AAE

GNOMON

Newsletter of the Association for Astronomy Education

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EDITORIAL COMMENT

Metric Moods?

The scientific community has used metric units for a considerable time now, well in advance of the general public. Astronomers will probably be the last group of scientists to change from old-fashioned units, however, as we still encounter Ångström units and light-years in the literature.

But when we have all completely changed to metric units, are we to *abolish* words like "pounds" and "miles"? Will these words only be found in dictionaries of obsolete words, such as those used in the popular BBC TV game "Call My Bluff"? When we fail to evoke a response from someone in a brown study, will we say that he is "kilometres away"?

There is a certain poetry about these old words (does anyone remember the shilling, and the "bob-a-job week"?); it is to be hoped that their retention in everyday use will be matched by complete acceptance of metric (SI?) in scientific communication.

QUADRUPLE SUMMER TIME?

Once again, the canutes are at it. Their idea is to impose a uniform time system over the whole of the European community. In this way, they argue, commercial links between different parts of the community would be harmonized – for example, someone in Scotland will be able to speak (on the telephone, presumably) to a colleague in Greece and be happy in the knowledge that both their clocks say exactly the same time. This would be quite independent of "real" solar time, i.e. whether it is still dark in Scotland whilst in Greece the sun is climbing steadily in the sky.

The most western longitude in the EC is about 10°W (western Ireland); the most eastern longitude is about 25°E (eastern Greece). This spans a solar time range of approximately 2 hours 20 minutes. The canuters want to shrink this to zero.

What would they suggest if Europe were to expand even more "remote" longitudes (such a system has already been proposed). The time span could cover a range of 5 or 6 hours, or even more. A world state would cover 24 hours!

The situation at present is realistic – the largest country in the world covers about 10 1-hour time zones, and all of this within *one* state! And normal life goes on quite untroubled; one merely has to recognize that the Earth rotates on its axis, and that it is dark in some places at the same time as it is daylight in others! Life has to be adjusted accordingly.

As a corollary to this, a recent BBC Radio programme informed us of the imminent demise of the "pips", and that even the term "Greenwich Mean Time" will go. Will Greenwich's historic rôle become merely part of history?

And what will happen to UT?

ENVIRONMENTAL EDUCATION

The summer 1989 journal of the National Association for Environmental Education (NAEE) will be of particular interest to AAE members. It is full of interesting information, articles, news, etc. In particular in this issue is an article on the National Curriculum by Joy Palmer, of the School of Education, Durham University.

AAE members who would like a sight of the journal should contact the Editor (of *GNOMON*) who will arrange for a copy to be sent. A small charge (for postage, etc.) may be made to cover expenses.

ADDRESSES FOR CORRESPONDENCE

Secretary: Bob Kibble, 34 Acland Crescent, Denmark Hill, London SE5 8EQ. *For all general enquiries* (Tel: 01-274 0530).

Treasurer: Nicholas Steggall, 38 Victoria Crescent, Birkdale Road, Dewsbury WF13 4HJ *for all financial and subscription enquiries* (Tel: 0924 454718).

Editor: Eric Zucker, 35 Gundreda Road, Lewes, East Sussex BN7 1PT *for all enquiries concerning the Newsletter* (Tel: 0273 474347).

NEW NORTON'S STAR ATLAS

A new edition will be published on 18 September. It will be called NORTON'S 2000.0.

ANNUAL SUBSCRIPTIONS

Members will find in this issue a membership renewal form. The new subscription year begins on 1 September 1989. Recently joined members have been enrolled until 31 August 1990.

Please help the Association by prompt payment of subscriptions – to send out renewal reminders is heavy on postage. The rates are:

Individuals	£6.00
Affiliated institutions (e.g. schools, colleges, societies)	£12.00
Members who are retired	£4.00

The renewal form also gives details of AAE publications, some of which are now being offered at reduced prices.

FROM THE LONDON PLANETARIUM

Changes in Schools' Programmes

THE EARTH IN SPACE

All Schools' programmes at the London Planetarium have been reviewed in the light of the National Curriculum, and the inclusion of Astronomy in it.

Our previous programmes (Earth, Sun and Planets, Our Skies, etc.) have been redesigned to complement Attainment Target 16, and have been renamed "THE EARTH IN SPACE". Although much of the content remains relevant, we have also taken into account other Attainment Targets, specifically "The Nature of Science" (AT17); and we shall continue to ensure that each programme is suitable for the age groups booked into it.

As an extra, and complementary, programme for Junior Schools we will be showing a monthly programme "Stars in Space", which, as the title suggests, concerns stars rather than the Solar System, and will be a useful follow-up for schools who wish to pursue astronomy a little further.

TEACHERS' EVENING

As an aid to communicating these changes to teachers of all levels, we shall be holding a TEACHERS' EVENING on September 25 from 6.30pm to 9pm. Primary and Secondary teachers will be given a separate demonstration of the different levels of programme. In addition there will be a short explanation of some of the figures in our Astronomers' Gallery. Refreshments will be provided, and there will be plenty of time for informal discussions with our lecturers and other staff.

Admission is FREE, but by advance booking only. Apply to the Planetarium Administrator, Undine Concannon, by September 20. (The London Planetarium, Marylebone Road, London NW1 5LR. Tel: 01-486 1121).

PHYSICS AND ASTRONOMY VIDEO AND FILM RESOURCES

A catalogue under this title has been produced jointly by the British Universities Film and Video Council (BUFVC), the Institute of Physics and the Royal Astronomical Society. The catalogue gives details of over 600 titles, all suitable for 6th form level and above.

