AAE

NEWSLETTER

of the

Association for Astronomy Education

Vol.5, No.1 September, 1985

TYCHO BRAHE

The First Scientist to prove that Comets were not Atmospheric Phenomena (1577)

Contents

A NOTE FROM THE SECRETARY

By the time you read this note, I expect that you will all be back at work wondering why you haven't taken early retirement to continue the balmy days of the summer recess - away from the stresses of the classroom.

Since the last edition, we have had our A.G.M. and annual association meeting. It took place on the 8th of June at the London Schools' Planetarium, which apparently was just about the right venue insofar as it was only three minutes walk from the underground station. It was a most invigorating and full day and I would like to take this opportunity of publicly thanking all those involved who helped the day go so well. Thank you!

Of the discussions that took place on that day, the one that seemed to crop up most was the worry that astronomy wasn't being taught in schools. In other words, it was not in the curriculum and although a number of schools touch lightly on the "Solar System" at sometime during the general science course, it is usually a hotchpotch variety of minor lessons usually based on 'Space' environment. It was strongly felt that astronomy should be taught as a module (however small) within the existing science system and regularised within a certain year group as part and parcel of normal teaching. In order to do this, the subject must be accepted into the curriculum on a national basis. To this end I am happy to tell you that a working party was immediately formed in order to work out some form of small astronomy module to present to the government committee who are currently reorganising science teaching in secondary schools. The team is headed by Dr. McNally and Mr. Kibble. Let us hope that this time we may obtain an official niche in the curriculum - we have been the Cinderella of Science for too long.

When all is said and done, it is during this era that we have made such great strides in astronomy related subjects. The public are all agog and yet our children are taught so little.

One way to progress is, of course, to be strong in ourselves with every member dedicated to teaching some astronomy. The latter aim is already reaching full realisation, but the former can only be achieved by having more members. Will you personally do anything. Send me an address and I will send you brochures, pamphlets and application forms.

In this edition we are concluding our Comet Halley information sheets. Hopefully they will be useful to you, especially if you intend to "run them off" for the pupils. However, do remember that the diagrams are for the lay person in particular and are therefore shown in easy approximations. A number of you, I know, are running small competitions both locally and in your schools; writing poems, drawings, essays and even sightings of Comet Halley; this is excellent work and one way of bringing the subject to the attention of other members of staff and hopefully the Advisory Inspectorate.

Finally, the B.A.A. is holding a provincially based lecture on Tuesday, 24th September (that's now) at Bilston Community College, Bilston, West Midlands. This is educational. It is geared to 5th and 6th formers in the afternoons and adults in the evening. The speaker is Dr. Ron Maddison of Keele University and the subject? – Halley's Comet. Telephone Dave Harris for further information on Bilston 42871. I look forward to seeing you.

P. Richards-Jones

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A PERSONAL STORY

"Right folks, I need to know what titles you have in mind for your major coursework essays. Karin, what about you?"

The good thing about the AEB 'Alternative' A/Level English syllabus is the coursework element, part of which is a three thousand word essay on an approved subject of personal choice. Out of about three subjects I had in mind, I decided on the one that seemed most challenging.

"Well, I was thinking of 'Astronomy and Astrology in the works of Chaucer'."

The response was as expected - a grimace and warning through gritted teeth not to make it too technical. That was sufficient encouragement for me to plough through myriads of rhyming couplets over the summer holidays last year, and go spotting references to anything that seemed relevant. English suddenly became far more interesting.

The idea came from reading one particular Tale of Chaucer's and finding it littered with astronomical references, and understanding these actually added to the enjoyment of the Tale. However, I had to include astrology in the title because of the state of fourteenth century science - the two subject were then one, though in the literature it was usually easy to divide them up. The astrological references were useful in character analysis, using the 'accepted' interpretations of planetary combinations without needing to trust their validity. For example the notorious Wife of Bath (she of the four husbands) is given a very fertile horoscope. She even claims that all she has done has been by "virtue of her constellation" - probably passing the buck for having nagged four exhausted husbands into their graves.

Sadly in 'The Miller's Tale' an astronomer is portrayed as a buffoon:

"He walked in feeldes, for to prye
Upon the sterres, what ther sholde bifalle,
Til he was in a marle-pit yfalle;
He saugh nat that."

However Chaucer may be forgiven for this as the character he created to utter this is in fact a total idiot who is later seen hiding in a bath tub on a hill as he thinks the Second Flood is about to begin. Some astronomer/astrologer has convinced him of this, and is meanwhile committing adultery with the speaker's wife!

As well as in 'The Canterbury Tales' food for thought was to be found in 'Treatise on the Astrolabe': a translation from a work of Latin prose that Chaucer undertook so his son Lewis could learn how to use an astrolabe without having to drag through complex Latin syntax. Although it is a textbook, it is indeed written in a very paternal tone, almost affectionate in places. Literary talent creeps through with an occasional smile, for instance relating patterns to a spider's web. Obvious, but the work is far more readable with these insertions.

Further astronomical documentation occurs throughout the works. In the first lines of 'The Canterbury Tales' there is a comment that has aroused criticism from many: The sun is said to be in Aries in early April. Any claims that this is wrong are founded on ignorance: critics tend to forget - or remain ignorant of - the precession of the First Point of Aries.

Many references were purely to establish a time for whatever was going on. But one poem (granted, a minor one) was actually based on a conjunction of Mars and Venus. 'The Complaint of Mars' details a brief 'romance' between the planets as Mars approaches, but when he rapidly moves off and fades in magnitude he is doing so because he is languishing for love. Venus, always magnificent, merely carries on her course to look for Mercury.

'The Complaint' was probably the most enjoyable piece I studied. Although simple it demonstrated that science and literature could be combined very successfully with just a little imagination. I must add that the poem was not slushy, nor over sentimental. I would recommend reading it to anyone - particularly in Middle English (if one is familiar with this 'alien' tongue).

When finished, the study turned out to be very rewarding, and not too technical. It was also relevant - both in terms of a contribution to Eng.Lit. for academic purposes, and for a historical background to astronomy. I await the official verdict on the essay, but at least the initial grimaces were unnecessary.

(17th May, 1985) Karin Parker

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A comet is a star that runs not being fixed like a planet, but a bastard among planets. It is a haughty and proud star engrossing the whole element, and carrying itself as if it were there alone.

Martin Luther (1483 - 1546)

HALLEY'S COMET

A Pack of Information for Schools

The Inner London Education Authority's Learning Resources Branch has produced a pack of material to help schools make the most of the arrival of Halley's Comet in our part of the solar system. It includes:

a poster to stimulate interest;

two friezes of information for children;

a teacher's booklet giving lots of ideas for practical classroom activities.

The friezes are over 1½ metres long. They are printed on one side only, so that they may either be displayed on a wall or folded up and used as booklets by small groups or individual children. They are visually very striking, printed in deep blue, yellow and black.

The materials are designed for primary and early secondary children. They are written in clear, non-technical language, and should be appropriate both for children who are just beginning to learn about space, and for those who are ready to develop and extend their understanding.

The HALLEY'S COMET pack (code: HAL) can be ordered from the ILEA Learning Resources Branch, Centre for Learning Resources, 275 Kennington Lane, London SE11 5QZ. The price is £3.50 for ILEA schools, and £5.50 for schools and other establishments outside the ILEA.

Further information may be obtained from the Marketing and Publicity Section at the Centre for Learning Resources (01 633 5971).

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Old men and comets have been reared for the same reason; their long beards and their pretences to foretell events.

(Johnathan Swift, 1667 - 1745)

Edmond Halley was born near Shoreditch, just outside London, in 1656. The exact date of his birth is uncertain but is believed to be October 29th. His father was reasonably well-to-do working both as a soap boiler and salter. He also owned various properties in London some of which were destroyed in the Great Fire of 1666.

Edmond was educated first at St. Paul's School, where he became proficient in Greek, Latin, Hebrew and mathematics, being made school captain in 1671; and then at Queen's College, Oxford where he went in 1673 taking with him a 24 foot telescope and other astronomical instruments, supplied by his father. Already a keen observer, he was determined to become an astronomer.

Impatient to succeed he left Oxford at the age of twenty before taking his degree in order to compile a catalogue of Southern Hemisphere stars. In this venture he not only received the paternal blessing (plus an allowance of £300 p.a. to support himself), but also encouragement from Rev. John Flamsteed, the first Astronomer Royal, and his University tutors. King Charles II, no less, recommended the East India Company to grant him a free passage to St. Helena (16^{o}S); a Crown Colony off the West Coast of Africa. Here he laboured for just over a year, plagued both by bad weather and an unsympathetic governor. He returned to England in 1678 having charted 341 stars and was immediately created a Fellow of the Royal Society, given an M.A. degree by command of the King, and christened "the Southern Tycho" by Flamsteed.

In 1680 he toured the continent accompanied by an old school friend (the religious writer Robert Nelson), staying for some time with G.D. Cassini, director of the Paris Observatory. In Paris he observed a very bright comet and made valiant but unsuccessful attempts to determine its orbit; Cassini himself throwing doubts on the currently held belief that comets travelled in straight lines.

1682 was in every way a memorable year for Halley. He returned home after several months in Italy and soon married an amiable lady named Mary Tooke, daughter of the

Auditor of the Exchequer. (These two remained happily married for the next 55 years). He set up his home, and an observatory, at Islington and started regular observations of the moon. He observed the comet that bears his name; but tragedy quickly followed. Both his brother Humphrey and his father died, the latter under most mysterious circumstances. In all probably he was murdered. There followed an unpleasant legal wrangle concerning his father's will. The judge who presided over the case was the famous Judge Jeffreys of the "Bloody Assizes".

At this time Fellows of the Royal Society met regularly to discuss scientific problems. Three of them - Christopher Wren, one time professor of Astronomy at Oxford before turning to architecture, Robert Hooke and Halley himself - were particularly interested in Kepler's Laws of Planetary Motion and pondered the nature of the gravitational force involved. They were, however, unable to cope with the complicated mathematics. Halley, in consequence, paid a visit to Isaac Newton in Cambridge (August 1684) and was surprised to learn that Newton had already solved the problem of universal gravitation but had lost his notes. Subsequently, due to Halley's persistence, Newton reworked the calculations and was eventually persuaded to publish believing that the Royal Society would carry the cost. The Royal Society was, unfortunately, broke! Its meagre funds had already been spent financing the publication of a book entitled "The History of Fishes" and, excellent as that book may have been, it proved to be a financial disaster. At one point Halley even had to accept fifty of the unsold copies in lieu of his salary as Clerk to the Society. Nevertheless, realising the importance of Newton's work, Halley paid for publication out of his own pocket, and, after a troublesome gestation period, the greatest single scientific book ever written, "Philosophiae Naturalis Principia" saw the light of day. The date was July 1687.

