NEWSLETTER

of the

Association for Astronomy Education

VOL. 6, No. 1 September, 1986

Some of the 1300 school pupils who visited the RGO for an Open Day in September 1985, relaxing on the lawns in front of Herstmonceux Castle.

AIMS OF THE AAE

The Association was founded in 1980 to promote the teaching of Astronomy *at all levels* in our educational system.

Membership is open to anyone who is interested in the promotion of astronomy education. Teaching establishments which have an interest in Astronomy (schools, colleges, polytechnics, universities, planetaria, museums) are eligible to affiliate to the Association.

NEWSLETTER

This is published 3 times a year (once a term) and is free to members.

ADVERTIZING

Members of the AAE may insert personal advertisements in the Newsletter free of charge, as long as they are of reasonable length.

Commercial rates are as follows:

Full page	£12.00
Half page	£6.00
Quarter page	£3.00

If you wish to advertize in the Newsletter, please contact the Editor at the address below.

ARTICLES FOR PUBLICATION

The Newsletter is a forum for the exchange of ideas and views. Members' contributions are *welcome*. Please send them, preferably typed, to the Editor at any time.

NEW MEMBERS - The Association welcomes new members - existing members can help in this respect by recruiting colleagues or friends who are interested in Astronomy education. Please show or lend this Newsletter to a friend who may be interested in joining. Extra copies may be obtained (while stocks last) from the Editor at a cost of £1 each.

EDITORIAL

At the time of writing, SERC has recommended that the Royal Greenwich Observatory (RGO) be moved from Herstmonceux to Cambridge University. Whether this recommendation still applies at the time members receive this copy of the Newsletter is uncertain, as the campaigns to rescind the SERC decision are under way. SERC has given no plausible reason for the move, and certainly has antagonized the majority of UK astronomers. The suggestion that Herstmonceux is "too remote" is ludicrous - one could argue that the more remote an astronomical observatory, the better.

Apart from its function as an observatory, the RGO is an educational centre and, as such, is an institution of special concern for the AAE. There are regular visits by school parties and by students studying astronomy and physics in higher education. Also, the magnificent surroundings (gardens and castle) cannot just be dismissed as irrelevant - they are now part of the RGO heritage.

Members are again urged to write to their MPs and to the Secretary of State for Education and Science expressing serious concern at the threat to UK astronomy.

* * * * * * * * *

An article by Dr. Margaret Penston of the RGO appears in this issue. Members will recall that Dr. Penston was our guest speaker at the Annual Meeting two years ago.

* * * * * * * * *

The format of this Newsletter is slightly changed, in that the size of the type has been reduced to $1/\sqrt{2}$ of its former linear size (approximately two-thirds). This means that rather more information can be presented in the same space. It is hoped that members can still read this print size in comfort (it is not uncommon), but readers' views are welcome.

The Newsletter is a forum for the exchange of ideas - please send in your contributions at any time.

ERIC ZUCKER.

ANNUAL MEETING: 7 JUNE 1986

This took place at the London Schools' Planetarium, Wandsworth School. The meeting commenced formally at 11 o'clock, after the initial registration and refreshments. The first item was the Annual General Meeting (business meeting), which is reported separately in this issue. This was followed by demonstrations of various exhibits submitted by members, and lunch (Wandsworth Ploughman's lunch, followed by an exotic Mediterranean fruit drink).

Members then settled down for the afternoon session, which covered a variety of topics connected with the work of Resource Centres. Thus we heard Dr. Anne Cohen talk about the work of the Jodrell Bank Visitor Centre, including the Planetarium; Martin Suggett speaking about the educational programmes at the Merseyside County Museums and Planetarium; Dave Harris on the intriguing title "How teachers may use their local societies".

The guest speaker, who came along as a substitute at almost the very last minute, was Norman Walker of the Royal Greenwich Observatory, Herstmonceux. His talk was divided into three unrelated topics: (1) an attack on the proposed move of the RGO, (2) black holes, and (3) a new kind of photometer using a large diameter liquid light-pipe.

Bob Kibble, chairman of the curriculum Working Party, gave an up-to-date account of its activities. (These are reported in more detail by Bob Kibble elsewhere in this Newsletter.)

AAE Council 1986-7

The names of officers and members elected at the AGM for the current year are given on page 27.

MINUTES OF THE AGM, 7 JUNE 1986, HELD AT THE LONDON SCHOOLS' PLANETARIUM

1105 h. The Meeting was opened by the President, D.J. Gold, Esq., as Chairman. Apologies were received from: A. Roy, G. Day, P. Seymour, I. Robson, D. Clarke, V. Barocas and I. Nicholson, the foregoing being members of the Council.