The catalogue may be obtained from the BUFVC, 55 Greek Street, London W1V 5LR (Tel: 01-734 3687) for £12.00 for members, or £7.00 to BUFVC members.

Further details of this catalogue will be given in the next issue of *GNOMON*. It should not be confused with the AAE Film and Video catalogue, which, in the main is at a lower level (pre-6th form), and does not, with few exceptions, deal with physics.

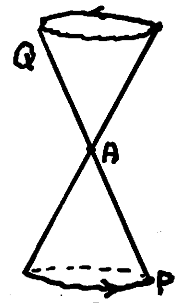
ESPERANTO KAJ ASTRONOMIO

To honour the convening of the 74th World Esperanto Congress held in Brighton last July, the Brighton Astronomical Society put on a programme of two talks open to delegates to the Congress, as well as to members of the Society. Delegates came from all over the world, and Esperanto was the language which united them (there were 2,400 delegates).

There was a simultaneous translation from English into Esperanto, by an astrophysicist from Israel, which proceeded as the talks were given.

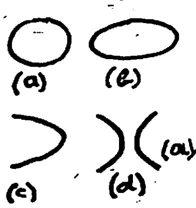
The meeting was very well attended.

THE ELLIPSE IN ASTRONOMY



If a straight line QAP passing through a *fixed* point A is revolved so that the point P traces out a circle (the point Q will trace out a similar circle), then the line QAP will generate a *cone*. (An inverted cone appears to "sit" on top of another cone, both sharing a common apex A).

If we *slice* through the cone in any general direction, the shape of the slice (cut) will be an **ellipse.** If the slice is made perpendicular to the axis of the cone, the shape of the slice is a **circle.** If the slice is made *parallel* to the "side", i.e. the line AP which generated the cone, the shape is a **parabola.** Finally, if the slice is parallel to the cone's axis (thereby cutting into the top, inverted cone as well, the shape of the slice is a **hyperbola.** In this case, the slice is in two separated parts.



These 4 shapes are called, for obvious reasons, **conic sections.** They are shown below:

(a) CIRCLE (b) ELLIPSE (c) PARABOLA

(d) HYPERBOLA

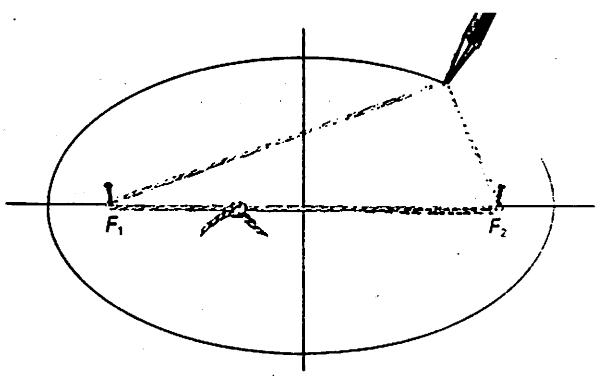
It is apparent that all 4 shapes are related – it is only the angle of the cut that distinguishes one from another. Thus the parabola, for example, may be regarded as a special case of an ellipse (a very elongated one).

All 4 conic sections have applications in astronomy. We shall concentrate on the ellipse and the parabola which have applications in (a) orbits of planets around the Sun (Kepler's Laws), and (b); mirrors of telescopes.

HOW TO DRAW AN ELLIPSE

One way would be to take a cone, make a slice through it in the appropriate direction, and trace round the cut. There are obvious practical reasons for looking for an alternative method.

The diagram below gives an easy method requiring only a length of string, two drawing pins, a pencil and a piece of card or other stiff material.



The two drawing pins are pushed into the card at F_1 and F_2 (these are called the **foci**). The length of string is tied into a loop, passed over the drawing pins and kept taut with the pencil. The pencil is then moved in a complete revolution, keeping the string taut all the time. The path traced out is an ellipse.

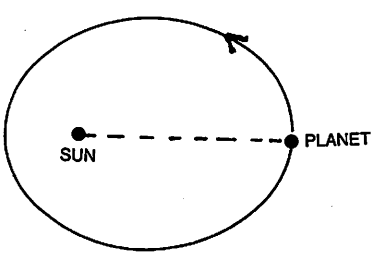
It can be proved mathematically that the trace produced is indeed the same as the conic section in the original definition.

It is instructive to draw a variety of different ellipses, with different distances between the drawing pins. The diagrams below show a few of these:

It will be seen that the further apart we place the drawing pins, the more elongated is the ellipse. Also that if the two pins are very close together, the shape is very close to a circle (from which we infer that a circle is a special kind of ellipse in which the two foci coincide).

PLANETARY ORBITS

Kepler showed that each of the planets in the Solar System travelled around the Sun in an elliptical orbit (this is an ideal case, which ignores the effects of the gravitational forces of the planets on each other). Furthermore, the Sun is fixed at *one* focus; the other focus is "empty", i.e. no body is situated there.



Another of Kepler's Laws states that "equal areas are swept out in equal times". (This means that the line joining the planet to the Sun sweeps out equal areas in equal times). Careful consideration of the motion shows that the equal area law means that the planet cannot travel in a uniform speed, but that it must travel faster when it is closer to the Sun than when it is more distant. The point corresponding to the closest approach is called the *perihelion;* the most remote point in the orbit is the *aphelion.* The speed is thus greatest at perihelion, least at aphelion.