Much of Halley's time during the next few years was devoted to editing the "Philosophical Transactions" and doing other work for the Royal Society. Even so, nothing could stem the flow of his own scientific activities.

He was interested in an extraordinary variety of things. For instance, in 1689 he became involved in deep-sea diving and experimented off Selsey Bill. Not only did he invent a diving bell in which he was able to keep three men underwater at a depth of ten fathoms for 1¾ hours, he also designed a diving suit and helmet. The equipment proved good enough to be used by a public company founded for salvaging wrecks in which Halley had shares. Later he worked with Papin (the inventor of various steam engine devices) conducting experiments on the firing of projectiles by vacua. In 1693 he published his analysis of the tables of births and funerals at the City of Breslau and carried out "a most laborious calculation" producing rates of insurance for persons of various ages. His tables later formed the basis of assessment for life assurance.

In 1693 he put forward the idea that the age of the earth might be determined by estimating the saltiness of the oceans and then in the following year delivered a paper on the Biblical Flood. He argued that an ark full of animals was scientifically implausible.

Halley held fairly modernistic views on the interpretation of the Scriptures, a fact which may have sparked off the animosity of certain church dignitaries. He had already, in 1691, lost favour with Rev. Flamsteed, who had been instrumental in having Halley turned down for the Savilian Professorship of Astronomy at Oxford on the grounds that he would "corrupt the youth of the University with his lewd discourse". He was labelled a "scoffer" and an "unbeliever".

In 1695 he turned his attention to comets and examined all the observational information he could find in order to ascertain the nature of their orbits. At every stage he exchanged information with Newton. He calculated the tracks of 24 different comets and gradually became convinced that all cometary paths were elliptical and elongated. He was certain that the comet he had seen in 1682 was the same one that had appeared in 1607 and 1531. (The rest of this story is too well known to repeat here). Halley published his results in 1705 in "A Synopsis of the Astronomy of Comets" but he had made his findings known to the Royal Society as early as 1696.

In that same year (1696) Halley was appointed Deputy Controller of the Mint at Chester. He was far from happy in this post but, characteristically, made the most of it by becoming absorbed in the town's history. Among other projects he studied tidal currents in the Dee and tested out a theory on Mt. Snowdon for gauging height by barometric readings. He returned to London in 1698 and was designated companion to Peter the Great, Czar of Russia, who was in Deptford at the invitation of William III to study shipbuilding in order to strengthen his Navy against the Turks. The two men became great personal friends. They dined often, discussed science and held riotous parties.

Quite naturally, Halley was interested in the major scientific problems of his time - that of finding longitude at sea being the most vexing of them all. He suggested many methods of solving this problem. One of his ideas was to plot variations in the earth's magnetism on a chart and then use it to ascertain one's position. He informed the Admiralty that he would be willing to prepare one such chart covering the whole Atlantic Ocean. This led to his being commissioned as a Naval Captain and appointed Commander of the first ever English Oceanic Expedition for Scientific Research. He was also commissioned to determine the longitudes and latitudes of British Settlements in America.

The Navy supplied him with a small warship called the "Paramour", a three-masted vessel of the type known as a "pink"; it displaced only 89 tons and carried ten guns. Captain Halley sailed in November 1698 with a crew of twenty men and enough food for one year.

Halley, of course, was not a professional seaman and asked that one of his warrant officers should be made first lieutenant. This man (John Harrison) insulted Halley in front of his men, stating that "he was not only incapable of taking charge of the pink, but even of a longboat". Later he mutinied. On reaching Barbados Halley confined the lieutenant to his cabin and returned to England, navigating the pink himself. In July Harrison was court-martialled and cashiered; in September Halley set sail again with the same scientific objectives, this time as the commodore of two ships.

For the next five months he sailed down the Atlantic, passing the latitude of the Falklands (52^{o}S) and reaching the very edge of Antarctica where he "fell in with great islands of ice of so incredible a height and magnitude that I scarece dare write my thoughts of it". Near Newfoundland he nearly lost his ship in a thick fog, and was fired on by New England fishermen who suspected him of piracy. On another occasion he was actually arrested as a pirate. His ship finally docked in Plymouth on August 27th, 1700 and the findings were published during the following year in the "First Edition of Halley's Atlantic Chart".

His sailing days were not over. In 1701 he was commissioned by William III to survey the coast, headlands and tides of the English Channel. This he managed with "more success than he had expected".

In 1702 he worked on methods of surveying enemy coastlines and suggested the use of sound for measuring the distance of targets. Subsequently he was sent by Queen Anne (William having died in 1702), to the Adriatic to advise Emperor Leopold of Austria on the fortification of the Dalmatian coast. He returned to England having received a diamond ring from the Emperor's finger, and having dined with the Queen of Prussia in Hanover.

In 1703, this time in spite of Flamsteed, he was appointed Savilian Professor of Geometry at Oxford and immediately set about translating and editing the works of the Greek mathematician, Appollonius, from Arabic texts. He not only translated the whole of Appollonius's great treatise, "Conics", but even reconstructed a missing section from a commentary on it by the mathematician Pappus. This brilliant achievement was duly rewarded in 1710 when Halley was granted the Degree of Doctor of Civil Law.

Astronomical discoveries followed apace. 1715 was a particularly fruitful year; there was the discovery of the star cluster in Hercules; a careful description of the sun's chromosphere during a total eclipse; a calculation that a bright meteor he had observed had a height of 73 miles; a suggestion that aurorae had some connection with the Earth's magnetism and a proposal that certain hazy patches, now known as nebulae, were clouds of glowing gas among the stars.

Probably his greatest discovery was made in 1718. He observed the stars, Sirius, Procyon and Arcturus and noted that their positions had changed from the ones given in the ancient tables of Hipparchus and Ptolemy. Realising that this could not be an error of these early observers, he postulated that the so called "fixed" stars actually moved through space. This discovery, coupled with his arguments concerning infinity (Halley reasoned that the Universe must be infinite otherwise it followed from Newton's Universal Law of Gravitation that it would collapse to a point) did much to bring about a new conception of the Universe.

In 1719 Flamsteed died and Halley was appointed, at the age of 63, to succeed him as Astronomer Royal. He moved to Greenwich and asked Mrs. Flamsteed to leave as soon as possible. This she did, taking all the observatory's instruments with her. (Flamsteed had paid for them himself). They were never seen again. Halley used his influence to obtain a grant of £500 and was thus able to refurbish the observatory. His salary, like Flamsteed, was only £100 p.a., but he also wangled an increase by accepting a retirement pension in respect of his services as a Naval Commander.

The problem of finding longitude at sea now occupied his mind again. He believed that the answer lay in plotting the moon's position with so great an accuracy that it could be used as a celestial clock indicating a standard reference time which could then be compared with a ship's local time, thus enabling the calculation of longitude. The moon's movements, however, are very complicated, repeating their irregularities over an eighteen year period. Nothing daunted, in 1723, at the age of 66, he commenced this marathon task.

He observed unaided until 1736 and it is said that he never missed a meridian view of the moon when it was visible. His wife died during that same year and, in January, 1737, Halley suffered a minor stroke. An assistant was therefore appointed to help him and observations continued until 1739.

(In 1763 "A British Mariner's Guide" was published setting out methods of finding longitude based on the work of Halley. Yet another achievement the fruits of which he did not live to see).

He attended Royal Society meetings until he was 81 years old, dining afterwards only on specially ordered fish as he had no teeth. In 1741 his health began to decline and he was "supported by such cordials as were ordered by his physician. On January 14th, 1742, he asked for a glass of wine and having drunk it passed away as he sat in his chair.

Halley was undoubtedly the greatest English scientist of his generation, Newton excepted. His range of interests was far wider. His personality was equal to his gifts. Halley's most original work and ideas were well ahead of their time. It is sad that this remarkable man is only remembered as an astronomer who correctly predicted the return of a comet.

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DEVELOPMENT OF A DIDACTIC MEASURING SET
"YOUNG ASTRONOMER"

V. VUJNOVIC, Institute of Physics of the University, Zagreb
M. SUVELJAK, Primary School, "Spansko", Zagreb

Summary

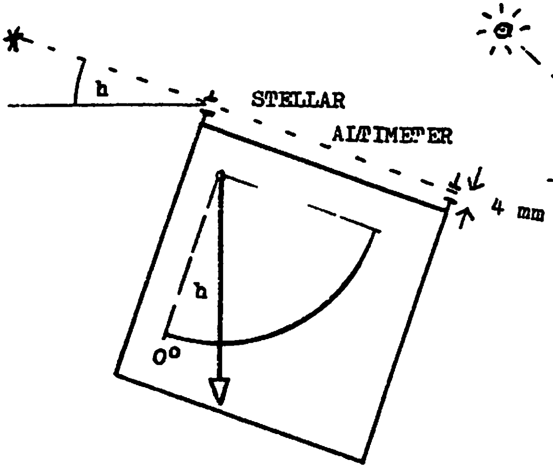
A set of portable measuring devices for practical astronomical exercises is described. The set consists of a cross staff, stellar and solar altimeter (quadrant), gnomon, co-ordinator (star finder in double axes mounting, turned along two co-ordinates), and photometer. The article describes the characteristics of the equipment, problems which could be studied and the experience gathered from its practical use. The accuracy of measurements of the celestial and terrestrial co-ordinates is about 0.5°.

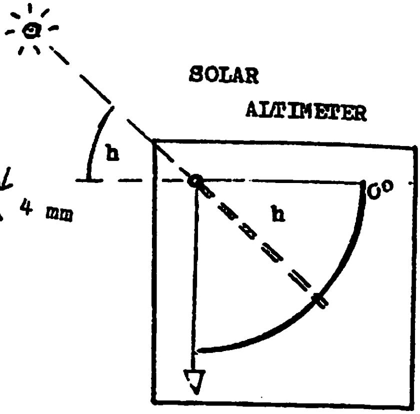
A prototype of the outfit was constructed in collaboration with the Workshop for School Equipment (Zabod za skolsku opremu), Zagreb, and on the basis of the experience obtained during exercises with a school group of young astronomers.

