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hermes

JOURNAL OF THE JUNIOR ASTRONOMICAL SOCIETY

This spectacular picture of the lunar crater Kepler was taken by Lunar Orbiter-3. For more details and pictures, see pages 94-96.

VOLUME 14 NO 3 APRIL 1967

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The Junior Astronomical Society

For people of all ages interested in astronomy as a hobby. Annual subscription of 15s. includes 4 issues of *Hermes*. Full details may be obtained from the Secretary.

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from the president

April is Budget Month in Britain, and at the time of writing, the signs are that the National Budget will show no signs of easing of the credit squeeze, with incomes purchasing less and less. You may suspect that this introduction is a hint that subscriptions are to be raised, or something equally unpalatable, but I am pleased to announce that this April Budget of the JAS is going to offer you even more value for money. The services provided by the JAS are going to be expanded and improved.

Firstly, our meetings. This July will mark the beginning of **new style** Caxton Hall meetings. Meetings will run from 14 hrs—17 hrs, rather than the present 18 hrs—21 hrs, as this is more convenient for the majority of people. The session from 14 hrs to 14.30 hrs will be a beginner's meeting, with a *very elementary* talk on some fundamental aspect of astronomy. The more advanced members will be discouraged from attending this session.

I am giving you plenty of notice of this change in the hope that you will try and bring a friend along to the July meeting, so that they can start right from the beginning of the series. Notes on these sessions will be available for those who are not able to get along to Caxton Hall. Exact details of how to apply for these notes will be given in the July *Hermes*, which will also contain a programme and a questionnaire to help us in fixing future programmes and facilities.

In future it is intended to give short accounts of appropriate Caxton Hall talks, with relevant reading lists suggested by the speaker. There are many other innovations on the way, and I will tell you of these when the details have been finalised. In essence, it is my intention to give an even better service to all our members, particularly those living out of London. The beginner's notes and summaries will, I hope, help you all to benefit from our meetings. When these things are done, I am sure there will be no difficulty in doubling our membership during my term of office.

On the question of the change of name, out of a total of 13 letters received, 11 wanted a change, but only three suggested a new name. Clearly, council could not recommend a change on such a poor mandate. I, personally, was in favour of a change, but the only thing to do now is to 'sell' our present name rather than apologise for it. We should explain that the 'Junior' refers to knowledge, not age. Our publicity will also make this point.

Forthcoming JAS Events

Day trip to Jodrell Bank. This is the first of the promised JAS visits. A coach has been booked for Sunday, September 3, leaving Croydon at 8.15 hrs, arriving at approximately 14 hrs, to give two hours conducted tour, and returning to Croydon by 22.30 hrs. There will be picking-up points in the Marble Arch and Harrow areas.

The first 45 people to write to **me** with a deposit of 10s. 0d., made payable to the Junior Astronomical Society, and enclosing a stamped self-addressed envelope will be assured of a place. The SAE will be used to send your receipt and further details, or to return your deposit.

The cost—we have been able to keep this down to 30s. 0d., inclusive of entry fee. There are no extras except your own spending money, and *we are offering a special reduced rate* of 27s. 6d. for JAS members (please quote your membership number).

Affiliated societies and individual members—why not arrange your own trip and meet the London contingent? Make it a JAS day! I hope to meet many of you at Jodrell Bank.

National Physical Laboratory Open Days. The JAS may be able to obtain 20 tickets for either Thursday, 6 or Friday, 7 July. The first 20 to write to me, enclosing a SAE and stating which day they prefer, will receive these.

Our next Caxton Hall meeting is on Saturday, April 29 at **18 hrs.** Our speakers will include:

Mr. John Wall—'Making a 20-inch Telescope.'
Mr. Ian Ridpath—'Recent Developments in Lunar Study.'

MICHAEL J. de FAUBERT MAUNDER
March 4, 1967

the old royal observatory, greenwich

by D. V. Proctor, MA

The programme of restoration work on the buildings of the Old Royal Observatory which now form part of the National Maritime Museum has continued, and it is planned that the Meridian Building, the range of buildings to the south of the entrance court-yard, will be opened to the public in mid-July of this year. The aim of this work is to restore these buildings to show, where possible, the original instruments in their working settings. The visitor will then be able to gain a good impression of the working rooms and equipment of the Old Royal Observatory as they were in the late seventeenth, eighteenth, nineteenth and twentieth centuries. These buildings are in fact of the greatest interest to historians of astronomy, for it was in this part of the Observatory that most of the Royal Observatory's important and historic observations were made.

One building, detached from the others, has required almost complete reconstruction. This is Flamsteed's Observatory, which incorporates the Quadrant and Sextant Houses used by John Flamsteed (1646–1719), the first Astronomer Royal. Flamsteed's great 7 ft. Sextant was removed by his widow after his death, and has not been heard of since. A replica is therefore being made in the Museum's workshop. It has proved a fascinating task to draw precise plans from the contemporary engravings and sketches still extant. Curiously, the best contemporary picture of Flamsteed's other major instrument, the Mural Arc of 1689, is a painting in the ceiling of the Painted Hall of the Royal Naval College. The design of the roof of the Sextant House has also given cause for many hours of research. Originally, of course, it opened. Now it will be fixed, but will give the impression that it can be opened for work to take place.

It was in 1725 that Edmund Halley (1656–1742) erected a massive stone pier as a mounting for the great 8 ft. iron quadrant, which he ordered from George Graham (1673–1751). This pier still stands in its original position just north of Flamsteed's Observatory, and Halley's original quadrant will be remounted on it. On the other side of the pier will be mounted the 8 ft. brass Quadrant ordered from John Bird (1709–1776) by the third Astronomer Royal, James Bradley (1693–1762). To gain more working space Bradley erected a new building which incorporated the stone pier. This now forms part of the West end of the Meridian Building, and will also house Halley's original transit instrument, the first instrument of this type to be used in the Observatory (1721), as well as Bradley's transit instrument (1750). The most famous of Bradley's instruments, his zenith sector, with which he discovered the aberration of light and the nutation of the Earth's axis, was first erected in Wanstead and only came to Greenwich after his appointment as Astronomer Royal in 1742. This will also be mounted near the 8 ft. quadrants in one of the positions where it was once used.

Long before assuming office, the fifth Astronomer Royal, Nevil Maskelyne (1732–1811) had taken a profound interest in the problems besetting seamen in the field of astro-navigation, particularly in the matter of determining longitude at sea. He had made a special study of the lunar distance method of solving this problem and, to assist seamen, he produced the *Nautical Almanac*. This was first published for the year 1767, and the *Almanac* has been a best-seller among seamen ever since. Its bicentenary is marked with a special exhibition entitled "Man is Not Lost," which is mounted in Flamsteed House, just north of the Meridian Building.

In 1807 Maskelyne made a formal order for a mural circle, which at that time it was hoped would combine the functions of a transit instrument and a mural quadrant. But he did not live to see this plan realised, and it was left to his successor, John Pond (1767–1836) to receive the mural circle from the celebrated instrument maker, Edward Troughton (1755–1835). However, its order of accuracy was found to be insufficient for transit observations, and Troughton made a new transit instrument as a replacement. Both the mural circle and the transit instrument will be on view in their working settings.

A successful design for a transit circle instrument was first realised at Greenwich by Sir George Airy (1801–1892), the seventh Astronomer Royal. A firm disciplinarian, and very much aware of the true purpose of the Observatory, Airy set high standards for its work. It was he who led the Observatory to regain its world pre-eminence, after it had had rather a "bad press" in the 1820's. It is a fitting monument to his achievements that his great Transit Circle, now retired after more than a century of work, and with almost 700,000 observations to its credit, will be restored and open to close inspection by the nation it served so well. The Greenwich Meridian, the Prime Meridian for the world, is, by an international agreement of 1884, defined by the cross-wires of this instrument, and the Meridian Line will be clearly marked out on either side of the Block. Nearby within the building will stand another of Airy's instruments, his Altazimuth telescope of 1847. However, it is not practical at this stage to reconstruct the famous "Onion" Dome that stood on the Great Equatorial building. Perhaps the most unusual instrument to be commemorated will be Flamsteed's 90 ft. well, which he designed as a Zenith telescope to try to detect parallax in the star Y Draconis, and thereby discover its distance from the Solar system. The idea of using wells is old and was apparently tried, without much success, in Islamic observatories from the thirteenth century. Although excavations have not been completed, it is thought that the site of this well has been found, and at a later date it will be properly marked.

In due time also auxiliary displays will give a fuller explanation of general astronomical subjects. So from mid-July, 1967, the outstanding achievements of those British astronomers who worked in the Old Royal Observatory, and who gave it such an eminent position among observatories throughout the world, will have a more fitting memorial than has hitherto been possible, a memorial that will be open for all to see and enjoy.

observing the constellations

by P. Lancaster Brown, FRAS

In autumn when the sun in Virgine
By Radiant heat enripened hath our corne.

Virgo, the Virgin, is the sixth sign of the Zodiac and in the month of April its sprawling configuration straddles the meridian at midnight. Virgo is an extremely long constellation bounded on the east by Libra, on the west by Leo; to the north by Boötes and to the south by Corvus.

Various accounts have been given about the origins of the constellation. Some say that this sign, the Virgin, was, while on earth, Justia, who lived in the golden age and taught mankind their duty. However, when their crimes increased she was obliged to leave the earth and take her place in the heavens. Other authorities say that she is Ceres. The ear of corn which this celestial maid holds in her hand evidently denotes the time of harvest among the people who invented this sign.