COMETS

Kepler's Laws are not solely applicable to the planets. They apply equally to the comets. Comets differ from planets, in as far as their orbits are concerned, in having very elongated orbits. The elongations of most planets are so small that they are almost circular. The well known comet Halley has such an elongated orbit that the "empty" focus is well beyond the orbits of the outermost planets (Neptune and Pluto). So slowly does this comet travel at aphelion that it is not surprising that the time for one complete revolution is 76 years.

HOW TO PLAY AT BEING A COMET

Apparatus required: two wooden posts, capable of bring driven into the ground, a length of rope (the longer, the better), a large expanse of open ground (a school playing field is ideal), and a willing volunteer to play the part of the comet – he or she may like to dress for the part.

As a trial, drive *one* post only into the ground, tie the rope into a loop, and pass this loop over the post and the volunteer, who sets off at a trot, keeping the rope taut, in a *circular* orbit. The path taken has no elongation, there is no perihelion or aphelion, and the volunteer is obviously simulating a *planet.* The speed in the orbit should be kept constant.

Having mastered the technique, go on to use the two posts. Drive them into the ground say 20 feet apart, use a loop of rope about 50 feet long, and the volunteer (making sure the rope is always taut) sets off on the cometary orbit. To be realistic, the volunteer should travel fastest at perihelion, and gradually slow down as aphelion is approached. (There is a mathematical formula which gives the velocity at any point of the orbit).

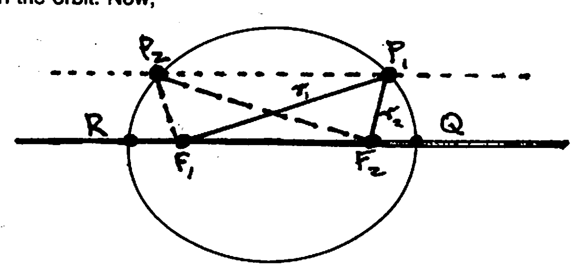
Once confidence has been established, we can go on to even more ambitious orbits, that is, for very elongated orbits. The larger the scale on which the exercise is done, the more realistic is the demonstration (maybe two trees can be substituted for the posts?).

THE MEAN DISTANCE OF A PLANET (OR COMET) FROM THE SUN

One of Kepler's Laws states that the time for one complete revolution depends on the *mean* distance of the body from the Sun.

What is this mean distance? Is it merely the mean (average) of the perihelion and aphelion distances?

We need to find the mean *not only of these two points,* but of every point in the orbit. Now,



for every point such as P, in the above diagrams, there is a corresponding symmetrical point P_2. The *mean* of these two distances from (say) F_1 is $\frac{1}{2} \times (r_1 + r_2)$. *Whatever* the position of P, there is always such a corresponding point P_2 and the mean distance is always $\frac{1}{2}(r_1 + r_2)$. This must be true for the whole orbit.

But $(r_1 + r_2)$ remains constant as P, moves in its orbit. We can find this distance by considering its value when P, is at Q. In this case $(r_1 + r_2) = F_1Q + F_2Q$, which by symmetry, is equal to $F_1Q + F_1R = RQ =$ the major axis of the ellipse (2a). The mean distance is $\frac{1}{2}(r_1 + r_2) = a$ (the semi-major axis of the ellipse).

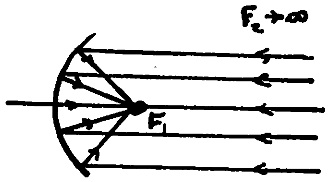
It is interesting to work out the mean of the perihelion and aphelion distances. This is the mean of F_1Q and F_1R, i.e. $\frac{1}{2}(F_1Q + F_1R) = \frac{1}{2} \times RQ = a$.

It turns out, then, that the mean distance of the planet from the Sun is, after all, equal to the semi-major axis; however, it does not *always* follow that the mean value of a set of numbers is equal to the mean of the lowest and highest in the set (consider, for instance, the numbers 1, 2, 2, 2, 5).

ELLIPTICAL AND PARABOLIC MIRRORS

It can be proved that if a point source of light is placed at one focus of an elliptical mirror, then all the rays of light emanating from that point source will, after reflection at the mirror, pass through the other focus. This is an exact relationship, with no approximations; it means that a point object gives rise to a point image. The argument may be extended to a *real* mirror (in 3 dimensions), which is the surface generated by rotating the ellipse around its major axis (this is called an ellipsoid of revolution).

As a parabola is merely an ellipse with one focus at infinity, it follows that the rays of light emanating from a point source situated at the focus will, after reflection at the parabolic surface (more realistically, a paraboloid) give rise to a set of rays which meet at infinity. This is another way of saying



that the reflected rays form a *parallel beam*. Conversely, a parallel beam of light falling on to the mirror will, after reflection, all pass through the focus.

This is the reason why the main mirror of a reflecting telescope (Newtonian) is a paraboloid, not a sphere.

In the Gregorian telescope, now rather obsolete, the parallel light falling on to the main mirror is brought exactly to the focus. This focus is arranged to be also one focus of a small concave ellipsoidal mirror; the ellipsoidal mirror then focuses the light to its other focus. This is the final image, which may be examined with an eyepiece.

In the Cassegrain form of reflector, the concave ellipsoidal mirror is replaced by a convex hyperboloidal mirror. It can be shown that light converging towards one focus of the hyperboloid (which, it may be recalled, is in two sections) will, after reflection, pass through the other focus. This constitutes the final image, which may be observed with an eyepiece.