Item 1 The President warmly welcomed Mr. A. Lacey, the H.M. Inspector who had been officially appointed by the Department of Education and Science (DES) as an observer to the Association.

The President then stated that he was sorry that the number of new members had not reached expectations; although teachers were making use of the resource centres, they were not joining. Perhaps this occasional help was all that they required. Moreover, perhaps it was what the active members put into the Association that counted.

He then went on to the interim report from the Working Party formed at the AGM last year. Progress was slower than he had anticipated, and he urged the Working Party to forge ahead as time was desperately short.

Mr. Gold then spoke of his trip to Australia with many other amateur astronomers, amongst whom he had spoken with Patrick Moore who had agreed to act as presenter to a video tape that the Council were to make, promoting the AAE. This was another aspect which we should hurry ahead, especially in these times of apathy among the British public with respect to astronomy in the UK, as the proposed closure of the RGO (Royal Greenwich Observatory) showed. He had also made contact with the Nuffield Foundation hoping that they might help towards financing a research assistant to investigate the needs and shortcomings of astronomy in education in the UK. They had, however, indicated that they would need a more detailed request. The proposed video tape would be of value here, he said.

He finished by saying that the comet (Halley's) had been a little disappointing to view. However, it had resulted in a deal of interest in astronomy for which we could thank it. Wishing everyone a happy and productive year and thanking the Council officers for their support, he ended.

Item 2 (a) Minutes of the last AGM were offered for comment.

(b) Matters arising: Further discussion was made on how the Association could be funded. A suggestion to approach the Carnegie Trust had come from Mr. A.E. Beet, who had been their contact for the BAA over a period of years.

Dr. D. McNally informed the meeting that the IAU were holding a colloquium in 1988 at Baltimore, USA. The theme was education and astronomy. He thought that we (the AAE) should give them moral support as an indication of strength and support from the UK. The person organising it was Prof. Percy of Toronto University. It was agreed to send them a list of our resource centres in order for them to send advertising material. The Secretary said that he would see to this if the meeting approved. Approval was given.

There being no further matters arising, the minutes were duly passed and signed by the President.

Item 3 Secretary's report - The Secretary opened by giving apologies from Geraint Day, who was doing a lot of work for the Association in his position of PRO, and said that a vote of thanks would be in order. This was agreed, the President wishing his own thanks to be recorded.

Advertising of the AAE was going ahead wherever possible. The Secretary mentioned the President's recent letter in The Times and Geraint Day's letter last month to 'Today' newspaper.

During the year a lot of work had been done without necessarily showing immediate results, ranging from the many meetings of the Working Party to checking for computer and video programmes which may be of educational value, by individuals.

We had also had a joint meeting with the Education Committee of the British Astronomical Association. This had resulted in agreement to combine efforts wherever possible, in particular with resource lists. The number of resource centres had now reached twelve; most of them were also supplying their own area chairmen. Council felt that we were perhaps nearing the sufficiency point and we should concentrate in giving these existing ones any help they might require in order to further the aims of the Association. Meanwhile, Undine Concannon was compiling a list of resource centres' activities, and Geraint Day was compiling a master list of AVA material from lists sent to him from resource centres.

The course organiser, Dave Harris, had been disappointed in attendances at the courses run since the last AGM but thought it due mainly to the lack of expenses from the LEAs to the teachers.

The Secretary then closed his report to allow open discussion.

Open discussion - Members discussed ways and means to promote the Association. Ultimately it became apparent that we should definitely become associated closely with the Association for Science Education. The ASE held meetings all over the country, and we would benefit by having a representative at most. Perhaps we could arrange to hold a combined meeting at resource centres. Anne Cohen of Jodrell Bank had already tried this successfully.

Closing the discussion, the President said this was an item for the agenda and an immediate letter to the President, Mr. John Ellis, to see what could be achieved. Derek McNally suggested an article about the Association could be offered to the journal of the ASE.

Item 4 Treasurer's report - The Treasurer handed out copies of the Association's accounts to those present. The accounts balanced for 30th April 1986 and were signed by the Hon. Auditor, Mr. R.C. Jacob. Certain points were explained by the Treasurer to the satisfaction of the meeting. Dave Harris proposed acceptance and Ivor Stott seconded. The proposal was carried. The President thanked Raymond Butt not only for the hard work of keeping the accounts but the succinct manner in which they had been presented.