Yet the constellation of the Virgin is one of the most mysterious of the zodiacal groups for although she is commonly thought to represent the figure of the Virgin, there appears to be little resemblance to a human form. Traditionally her hand is supposed to lie towards Regulus, while the feet are made by two stars south of Arcturus. Four stars make the head, three the shoulder and another her outstretched right arm. Other members of the constellation form the draperies or clothing.

To the Greeks the constellation name Virgo symbolised the integrity of an Earth as yet uncontaminated by decay. Some authorities contend that the title originated when the sun was in Virgo at the spring equinox (at the time of the Egyptian harvest), but for this situation we must look back 15,000 years. The Egyptians also associated Virgo with Isis, and it is related that she formed the Milky Way by throwing millions of wheat heads into the heavens. Another variation of this story is that Isis let fall a sheaf of corn as she was fleeing to escape Typhon, but in his pursuit it became scattered over the sky, the sparkling golden grains of corn becoming stars. According to Pliny, the appearance of a comet within the borders of Virgo implied grievous ills to all females.

Virgo is principally dominated by the 1st magnitude star called Spica which traditionally marks the ear of wheat in the Virgin's left hand. Spica can be located from the Great Bear by extending a curved line through Alpha (Dubhe) and Gamma (Phad) of that constellation. At a distance of approximately five times the distance between the latter marker stars, the eye will arrest on the brilliant whiteness of Spica. Spica also forms a striking equilateral triangle with Arcturus (Alpha Boötes) and Denebola (Beta Leonis).

Alpha Virginis (Spica), magnitude 1·2, is a spectroscopic binary system, the companion star and the primary revolving round a common centre of gravity in a period of 4·01 days. Many years ago the astronomer Gould thought he could detect a variation in the brightness of Spica but others denied this. However, modern photo-electric measurements indeed show that there is a regular fluctuation of 0·1 magnitudes every four days. Spica is a well known object to navigators and it is known as a lunar star since

it is situated 2° south of the ecliptic. The Arabs called it the Solitary, Defenceless, Unguarded one owing to its isolated position in the sky. In ancient Greece several temples are believed to have been constructed deliberately orientated to this star. On Flamsteed's star map it was designated the Virgin's Spike.

Beta Virginis (Zavijara or Zarijan), magnitude 3·8, lies near the constellation's boundary and can readily be identified approximately 10° south of the prominent Leo "triangle."

Gamma Virginis (Porrima—so named by the Latins after an ancient goddess of prophecy, sister of Carmenta, who was worshipped by their women.) It is one of the finest binary systems in the entire sky, magnitudes 3·6 and 3·7. The orbit of the companion star is very eccentric, and when the separation between the two stars narrowed to 0·5 seconds in 1836 only the 9½" Dorpat refractor showed some semblance of duplicity. When at its widest separation of about 6 seconds, it forms an easy object with small telescopes. This last event occurred in 1920. At present the system is closing again (distance approximately 4·8 seconds) and minimum separation will next occur about the year 2016.

Delta Virginis, a golden-yellowish star, magnitude 3·6, with a rapid annual proper motion and situated about 200 light years away. This star is more than 700 times more luminous than our own sun.

Epsilon Virginis (Vindemiatrix, Almuredin or Mukdim el Kitáf), magnitude 3·3, lies 7° north of Delta.

Theta Virginis is a fine triple system, magnitudes 4·4, 9·0 and 10·0. The 9·0 magnitude star has often been described as violet in colour, but this a subjective phenomenon and is due, at least in part, to spectral differences in adjacent stars and to what is known as 'dazzle tint.' To view Theta at its best, a 4" O.G. is minimum and a 5" O.G. is desirable; however, there have been a number of observers who have claimed to see its triple form with only a 3" O.G.

Eta Virginis, magnitude 4·0, is a spectroscopic binary system with a period of 71·9 days.

One of the best known features in Virgo is what is known as "The Field of Nebulae" where uncountable numbers of extragalactic nebulae can be photographed with large reflectors. The area is roughly outlined by the stars Beta, Eta, Gamma, Delta and Eta—forming two sides of a square some 15° across. The region is not confined to Virgo and extends across the constellation boundaries into Coma Berenices. This region has often been labelled 'The Comet Hunters' Nightmare' and is recommended as best avoided. However, only the brighter members are visible with small instruments. Within Virgo are listed 11 Messier objects ranging in visual magnitudes from 8·7 to 10·0; including M 104, nicknamed 'The Sombrero Nebula' because of the unusual shape it portrays in long exposure photographs. Magnitudes for nebulae can be very misleading and their visibility is much dependent on the state of sky transparency. On a really clear night all these Messier objects can be readily seen with a 3" aperture—some with much less. With a larger instrument the scope is greatly increased, for example, with the writer's 12" spec. comet sweeper more than 180 nebulae can be observed within the boundaries of Virgo under ideal conditions.

Lastly, before leaving Virgo, perhaps mention should be made of the Virginids meteor shower which occurs in early spring between the dates March 5 and April 2—peak activity occuring about March 20. The radiant co-ordinates are R.A. 190° Dec. 00°. The observation rate may be as few as 5 meteors per hour (or even less). So far this stream has not yet been identified with any known cometary orbit.

the nautical almanac, 1767-1967

by J. G. Porter, PhD, BSc, FRAS

The Astronomical Ephemeris, which was known as the *Nautical Almanac* before 1960, has a special Introduction in this year's edition, commemorating the two hundredth anniversary of the first publication of the *N.A.* in 1767; the Introduction includes a facsimile of Maskelyne's original Preface. The *N.A.* was not by any means the first navigational almanac—Columbus must have had some crude form of almanac when he sailed from Spain in 1492, and others of its kind were still being published on the continent. But the *N.A.* set a new standard in accuracy, and this was entirely due to Maskelyne.

The Royal Observatory had been founded in 1675 " . . . in order to the finding out of the longitude of places for perfecting navigation and astronomy . . ." and Maskelyne, the fifth Astronomer Royal, had always taken a special interest in this problem of finding longitude at sea. His interest had been stimulated by his voyage to St. Helena to observe the transit of Venus in 1761, and he was convinced that the problem could be solved by the method of lunar distances, in which the apparent distance of the Moon from certain selected stars was used as the basis of the calculation. The Greenwich observations had led to improved Tables of the Moon and to better star catalogues, while the invention of the sextant made the measurement of the appropriate angles a simple matter. In 1763 Maskelyne published the *British Mariner's Guide*, in which the method of lunar distances was used, and soon after his appointment as Astronomer Royal in 1765 he produced the first number of the *Nautical Almanac*, which was clearly based on the *Guide*. It is interesting to note that at this time the problem had really been solved by Harrison's invention of the chronometer, but chronometers, however good, are not perfect timekeepers, and the method of lunar distances continued to be given for over a century.

The *N.A.* originally contained twelve sets of monthly Tables of the Sun, Moon and planets, with distances of the Moon's center (yes, it *was* spelt like that!) from the Sun and certain selected stars. There were also predictions of the phenomena of the four great satellites of Jupiter, with diagrams showing their positions for each day. These diagrams were published continuously until 1959; they have been superseded by a graphical method of displaying the movements of the satellites. Throughout the volume, time was measured as apparent solar time—there were no mean time signals in those days. Perhaps the most significant part of the original Preface was contained in the last paragraph: "All the Articles of the Ephemeris were computed by Two separate Persons, and examined by a Third . . . ", but in the case of the Moon, the various quantities were computed for noon by one person, and for midnight by another, ". . . . and the Truth of these Calculations ascertained by means of Differences . . .". This explains why the *N.A.* rapidly acquired its high reputation for accuracy.

It should be understood that there was no permanent staff at Greenwich to do this work. The computors and comparers came from all walks of life, and they worked at home; for this work the pay was £75 a year. In his Preface, Maskelyne refers to improvements introduced by Mr. Lyons and Mr. Dunthorne. Israel Lyons was quite a young man at this time, but had a peculiar gift for mathematics. Richard Dunthorne was much older, and was employed as butler to Dr. Long, one of the Admiralty Board. University education was difficult if not impossible to acquire without money, and many of the most brilliant men of the eighteenth century achieved fame without any academic distinctions whatever. There is one name that will always be associated with that of Maskelyne in the production of the *N.A.*—that of Malachy Hitchins. He was born in Cornwall in 1741, and already had something of a reputation when he joined Maskelyne in 1767. It was he who was mainly responsible for the accuracy of the *N.A.* Hitchins was more fortunate that most of his colleagues, for his wife had money, and he was able to study at Cambridge, later taking holy orders, and with Maskelyne's influence obtained two clerical appointments; these do not seem to have interfered with his supervision of the *N.A.*

After the death of Hitchins in 1809 and of Maskelyne in 1811, the *N.A.* fell into disrepute—clearly nobody was taking the same trouble that these two had done. Critics published pamphlets and told funny stories, and things reached such a pass that questions were asked in the House of Commons. This is not the place to go into details—if you are interested in these old controversies you can read about them in the *History of the Royal Astronomical Society*, 1820–1920. The upshot of the row was that the Government asked the Astronomical Society of London (it had not then received its Royal Charter) to make recommendations, and this they did in a very comprehensive report; almost all of the suggestions were adopted in the revised *N.A.* published in 1834. In particular the ephemerides were given in Mean Time though lunar distances were still given), more attention being paid to the needs of astronomers, and the *N.A.* continued in much the same form until the revision of 1931. Lunar distances were dropped in 1906, and in 1925 the method of measuring time was changed, the day beginning at midnight, instead of at noon as it had done previously. The revision of 1931 paid much more attention to machine calculation, to better methods of presentation and the interpolation of data.