The cross staff serves for the visual determination of angles from $5^\circ - 40^\circ$ with an accuracy of 1°. Measured angles were compared with the angles obtained by the use of stellar maps. The measurements are useful for becoming acquainted with constellations, their relative size and with stellar maps. (see page 17)

The altitude of a star can be measured sufficiently accurately with a stellar altimeter, since deviations of the quadrant plane from the vertical plane have no critical effect. In order to ensure precision, especially when observing fainter objects, the line of sight should be properly constructed. Two holes 4mm in diameter and 25cm apart, lead to an error less than 0.9°. The hole facing the eye must not be less than 4mm in view of the size of the pupil at night. To obtain a precision of 0.5°, the quadrant plate should be fixed on a tripod.

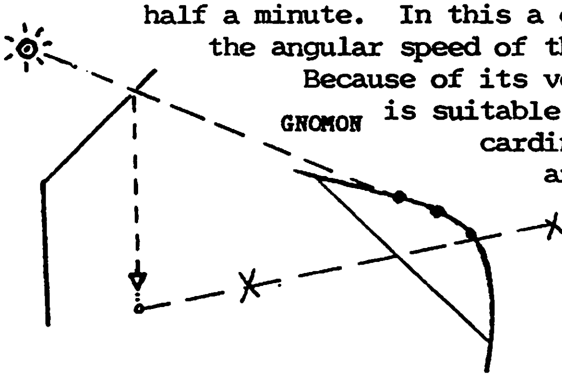
The altimeter serves as a suitable tool for measuring latitude (by observing the Polar star, or the culminations of circumpolar stars); for gaining first knowledge of stellar movements and for measuring the sideral day, and the height and time of the lunar meridian transit.



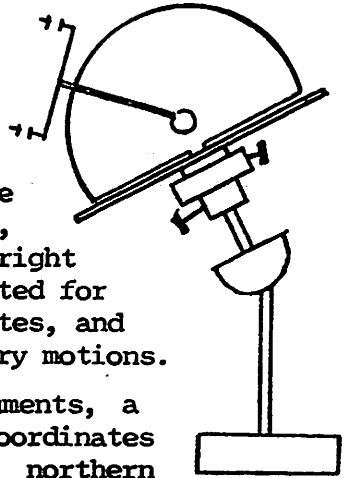


The solar altimeter, which is another version of the quadrant, has a short rod which casts a shadow on the circular limb (inserted curved ribbon). With it, the diurnal change of solar height can be followed and the height at the culmination, and apparent noon and solar day length can be determined. (For this and other time measurements, any clock with controlled clock correction will be more than sufficient, not to mention the digital quartz.

The gnomon, the simplest astronomical tool, gives results the value of which depends on the attention paid to it. It was used to define the meridian line with an accuracy of 10' and the instant of the apparent noon within half a minute. In this a graphic description of the angular speed of the shadow was helpful. Because of its versatility, the gnomon is suitable for determining the cardinal points, longitudes and latitudes, obliquity of the ecliptic, time of day and year, and length of apparent solar day, and for checking the equation of time.



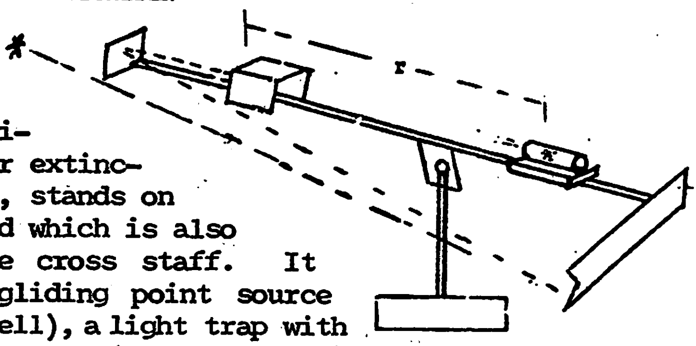
COORDINATOR



The coordinator is a complex tool, simulating both the altazimuth and the equatorial telescope, but designed without a telescope. Instead, a sight line is provided on a lever which moves round a horizontal axis. Its limbs include protractors divided in declination, altitude, azimuth, hour angle and right ascension. It is equally well suited for horizontal and equatorial coordinates, and the study of the lunar and planetary motions.

Using several of these instruments, a group of students determined the coordinates of the town of Hvar as $42^{\circ}5 - 43^{\circ}5$ northern latitude (exact value $43^{\circ}17$) and $16^{\circ}4$ eastern longitude (exact value 15.44°).

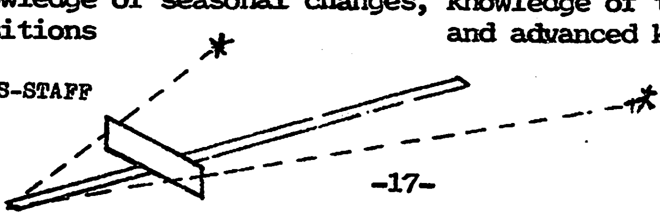
PHOTOMETER



The photometer used for comparing stellar magnitudes and for extinction studies, stands on a 1m-long rod which is also used for the cross staff. It includes a gliding point source (dry power cell), a light trap with an artificial star (frosted glass), and a mirror. The illumination of the artificial star can be varied by gliding the point source.

The described set of simple astronomical tools has been found useful not only in astronomy but also for wider educational purposes. The analysis of the results comprise the calculus of angles and the transformation of angles into time units, orientation against horizon, knowledge of seasonal changes, knowledge of terrestial positions and advanced knowledge of photometry. At the same time the

CROSS-STAFF



outfit can be used as an indoor teaching aid. Even university students have difficulties with the relationship between the real and the apparent motions of the Earth and heavenly bodies. The use of the aid makes it easier for students for form ideas and help them in developing conceptions and reasoning. It is suitable for simulating measurements and for discussions and subsequent analysis of outdoor measurements.

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THE GEOLOGICAL MUSEUM

Exhibition Road, South Kensington, London

The Geological Museum is situated in Exhibition Road, South Kensington (District Line, South Kensington). The present building was opened in 1935, previously it was housed in Jermyn Street, Piccadilly. The ground floor displays are well worth a look, in particular 'Story of the Earth', British Fossils, Britain Before Man, and a superb collection of Gemstone. In addition, a new exhibition 'Treasures of the Earth' is to be opened this year.

The Story of the Earth Exhibition starts with a look at the Earth from Space, gives an account of the origin of the earth and the evolution of its major features; deals with geological processes through time and finishes with an exhibit of the history of life.

The First Floor is devoted to displays of characteristic rocks, minerals and fossils from all areas of the British Isles, together with a number of relevant relief models, dioramas and maps.

The Top Floor displays a large collection of metalliferous and non-metallic minerals of the world. Building Stones and marbles are also to be seen here, together with a model of Stonehenge.

There is a programme of public lectures, demonstrations and films, details available on request. School groups and other organisations can be catered for with suitable events. For further information please contact the Education Department at the Museum.

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THE LONDON PLANETARIUM

Once In A Lifetime

A PROGRAMME TO MARK THE RETURN OF HALLEY'S COMET

Make sure of seeing Halley's Comet as it visits our skies once more, since it will not be back again until 2061! This time it will appear very small and faint compared with its past visits, but the Planetarium will give you a chance to see it in really spectacular style. Find out what comets are; glimpse the history of Halley's Comet, the most famous of all; follow it through the winter skies of Britain, and then southwards to South Africa in 1986, when its tail is fully developed; and encounter it with Giotto and the other comet probes as they speed towards it early next year.

En route you will land on the corroding surface of Venus, watch the sun rise and set with its family of planets, and witness the life and death of familiar and unfamiliar stars. You may even 'see' a black hole, if such a thing exists.

Above all, don't miss your once-in-a-lifetime chance to see Halley's Comet in close-up, and in perfect skies.

Once In A Lifetime will be shown every day from 7th November through May 1986 (except Christmas Day). Every 40 minutes from 12.15 p.m. to 4.20 p.m.; and from 11.00 a.m. at weekends and holiday times.

Admission Prices to 31st December, 1985

	LONDON PLANETARIUM	COMBINED TICKET Planetarium and Madame Tussauds
Adult	£ 1.85	£ 4.45
Child (under 16 years of age)	£ 1.20	£ 2.55
GROUP RATE (Parties of 10 or more)		
Adult	£ 1.60	£ 3.90
Child (under 16 years of age)	£ 1.00	
SPECIAL CHILD GROUP COMBINED TICKET - until 21st March, 1986		£ 1.95

ONE TEACHER / SUPERVISOR admitted FREE for every 10 Pupils

ADDITIONAL ADULTS at Child Price

(continued)

A Free Teacher's Pack is given to every school booking a visit between September and May. The pack contains an illustrated Souvenir, notes and project suggestions for teachers, and worksheets for the children. Please note that only ONE copy of each worksheet is provided, but they are A4 size and can be photocopied at school.

We strongly recommend that preliminary work is done in class before a visit to the Planetarium.

Advance Booking is essential for Schools' Programmes.

Please telephone the Group Booking Office to make a provisional booking, and confirm by letter. Payment on arrival only - we accept schools' cheques.

All children must be supervised, and we regret that children under five are not admitted to the Planetarium.

Group Booking Office: Telephone 01 486 1121

London Planetarium, Marylebone Road, London NW1 5LR

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NATIONAL ASTRONOMY WEEK

November 9th - 16th commemorates the return of Halley's Comet, with events all over the country.

Throughout the week at the London Planetarium:

EDMOND HALLEY, England's second greatest scientist, joins other astronomers in wax in The Astronomers' Gallery, supported by information about comets, his own in particular and including the latest on the comet probes.

"RETURNING FIRE" - An exciting new play by Stephen Jeffreys which tells the story of a brilliant astronomer, a refugee from the Russian Revolution of 1917, whose happiest memories are associated with the last appearance of Halley's Comet in 1910, and her ambition to see it again in 1986. 'Vivid, impressionistic and theatrical.'