A SURVEY OF ASTRONOMICAL SCIENCE

by Dr. M. D. Mannion

Astronomy can be said to be the study of everything in the Cosmos, including the Earth and its relationship to the Cosmos. It can claim to be the oldest science both in a human context and a scientific context. However, astronomy is unlike any other science in that it derives all (or nearly all) its observational data indirectly, from electromagnetic radiation and cosmic rays to events that will have occurred millions of kilometres from earth-bound laboratories. Because of the emphasis on observations, it is an ideal science for examining how observations are used in science methodology.

Astronomy has often been observation-led in that the opening up of new observational wavelengths have led to the discoveries of many strange objects and phenomena which theorists have had to explain. This emphasis on observations is inherent in astronomy – the question of what interstellar dust is made of has not been satisfactorily answered in 60 years – one could, of course, send out an interstellar probe to answer the question, but this would take a million years!

Outlined below are a few notes on the developments of knowledge in astronomy through the many kinds of observations now used.

Data on stars and interstellar matter in our Galaxy and observations of the myriads of galaxies in our Cosmos come from:

electromagnetic (e.m.) radiation or photons over the range radio to gamma wavelengths;
cosmic rays – energetic particles mostly protons;
neutrinos and gravitational radiation.

Considering e.m. radiation first, one can state there are in general terms four types of information an e.m. photon carries:

(1) spatial information – where have the photons come from?
(2) temporal information – what is the variation of intensity with time?
(3) spectral information – what is the distribution of intensity with photon energy?
(4) polarization information – what is the orientation of the electric field?

Splitting the e.m. spectrum into six regions in order of increasing wavelength we have:

1. Radio astronomy

This began with observations by Karl Jansky in 1932 and has now amassed a wealth of data; from the detailed structure of our Galaxy to quasars, from gas clouds in the process of producing new stars to the relic of the radiation produced in the Big Bang. Observations are made of the 21 cm neutral hydrogen line, radio recombination lines, non-thermal continuum and the many molecular lines, e.g. CO.

2. Infra-red astronomy

This branch of astronomy may be said to have started with the observation of infra-red radiation from the Sun in 1800 by Sir William Herschel. However, it is only in the last thirty years with the advent of semi-conductor detectors, cryogenics and space-flight that infra-red astronomy has advanced. The Earth's atmosphere blocks most of the infra-red radiation from space, but allows observations through a few windows in the J, H, K, L, M, N, Q wavebands. Observatories such as Mauna Kea, Hawaii, where the UKIRT (United Kingdom Infra-red Telescope) facility is based, is 4,200m above sea level, in order to be above the bulk of the Earth's water vapour which blocks most of the infra-red. The Satellite, IRAS (Infra-red Astronomical Satellite) and its offsprings will revolutionise infra-red astronomy with observations from space surveying the entire sky.

3. Light

Our eyes are sensitive to e.m. radiation between about 400 and 700 nm and visual observation was the most important means of detection in astronomy until the advent of the photographic plate. The use of the telescope from 1610 has progressively increased the light gathering power and resolution of optical observations while the spectroscope has given information on the composition, magnetic flux and radial velocity of stars, interstellar matter, and galaxies. Light observations have led us to conclude that the Cosmos is expanding and that there is a standard abundance distribution of elements; it also gives us an idea of the scale of the Cosmos.

4. Ultraviolet astronomy

UV astronomy deals with wavelengths in the region 10 – 330 nm and has had to wait for satellite-borne observatories such as Copernicus (1972) and IUE (1978) as the Earth's atmosphere absorbs radiation shorter than 310 nm. UV observations are mainly of very hot stars and interstellar gas at 30,000 – 1 million K.

5. X-ray astronomy

The first non-solar observations of X-ray radiation were made in 1963 by satellite-borne detectors of the source named SCo X-1. Since then there have been many x-ray sources catalogued by satellites such as UHURU (1970), Copernicus and the Einstein X-ray observatory. These include pulsars, quasars and active galaxies and from hot intergalactic gas as well as detection of supernovae remnants and some stars.

6. Gamma-ray astronomy

Cosmic gamma-rays have the highest energy photons (normally measured in electronvolts) in the ranges: low energy gamma rays, less than 5100 keV; medium energy, 5100 keV – 10 MeV; high energy, 10 MeV – 1 GeV; and ultrahigh energy, greater than 100 GeV. The first detection of cosmic gamma-rays came in 1967 using a satellite-borne detector on OSO III. Medium-energy gamma-rays offer the chance to observe the radioactive products of supernovae. A few extragalactic discrete sources of gamma-ray have been detected by satellites such as COS-B, SAS II, and some of them have been identified as quasars and Seyfert galaxies while sources in our Galaxy include the Crab nebula and Vela pulsar.

As well as e.m. radiation, the Earth is continually bombarded by energetic particles, as was first shown by balloon-borne observations in 1912 by Victor Hess. These cosmic rays are mostly protons and have energies from 1 million eV to more than 10^{20} eV! Cosmic rays being energetic nuclei experience a magnetic force as they move through the Galactic magnetic field and therefore travel in spiral paths. They do emanate from intergalactic (and possibly for the very highest energies, extragalactic) material and will help our understanding of the most energetic processes in the Cosmos and the evolution of stars and our Galaxy.