Although much material was added from time to time, very little of this was of use to the navigator, and in 1896 the first part of the *N.A.* was issued separately for the use of seamen. This volume was further redesigned in 1914, 1929 and again in 1952, when it was given the title *The Abridged Nautical Almanac*. From 1960 this volume has been known as the *Nautical Almanac*, while the purely astronomical data are published as the *Astronomical Ephemeris*. There are also separate almanacs for air navigation and for land surveyors; in these volumes, some of the calculations are already carried out—for example, hour angles are given instead of R.A.

In the present century there has been a remarkable increase in the co-operation between various countries, mainly designed to avoid duplicate calculation. Although the main part of the *N.A.* is prepared by the British N.A. Office, the remainder of the work is shared by the American, French, German and Spanish Offices. The unification of the British and American almanacs in 1960 was a further logical step. It is prepared in two parts; the first part, distributed some years in advance, is printed in England, and contains the ephemerides of the Sun, Moon and planets. The second part, prepared and printed in the U.S.A., contains the remaining material, star-places, satellites, Tables for the physical observations of Sun, Moon and planets, and some other subsidiary Tables useful in calculations. The volume is known as the *American Ephemeris* in the U.S.A., and as the *Astronomical Ephemeris* in this country, but although the title pages may differ, they are otherwise identical. The two parts are readily distinguished because the American typography in the second part is, unfortunately, different from that of the British first part.

Today the N.A. Office, which moved down to Herstmonceux in 1949, has its own electronic computer, which is used also for other work of the Royal Greenwich

Observatory. Methods may differ, but the same emphasis on accuracy remains. Machines, however fast, are stupid things, and it is never safe to assume that they do not make mistakes, so the same system of checking by differences, independent calculations and comparing is used, and nothing is left to chance. The *Nautical Almanac* is truly a model of accuracy.

One other change I must mention. The first volume of the *N.A.* cost 3s. 6d., and even in 1937, when the volume had nearly a thousand pages, it was still only 6s. 0d. The price of the 1967 edition is 35s. 0d., but this is one figure for which the N.A. Office is not responsible.

the quiet revolution in solar astronomy

by James Muirden

Our knowledge of the Sun in 1840 was not very profound. Nobody had calculated its rotation period in satisfactory agreement with anyone else; we did not feel sure of its distance to within an accuracy of less than a few million miles—and as a result we did not know its exact size; and least of all did we have any idea of why it shone as it did, and what dark spots were doing on its surface.

Other departments of astronomy were forging ahead. Herschels I and II had laid the basis of stellar astronomy, with such giants as F. W. Bessel (1784–1846) and F. G. W. Struve (1793–1864) leading contemporary research. The Moon had been studied and maps drawn. The planets, too, had received searching surveys, and Neptune was a few years from being netted. It was the golden age of minor-planet discovery. But the Sun, the brightest and most influential object in the sky, was amazingly neglected. The most important series of observations being made at the time were by Hofrath Schwabe (1789–1875). Using a 2-inch refractor, he discovered the 11-year sunspot period!

One reason for the vast fermentation of solar knowledge during the next 40 years was the invention of photography. The Daguerreotype process, announced in Paris in 1839, led to the faster "wet-plate" process of Scott-Archer, introduced in 1851, and the extremely fast dry plate, forerunner of modern emulsions, in 1875.

The very slow plates used in the first days of photography were of no handicap as far as the Sun was concerned. Indeed, they were much too fast for the purpose! The first photograph of the Moon, showing vaguely the maria, was taken as early as 1840 by J. W. Draper (1811–82), with an exposure of several seconds. Not until 1845 did two French astronomers, Fizeau and Foucault, manage to make a shutter giving a sufficiently short exposure to produce a solar photograph that was not hopelessly over-exposed. It is significant, though, that this pioneer photograph showed plenty of detail, with two sunspot groups sharply defined.

Now it was obvious that the sunspots provided the clearest key to the Sun's constitution, and accurate observation of their position and form was required. Some painstaking observers, notably Richard Carrington (1826–75), were making drawings of high quality; but these took a great amount of time and labour, and even then were subject to errors. Moreover, a spell of cloudy days could wreck the record. Sir John Herschel realised this, and with characteristic promptness recommended the establishment of a world-wide network of photographic instruments taking daily sunspot photographs. "Now that photographic delineation can supply, in the utmost perfection, the talent of the draftsman, it were much to be wished that the subject were seriously taken up as part of the regular business of observatories." Herschel was much ahead of his time; but under his instigation a "photoheliograph" was installed at Kew Observatory in 1857, and took regular photographs until 1872, when a larger instrument took over its work at Greenwich. It now resides in the Science Museum, the forerunner of all the solar research that is conducted today.

These regular photographs soon brought to light a great amount of information about the Sun's rotation and the nature of sunspots. But another region of the Sun—the chromosphere and corona—was demanding attention.

It is strange to relate that the first scientific observations of a total solar eclipse were not made until 1842! Before then, the pearly coronal appearance had been the subject of much exclamation but little thought; but the 1842 eclipse was observed by Struve, Francis Baily (1774–1844)—who observed the bright spots of light known as 'Baily's Beads' at the 1836 eclipse, and George Airy (1801–92), the Astronomer Royal. They not only noticed the coronal appearance, but also saw three "protruberances," which we know now as prominences, poking out from the dark limb of the Moon.

Did these objects belong to the Moon or to the Sun? Opinion was divided, but a good many authorities held that the corona was nothing more than a thin lunar atmosphere made to glow by the back-lighting of the Sun. In the light of current knowledge, this theory was not unreasonable, but it demanded observational proof, and photography was called in.

The test was this. If the protruberances were lunar, they would appear to move *with* the Moon as it passed across the Sun. If they were solar, the Moon would appear to pass across them.

It might seem as if this simple observation could be made by telescopic means. But results were totally uninformative. Anyone who has experienced a total solar eclipse will know how impossible it is to make calm, definitive observations during the precious seconds. Observers disagreed violently among themselves, even after the favourable eclipse of 1851, which was widely observed, and during which the first coronal photograph was taken.

So photography was called in. At the eclipse of July 18, 1860 the Kew photoheliograph was taken to Spain by Warren de la Rue (1815–89), a wealthy amateur astronomer. Despite gloomy forecasts about the chances of photographing the corona on such a large scale (he used a 4-inch image), he in fact obtained a brilliant series. He was very nearly thwarted by cloud, which engulfed other parties, but the Sun remained clear and he was able to prove to the bitterest sceptics that the Moon really did move across the corona and prominences. His series was confirmed by another photographer, the Jesuit priest Secchi (1818–78), whose plates agreed in the minutest details.

These two lines of research had consolidated our knowledge of the Sun. Within a very few years, daily photographic records had unravelled a number of mysteries about the Sun's rotation and the behaviour of sunspots, and photographic eclipse observations recorded the corona and prominences far more accurately than any eye. By 1880, such photographs were comparable with the best obtained today.

It was left only for G. E. Hale (1868–1938) to devise the spectroheliograph (1891), which allowed him to photograph prominences on the face of the Sun as well as at the limb, and the solar astronomer's armoury was practically complete. However complex and expensive modern instruments may seem, they are only descendants of these earlier devices—and at the focus of every one we find a photographic plate.

galaxies and nebulae

M.J.Hendrie, FRAS

The title of this series is intended to include hazy objects as well as true nebulae. Some open and globular clusters are included in Messier's Catalogue and one of the best known is the globular cluster M 3 in Canes Venatici. This object is well placed for observation in the northern summer months and the following information appears in the *Handbook of the British Astronomical Association* for 1964 and the *Atlas Coeli II Katalog*:

M 3	*RA* (1950·0)	*Dec.* (1950·0)	*Mag* (*vis*)	*Mag.* (*phot*)
(NGC 5272)	13h 39·9m	+28° 38′	6·4	4·5

Apparent diameter	...	9·8′
Linear diameter	...	35 parsecs (115 light years)
Radial velocity	...	−150 kms/sec
Distance from Sun	...	13·8 kiloparsecs (45,000 light years)

Compare the distance of M 3 with the distance of the Sun from the centre of the Galaxy at about 27,000 light years. M 3 is a very distant object but still a part of the Galaxy (M 31 Galaxy in Andromeda is 2·2 million light years away). It is more distant than most of the individual stars that we can see. Another interesting point is that it is only some 15 degrees from the North Galactic Pole so that when we look towards it we are looking out perpendicularly from the galactic plane.

The globular clusters are heavily concentrated towards the galactic centre. Dr. Shapley showed 40 years ago that they are distributed within a more or less spherical volume centred on the centre of gravity of the Galaxy, the galactic centre being located beyond the great star clouds in Sagittarius. The radius of this volume is about twice that of the galactic disc, 65,000 light years (galactic disc 40,000 light years). He therefore showed that the Sun occupied an eccentric position in the Galaxy and was not situated near the centre as had previously been thought. This may appear obvious now but at that time it was not known whether the galaxies were part of the Milky Way or separate star systems.