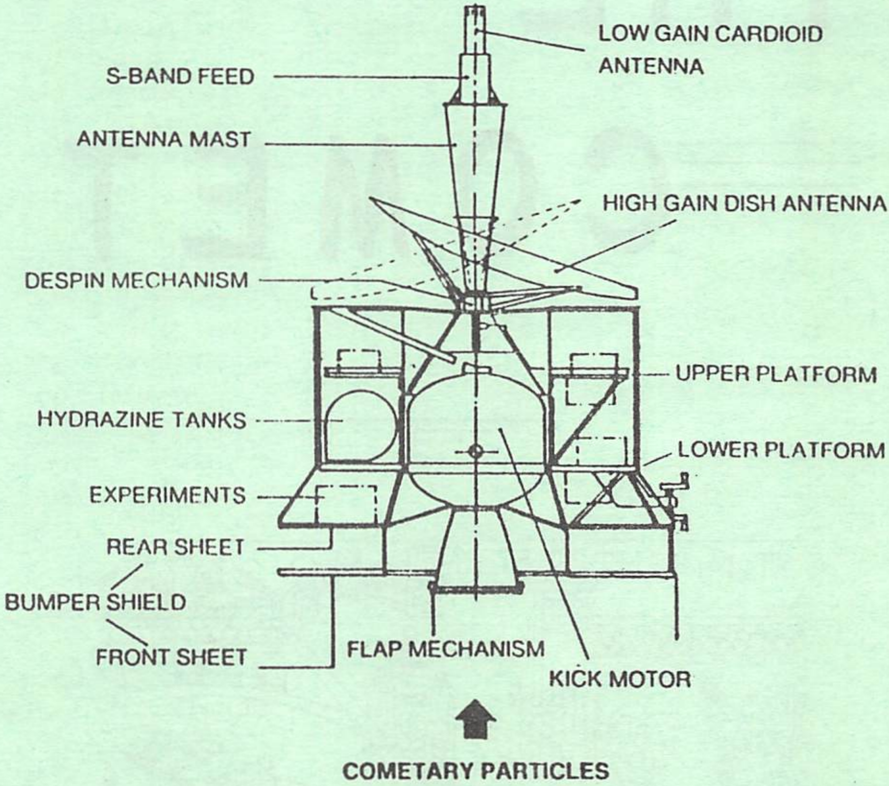
10.30 am November 9-15 only - replacing the usual programme at 11 am at no extra charge.

(I am very surprised (and not a little concerned) that local Societies and Educational Establishments and others have not supplied me with more information on their activities during NATIONAL ASTRONOMY WEEK - Sorry! I could not delay publication further. Please keep your Newsletter alive by supplying 'up to the minute' information). Editor

THE COMET

The stylised 'shuttlecock' version of the Bayeux Tapestry's depiction of the 1066 Comet. The earliest of all the drawings, but *not* the first apparition to be drawn.

Cross-sectional view of the Giotto Spacecraft



The Giotto spacecraft was named after the Florentine painter, Giotto di Bondone, who, in 1301, saw Halley's comet when it had a particularly long and brilliant tail. He was so impressed that later he incorporated it in a fresco decorating the interior of the Arena Chapel in Padua. This fresco "The Adoration of the Magi" is one of a series depicting the life of Christ and in it Giotto portrayed the comet as the star of Bethlehem even though there is no possibility that its appearance could have coincided with the date of Christ's birth.

Giotto is the brainchild of a consortium of companies of which British Aerospace is the main contractor. It is cylindrical in shape, stands 2.85 metres high, has a width of 1.87 metres and is stabilised by rotation at 15 r.p.m. with its spin axis aligned with the direction of travel relative to the comet. Its main features (see diagram) are its three platforms, two for systems and one for experiments; its dual bumper shield; and its 1.5 metre high-gain, dish antenna, inclined at 44.2° to the rotation axis, and "despun" in order to point precisely at earth during encounter. It also has a low-gain large beam-width antenna, and carries ten experiments.* More than half its exterior surface is covered with solar cells which, in addition to supplying all the immediate 'on board' electrical requirements, will charge up four batteries needed for extra power during the four hour encounter phase. The spacecraft also possesses a hydrazine fuelled reaction control system to be used for course correction manoeuvres if necessary.

On July 2nd this year the Ariane - 1 launch vehicle V-14 carried Giotto into Geostationary Transfer Orbit (GTO) after fifteen minutes of powered flight. Lift off actually took place at 11:23:16 GMT from Kourou, French Guiana. Some 32 hours later, at third perigee, the solid propellant Transfer Propulsion System fired and injected it into Hall Transfer Orbit. The firing took place without a single hitch and, three hours later, an orbital determination confirmed that Giotto was speeding away from the earth at approximately 12km/sec exactly on course for its rendezvous with Halley's comet.

Spacecraft and platform systems have already been checked (at the time of writing) and further checks and practice procedures will be made periodically during the eight months "cruise" period. At the same time astrometric observations will be carried out on the comet in order to supply Mission Control with more accurate data on its position. The probe will remain all the time within the ecliptic plane (necessary in order to conserve energy) and will meet the comet at 24.00 GMT on March

13th, 1986 when it makes its post-perihelion crossing of that plane. It will then be 0.89 A.U. from the sun and 0.98 A.U. from the earth. About one week before Giotto makes its final encounter the USSR's two Vega spacecraft (Newsletter Vol.4 No.1) will by-pass Halley at a distance of 10,000 km and, if all goes well, return pictures of the nucleus. It is hoped that sufficient information will be made available (through numerous observational sources), to enable Control to target Giotto precisely at a point 500km from the nucleus of the comet on the sun-ward side (Newsletter Vol.4 No.3).

During all phases of the mission, ground stations will be connected to the ESA Operations Centre in Darmstadt, West Germany.

A data take period of four hours, at the time of closest approach, has been planned, During this period cometary dust particles will impinge on the spacecraft at 68km/sec presenting a number of serious hazards such as loss of contact with earth, due to displacement of the high-gain antenna, or damage to the instrumentation inside, due to an expanding cloud of debris. At this speed particles of mass 0.1 gram can penetrate an 8cm thick sheet of solid aluminium, and a particle the size of a pea could completely destroy Giotto.

It is to overcome this difficulty that the dual bumper shield has been devised. The front sheet, a 1.3mm plate of aluminium, is struck first. Behind this, separated by a space of 25cms, is a 13mm thick Kevlar/aluminium shield struck second. (Kevlar is used in the manufacture of armoured cars and bullet proof vests). The front shield breaks up the dust particles and a cloud of gas and debris then expands into the intervening space, distributing the energy over a large area and making the force of the impacts on the rear shield small. The degree of hazard to the craft has been calculated and its expected that it will survive up to a few hundred kilometres from the nucleus when the mission will probably terminate. All data will be relayed "in real time" and not stored on tape.

To the general public the most interesting gains from a successful mission would undoubtedly be the images of the nucleus. To achieve these the craft carries a one-metre focal length camera capable of providing full colour pictures of high resolution. It is secured well inside the spacecraft for protection purposes and the incident light reaches it via a "flat" mounted at 45°. If the proposed fly-by distance of 500km is realised, details of the surface down to 20m in diameter may be obtained. Other experiments, of interest to the astronomer, will provide information on the temperature, composition and rate of rotation of the nucleus; the composition of gases and dust in the coma and tail; the size of the particles and details of the chemical and physical processes occurring in all parts of the cometary atmosphere. Problems arising from the motion of the comet are also under investigation, such as its reaction to the solar wind and the flow of gases throughout the coma and tail.

There is little doubt that, as was the case in earlier planetary probes, we shall be in for many surprises.

* Scientific experiments on the Halley spacecraft

CLOSE FLYBYS		Vega-1&2 (three-axis stabilised)	Giotto (spin-stabilised)	Planet-A (spin-stabilised)	Combined complement
Remote Sensing	Camera Wide Angle	X			X
	Camera Narrow Angle	X	X		X
	UV Camera			X	X
	IR Sounder	X			X
	Photopolarimeter		X		X
	Three-Channel Spectrometer	X			X
Gas/Dust In-Situ Measurements	Neutral Mass Spectrometer	X	X		X
	Ion Mass Spectrometer	X	X		X
	Dust Mass Spectrometer	X	X		X
	Dust Impact Detector	X	X		X
Plasma In-Situ Measurements	Solar-Wind Ions	X	X	X	X
	Solar-Wind Electrons	X	X	X	X
	Plasma Waves	X			X
	Energetic Particles	X	X		X
	Magnetometer	X	X		X

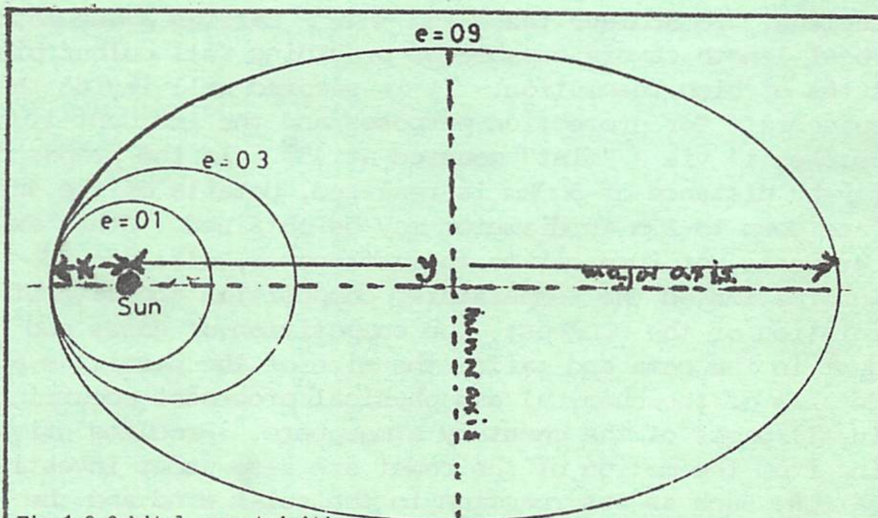
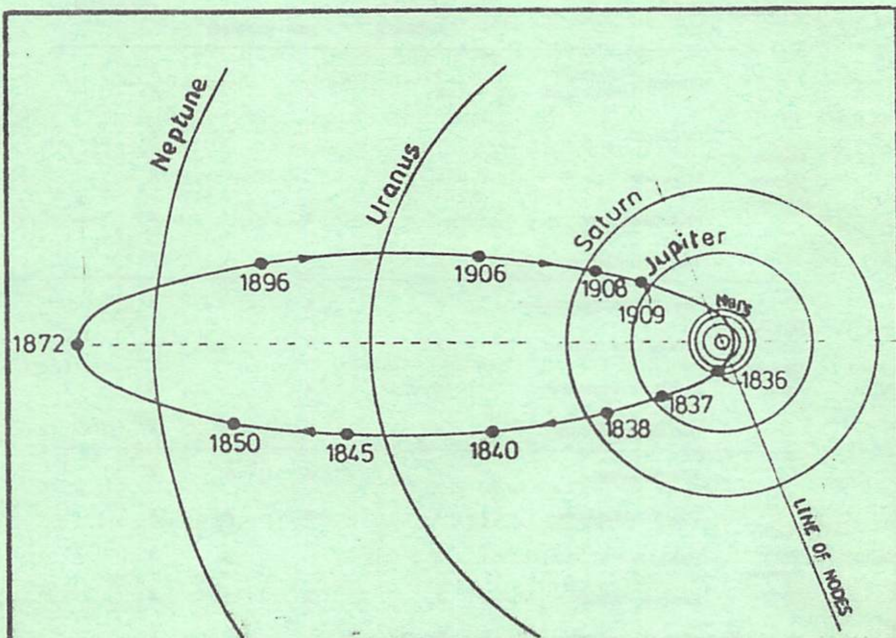


Fig 1.2 Orbital eccentricities

SUN is at one focus Semi-major axis $\frac{x + y}{2}$ Eccentricity $\frac{y - x}{y + x}$

Fig 7.1 The path of Halley's Comet between 1836 and 1909



THE ORBITAL ELEMENTS

The orbit of a comet moving round the sun may be defined by six parameters known as its "orbital elements". Two of these elements describe the size and shape of the orbit, three specify its orientation with respect to some system of reference and a final one is needed in order to determine where the object may be found at some particular time so that its location at other times may be computed.

