, a book published in both New York and London alleges 90 astonishing photographs. Ridpath says he's not convinced by any of these, either.

"On the A1 road recently I saw an object with white flashing lights that turned from a cigar into a saucer shape. It was the outline of a distant aeroplane with headlights on.

"I could have sold a snapshot of it for a small fortune. The more I see of saucer photographs, the less I believe in them."

SURVEY ON A HOT VOLCANO. For the third year running, JAS members have spent the summer carrying out scientific investigations amongst the volcanic wastes of central Iceland.

This year's party, of fifteen boys and two girls, was organised by Croydon Astronomical Society. With three Land Rovers, they travelled 1,000 miles in search of lava specimens from all over Iceland. These samples are to be examined under mock-lunar conditions by University of London astronomers in an attempt to discover the true nature of lunar rocks. This is of prior importance to scientists in the man-on-the-Moon race.

At one stage the young Expedition members were camped in snow under sub-zero arctic conditions on the volcanic mountain Askja, site of an eruption in 1961. The survey team, headed by Cambridge graduate John Murray (pictured), mapped in detail this eruption centre which even after six years is still warm and steaming.

Expedition leader John Marsh writes a full account of their exploits and adventures in the January *Hermes*. Also in the next number: Dr. Vincent Reddish describes the life-history of a star; Nigel Heath begins a tour of America; plus many more top rate items in a feature-packed, bigger-than-ever magazine. Make **sure** you receive the next issue of *Hermes*.

sky diary

by H.N.D. Wright, FRAS

Principal Phases of the Moon

	OCTOBER	NOVEMBER	DECEMBER
New		2d 05h 48m	1d 16h 10m
			31d 03h 38m
Full	18d 10h 11m	17d 04h 52m	16d 23h 21m

The fact that there are two New Moons in December is interesting and fairly rare, but not possible to verify by direct observation!

Date		Star	Mag.	Phase	Time	Position Angle (degs.)
Oct.	20	Pi Ari	5·4	R	05h 26·4m	240
Nov.	9	161B Cap	6·4	D	20h 26·6m	105
	14	73 Psc	6·2	D	02h 06·9m	352*
	15	54 Cet	5·9	D	03h 20·1m	88
	19	136 Tau	4·5	R	24h 31·3m	276
Dec.	7	56 Aqr	6·4	D	18h 04·3m	56
	8	Psi[1] Aqr	4·5	D	17h 52·0m	37
	9	27 Psc	5·1	D	17h 09·4m	30
	9	29 Psc	5·2	D	19h 34·7m	47
	9	74B Psc	6·8	D	20h 20·1m	2*
	12	+13° 351	7·4	D	21h 39·1m	356*
	13	44 Ari	6·9	D	18h 11·8m	72
	13	Rho Ari	5·6	D	19h 17·4m	58

*The disappearance of 73 Psc on November 14, 74B Psc on December 9 and B.D. +13° 351 on December 12 are all near-graze phenomena near the North Point of the Moon's disk, and timings of these will be of particular value. For those observing in the Midlands and North of England, it may be that an occultation will **not** occur, and it is most important in this case that a report is sent, with the exact Geographical location of the observer.

MERCURY is placed favourably in the morning sky from around November 10 to 22. Observers with a good horizon should be able to find the planet in the E.S.E. about an hour before sunrise. Greatest Elongation West of 19 degrees from the Sun is on November 17.

VENUS has now reached a very favourable position in the morning sky. At Greatest Elongation West on November 9, there is no mistaking the brilliant object in the East at mag. −4·0, about seven times brighter than Jupiter, which is preceding, or to the West, of Venus by some 40 degrees. Venus remains prominent until the end of the year, though rising a little later as the planet moves South in Declination.

MARS continues to moves rapidly Eastward among the deep Southern constellations of the Zodiac. During October the planet enters Sagittarius, and at the end of November moves on into Capricorn, having covered about 25 degrees in the course of one month. The brightness has faded now to about the level of a first-magnitude star such as Aldebaran, and Mars no longer attracts attention as it did earlier in the year at opposition. The 4-day-old Moon lies close to the S.W. of the planet on the evenings of November 5 and December 4.

JUPITER increases steadily in observability in the morning sky in this period, and at the end of November is rising before 11 p.m. In the July "Hermes" of this year an interesting 'double' shadow transit occurring on October 27 was detailed (p.136). A further instance occurs on November 19 when the shadow of Satellite III enters the disk of Jupiter at 01h 22m, followed by the shadow of Satellite I at 01h 38m. The Last Quarter Moon is 4 degrees North of Jupiter on the morning of November 25. Just at the New Year, Jupiter reaches a stationary point among the stars in Leo, and will then start to move Westward toward the 1968 opposition.

SATURN is situated at its best for the 1967 apparition during this period, and when at culmination, or in the South, reaches an altitude of nearly 40 degrees from the horizon. For the meridian of Greenwich, which serves as a good approximation for observers in Britain generally, culmination is at 22h 58m in mid-October, 20h 54m in mid-November, and 18h 50m in mid-December. The brightest satellite of Saturn's system, Titan (mag. 8.4) is at elongation from Saturn on the following dates:

West—October 20; November 5 and 21; December 7 and 23.
East—October 28; November 13 and 29; December 15 and 31.

Leonid and Geminid Meteors

The presence of the Moon affects observation of both these meteor showers this year. However, if the Leonids present a spectacle for British observers such as was seen in America last year (an all-time record) the Moon will present no problem. So keep watch if you can on fine nights between mid-November and the 20th, as the predicted rate is high. Maximum should be on the 17th.

For the Geminids the Normal Limits are December 9 to 14, with maximum on the 13th. There is an advantage in this case, in that the radiant reaches a very high altitude soon after midnight.

an appreciation of eric turner

by Patrick Moore, FRAS

It was announced in the July *Hermes* that Mr. Eric Turner has resigned his official positions in the JAS. As an ex-President (and ex-Editor), I cannot let this occasion pass by without comment.

Mr. Turner was the founder of the JAS. Without his impetus, given so many years ago, the Society would not exist. In the early days it was an uphill battle; I well remember one 'Council Meeting,' attended by Mr. Turner, Mr. Noon and myself as the three Officers, held on the steps of Burlington House at the end of a B.A.A. Meeting!

Since then, until his recent and much to be regretted resignation, Mr. Turner has spent immense time (and money) in supporting the Society in every possible way; his spell as Secretary was long and arduous. I well know the amount of labour that he has expended in the interests of the JAS.

The Society's debt to him can never be repaid, though I know him too well to suppose that he would want repayment. But at the time of his resignation we should all say a very sincere 'Thank you,' coupled with the hope that even though he has retired as an Officer, he will stay with the JAS and be on hand with his invaluable counsel and assistance.