Item 5 Editor's report - Colin Goodman announced that he had to resign the Editorship as he was now doing too much work overall. However, he was able to tell the meeting that Eric Zucker had kindly offered to take on the job of Editor. Eric Zucker then stood up and said that, due to the change in editorship, there had been a delay in publishing the last Newsletter. He also reminded the meeting that mid-July was the deadline for material for the next issue. The Chairman gave a vote of thanks to Colin for the sterling work he had done to date. He anticipated another good editor in Eric and expressed the view that we were fortunate as an Association to have such members.

Item 6 Council changes - Apart from the change of Editorship, there were other changes to the Council. Dr. Derek McNally and Ian Nicholson were standing down from Council, leaving two vacancies.

Colin Goodman indicated that he would stay on Council if required; this was accepted.

Dr. Russell Eberst was elected to Council, proposed by Dr. F. Vincent, seconded by Dr. D. McNally.

Robert Kibble was elected to Council, proposed by Dr. D. McNally, seconded by I. Stott.

Item 7 Bob Kibble then gave a short report on the progress of the Working Party, which was gratefully received.

The president then closed the meeting at 12.35 p.m.

* * * * * * * * *

ANNUAL MEETING 1987

It is hoped that this will take place at the Old Royal Observatory, Greenwich.

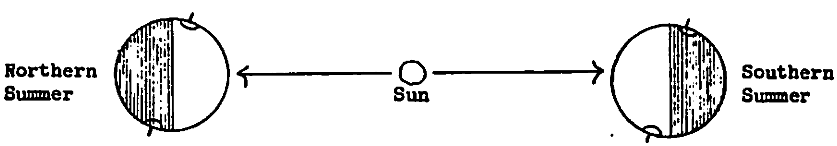
* * * * * * * * *

LUNAR CURIOSITIES

By: *Peter Ecker,*
Breaston, Derby.

A feature of the long winter nights of the northern latitudes is the enormous arc spanned by the full moon, rising high on the north-eastern horizon and setting high on the north-western after dawn on the following day. Seeing it, we may well remember that, in contrast, the midsummer full moon describes a very shallow arc in the southern sky, and we might well conclude that the movements of the sun and moon are so geared as to compensate the one for the other according to season. Is this really the case?

We understand well enough the feature which brings the sun high in the sky during our summer and which takes it low to bring about our winter. It is that the earth in its spinning along its path around the sun does so with its axis not at right angles to its line of travel. At one point, therefore, the northern hemisphere is inclined towards and enjoys the sun while, at the opposite point, the southern has its opportunity. The diagram below, which is only illustrative and not to any scale, shows these situations:



At the two points halfway in between these extremes, both hemispheres are equally served by the sun, each enjoying twelve hours' light and dark.

Figure I.

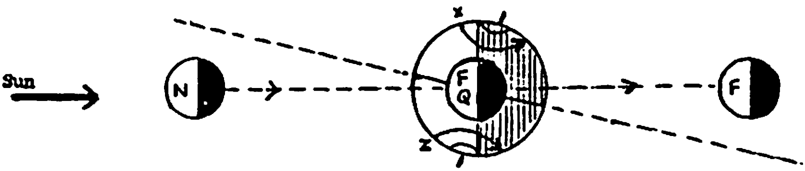


Figure II. Northern Winter.

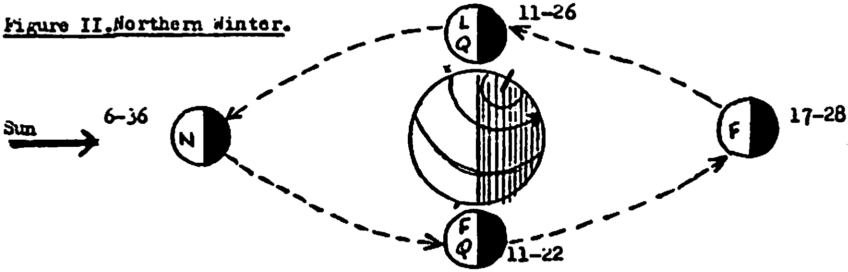


Figure III. Northern Summer.