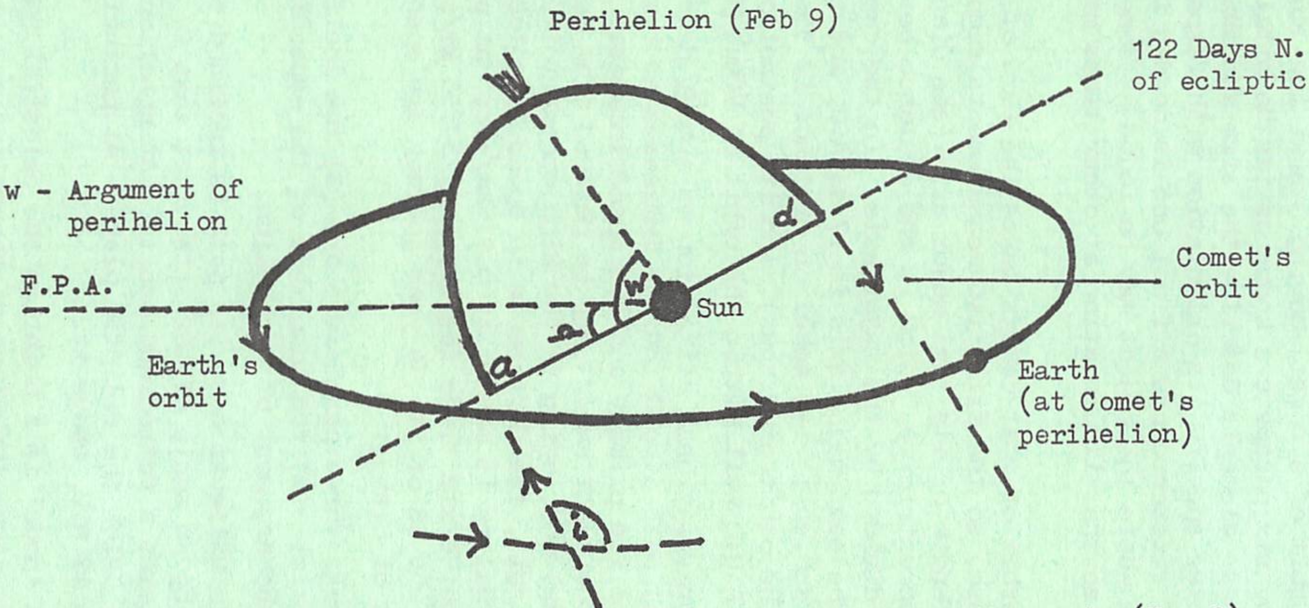
The orbit of most comets takes the form of an elongated ellipse, so the first two measurements required are (1) the length of its semi-major axis (see diagram A) and (2) its eccentricity, which is the distance between the two foci divided by the major axis. In the case of Halley, the semi-major axis is 17.94 A.U. and the eccentricity is 0.967; its aphelion distance is 35.29 A.U. (beyond the orbit of Uranus), and its perihelion distance is 0.587 A.U., well within the orbit of Venus (Diagram B).

The gravitational attraction on a body describing an elliptical path around the sun increases as that object approaches its primary and its speed increases accordingly, (the exact amount may be derived from Kepler's Second Law) and, owing to the high eccentricity of a comet's orbit, the difference in speed is notable. At aphelion Halley is moving at 0.91 km/sec; at perihelion it is about sixty times faster, i.e. 54.55 km/sec. This explains why 58 of its 76 year journey are spent beyond the orbit of Uranus.

The next three parameters are (3) the inclination to the ecliptic; (4) the longitude of the ascending node and (5) the argument of perihelion.

(3) In Halley's case its path is inclined to the ecliptic by an angle of 162° (the fact that it is over 90° indicates a retrograde orbit). At aphelion it was 9.99 A.U. below the ecliptic plane - at perihelion it will be 0.17 A.U. above it.

(4) A 'node' is a point on the celestial sphere where an object passes the plane of the ecliptic - 'ascending'



☊ - longitude of ascending node

i - inclination to the ecliptic

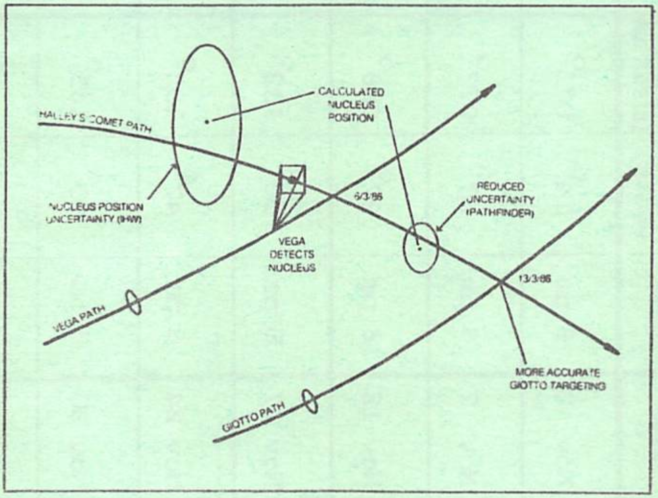
a - ascending node (Nov 9)

d - descending node (Mar 10)

when moving from South to North, 'descending' when moving from North to South. The 'longitude of the ascending node' is the angular distance from the First Point of Aries, measured to the East, along the ecliptic plane, to the point where the object crosses the ecliptic travelling from South to North (58^{o} for Halley). The date on which Halley passes through the ascending node is the 9th November when the comet will be 1.81 A.U. from the sun. The comet will then remain above the plane for 122 days passing through the descending node on the 10th March, 1986. As diagram C shows both nodes lie inside the earth's orbit. It is important to realise that the nodes do not coincide with the comet's closest approaches to the earth.

(5) Argument of perihelion. This is the angular distance between the perihelion point and the ascending node measured in the plane of the object's orbit and in the direction of its motion. (For Halley its value is 112^{o}).

Finally (6). We need one of the precise times at which the object passed the perihelion point. (In the case of a comet, the mass of which is negligible, the period of the orbit can be obtained from the semi-major axis using Kepler's third law). Halley's orbit is 76.03 years on average but may vary by 2½ years either way due to perturbation by the major planets.



HALLEY'S COMET 1985

WHEN, WHERE AND HOW TO SEE IT

Date	Time	ALTITUDE (HEIGHT)	AZIMUTH (COMPASS DIRECTION)	Time	ALTITUDE	AZIMUTH	Time	ALTITUDE	AZIMUTH	How to see it	MAG
Nov 2	8 pm	14°	073°	10 pm	30°	095°	Midnight	47°	125°	Strong binoculars or largish telescope	8.8
Nov 7	8 pm	20°	077°	10 pm	37°	103°	Midnight	52°	137°	Strong binoculars or largish telescope	8.8
Nov 12	8 pm	27°	088°	10 pm	43°	116°	Midnight	56°	155°	Binoculars or small telescope	7.8
Nov 17	8 pm	36°	102°	10 pm	51°	136°	Midnight	58°	182°	Binoculars or small telescope	7.8
Nov 24	8 pm	47°	132°	10 pm	55°	175°	Midnight	44°	222°	Most Binoculars	6.4
Nov 30	8 pm	50°	165°	10 pm	48°	210°	Midnight	35°	245°	Most Binoculars	6.9
Dec 25	8 pm	20°	240°	10 pm	-	268°	Midnight	-	-	Most Binoculars	6.1

Note: Intermediate dates may be calculated on a pro-rata basis. Mag = magnitude or brightness based on 5 = the recognised limit of visibility to the naked eye; the number decreases for increase in brightness. Christmas Day: Best viewing times 4-6 p.m.