The distances of the globular clusters were established mainly by the study of the variable stars found in them. These are of the Cepheid type and we may assume that all the stars within a given cluster are at the same distance from the Sun, as the clusters are compact objects. By measuring the time interval between successive brightness maxima of each star and by knowing its apparent brightness a distance can be ascribed to the cluster. It was found that all stars of the same period had the same apparent brightness in a particular globular cluster and as there was every reason to believe that all these stars were of the same type the relative distances of the clusters could also be found; if the distance of any one cluster could be obtained the distances of all could be calculated. Two types of Cepheid are now known, those found in globular clusters being known as cluster variables or RR Lyrae stars.

Globular clusters have been very useful in stellar studies as a common origin for the stars in any one cluster seems certain and they are all at the same distance and subjected to similar galactic absorption. M 3 has about 180 cluster variables and the total number of stars is of the order of one million.

Photograph by courtesy of the Mount Wilson and Palomar Observatories

space exploration

by Robin S. Scagell

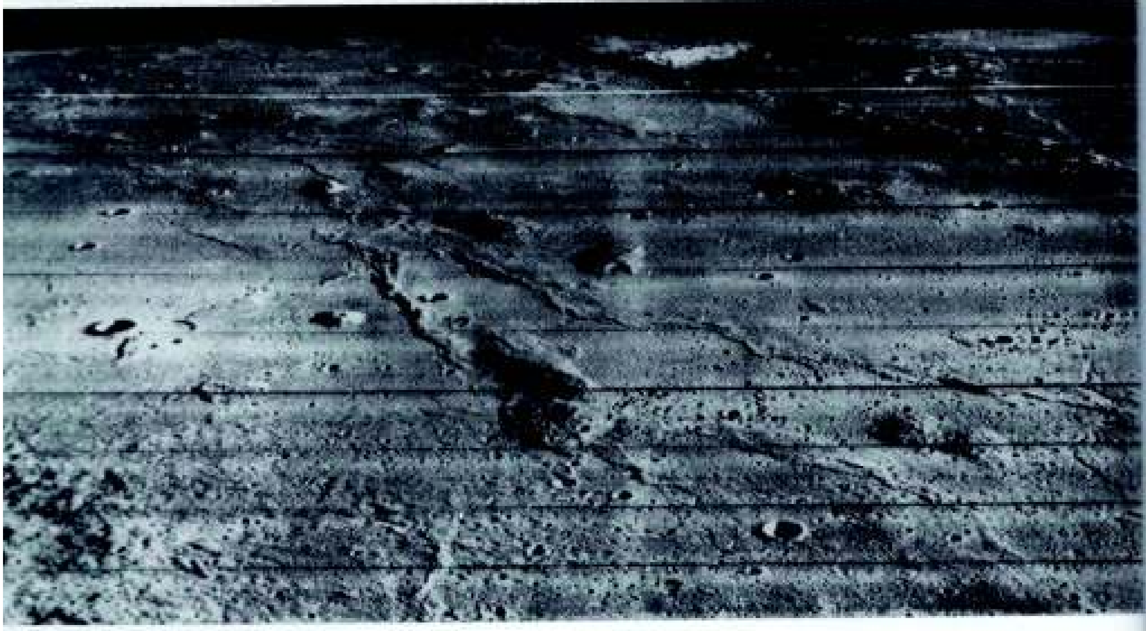
The information explosion. That's what they call the recent massive increase in publications of all sorts dealing with various aspects of science; as Ian Ridpath says elsewhere in this issue of *Hermes*, it applies to astronomy just as much as to the other branches of knowledge.

A supreme example of this is given by America's *Lunar Orbiter* series. With pictures back from three of these so far, and the promise of many more to come, it is clear that we shall soon be inundated in a sea of White Smooth Glossy photographic paper revealing the finest details of the Moon. What makes it even more embarrassing to the astronomers trying to keep their heads above prints is the marvellous quality of the *Orbiter* pictures. Only on very rare occasions before have we been able to pick up a magnifying lens and find yet more and more detail on a photograph of the Moon. Now, however, we are almost in need of more powerful magnifying glasses!

Over 1,000 high quality photographs are now in our hands, of which, for reasons of economy, we can print here just four (another five appear in JAS *Circular* No. 4). Each is rich in selenographic detail.

Of the *Orbiter*—2 shots, fig. 1 shows an array of domes. The crater in the distance is Marius, which is 25·5 miles in diameter—the whole of London would just about fit inside it, if you like. Reiner is just off the picture to the left, since we are looking south; interesting striations can be seen leading up to it.

About one third the way down the picture on the left can be seen a small crater which, on closer inspection, is centrally placed inside a ring fracture. This whole area is covered with interesting formations.



Now on to the latest *Orbiter*—3 pictures. One of the most striking is the oblique photograph of Kepler, 20 miles in diameter (*cover*). In the foreground of this crater can be seen what have been called 'perfect' craters—beautiful circular bowls. Near several of these can be seen hemispherical domes, which appear to be very much connected with the formation of this type of crater. Perhaps they are in the process of formation, or were in the process of formation when activity died down—a moot point! Interesting fault and scarp type features can also be seen on this frame.

Fig. 2 is a close-up of the interior of the crater Hevelius. This is at the western edge of the Oceanus Procellarum, and is seen only obliquely from the Earth, being situated about 1,250 miles from the centre of the face of the Moon as seen from Earth.

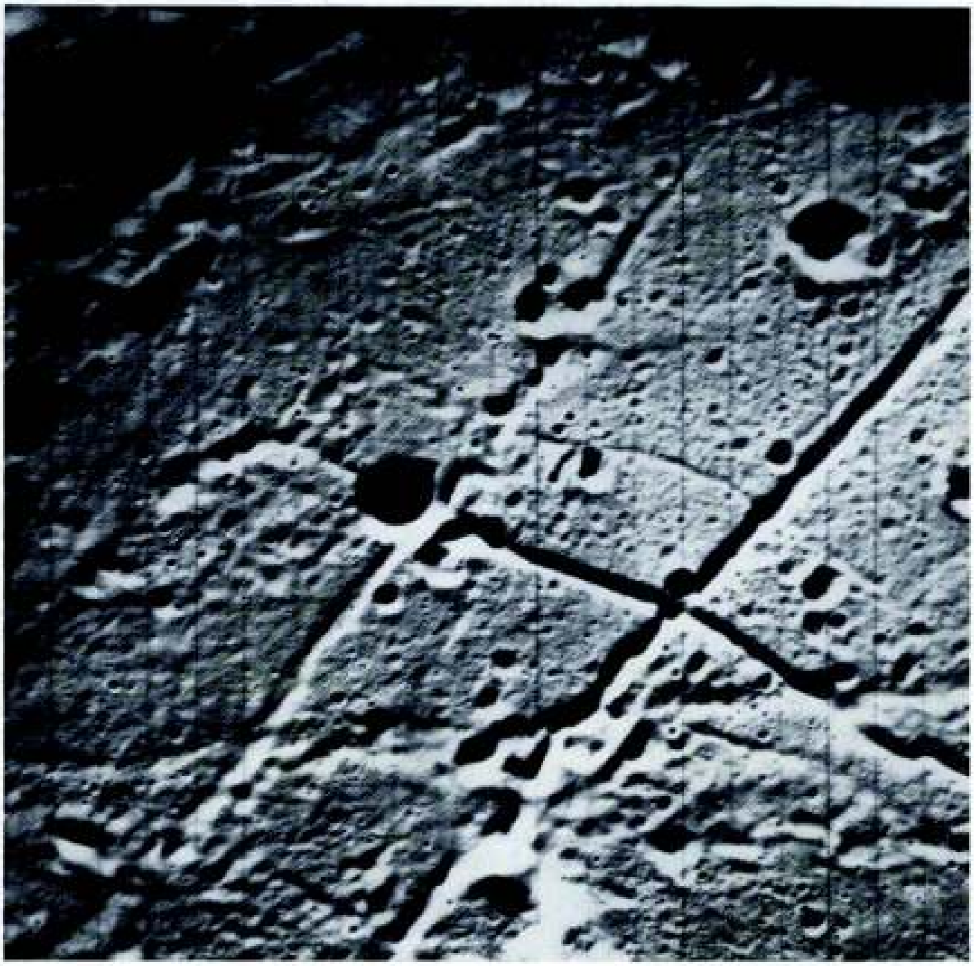
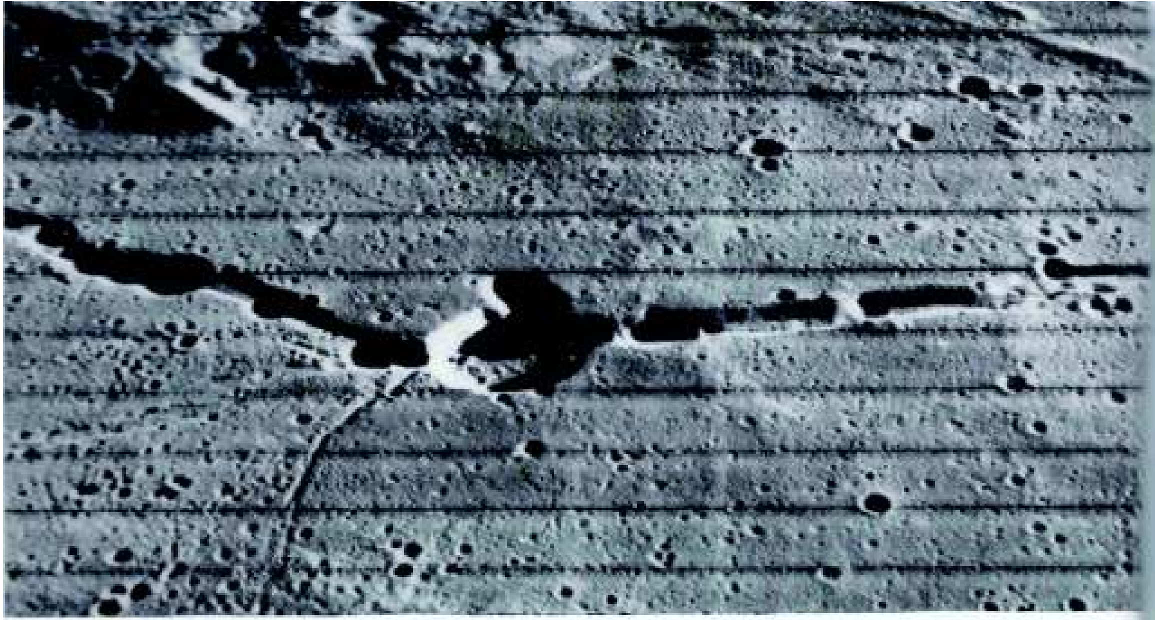


Fig. 2

The inside of Hevelius, showing the complex fault and rille structure. Compare this with the photograph overleaf of the Hyginus Cleft. Both these photographs have north at the top. Also see the Ranger-9 picture of Alphonsus, on the front cover of Hermes, Vol. 12, No. 4 (July, 1965).