More exotic radiation such as neutrinos and gravitational waves have been looked for in the last 25 years. Neutrinos are massless particles which only interact via the weak interaction and consequently are very difficult to detect. Solar neutrinos have been detected and it is hoped that the powerful bursts of neutrinos from supernovae will be detected in the future as detectors become more sensitive.

Gravitational waves are predicted by Einstein's general theory of relativity and gravitational wave detectors used large masses of aluminium which will oscillate when a gravitational wave impinges. The problems of detecting such weak signals are enormous and at present one can say only indirect evidence of gravitation radiation has been found from the slowing down rate of binary pulsars.

The future of observational astronomy lies with more satellite-borne observatories such as Hipparcos and the Hubble Space Telescope. Astronomy has come a long way since its beginnings thousands of years ago. Indeed if one takes the last five hundred years we have gone from believing the Earth to be the centre of the Cosmos, with five planets and one sun, to the present day concept of the Cosmos with some 20 billion years of age and having a 100 billion galaxies. And still we go on . . .

REFERENCE

Observing the Universe (a New Scientist guide), edited by Nigel Henbest (1984).

This article was written before the problems with Hipparcos were encountered.

GNOBLEM 6 (The Falling Moon)

The *vis viva* equation for an elliptic orbit is:-

$$v^2 = G(M+m)(2/r - 1/a) \qquad \text{(i)}$$

where v is orbital speed, r is radius vector and a is the semi-major axis. The straight line path of the falling Moon is an elliptic orbit of unit eccentricity so this equation is applicable. Putting v = dr/dt and separating the variables we have:

$$dt = dr / G(M+m)(2/r - 1/a)^{1/2}$$

This can be integrated by some 6th form pure maths. But as astronomers we are allowed to tidy it up a little and then take the solution from a table of integrals. Inserting the boundary condition, r = a when t = o, the time of fall is then:

$$t = \pi a^{3/2} / 2\sqrt{2}\,[G(M+m)]^{1/2}$$

Substituting in this with the modern form of Kepler's 3rd law, viz:

$$P^2 = 4\pi^2 a^3 / G(M+m) \qquad \text{(ii)}$$

we obtain the desired solution

$$t = P/4\sqrt{2}$$

(where P is the Moon's sidereal period in orbit)

This gives t ~ 4 days 20 minutes.

Cmdr. L. M. Dougherty

BOOK REVIEWS

FOR ALL MANKIND by Harry Hurt III. Published by Queen Anne Press, a division of Macdonald & Co. (Publishers) Ltd., 1989. ISBN 0-356-17887-9, £12.95.

If you have ever wondered (or been asked!) how the Apollo astronauts coped with bodily functions during their spaceflights, then this book will tell you all you need to know. It recounts in the astronauts' own words how it felt to be crammed into the command module and hurled towards the Moon. We follow the triumphs and crises of each Apollo mission, from training all the way to post-splashdown conferences. Armstrong and Aldrin share their excitement at the point after touchdown on the Moon's surface. We share the thoughts of the remarkably calm Apollo 13 crew as they coaxed their crippled spacecraft home.

Unfortunately there are factual errors. The north-eastern and north-western quadrants of the Moon's surface are muddled in the first chapter. The photograph showing the location of the landing sites purports to be a map of the "far side of the Moon"! The words "force" and "momentum" are somewhat ambiguously used. Finally, the experience of weightlessness in Earth-orbit is erroneously explained away as "microgravity" and not connected with the fact that the astronauts, together with their spaceship, are in free-fall.

However the narrative is racy. Its immediacy comes from the on-the-spot conversations recalled by astronauts themselves and from records of the radio contact with Houston. If you held your breath at the critical moments while the missions were actually under way, then be prepared to be held in suspense again as those moments are relived here. This makes the book highly readable and often difficult to put down. It is easy to forgive the tendency to dwell on the "firsts" of each mission and what was "longest" or "most productive" about each one; together with Neil Armstrong the reader is encouraged to put everything into stark perspective as he gazes up at the Earth ". . . . that small, fragile, remote blue planet".

Despite the scientific blunders, this book has a strong contribution to make to the documentation of these historic flights. At this price perhaps it is a volume for the library rather than the individual shelf.

Dr. Anne Cohen

MARS: THE NEXT STEP by Arthur Smith (September 1989, Adam Hilger, IOP Publishing Ltd., pp151, paperback, £12.50, ISBN 0-85274-026-3).

What is it about the planet Mars that evokes such interest amongst not only astronomers, but members of the public at large? Even those who do not quite know what a planet is are stirred when there is discussion about this object. Its reddish colour prompted the Greeks to associate the planet with the god of war; H. G. Wells wrote the "War of the Worlds" which spine-chillingly described a Martian invasion. But Mars has not always been a symbol of evil; I can remember as a listener to pre-war Childrens' Hour a serial called "The Man from Mars", which dealt with the benign influence on earthly matters by a Martian called Olyon. It is with these refreshing feelings that I, and no doubt millions of others, can now venture out into the darkness of our gardens and gaze up with awe (not fear) at this denizen of the inner Solar System.

The first chapter puts Mars into perspective, dealing with its position in the family of planets, how easy (or difficult) it is to observe, its mass and size, etc. The remaining eight chapters, i.e. the bulk of the book, deal with space probes. The first space probes were launched nearly 30 years ago (in 1960) by the USSR; unfortunately neither of the two launched probes succeeded in reaching the planet. Nevertheless, this was a hallmark in future attempts, and it is salutary to reflect on the fact that everything else we know about Mars is based on data received during the last 30 years. After several more Soviet attempts, some of which led to pictures sent back to Earth, the Americans entered the "race" in the late sixties and early seventies. Like the Soviets, the Americans experienced mixed successes.