Issued by the I.L.E.A. London Schools' Planetarium, Wandsworth

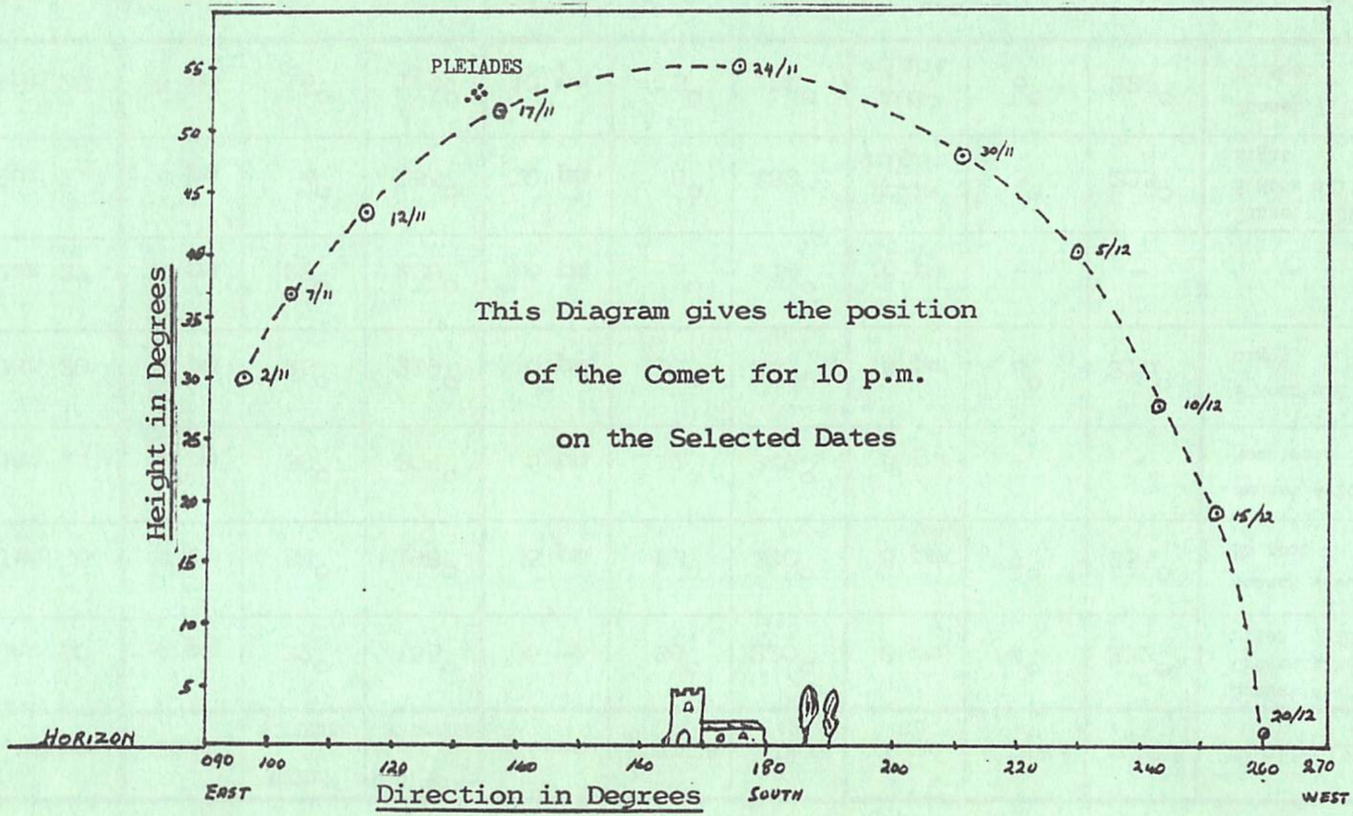
HALLEY'S COMET 1986

A WHEN AND WHERE TABLE

Date	Time	HEIGHT ALTITUDE	DIRECTION AZIMUTH	Time	ALTITUDE	AZIMUTH	Time	ALTITUDE	AZIMUTH	Visibility
Dec 30	4 pm	37°	185°	6 pm	30°	220°	8 pm	4°	272°	Sunset 4.10 pm Crescent Moon rises 7.20 pm
Jan 6	4 pm	34°	198°	6 pm	23°	230°	8 pm	7°	256°	Sunset 4.00 pm No Moon
Jan 13	4 pm	30°	209°	6 pm	17°	239°	8 pm	-	-	Sunset 4.20 pm Moon sets 8 pm
Jan 20	4 pm	25°	219°	6 pm	10°	247°	8 pm	8°	270°	¾ Moon all night
Jan 27	4 pm	20°	228°	6 pm	3°	254°	8 pm	-	-	-
Apr 21	8 pm	4°	155°	10 pm	8°	180°	mid-night	3°	205°	Sunset 7.00 pm ¾ Moon all night
Apr 28	8 pm	16°	169°	10 pm	15°	198°	mid-night	6°	224°	Sunset 7.15 pm No Moon

Note: The altitudes have been calculated for latitude 51°N, which is just South of London. For every degree of latitude further north, subtract ¾ degree of altitude. For a guide Newcastle is latitude 55° North.

HALLEY'S COMET 1985



Note: On the 17th Nov. the Comet is very close to the Pleiades (or Seven Sisters)

NATIONAL ASTRONOMY WEEK

November 9th - 16th

WHAT WILL HAPPEN?

Among the most popular events will certainly be 'star parties' - public observation sessions arranged by amateur astronomical societies. Members of the public will have the opportunity to look through a variety of telescopes at the wonders of the heavens - weather permitting.

These 'star parties' will take place in a variety of locations - from society observatories to local parks. During the day there will be exhibitions in libraries and shopping centres. Passing shoppers may even be able to examine sunspots on projected images of the sun.

There will also be special public meetings, popular lectures, museum displays and planetarium programmes. Professional observatories too are expected to hold open days during the week.

By using the comet as a focus, astronomers aim to make the science of astronomy and its achievements more widely known. The scheme has the active support of professional and amateur bodies all over the country, including astronomical societies, observatories, planetaria, museums and universities.

The Astronomer Royal, Professor F. Graham Smith, FRS is President and Patrick Moore, Vice-President, of a committee which has been set up to encourage and co-ordinate activities at both national and local level, with members drawn from every kind of astronomical organisation.

* * * *

In the year of our Lord 729, two comets appeared around the sun striking terror into all who saw them. One comet rose early and preceded the sun, while the other followed the setting sun at evening, seeming to portend awful calamity to east and west alike. One comet was the precursor of the day and the other of the night to indicate that mankind was menaced by evil at both times.

(Bede AD 673-735)

Time problems revealed

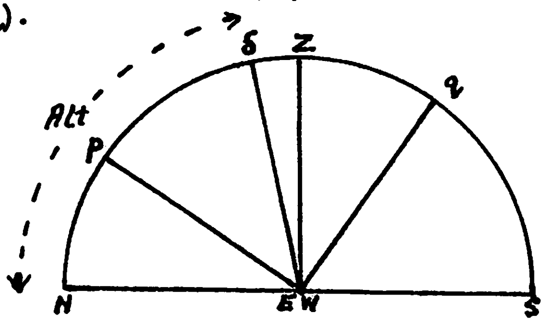
So many candidates for "O" level astronomy are afraid of any time problem, and the reason is simple, it is a fear of the unknown, which is quite unfounded because the problems are simple. They may be divided into two parts which are basic parts of positional astronomy. They are: (i) a knowledge of the connections between latitude, altitude and declination, and (ii) a knowledge of the link (in terms of time and/or arc) between meridians of longitude and hour angles. Possibly azimuth may be used, however the candidate would not have to use it in calculations. Therefore calculations are usually confined to transits, as the Right Ascension is equal to the local sidereal time at transit or, only at transit RA = LST.

Make sure you understand this before you attempt to proceed.

Example (1) - A celestial body transits (you) an observer in Lat. 35° 11' N. Long.111° 45' W. The declination is + 45° 06'. What is the altitude of the body?

Firstly, draw a figure to help sort things out.

Draw a semi-circle to represent the observer's hemisphere NEWS = compass directions on the observer's rational horizon. Z = You. Now draw the equator (q) at 35° 11' to the S of your position (zenith). Now place the cel.pole which must be 90° to the North of (q). The stage is now set. Mark in declination (δ) 45° 06' North of the equator (q).



The picture is now complete and all you have to do is give a value for N = altitude above the Northern horizon. I make it 80° 05' ! Remember always draw a rough figure - it shows you what to do.

Example (II)

Let us take the above situation (page 34) and say that the transit takes place at midnight at Greenwich when the sidereal time was 17h 5min; in other words, at transit Greenwich, the GMT (UT) was 00h 00min and GST 17h 5min. What will be the GMT when the body transits the observer's meridian?

At UT (GMT) 00h 00min. the GST	=	17 - 51.0
Long 111° 45' W converted into time (At Greenwich)	=	7 - 27.0
∴ at GMT 00h 00min x the LST (At Observer)	=	10 - 24.0
Now RA at transit = LST ∴ transit LST (At Observer)	=	20 - 39.7
The sidereal time interval between them	=	10 - 15.7
But it is a sidereal amount ∴ correction to make it a mean time amount	=	1.7
correction subtractive because Mean time is (slower !) than sidereal time		10 - 15.0
Greenwich transit		00 - 00.0

meantime interval which is to be added to Greenwich time as Long is West.

∴ Local transit takes place at GMT 10.15.0 Q.E.D.

Remember that going the other way the correction would be positive.

Correction Diff. in one rotation	24 - 00.00
	23 - 56.04
(say 4 mins.)	03.56

per hour	=	10" or 10 secs
10 hours	=	100 secs.
15.7 mins	=	2½ secs.
		102½ secs. = 1 min. 42½ secs.
	say	1.7 min.

* * * *

NOT SO ORDINARY LEVEL FANTASMAGORICALS AND COMMENTS

Stars are bad time keepers and their time fluctuation and/or gets slower. Does delta Cephei know this?

There is no atmosphere on the Moon so there is no pressure pushing down, so the mountains grow higher.
Everest climbers notice this!

Pollux is a very small Red Giant.
Or perhaps a very large dwarf.

When Halley's Comet comes to Earth at the end of this year many astronomers will have their eyes pinned on it.
Is this being blinded with science?

Sunspots are the burnt meteors or other particles mostly in solid form. Ash-actly.

Proper Motion: When a star falls towards the Earth, not noticed because the Earth is falling away as well.
Trying to side step the issue?

A meteor radiant is a heavenly body that becomes excited.
This must be a Freudian slip!

A star's spectrum can show a Red Shift if that star is not in our local group according to the expansion of the universe.
Or any other gibberish you can think of!

* * * *

Hung be heavens with black, yield day to night;
Comets importing change of Times and States,
Brandish your crystal tresses in the sky
And with them scourge the bad revolting stars
That have consented unto Henry's death . . . .

(W. Shakespeare)

Meanwhile a comet, popularly thought to be a phenomenon portending change in goverments, blazed brightly...

(Tacitus AD 56 - 117)

CONSTRUCTING THE UNIVERSE

DAVID LAYZER 313 pp including appendix

Scientific American Books 1984 hard cover

ISBN 0-7167-5003-1 £ 15.95

Professor Layzer of Harvard University has written this volume on cosmology as part of the Scientific American Library. As noted in earlier reviews (AAE Newsletter Vol.4 No.1, pp 18 - 20), books in this series are not collections of articles from "Scientific American" but are complete works in themselves.

Largely because of the mathematical approach, this book would best suit the undergraduate student of science or mathematics. Although there is an appendix on vectors, much of the mathematical parts of the text would certainly be lost on those not skilled in algebra, geometry and calculus to "A" level standard. Professor Layzer believes that complete understanding of nature will only come with some degree of mathematical understanding. In a subject like cosmology this is certainly a valid point.

The eight chapters follow a course from the science of Aristarchus to that of Einstein, with many lessons on the scientific advance drawn from the various theories of Archimedes, of Copernicus, Kepler, Galileo and Newton for example.

The final chapter, on cosmic evolution, is mainly concerned with David Layzer's cosmogony which rests on the assumption that the microwave background radiation is a result of starlight rather than a "big bang" relic. He sets out the astronomical and physical evidence in favour of his own and of other hypotheses, so that this is not a one-sided account.

There are over two hundred illustrations, which are fine except for some lapses in labelling of diagrams. As with other books in the series, it is very well printed and pleasant to handle.