Fig. 1



The Hyginus cleft is shown above; a feature which has fascinated observers. As soon as this picture was released, we showed a copy to Dr. Gilbert Fielder, of the University of London Observatory at Mill Hill—one of the world's acknowledged experts on the Moon. He commented that the picture showed the central cater Hyginus to be a collapse feature—it has no rim, he said. Furthermore, the rille has a gentle slope, which confirms his original opinion that rilles are formed as a result of fractures. He has pointed out that the craters may well have formed after the rille itself. Certainly there are no signs of that this is a dried-up watercourse, which is one explanation, put forward by the famous selenographer Neison!

One of the most remarkable things which has come out of the publication of the *Orbiter* photographs is the almost complete acceptance of the volcanic theory of evolution of the Moon's surface. I use the term 'volcanic' loosely, of course; perhaps the word 'tectonic' would be better, but everyone knows what we are talking about when we say volcanic. The information distributed by NASA and prepared by their experts now makes reference to lava flows and subsidence features almost exclusively, yet only a few years ago the American view seemed to be that all the Moon's craters were due to impact.

Over in Britain, the tectonic theories were put forward by Fielder, Moore and others; on the basis of the latest pictures, we are almost hard put to find any impact craters at all!

An exclusive report from New York by PAUL MURDIN

the third texas symposium

Since the quasars were discovered in 1963 they have produced surprise after surprise for those conservatives who think that nothing ever happens these days. The Third Texas Symposium on Relativistic Astrophysics which, despite its name, was held in New York City in January, 1967 heard papers read by Maarten Schmidt, Alan Sandage, and Geoffrey and Margaret Burbidge (amongst others), reporting new observational data on these faint objects.

Apparently (as the theoretical papers showed) there is still confusion over the most basic properties of the quasars. Are they nearby, or are they the furthest known objects in the Universe? Are their huge redshifts caused by their taking part in the general expansion of the Universe, or due to esoteric effects of general relativity, or possibly even a completely unknown mechanism? Are they large or small, recent or old?

We don't know what the answers are to these questions, though plenty of theoreticians are willing to guess.

Maarten Schmidt tried to define quasars: he chose the following description. They are blue, starlike objects with large redshifts up to a z of about 2.† The quasars often show variability with periods of between a day and about ten years, indicating that they are small (less than 10 l.y. across). Their spectra show emission lines and a continuum (some have absorption lines too), the emission lines coming from a low density object.

Schmidt and Greenstein reported the meeting's biggest redshift at $z = 2{\cdot}2$. If the redshift is an ordinary Doppler shift, then z is related to the speed of recession, v. For normal purposes, $z = v/c$ is the formula relating them, where c is the speed of light. If we use this formula for 3C191, we get $v = 1{\cdot}94c$, or nearly twice the speed of light! From the theory of relativity we know that this is impossible—nothing travels faster than light. The reason we are in this fix is that our formula is only approximately true. It is good enough for ordinary objects, such as stars in the Milky Way, but for high-velocity objects like quasars we have to use the relativity formula:

$$\frac{v}{c} = \frac{(z+1)^2 - 1}{(z+1)^2 + 1}.$$

If we set $z = 1{\cdot}94$ in this formula we get $v = 0{\cdot}794c$ so that 3C191 is receding at 79·4% the speed of light, a rather more lawful figure.

A group from the National Radio Astronomy Observatory in W. Virginia gave the results of radio observations at several wavelengths. Quasars are variable, but the radio variations do not correlate with one another; nor do they correlate with optical or infra-red variations. However, the emission-line spectra are constant, regardless of the variation of the rest of the radiation! The radio astronomers suggested a variable-shell model for quasars, each shell responsible for a different kind of radiation.

Sandage reported that there were 150 quasars known (93 have redshifts measured).

† For convenience, we give redshift the symbol z, for which we examine some particular line in the spectrum. Then z is *change in wavelength* over the *original wavelength*. The 1216 Å Lyman-alpha line, for example, is observed in 3C191 to be at 3581 Å, displaced by 2365 Å. So the redshift is $z = 2365/1216 = 1{\cdot}94$.

The 'distant' (?) ones, those with z more than 1·5, show a correlation with galactic co-ordinates which probably means that there are selection effects operating in their discovery rather than that they are galactic objects [see JAS Circular No. 3—Ed.]. He gave details of systematic trends in the colour of the quasars as a function of z, but attributed this to the structure of the spectrum of the typical quasar rather than to a difference between the 'near' and 'far' ones. As z gets larger, the spectrum shifts progressively, and the colour filters are looking at different parts of the spectrum of the object. Since quasars are often selected on the basis of their positions on the colour—colour (U—B versus B—V) diagram, we should be careful that we don't have preconceived ideas of what the position 'should' be.

Perhaps the most provocative paper was read by Geoffrey Burbidge. He produced spectra of a group of 5 quasars with redshifts greater than 1·9 which have absorption lines as well as the usual emission lines. *Although the redshifts from the emission lines varied from 1·90 to 2·24, the absorption line spectra show a constant redshift of 1·95!* Burbidge made three hypotheses to account for this:

(1) All five objects are observed through an absorbing cloud receding at 79% the speed of light from us. Since the five objects are in different directions we deduce that either all intergalactic material had this recession speed at about the time when the light left the quasars (if they are distant), or the absorption cloud surrounds the Galaxy, having been ejected from it at a speed near that of light.

(2) Maybe the absorption lines arise in the quasars and they happen to have the same speed with respect to us, having been ejected *à la* Hoyle from nearby galaxies (our own?).

(3) The redshift is not a Doppler shift at all. Perhaps it is a so-called gravitational redshift caused by the light losing energy as it 'climbs' from very heavy compact objects. There is a limit to the amount of redshift which can be caused by this effect—Schwarzchild gives $z = 2$ as the greatest redshift possible, and these objects have absorption redshifts just under this limit. The emission lines are then supposed to arise from nebulous material falling into the heavy object.

More scepticism about the usually-accepted Doppler-recessional nature of the redshift arose from the paper by the Burbidges and Hoyle comparing some identifications of lines in two quasars with $z = 1.94$ (3C191 and PKS 0237—23) with some lines identified by Greenstein as helium in a zero-velocity hydrogen—poor white dwarf (HZ 29)!

If anything can be said to illustrate the confusion about quasars then this is it. The one defining property which everyone is excited about might all be a misunderstanding because the spectra have been wrongly identified!

society notices jas

What is the Sound of Astronomy? See *Spectrum* in this issue if you don't know. You can hear the latest Sound of Astronomy for only 2/6. Write to JAS Tapes, 4 Green Moor Link, Winchmore Hill, London N21.

JAS Circulars offer unprecedented value in the latest news of astronomical happenings. Issued eight times a year for just 5/- (7/6 to non-members of the JAS), they offer really up-to-date observational information. Send your 5/- to Miss E. R. Atwell, 10 Moreton Road, South Croydon, Surrey.

General Editor of the *Circulars* is Robin S. Scagell, 1 Milverton Drive, Ickenham, Uxbridge, Middlesex. Write to him for back-numbers of issues 2, 3 and 4, which each cost 6d. (post free), in 3d. stamps, please. He would also like to hear from anyone with material for the *Circulars*.

Future meetings of the Society are listed on page 83. Please note that the April 29 meeting will be at 6 p.m., and all meetings thereafter (July 29 and October 28) at 2 p.m. Meetings are held at Caxton Hall, Westminster, London S.W.1—just round the corner from St. James' Park tube station and the New Scotland Yard.

We are pleased to announce that life-memberships of the JAS have been given to Mr. C. A. Tomes, LDS, RCS (ENG), FRAS, and to Mr. Henry Wildey, FRAS. Both have been with the JAS from the start and much of its success is due to their efforts.

To both our new Honorary Life Members we extend our grateful thanks.

The hearty congratulations of the JAS go to Peggy Mence and Norman Wright, both well-known to JAS members, who were married on March 10. Peggy will retain her maiden name for the post of Enrolment Officer, but please note that her address is now 96 Elmbourne Road, Tooting, London S.W.17.

Membership of the JAS is really increasing fast, and any set of figures are out of date as soon as they are published. By the time you receive this, the membership should be about 1,250.