There are some interesting diagrams showing the workings of spacecraft, as well as photographs of these vehicles. Terrestial vulcanologists will be interested to see the composite picture of what seems to be the biggest volcano in the Solar System, Olympus Mons, covering an area as large as France. A close-up of the moon Phobos shows it to be a shapeless chunk of rock pock-marked with craters.

Chapter 3 deals with the search for life. The surface of the planet where the Viking I touched down was found to be a rock-strewn plain; the sky (after some interesting manipulation of the processing computers) was found to be pink! When this was announced at a press conference, the statement was greeted by booing! Later landings showed no sign of carbon, hydrogen, nitrogen or oxygen, all present in Earth-type living organisms. Many other experiments on the possibility of life were conducted, but were inconclusive in their findings.

There is a fascinating account of the 1988 Soviet probe launched towards Phobos, and possibilities in this direction for the future.

One chapter deals with putting a man (or woman) on to Mars. Many will find this chapter the most interesting in the book. An associated chapter is concerned with the biological and medical problems confronting a human being in this situation.

The section on the cost of these projects will no doubt be read with avid interest not only by scientists but by those whose prejudices have already shaped their thinking. There is no doubt where the author stands on this issue.

The author of "Mars" is a freelance journalist who has been present at many launchings at Cape Canaveral. He is to be congratulated on producing such an interesting book.

If I may end with two criticisms, which apply to the format of the book: (1) it would be an improvement if there were more *colour* photographs spread throughout the book, rather than concentrating them together, and (2) this paperback falls into the same class as many others nowadays, in that it is virtually impossible to keep the book open at a chosen page without damaging the binding. Dover Books (paperbacks) pride themselves that they have solved this problem. Why can't other publishers follow suit?

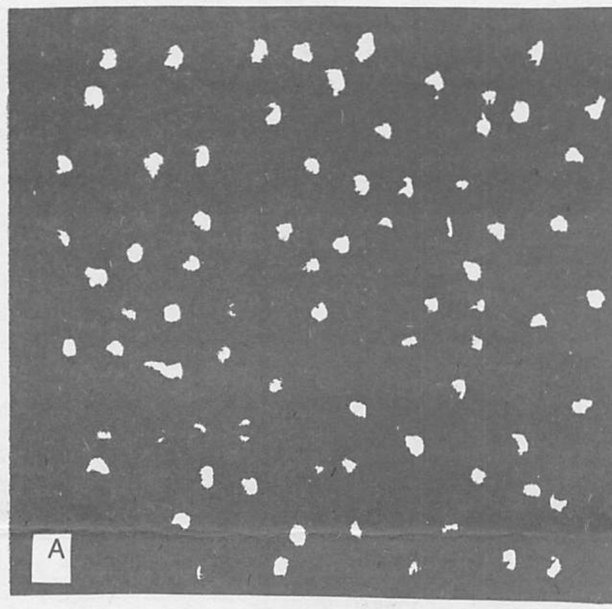
Eric Zucker

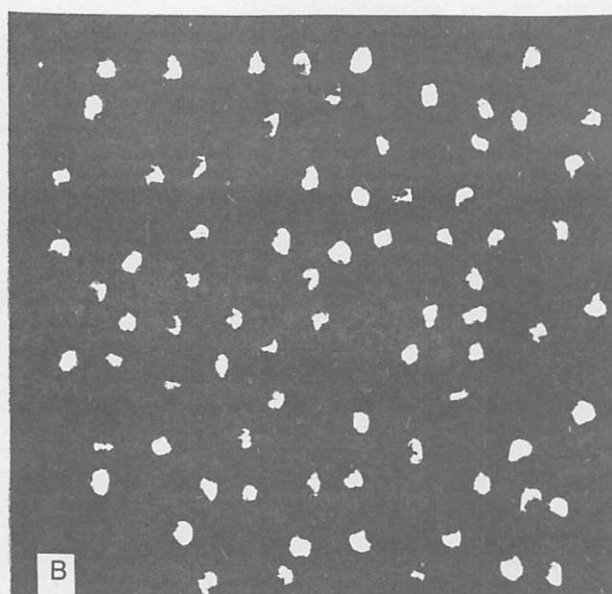
ORCHARD BOOKS

We have received the 1989 catalogues of childrens' books from Orchard Books, and Franklin Watts. Several of these books, for young children, deal with astronomical and space topics. Please apply to the Editor for further information.

GNOBLEM 7

The accompanying photographs show the same star field on two successive days. But there is a planet present, and the only way this shows up is that it has moved, slightly, over the one day's interval. All the other stellar images are in the same place.





Can you spot the planet? Specify its position by a simple co-ordinate system – so many millimetres along the "horizontal" (x) axis, and so many millimetres up the "vertical" (y) axis; take the origin at the bottom left hand corner. Answer in the next issue.

In practice, astronomers use an instrument called a "Blink comparator" to detect this motion. This presents views of the two star fields in rapid succession, alternately. The change in position of the planet appears as an obvious "blink" in the field of view. Perhaps some of our readers who like "to dabble with gadgets" would like to design a simple blink comparator which may be constructed out of cardboard, string, the odd lens or so. If so, we would be pleased to print details of the instrument in *GNOMON*.