Geraint Day

* * * *

HANDBOOK FOR ASTRONOMICAL SOCIETIES

Federation of Astronomical Societies - Annually
£1.75 (£1.25 to Federation Members)

The Federation of Astronomical Societies' Handbook, which has now appeared eight years running, is an extremely useful publication. (The Federation itself was founded in 1974 to improve communication between local astronomical societies and exchange information of mutual benefit. It is interesting to note that one of its aims is to encourage the teaching of astronomy in educational establishments).

The 1984/85 edition, which I have for review, will no doubt have been updated by the 1985/86 issue by the time this review appears. If you are looking for useful addresses then this Handbook is the place to turn to. It contains a list of astronomical societies in Great Britain, with secretaries' addresses; a list of astronomical periodicals, equipment suppliers, places to visit (from Alton Towers Planetarium to Yorkshire Museum), a section giving details of speakers willing to talk to local societies on matters astronomical; some overseas "space" addresses (including the main N.A.S.A. institutes), and finally, addresses of sources of visual aids (important, of course, for astronomy teachers - although as an aside, do note that some of the official space agencies will readily supply charts and photographs free of charge to bona fide educators).

The Handbook contains even more, though. There's a list of slides that may be bought from the Federation, and tapes that may be hired from it. The 1984/85 edition contains four articles: on building large telescopes; types of observatory for amateur astronomers; planning permission and observatories, and women in the space programme. There is a bit of overlap between the two pieces on observatory buildings, and - although it is a fascinating article - I'm not sure that the one on the space programme is best placed in a publication of this sort.

Looking at the list of articles published in earlier editions of the Handbook, I see that there are ones that will be of interest to people trying to run an astronomical society, such as duties of a treasurer and society insurance.

A well produced publication which is of excellent value. Having recently received a request from a Federation official to check the text of a couple of Handbook entries with which I have some connection, I know that the editorial team takes some trouble to try to keep the Handbook up to date. If you are a society secretary get a copy now.

(Write to Brian Jones, 47 St. Blaise Court, off Manchester Road, Bradford, West Yorkshire, BD5 0QE, for details of the latest edition).

Geraint Day

* * * *

THE TEACHING OF ASTRONOMY

"Perspectives" issue 16, May 1985 74 pp

Edited by PETER PREECE and DOUGLAS CLISH

£1.30 (including postage) from: Curriculum and Resources Centre, University of Exeter, School of Education, Saint Luke's, Exeter, Devon, EX1 2LU.

This is a handy and concise little mine of ideas that should prove of value to teachers of astronomy.

It comprises seven short papers, every one of which is relevant to astronomy education, and which the AAE should welcome.

Not only that, but the authors should be well known to readers of the AAE Newsletter. We are presented with some reflections by Donald Gold on his experiences before the AAE was set up. "Astronomy in the middle school" is a useful piece by Douglas Clish, dealing with some possible things to include in teaching astronomy at this crucial level. Raymond Butt gives some advice on astronomy in the secondary school, including links with a range of other school subjects. Dr. Derek McNally has set out some well-meaning and frank thoughts that should prove of value to intending astronomers (and their lecturers), in "Astronomy at University".

Astronomy has a certain reputation for being done at night: Dr. Percy Seymour describes some of the indoor models of things heavenly that have been or are still used in astronomy education, from the ancient Greeks' spheres to modern planetaria (not just the somewhat costly commercial devices, but with references to instructions on how to build one's own). "Instruments for School Astronomy" are surveyed by James Muirden; he makes the point that it is no use having "one telescope and twenty children", but that the naked eye and suitable binoculars have their proper place, not just on grounds of cost of astronomical telescopes.

A final paper, by Dr. Peter Preece, on children's ideas about the Earth and gravity, although with a certain amount of educationists' jargon, is instructive for teachers when they actually have to deal with students' pre-entry knowledge (much of which, incidentally, will nowadays be shaped by viewing television science-fiction programmes of various degrees of "accuracy"): how often do we encounter the idea that there is no gravity on the Moon or that objects are somehow held down on the Earth by the atmosphere?

Some of the papers have references to other publications, although perhaps more references would have been useful. Recommended as a generally useful staring place.

Geraint Day

* * * *

THE UNIVERSE OF GALAXIES

Compiled by PAUL W. HODGE 113 pp

W. H. Freeman and Company 1984

ISBN 0-7167-1675-5 hard cover £20.95
ISBN 0-7167-1676-3 soft cover £10.95

This is a fascinating collection of nine articles which appeared in "Scientific American", 1973-1983 (all but two having appeared since 1980). The subjects are:- Our Own Galaxy (a marvellous piece by the late Bart J. Bok), the Andromeda Galaxy, dark matter in spiral galaxies, evolution of disk galaxies, intergalactic tides, Centaurus A, jets in galaxies, super-clusters of galaxies and quasars.

It is instructive to read the observational evidence for galactic coronas, which mean that most of the mass in spiral galaxies is invisible and that these objects are much larger than they appear in optical images. These and other topics are clearly presented and well laid out, as is normal in "Scientific American" articles.

The wealth of photographs and high-quality diagrams (96 illustrations in all) adds much to the text. Professor Hodge has contributed an introduction, and there is a list of follow-up references at the end of the book together with an index.

Very suitable for any relevant project work in astronomy by students at "A" level and above, I would have thought.

Geraint Day

* * * *

CONVERSION OF DAILY TELEGRAPH STAR MAP INTO ASTROLABE

Commander H. R. Mills, famous for his astronomical gadgets and for his 'versatile astrolabe', has produced a larger and more accurate form of his astrolabe which makes use of a star map. In conjunction with the Daily Telegraph he has designed a transparent overlay which is designed to fit over the star map and, with the aid of a drawing pin through the pole, to rotate relative to the map. The device is, in fact, a planisphere, with Right Ascension and declination on the map, altitude and azimuth on the transparent overlay. The usual lining up of date and time around the circumference enable the RA and dec. of any object to be converted immediately into altitude and azimuth. This is particularly useful for those who want to know where to look for an object (e.g. "almost south at 11.00 p.m., about 40° above the horizon"), and for whom merely giving the RA and dec. is not particularly helpful.

What is particularly novel about this astrolabe is its size; the Daily Telegraph star map has a diameter of 22 inches. The accuracy of the co-ordinate conversion is thus very good.

Also available with the graticule is a diagram of the path of Halley's Comet during its period of visibility in 1985 and 1986. This may be inserted between the map and overlay, so that the position of the comet may be read off on any given date and time.

My only criticism is that the overlay (made from an acetate sheet) is rather floppy: a stiffer material would have helped, especially as the star map is equally flexible. But for use indoors on a flat table, this is not so important. I have, in fact, modified my model by (a) pasting the map on to a stiff card, (b) fixing the graticule to a circular sheet of perspex and (c) tracing the path of Halley's Comet on to an acetate sheet (instead of using the original diagram on paper) so that the background constellations as well as the path of the comet can be seen. With a little ingenuity, the owners of Commander Mills' astrolabe should be well satisfied with this instrument. The Daily Telegraph star map, graticule, comet track and instructions may be obtained as a complete package from THE DAILY TELEGRAPH, DEPT. SN, 135 FLEET STREET, E.C.4 at a cost of £4.95, postage paid. (Without the star map the cost is £2.50).

Eric Zucker

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Letter to the Editor

Dear Editor,

I am sure that my dear friend Geraint Day has confused Messrs. Pictorial Charts Educational Trust with another publisher of similar ilk. Indeed a very easy mistake and one for which he may be forgiven. In his review 'Mapping the Weather', Vol.4 No.3, Geraint ended his review with almost a cri de coeur, hoping that the Trust would produce charts on astronomy and Space travel.

This error must be put to rights. It was the Trust's wall chart titled 'The Moon - Apollo Exploration' that was reviewed in the newsletter, Vol.3 No.1. Moreover, Messrs. P.E.C.T. have also published 'Exploring the Planets', 4 charts (200 x 170mm) with booklet of diagrams and data £2.85 + VAT. Also 'Man in Space', 4 charts (200 x 170mm) with notes of data and diagrams, £3.40 + VAT.

I know that Geraint will not mind me pointing this out, but Messrs. P.E.C.T. could have been most unhappy.

I am yours etc. etc.

Peter Richards-Jones

WHAT YOUR TELESCOPE CAN DO UNDER IDEAL CONDITIONS

FUNCTION	DEPENDS ON	THEORETICAL RELATIONS
LIGHT GATHERING POWER	The diameter of objective D only. (in mm's)	Night adapted eye pupil ≈ 8mm diameter. L.G.P. over unaided eye $= \frac{D^2}{8^2}$ Limiting magnitude m of telescope is $m = 2 + 5\log_{10} D$. (for D = 100 m = 12)
MAGNIFICATION for complete telescope, M. Objective part = M_o Eyepiece part = M_e $M = M_o \times M_e$. = mag. at primary focus as seen by the unaided eye.	F = focal length of Objective f = focal length of eyepiece S = distance of distinct vision (for normal eye S = 250 mm)	Approximately $M = \frac{F}{f} = \frac{D}{d}$ where d = diam of exit pupil of eye, and is true only if the eye is focussed on image at ∞ M_o = magnification of distant object with image at primary focus as seen by normal eye at 250mm $= \frac{F}{250}$ M_e = magnification by the eyepiece $= \left(\frac{250}{f} + 1\right)$ Total Magnification $M = M_o \times M_e = \frac{F}{250}\left(\frac{250}{f} + 1\right)$ $= \frac{F}{f} + \frac{F}{250}$.
MAGNIFICATION IN PHOTOGRAPHY By eyepiece projection	F, f, and v v = distance of film or plate from eye piece.	Magnification of primary image by eyepiece $M_p = \left(\frac{v}{f} - 1\right)$, the Effective Focal Length $= F\left(\frac{v}{f} - 1\right)$ and the Effective Focal Ratio $= \frac{F}{D}\left(\frac{v}{f} - 1\right)$
FIELD OF VIEW If t = time in secs for star dec δ to cross field [illegible] Then α in arc secs = [illegible]	MAGNIFICATION of telescope M. and Field of view of eyepiece	Field of view of Sky by an observer at the Telescope $= \frac{\text{Field of view presented by eye piece}}{M} \approx \frac{40°}{M}$. (Field of view of eyepieces may range from 35° to 45°.).
RESOLUTION RESOLVING POWER Smallest angle in arc secs that can be resolved at primary focus. (α)	α depends only on D but for visual resolution α must be magnified by the eyepiece to at least 1·5′ and so depends on f as well as [illegible]	Resolving power in theory $= \frac{\lambda}{D}$ but in practice is more accurately, $\frac{1{\cdot}22\lambda}{D}$ Radians. (λ for yellow light = 550nm) Resolving power $= \frac{138}{D}$ in arc secs. (For D = 150mm. α = 0·92″) For eye resolution use eyepiece magnification $\frac{1{\cdot}5 \times 60}{0{\cdot}92} = 97$·[illegible] using M_e above, f must be not more than 2·5mm.
BARLOW LENS Amplifying factor m_B	f_B = focal length of Barlow u = distance between Barlow Lens and primary image.	$m_B = \frac{f_B}{f_B - u}$. Effective focal length of telescope with Barlow $= \frac{F f_B}{f_B - u}$

HRM.