Our target, though, as mentioned by Michael Maunder, is 2,000, to be reached by October, 1969. Perhaps we can reach this figure before the first man lands on the Moon? To do this, we need the help of every single JAS member. A completely new style of prospectus has been prepared, suitable for display. As many copies as you like are available free of charge from the Public Relations Officer—with details on how to win a year's free JAS membership for yourself. But please enclose a 3d. stamped addressed envelope.

As one Council Member has said, the JAS is taking off so fast, you can almost feel the g-forces!

Small advertisements.

Wanted. Good Secondhand complete 8½-inch Newtonian Optics 1/10th wave, Guaranteed JAS Member. Details, Lake, 'Daisy Bank,' Frodsham Street, Kelsall, Cheshire.

observatories and telescopes

by J. H. Mathers

The Great Northumberland Equatorial. "*In the month of August, 1833, I was honoured with an intimation from the Duke of Northumberland (conveyed in the first place through Sir John Herschel), that his Grace was desirous of presenting to the Cambridge Observatory an object-glass of nearly 12-inches in diameter, then offered for sale by M. Cauchoix of Paris, if it should be judged to be good, and if it should be deemed a useful addition to the instruments of the observatory.*"

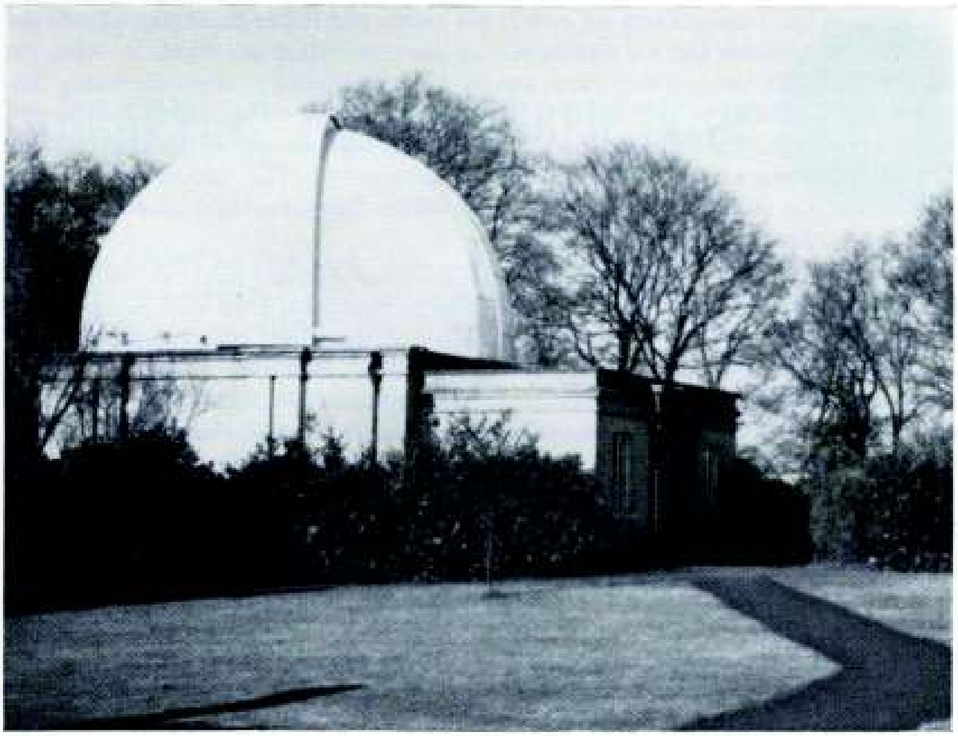
—from 'Account of the Northumberland Equatoreal and Dome'
by G. B. Airy

This was the beginning of what is perhaps Britain's most noble telescope—the Northumberland 12-inch at Cambridge Observatory. It is often thought that this was the largest refractor in the world at that time, but though it was probably the largest in professional use, and possibly the best in existence, it was certainly not the largest. In 1834, for instance, E. J. Cooper of Markree, Ireland, mounted a 14-inch and produced a detailed star catalogue, and this was probably the largest O.G. of any quality in use at the time.

Cauchoix, the brilliant French optician and one of the best of his day, made two O.G.s of 11¾-inch diameter and 20 feet focal length. One he sold to the great and eccentric observer James South, of London, and the other was sold for 15,000 francs to the Cambridge Observatory. George Biddell Airy was asked to design the instrument and to supervise its building, while financial support was ensured by the interest of the Duke of Northumberland, then High Steward, and later Chancellor of the Observatory. Airy received the O.G. from Cauchoix in December 1834, but it was not until May 1835 that he was satisfied that the objective was fully up to standard, and began work on the mounting and observatory. Later that year, Airy was appointed Astronomer Royal, and this slowed down the work, so that the Observatory was not fully operational until September 1838; Airy did not relinquish his post as supervisor until nearly a year later.

Airy chose, wisely, an English mount—probably the most stable and generally most satisfactory form, given the necessary space and money. The polar frame is made from six huge Norwegian fir-poles, connected at north and south by polygonal metal castings. At the south pier is the driving circle, nearly 5½ feet in diameter, which was originally driven by a falling weight escapement, but which was replaced by a synchronous motor later. The tube is square and made of wood. Although there is a finely divided circle in R.A., Airy used graduated chord-rods connecting the eye-end and the polar frame in order to find the declination angle. As far as I know, these are not used now. I noticed a few weeks ago that some undergraduate had fixed a make-shift scale on to the Dec. Axis, thus indicating that the chord-rods were probably lost some time ago.

The building which contained the instrument and which supported the dome was quite capacious. In fact, the whole observatory seems to have been built on a grand scale with a kind of leisurely Victorian atmosphere, smelling suspiciously (though



pleasantly) of better times. It was built to last a long time, and is still doing its work well. The building was straightforward, but Airy had difficulty in choosing a dome design, as most of those built at that time were subject to intermittent sticking—even jamming fast at times—and he was for this reason tempted to mount it in the open air. Eventually he decided to mount the dome on a number of cannon balls contained in a concave groove. This resulted in a suitably light movement, and he wrote '. . . a lady can turn it well without any machinery.' The dome itself was equal largest in the world.

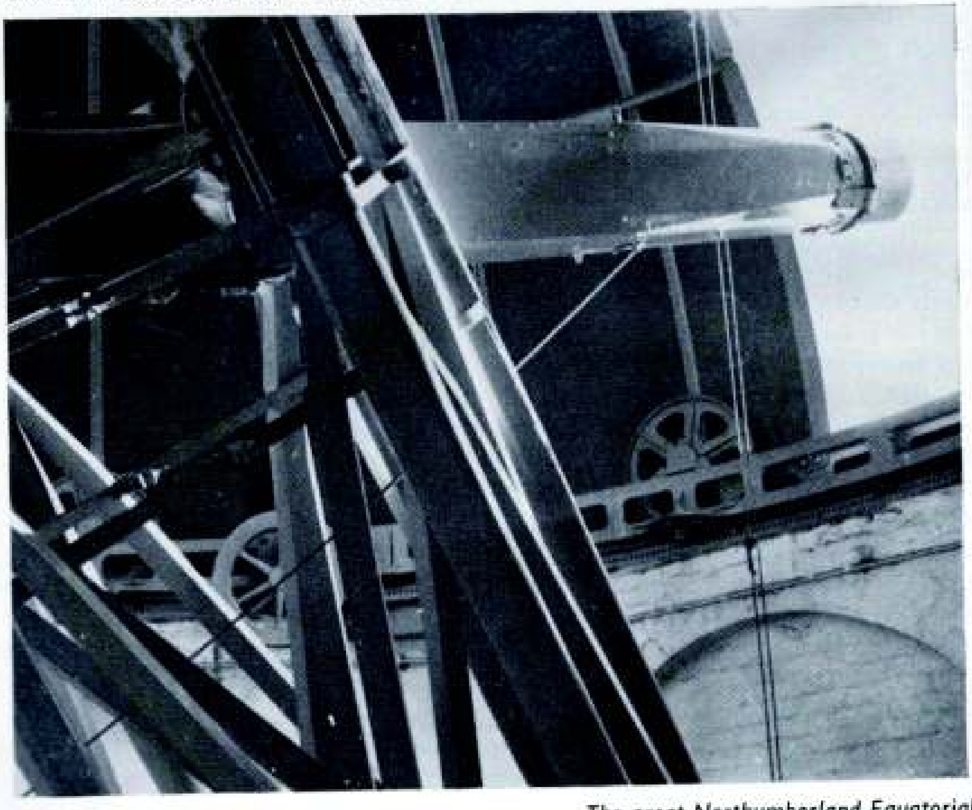
The telescope was swung into immediate use in the observation of planets, comets, and double and multiple stars. In 1846, Challis, Airy's successor, was busy with a newly discovered asteroid called Astraea, and was thrown into the well-known controversy over the discovery of Neptune. Professor Challis, working without a star chart, had to observe each star around a point at which Neptune was calculated to be, on several consecutive nights. If one object moved, then it could not be a star, and could well be Neptune. Challis did observe it several times, and it figured as one of his main suspects as he thought it showed a slight disc. He lost the chance of discovering the planet several months before Galle in Berlin, in his own words, "by deferring the discussion of the observations, being much occupied with reductions of comet observations and little suspecting that the indications of theory were accurate enough to give a chance of discovery in so short a time." In other words, he didn't get round to comparing his 3,150 observations of star positions.