Note: If you don't recognise the star fields in these two photographs, don't worry. They are entirely fictional – any resemblance they have to real star fields is entirely coincidental.

LETTERS

Dear Editor,

THE BRITISH SUNDIAL SOCIETY

The above society was formed at the beginning of May this year, with the object of stimulating interest in sundials at all levels of expertise. I enclose some information about the founders and an application form which states our aims in detail.

We now have about 80 members, a number of whom have expressed interest in devising educational projects for schools, so I thought it could be appropriate if you would give us a mention in GNOMON. Sundials, of course, can be used as a simple demonstration of the daily and yearly movement of the earth (and the moon) and so our activities have a certain amount in common which our members might like to be aware of.

Yours sincerely,
Dr. A. R. Somerville,
Secretary, The British Sundial Society,
"Mendota", Middlewood Road,
Higher Poynton, Cheshire SK12 1TX.
(Tel: 0625 872943)

We are pleased to bring this new society to the attention of our readers. Those interested should contact Dr. Somerville directly (in case of difficulty contact the Editor). The annual subscription is £7.50 for individuals or £10.00 for family membership. *Editor*

Dear Editor,

Here is a solution to the "falling Moon" problem, Gnoblem 6, which is closer to orbital theory than Atkins' solution in GNOMON 8 (4) or that outlined in my letter in the same issue. While I consider equations (i) and (ii) a required feat of memory for students of elementary orbital theory, I had not linked them in this way until the stimulus of Gnoblem 6. Thank you.*

Modern astronomical texts usually present the vis viva *equation kinematically whereas traditional applied mathematics treatments offer it as an indirect statement of the conservation of energy in the two body problem. This makes me wonder if* vis viva *is inherited from very early texts – which would be written in latin – when the energy conservers were angels pushing the planets around. Perhaps a member having classical scholarship could comment on this.*

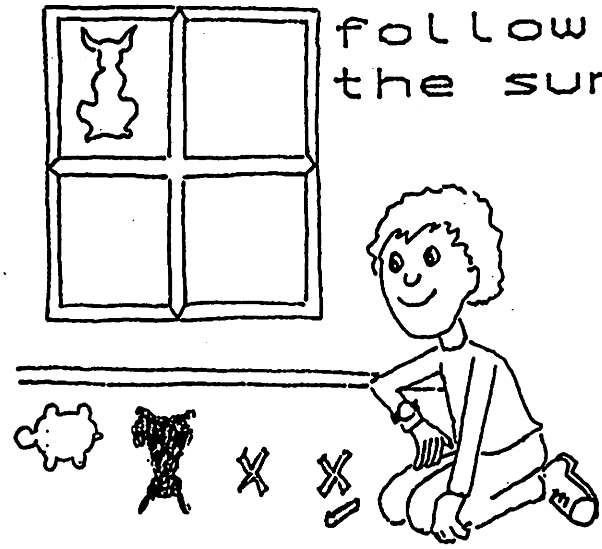
Yours sincerely,
Cmdr. L. M. Dougherty,
Dog Hill Farm,
Barkisland, W. Yorks.

* Cmdr. Dougherty's solution is printed in this issue.

A UNIVERSE PACK

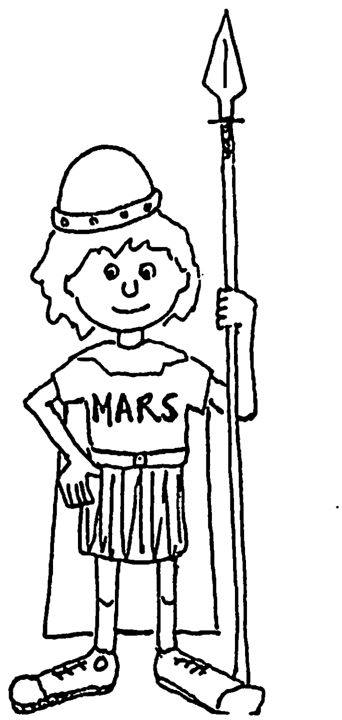
Some extracts from this pack (a collective operation involving planetaria at London, Armagh, Liverpool and South Tyneside College, as well as Jodrell Bank Science Centre and the Mills Observatory) are reproduced in this issue. We are indebted to Mr. D. M. Clegg and the South Tyneside Council for permission to reproduce these extracts. (Further details are available from South Tyneside College Planetarium, St. George's Avenue, South Shields, Tyne and Wear NE34 6ET).

follow the sun



* an appreciation of time within the day
* an awareness of where the sun rises and sets
* an understanding of the movement of the earth relative to the sun

Mars God of War



Mars is often called the red planet because of the red light that it reflects. A theme of orange and red on black or maroon can be used to create a Mars-scape with silver paper space ships.

Mars was the god of war and protector of Rome, a warrior nation tracing its foundation to Romulus a son of Mars. The Egyptions called the planet the star of death, associated with plagues, disaster and carnage.

A mobile could be made with a disc representing the planet and a warrior cut from card and armoured in baking foil.

Holst's planet suite gives good mood music.

This work reinforces the study of the planets in other parts of the work. It may be appropriate to consider the relative sizes of the planets by making scale models. The table shows how many times each planet is greater or smaller than the Earth.