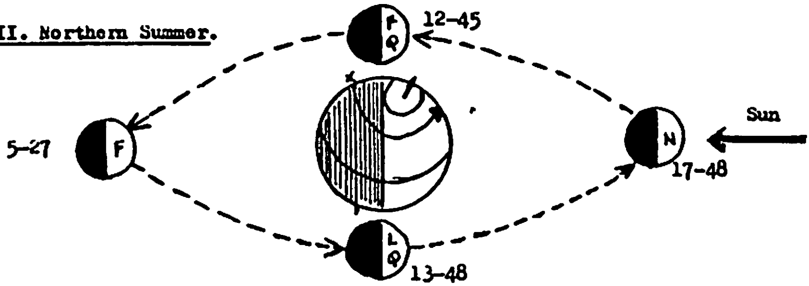


Figure IV. March Equinox.

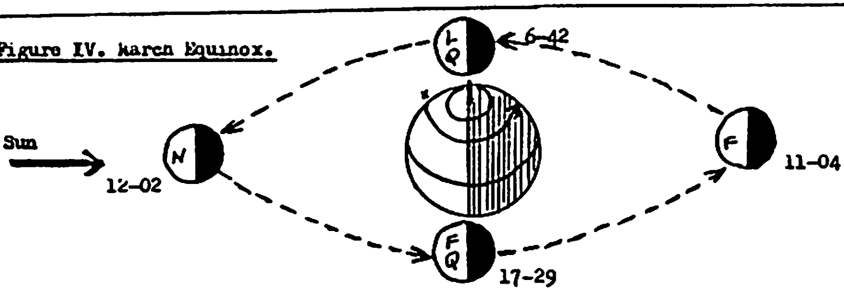
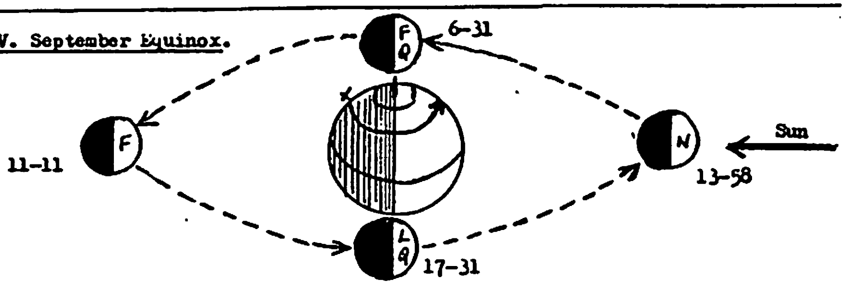


Figure V. September Equinox.



These, occurring in March and September, are called equinoxes, the earth's axis being sideways on to the sun.

The relationship of the earth and the moon, however, is a different matter entirely, and it is difficult to see how a similar seasonal situation could arise. After all, it is the moon that goes round the earth and it does so on a very small orbit compared to that of the earth round the sun.