This is perhaps the most infamous story in English astronomy, and the Northumberland was the centre of the controversy, being the instrument used by Challis during the search. After this time, the telescope figured in the early observations of Neptune's disc and in the observations of many newly-discovered minor planets. Double-star work was carried out and remained a major part of the programme.

What of the Northumberland now? No visitor can fail to be impressed with the size of the instrument and the atmosphere of grandeur which surrounds it. Alas, the original O.G. has been stored away, having been replaced by an apochromat. The original was refigured in 1937 by F. J. Hargreaves—one of the country's best-known astronomical opticians—but was later judged unsuitable because of the large amount of vein. The dome was replaced by a more modern one in 1932, but the instrument is substantially the same, including the huge wooden fully-adaptable observing chair, the most comfortable I have ever seen.

Since the formation of the Cambridge University Astronomical Society in 1942, the telescope has been given over to the undergraduates for their own observations. The impression there is one of serious amateur astronomical observation (and they feel that in this way they are contributing something to science); though a glance through the observing book betrays an underlying sense of humour. A notice greets the visitor—"*Do not let the telescope get below the horizontal or the O.G. will fall out*"—the real reason for replacing the original? Opening the log book we find "A malevolent curse is hereby pronounced on all cloud: may you drift forever and never precipitate" (David Foster), and Colin Reeves in more poetic mood, whilst observing Jupiter, writes "I can hear seas of liquid ammonia breaking in waves on the shores of the Great Red Spot." Or a polite comment on bad seeing—"The Moon displayed Birt and the Straight Wall waving gently in the breeze," or, later, "An exciting 13th moon of Jupiter proved, disappointingly, to be dirt on the lens."

For 130 years, this telescope has worked constantly, and one hopes that it will carry on serving the needs of students for many years to come, with no need to make use of the place reserved for it in the Greenwich museum.



The great Northumberland Equatorial

observing the southern skies

by Adrian Egan

The star without an even keel. Little did Halley realise, as he gazed out across the treasure-filled southern celestial ocean in 1677, that a mutiny was one day to break out on that great and mythical ship Argo circumnavigating the South Celestial Pole. Unfathomable even today, the story is nonetheless fascinating.

Halley, observing the chaotic orderliness of the southern Milky Way, noted down a fourth-magnitude star that seemed to have little claim to fame other than that it lay practically mid-way between the two prominent crosses, Crux (the true Southern Cross) and the 'False Cross.'

The False Cross (less spectacular than Crux, but sometimes mistaken for it—hence the name) forms part of the sprawling constellation of Argo Navis (the ship Argo); but the ship sails over such a large area of sky that it has been more conveniently sub-divided into Vela (the Sails), Puppis (the Poop), Pyxis (the Compass) and Carina (the Keel). It was in the latter that a certain stellar exhibitionist, designated Eta, refused to conform.

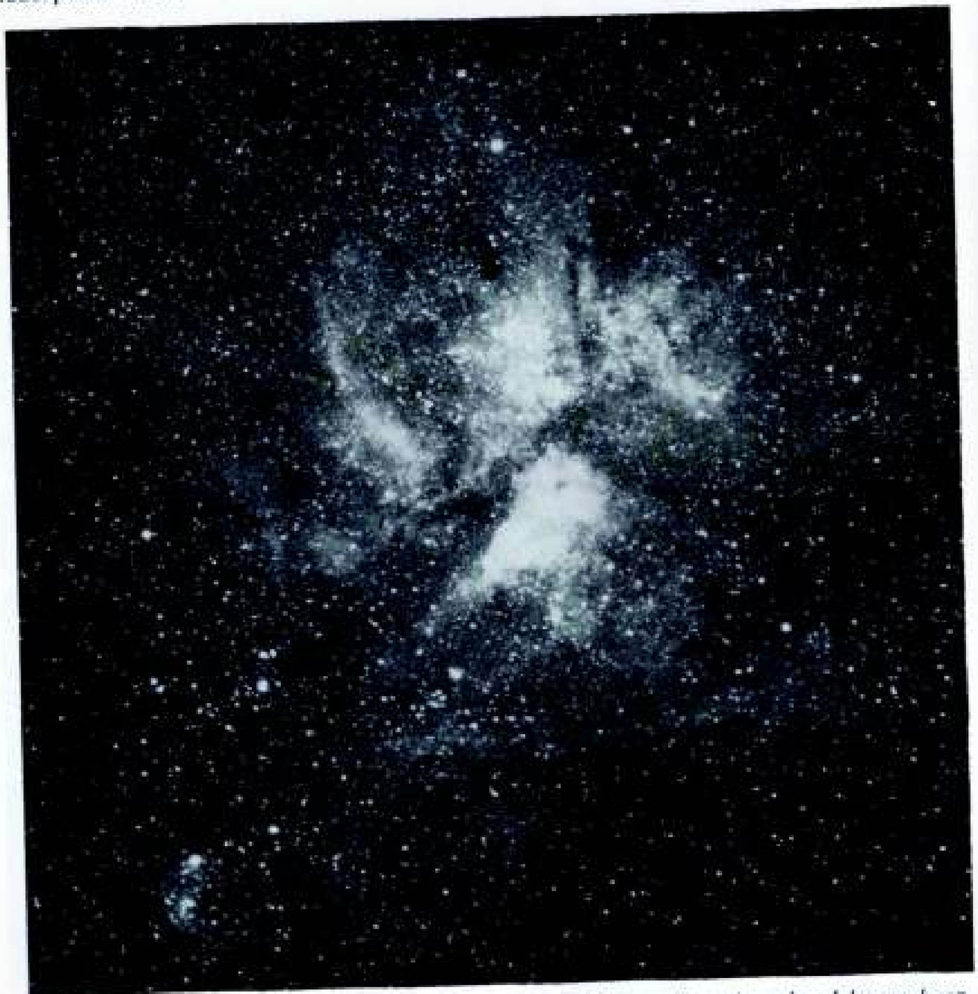
In 1751, Lacaille classed Eta Carinae—Halley's fourth-magnitude star—as of the second . . . and 86 years later, Sir John Herschel (working, as Lacaille had done, at the Cape, South Africa) was somewhat astonished to notice that the perverse showman had brightened to nearly zero magnitude. Since that time, Eta Carinae has attracted attention as the most schizophrenic star in the sky.

By 1843, it was outshining Canopus at magnitude −1, excelled in brilliance by Sirius alone. Then . . . just as unpredictably, it began a decline, and in 1880 it had dropped to magnitude 7. By 1886, Eta had faded still further to about the eighth. Three years later, however, obviously unable to bear being out of the limelight for any length of time, it was again visible to the naked eye, just, at magnitude 6. When it again reached the 8th magnitude, in 1897, it remained at about that level for many years. Perhaps, like another celebrated star, it 'wanted to be alone,' and had sunk into graceful retirement?

Arriving in the southern hemisphere for the first time in January 1952, Dr. Gérard de Vaucouleurs observed Eta Carinae visually at Australia's Mount Stromlo Observatory, and was (perhaps naïvely) surprised to find it about a magnitude brighter than he expected. Yet another rise had been in progress for some time, and observations (visual by de Vaucouleurs, photo-electric by Eggen and Hogg) revealed that the star was still brightening. Or, more accurately perhaps, the halo or 'shell' surrounding the star was brightening. The halo was first noticed about 1933 by the South African astronomer, Dr. H. Van den Bos, who also noted its redness.

Dr. A. D. Thackeray, of the Radcliffe Observatory, Pretoria, shows reason for concluding that the recent brightening is due mainly to the increasing luminosity of the halo—and that the nucleus itself has brightened little, if at all. Gaviola suggests that the halo has been moving outwards from the nucleus at a rate of about 5" per century since the 1843 outburst.

So peculiar is the spectrum of Eta Carinae that it is difficult to place it in any clearly-defined class: but visually the star appears orange-red. Most of the colour, however, is apparently due to the red halo. The first published observation of Eta's colour is that of Herschel, who found it ruddy or yellow. In 1899, Thome found that the colour had changed during the brightening of 1886–9 from red to bright orange. It was while this particular luminosity-rise was in progress that Miss Agnes Clerke (in 1888) had made the first spectral observation of the star visually at the Cape. At that time, it was an absorption spectrum; but by 1895 the absorption had disappeared and many bright lines were visible. The spectrum at this stage resembled that of Nova (T) Aurigae . . . but Eta Carinae was no ordinary nova. Neither was it an ordinary variable. Pickering (in his Second Catalogue of Variable Stars) listed it as Nova Carina 1, and Ludendorff classed it as a nova-like variable. But the only appropriate or suitable classification seemed to be 'freak.' Some stars with very enigmatic peculiar spectra seem to be related to novae, but certain astronomers believe that it is improbable that Eta Carinae is a supernova or a nova-like variable. It can be described as a P Cygni star—having a spectrum including combined emission and absorption lines.



Photograph of nebulosity surrounding Eta Carinae by Christos Papadopoulos, Johannesburg.

"Truly the most beautiful diffuse nebula in the Milky Way" is Bart J. Bok's description of the great gaseous complex surrounding Eta Carinae. The nebula was discovered and termed the 'Key-hole Nebula' by Sir John Herschel (who else?). Eta lies in the densest part of the nebula, close to one edge of the key-hole shape, but does not itself contribute to the illumination of the nebulosity, which is excited by the numerous O and B stars immersed in it. In fact, there is a great concentration of O and B stars centred on this emission area; there is evidence to suggest that Eta is actually associated with it, and is, in Miss Clerke's words, "really plunged in nebulous substance."