WATCH THEATRE

Watch Theatre is a "theatre in education" company, based in Reading, at present touring the country with a new play for schools called "Maths, Magic and the Moon".

The play is set in the court of Matthias, Holy Roman Emperor, at the turn of the 17th century. Johannes Kepler - astronomer and mathematician - attempts to defend his work against a barrage of criticism from astrologers, physicians, priests and politicians. Kepler is not alone though, the magic of theatre can bring Pythagoras and Hipparchus, Gallileo and Newton, even the odd astronaut to his aid.

Opening with the Genesis of the world as in the Ptolemaic system, the play then focuses on the political intrigues and power playing during the trial of Kepler's book, The Harmony of the World. With singing Greeks, punning jesters, audience participation and a fascinating central subject, MATHS, MAGIC AND THE MOON, should interest and excite everyone - even those who gave up Maths when they bought a calculator!

All schools booking the show will receive a free resource pack. This includes background material for circulating before the performance, simple mathematical and astronomical experiments for pupils to try, some examples of basic maths used in astronomy and a reading list for further exploration of the project. The pack has been prepared with the help of the staff at the Old Royal Observatory Museum at Greenwich.

We are also grateful to the London Planetarium for the loan of slides and other resource material, and to Helix Ltd. and A & B Theatre Services for help with the sets and projection equipment.

Maths, Magic and the Moon is a visually stunning show - the universe is projected on a huge screen which dominates the stage. The company carry their own technical equipment and can play in most halls and theatres with four 13 amp sockets.

With 250 pupils the cost is less than 50p per head and the Company is happy to consider additional performances day or evening, at reduced rates.

Booking Information

When:

Time: We suggest 10.30 a.m. or 2.00 p.m.; Setting up: 1 hour; Running time: 90 minutes.

Cost: 1 performance: £108 + VAT;
10% discount for advance payment: £97.20 + VAT.

Where: Ideally a 15' square; 10' clear on one side (for projection of slides) and 4 x 13 amp sockets.

Audience: 15' x 15'   Space: 10' clear

If you have any queries regarding dates, places or the content of the show, you are asked to contact Daryn Moody, "Watch Theatre", 48 Robin Hood Lane, Winnersly, Bucks. Telephone Wokingham (0734) 787 956.

* * * *

When beggars die, there are no comets seen:
The heavens themselves blaze forth the death of princes.

William Shakespeare (1564 - 1616)

*

A comet, which is a phenomenon, popularly supposed to herald the death of the highest rulers, began to rise in the sky . . . . .

Suetonius (AD 69 - 160)

*

"Ye country comets, that portend
No war nor prince's funeral
Shining unto no other end
Than to presage the grasses fall"

Johnathan Swift (1667 - 1745)

* * * *

COSMOS

AN EDUCATIONAL CHALLENGE

Copenhagen, 18th - 23rd August, 1986

What should be taught? By what means?

What are the Intellectual Possibilities and Constraints?

The Conference will:-

(1) focus on the educational impact of recent scientific advances on our understanding of cosmos;

(2) deal with the content of and the methods of the teaching of Astronomy, Cosmology and Space Science in schools and at the introductory university level;

(3) throw light on students' preconceived ideas about these subjects.

The Conference is to be held at the Conference Centre called "LO-SKOLEN" at Elsinore.

Elsinore is an old picturesque town placed in a culturally, historically and scenically rich area, an hour's journey from the centre of Copenhagen; Kronborg - Hamlet's Castle is situated in this town.

The programme will include plenary sessions, parallel sessions and posters. An exhibition of teaching aids and materials will be organised and new planetarium equipment will be demonstrated.

Examples of topics to be covered by papers, invited and contributed:-

- Cosmology and the scientific view of the world.
- Stars and galaxies.
- The Solar System (Halley's Comet).
- Space laboratories and their use for educational purposes.
- Teaching aids and materials.
- Students' conceptions of cosmic phenomena.
- Recent developments in the teaching of Astronomy, Cosmology and Space Science.

The Conference language will be English. Conference proceedings will be published in collaboration with the European Space Organisation ESA.

Detailed information about the Conference and the programme will be given in the second circular.

The participation fee will be approximately Dkr. 2,500 and covers full participation, programme, abstracts, social events, full board and accommodation in double rooms at the Conference Centre.

Single room accommodation will be available for a limited number of participants for an addition charge of Dkr. 1,100.

Accompanying guests can obtain accommodation at the Conference Centre for the same price as participants. (At present the rate of exchange is Dkr. 100 = US$ 8.50).

The number of participants will be limited to 150, and preference will be given to members of GIREP. If you want to participate write to:-

GIREP '86,
The Royal Danish School of Educational Studies
Department of Physics
Emdrupvej 115 B
DK-2400 Copenhagen NV, Denmark - as soon as possible.

* * * *

A light-hearted look at English as she is spoke

Letter to the Examination Board in Karachi

To Whom it may concern:

I feel great pleasure in certifying that this 'Project Work' attached with this letter is purely the work of Ali-Ben-Alu. I would also state that he has carried out the observations and experiments as advised.

I would wish him the best in future and pray to God that he shall serve this field of science as much as he can. I also hope that his keen interest in this particular subject will lead him to bright prospects and encourage him to serve mankind to the best of his capability and calibre.

Hafgan Ownd, Vizagapatam

(continued)

In answer to your esteemed note:

It is with great personal anguish and regret that I am in the unfortunate situation of being the bearer of disturbing and heart-rending knowledge; which I must directly impart to you without the slightest titter of delay. Indeed to suppress such knowledge for one jot of time would be the treating of you quite unfairly and dastardly. Therefore, without further delay, I am indicating that the future prospects of your candidate may not rightfully be used in service to this particular field of science to which he has in the past applied himself with such vim and vigour. He failed.

Fale M. Farst

Chief Examiner, Karachi

Note: Only the names have been changed to protect the innocent.

* * * *

CRUXWORD Number 2

Across:

1 - Black baby for critical radius of singularity (13)

5 - Make a hole with this for a simple camera (3)

7 - Famous variable in the Swan (2)

9 - Shortened lady who was rescued by Perseus (3)

10 - Comets are made largely of these, but not vanilla (4)

11 - If Earth comes third, what about Uranus (7, 6)

12 - P C Tess Cooper's dismembered for means of probing stars (13)

14 - Roman bear (4)

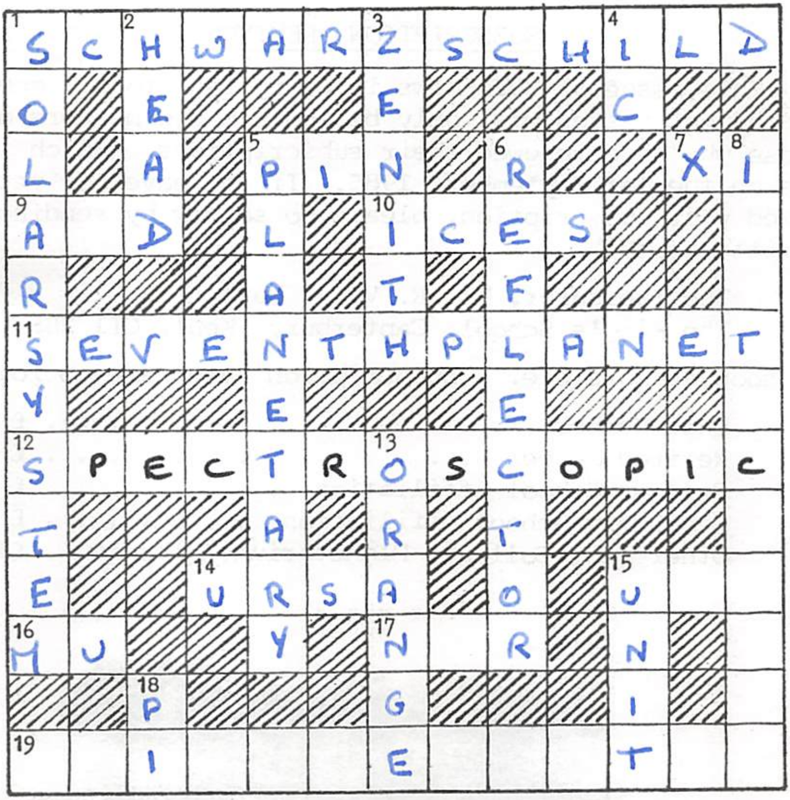
15 - Shortened ditto (3)

16 - 12th brightest star (2)

17 - Shortened southern level (3)

18 - Sirius barters tights around (9, 4)

(continued)



Down:

1 - Elmo's strays are confused for sun's family (5, 6)

2 - Comet's coma (4)

3 - Directly overhead (6)

4 - Supplement to N G C (2)

5 - Pertaining to relatively small cold astronomical bodies (9)

6 - Frere Clot mixed up for type of telescope (9)

8 - Jim's Rosy rat is wedge-shaped Martian feature (6, 5)

13 - Mars is rather this than red (6)

15 - 93 x 10^6 is an Astronomical ---- (4)

18 - $\frac{\text{Circumference}}{\text{Diameter}}$ (2)

* * * *

SUBSCRIPTION REMINDER

This issue of AAE News is being sent to all members. Subsequent issues will only be sent to new members or to those who have renewed their subscriptions, which were due on the 1st September, 1985. If you have not yet renewed your subscription, please do so now by sending your remittance to:

The Treasurer, Mr. R. V. J. Butt,
The King's School, Canterbury, Kent, CT1 2ES

as soon as possible. Subscription rates are as follows:

Full Member	£ 5.00
Retired Member	£ 4.00
Primary School Affiliation	£ 4.00
Secondary School Affiliation	£ 7.00
Other (eg. College, Planetarium, Library . .	£10.00

* * * *

"There it is, son, for better or worse . . the universe."

AAE COUNCIL

Articles, ideas, views and letters to the Editor for publication, should be sent to the Editor:-

Mr. C. S. GOODMAN
44 Balliol Road
Burbage
HINCKLEY
Leics. LE10 2RE

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NEXT ISSUE - JANUARY, 1986

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