Mercury	Venus	Earth	Mars	Jupiter	Saturn	Uranus	Neptune	Pluto
0.4	1	1	0.5	1.1	9.4	4	3.8	0.2

NATIONAL ASTRONOMY WEEK
1990 November 17–24

A CELEBRATION OF BRITISH ASTRONOMY

The Secretary of the "NAW 1990" co-ordinating committee, Martin Ratcliffe (Armagh Planetarium), has written to local astronomical societies, including those affiliated to the FAS, about their possible involvement in NAW. Whereas the rôles of societies and the AAE may be different, much of Mr. Ratcliffe's letter will be of interest to AAE members (some societies are affiliated to the AAE anyway). For this reason the letter is reproduced below.

Following the successes of National Astronomy Weeks in 1981 and 1985, one is being planned for 1990 to run from 17–24 November, inclusive. The theme of NAW is a Celebration of British Astronomy and the aim is to raise awareness of Astronomy among the public at large. There are a considerable number of astronomically related events in 1990, many of them in the British Isles.

SOME KEY EVENTS IN 1990

- ★ **BAA centenary (plus a possible IAU meeting);**
- ★ **Bicentenary of Armagh Observatory, with possible IAU colloquium;**
- ★ **Post Office astronomy stamp issue;**
- ★ **Introdcution of new science curriculum in schools, which includes Astronomy;**
- ★ **Total eclipse of the Moon (February 9th);**
- ★ **Total eclipse of the Sun visible from Finland (July 22nd);**
- ★ **International Planetarium Society biennial meeting in July in Sweden;**
- ★ **European meeting in the summer of the American Association of Variable Star Observers (AAVSO);**
- ★ **Move to Cambridge of the RGO;**
- ★ **Sunspot activity at a maximum;**
- ★ **30th anniversary of the Hampshire Astronomy Group;**
- ★ **Hipparcos observations start coming in *(problems with this project may cause considerable delay! Ed.)***

During NAW we have the up-dated MERLIN array operational, with possibly its inaugration during NAW, the peak of the Leonid meteor shower, the Moon going from new moon to first quarter, Jupiter and Mars visible all the week. As well as these, there will be events organised by universities, polytechnics, planetaria, other colleges, and, of course, astronomical societies.

The NAW 1990 committee is acting as a co-ordinating body to create a national publicity campaign and to supply information to those requesting it. It will also encourage groups to organise events and offer advice based on experience of the last two NAWs.

Societies which have taken place in the past have gained both in higher publicity profile and an ensuing growth in membership. It is therefore to the advantage of societies to organise events when they can capitalize on the natural publicity and press coverage generated by a National Astronomy Week. Locally, it will be up to each society to *organise* and *finance* its own events. The NAW committee will help all it can with publicity, but no financial responsibility can be taken. The committee will, however, offer any advice it can regarding money-raising ideas, but initiative will be found in most societies; many have found it easier than they imagined to raise funds.

***For example:* it is a peculiar psychological trait that people at a "star party" would rather pay to look through a telescope than to look through one for free! The argument runs that if it is free, it can't be worth going to. Some societies have found a much larger turnout at "star parties" at which members of the public are charged "50p a look" than if no charge were made. This may seem odd, but it works.**

As well as "star parties" there are other ways of involving and informing the public, *for example:*

- ★ **promote scout and guide organisations to take their Astronomy Badge;**
- ★ **organise with your local post office a distribution centre for First Day Covers of the astronomy stamps. The BAA and NAW will be producing special commemorative covers also;**
- ★ **arrange a "media event", such as the official opening of a Society observatory;**
- ★ **write an article for your local paper, including some *local interest* (e.g. is there an old observatory nearby? Was a famous astronomer born in your area? etc.)**
- ★ **organise a public lecture with a big-name speaker, possibly on a controversial topic such as Life in the Universe, Asteroids and the Death of the Dinosaurs, Astronomy Versus Astrology, and get local radio as well as newspapers to interview the speaker.**

LIGHT POLLUTION

NAW 1990 will include a major national campaign against light pollution, in collaboration with the International Dark Sky Association. Local campaigns and pressure at grass roots level are an important part of the process of ensuring dark skies for Astronomy. The co-ordinating committee will be sending out information and ideas on combating light pollution in due course.

All major astronomical organisations are represented on NAW 1990 committee. The AAE representative is Council member Dr. David Mannion.

Educational establishments which are expected to participate in NAW 1990, this phase of the operation being carried out by the FAS, are (so far):

University College, London;
Lancashire Polytechnic;
Mullard Radio Astronomy Observatory, Cambridge;
University of Glasgow;
Liverpool Museum and Planetarium;
University of Keele;
University of St. Andrews;
Armagh Observatory;
University of Southampton;
Jewel and Esk Valley College;
University of Newcastle-upon-Tyne;
Institute of Astronomy, Cambridge;
The Open University Physics Department and Astronomical Society;
University of Leicester, X-ray astronomy group.

PACKS ASTRONOMICA

The AAE has produced 2 packs for teachers (primary and secondary levels). We regret there has been some delay in production due to technical difficulties, but the packs should be available soon. Members will be informed as soon as they become available.

EARLIER GNOBLEMS

Why are day and night of equal length at the equinoxes? Ian Ridpath has provided this solution: sunrise and sunset are calculated for the upper limb of the Sun, not its centre, and furthermore the calculations take into account refraction by the atmosphere.

How may time be kept on the Moon (in the absence of conventional clocks)? We have had very little response to this problem, but some readers have suggested using the Moon's 28 solar "days". However, no-one has given a method for sub-dividing these "days" into "hours" and "minutes".

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