Enigmatic Eta continues to entertain, to confound and to perplex. Unpredictable and capricious, its behaviour is unparalleled by that of any known star. It may at any time flare up again to become one of the most splendid luminaries of the heavens. There's simply no knowing. But then, that's show business.

spectrum

by Ian Ridpath

Astronomy Takes Off. The latest participant in the information explosion is a lithographed publication called, predictably, *Astronomy*. Stepping into national circulation with this is the Wyevern Astronomical Society, a medium-sized group from the somewhat unlikely reaches of Gloucester.

Editing *Astronomy* until the new year was dark-haired 19-year-old Chemistry student, Alison Brown. She is also Chairman of Birmingham University Astronomical Society. Back at University after working six weeks as a vacation student at the Edinburgh Royal Observatory, she told *Spectrum* of Wyevern's development in the astronomical field.

"The WAS began as the West Gloucestershire Group of the JAS some six years ago; I was one of the founder members. We progressed through the Gloucestershire AS until our star party two years ago, which was a great success—lots of firms exhibited. We're holding another in Cheltenham this year. Then we became the WAS and decided to expand our original society magazine, *Sidereal Times*.

"The reason for expansion was that as our members live in an area which is very large, they cannot all get to meetings. We felt that a magazine—a really good one—was the best way to cater for them; and as we intended the mag to be good, outside sales looked on the cards. After all, BAA and JAS publications are usually only seen by the Society members, yet there are many people who have a layman's interest in the stars. So on the one hand we were trying to cater for the reasonably knowledgeable amateur, and on the other for the layman who might feel *New Scientist* and the like were too complicated.

"Our printing process is photo-litho. What happens is that MSS get typed to 36 characters per line and levelled off, then photo-copied and reduced by one of our members and printed by a local printer. Our main trouble is getting the printer to get it out on time as we haven't yet a big enough order.

"We try to get help with marketing from local shopkeepers. There's a chemist in Gloucester who has sold dozens for us. Whether we will ever make a profit, I don't know; it's true to say we only want to make one in so far as it will enable us to increase our readership and make the magazine better—and interest more people in astronomy.

"But just how well *Astronomy* is succeeding I'll leave for our readers to comment."

In a small television studio in the heart of London's West End, edition number two of the JAS tape magazine *Sound of Astronomy* prepares to go on the air. Our illustration shows Adrian Egan and Hazel Joyce memorizing their announcements. Recording Engineer on this session—Geoffrey Lindop.

The first *Sound of Astronomy*, recorded over the kitchen table, went across the world and brought back letters of praise. Special items in the new edition include: a report on the tracking of Lunar Orbiter I from NASA's South African tracking station; just what it's really like to use the Mount Wilson 100-inch telescope; an interview with the Leader of the JAS Iceland Expedition; as well as other intriguing items, news, views and interviews—plus the opportunity for *your* voice to be heard in the next issue.

Book your evening's sound astronomy listening NOW.

Sky Eye. Why rely on books and magazines for sky maps? asks 14-year old schoolboy, Roger Perris. He's not. He's making his own.

"I decided to make a map of the night sky because I think it's an interesting project," said Roger of Northwich, Cheshire. "I also expect to be able to gain a considerable amount of information on the constellations in this way."

Roger's sky-chart, drawn on Imperial size drawing paper, will cover the night sky as seen from the British Isles for all the year round. He's begun by first marking out ten circumpolar constellations. "I'm making my map mainly from an atlas, but using some observations of my own," explains Roger. "The map will include nebulae and similar objects. I have stuck to Right Ascension and Declination—I'm going to put a system of numbers around the circumference to work out the horizon for a given time."

Roger first heard of the JAS through Observers' Book of Astronomy. He wants to become a professional astronomer: "Either an astrophysicist, or working at Jodrell Bank—if I can do it.

"And personally," he added, "I think that the JAS is an excellent Society."

Watch This Space. Suddenly, the JAS is news—national news. The Society's growing strength is reflected in the interest taken by magazines, newspapers and TV, with much more yet to come. Many of you will have read JAS reports by Clare Dover, 29, of the *Daily Telegraph* Science Staff. A native of Lancashire, she obtained a BSc at Liverpool and came to London as a teacher before changing to journalism. Why did she find the JAS newsworthy?

Says Clare: "The idea of a crowd of interested people carting telescopes across St. James's Park to watch last May's solar eclipse fascinated me. These stories can be a deadly bore, but with policemen and geese milling around, this made a much better item. It worked out splendidly—everything happened so well. At one stage, I was holding a piece of bread to attract the attention of a duck, so that it looked to the camera as if the duck was viewing the projected image of the eclipse.

"The same went for the Leonids. The idea of people lying on deckchairs with sleeping bags up to their chins all night on Hampstead Heath sounded better than the the actual meteor watch.

"Comments on *Hermes*? There's certainly a lot of work in it. The result is a very professional looking job. I don't like the use of small letters instead of capitals—though the small 'h' in the *Hermes* title doesn't look so bad. I rather get the impression that it's just a little old-fashioned in layout. But I wouldn't change it, because it's bound to become fashionable again soon."

Mars or bust. Two *Mariner* spacecraft are scheduled to fly past Mars in 1969. They will each carry two TV cameras, uv spectrometers, ir spectrometers and ir radiometers, and will pass three times closer to the planet than did *Mariner*—IV in 1965, which went within 6,118 miles of the Martian surface.

Another *Mariner* has been modified to fly past Venus during this year.

A *Voyager* probe is scheduled to land on Mars in 1973. The spacecraft has been designed so that the experiments and the craft itself are separate, to allow for different experiments on future flights.

sky diary

by Adrian Egan

mid-April to mid-July, 1967 All times GMT

Principal Phases of the Moon

	APRIL			MAY			JUNE			JULY		
	d	h	m	d	h	m	d	h	m	d	h	m
New	9	22	20	9	14	55	8	05	13	7	17	00
Full	24	12	03	23	20	22	22	04	57	21	14	39

The Moon: The Brighter Occultations (Greenwich Predictions)

Date	Star	Mag.	Phase (D or R)	Time	Position Angle (degs.)
April 17	47 Gem	5·6	D	24h 13·3m	34
July 14	76 Vir	5·4	D	21h 31·0m	177
July 17	Sigma Sco	3·1	R	22h 14·0m	209
July 18	43 Oph	5·4	D	22h 06·3m	172
Visible from New Zealand (Wellington):					
June 2	Saturn	1·1	D	14h 44·1m	99
			R	15h 33·2m	199
Occultation by Venus—visible in Eastern S. Africa (Johannesburg):					
June 8	BD+22° 1915	7·4	D	16h 15·0m	133
			R	16h 22·0m	257

D = Disappearance. R = Reappearance.

Only the brighter lunar occultations have been given here. Anyone interested in observing the fainter ones should get in touch with H. N. D. Wright, address on p. 81.

The Brighter Planets

MERCURY, badly placed for northern observers in the morning skies during April will be 0°·5 S. of Saturn on 18th at 03h, and reaches superior conjunction (behind the Sun) on 11 May. It then once again becomes an evening star until on 12 June Greatest Elongation East is attained. Although the planet will then be 24° from the Sun, the brightness of the midsummer skies will not make observation easy. Plunging back into the overwhelming solar glare, the planet arrives at inferior conjunction (between the Earth and Sun) on 9 July.

VENUS, dominating the evening skies once more and becoming ever more brilliant and conspicuous only reaches its greatest brightness on 24 July. As the crescent becomes narrower, searches for any sign of the elusive Ashen Light can be made. Moving south in declination, the planet will be 45° from the Sun at Greatest Elongation East on Midsummer's Day (21 June).

MARS, with a synodic period (interval between successive oppositions) of about 780 days comes to opposition again this year, on 15 April, when it will be due south (for northern hemisphere observers) at midnight and will shine with a ruddy brilliance at magnitude −1·3. Unfortunately, with the planet at a distance from Earth of nearly 56 million miles, this is an unfavourable opposition, but useful observations may still be made. The planet's northern hemisphere will be tilted towards the Earth until the end of October.

JUPITER, which has for some months been such a prominent and rewarding object, starts to move in towards conjunction, reached on 8 August. By July, the Sun will start to swallow it up, so while the opportunities for good observations exist, they should not be missed. The planet's magnitude is steadily decreasing as it gets further from Earth.

SATURN, now actually out of the Zodiac in Cetus, reaches a stationary point on 26 July. The first of ten occultations of the planet in 1967 occurs on 8 April, but unfortunately none of these very interesting phenomena will be visible from Britain. The planet's recently-discovered tenth satellite, at mag. 13·5 is too faint to be seen with most amateur instruments; unconfirmed reports claim sightings with a 10" refractor, which has a theoretical limiting magnitude of 14.

URANUS, having reached opposition on 13 March (the date, 186 years ago, on which Herschel discovered it) is now favourably placed for observation between Leo and Virgo. Its magnitude has been suspected of variation, and a list of suitable comparison stars can be found in JAS *Circular* No. 4.

constellations near the meridian at 22 hrs.

mid-April	Leo; Leo Minor; Ursa Major; Crater; Sextans; Hydra.
mid-May	Coma Berenices; Canes Venatici; Ursa Major; Ursa Minor; Boötes; Leo; Virgo; Corvus; Crater; Hydra.
mid-June	Canes Venatici; Boötes; Corona Borealis; Serpens; Virgo; Libra.
mid-July	Lyra; Hercules; Corona Borealis; Serpens; Ophiuchus; Libra; Scorpio; Sagittarius.

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