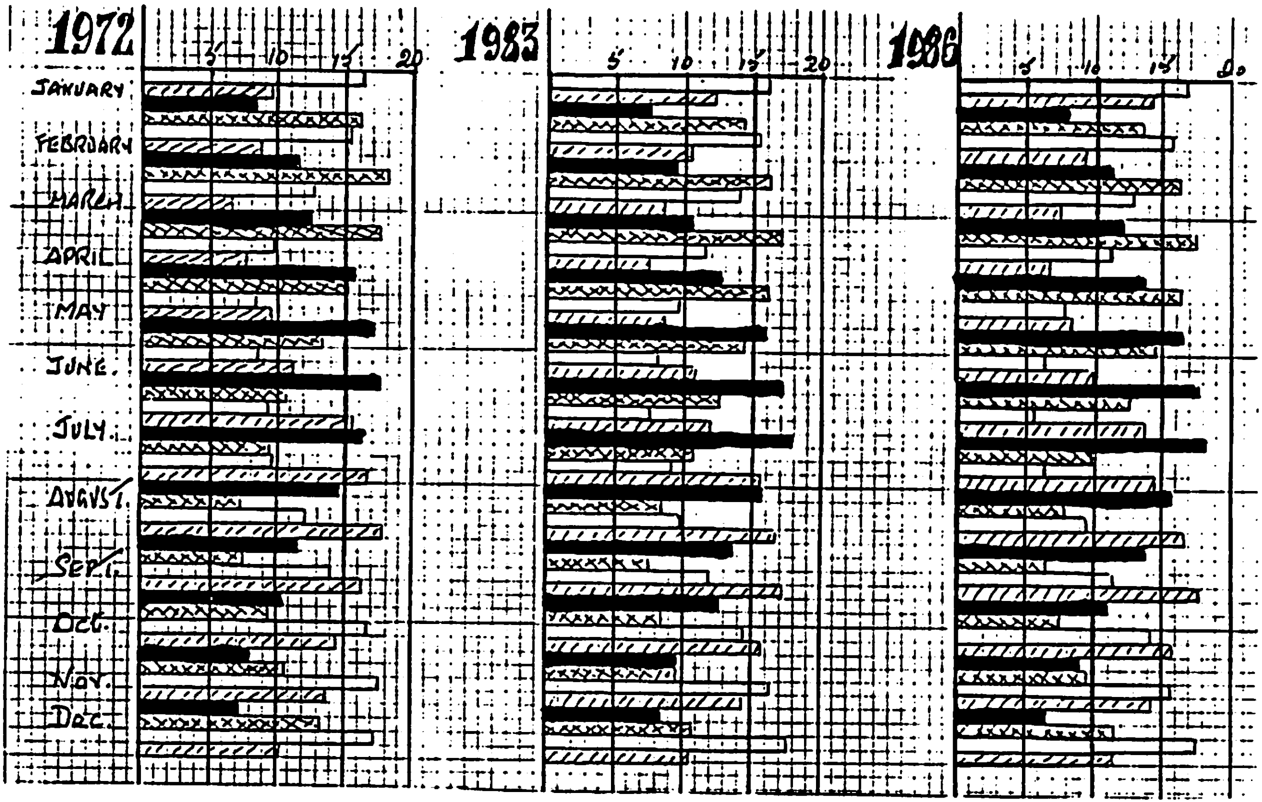
The length of the track of the moon in the sky is of course reflected in the time it takes. If, therefore, we make note of the hours between moonrise and moonset over the horizon, we might discover something. The histograms therewith show the hours above the horizon of each of the four phases of the moon for three separate years. These years were used simply because the pertinent Whitaker's Almanacs were to hand. It is seen immediately that the overall yearly patterns are similar. A closer examination shows that the hours for each phase create a wave pattern, the shortest and the longest being some six months apart. If we look at the full moon we straight away see what we had been aware of in the sky, viz. that in midwinter it shines for some 17 hours. In contrast it only shines for 8 or 9 in June/July, having diminished gradually each month in between. In contrast the winter new moon is above the horizon for only about 8 hours and increases by monthly stages to its maximum of 17/18 hours in midsummer. It is noted that the total hours for the four phases per month are around 50. What is emerging is that the moon does the same sort of thing every month. What proportion of its total performance is in this or that phase depends entirely on the relative positions of itself, the earth and the sun. After all, a phase is only the degree of illumined surface visible to the human eye.

Each month, therefore, the moon describes its highest arc in the sky and also its lowest. In technical terms, it passes from its highest to its lowest declination and back again within a month, a feat which takes the sun a whole year. We can now realise that our appreciation of the 'riding high' of the winter full moon was due simply to the fact that it was full since in that phase it is most noticeable. In midsummer we are not likely to have noticed the new moon passing along the same path for it would have been doing it in broad daylight and would not have been visible.

As we have said earlier, the sun is caused to pass from high to low declination and back again by the movement of the earth around it. The progression in declination of the moon is brought about not by the earth's behaviour but by the moon's as it spins round the earth in an easterly direction. Spin is perhaps misleading because it only turns once during its monthly journey, always keeping one face towards the earth.

There are certain other features which affect the moon's behaviour but they need not concern us here, being more for the attention of and application by the expert astronomer. Our histograms have shown us that the moon's overall behaviour is to a pattern. How this pattern is shaped is attempted to be clarified by the accompanying diagrams and their interpretation. They must be understood as purely illustrative and not to any scale or measurement.

Figure 1 shows a side view of the earth, its tilted axis being indicated by the 'poles' and the sloping equator line. Three positions of the moon are shown and, with the sunlight coming from the left, the first one from that side is a new moon since it is its unlit side which faces the earth, the middle one is first quarter since it shows half of its face to the earth, and the right-hand one is full moon since all of its face is visible from the earth. In imagining such a situation, we need of course to take ourselves out into space and look back at the earth with the moon riding round it. From the earth we see the moon going over the sky in a curved path and, to imagine this in relation to the diagram, we must imagine we are standing on the surface of the earth, say at the point represented by the 'x', and being carried along the



MOON-HOURS BETWEEN RISING AND SETTING AT 52° LATITUDE

= NEW = FIRST QTR. = FULL = LAST QTR.

curved path leading from it as the arrow-head at the end of it indicates. From 'x' we apparently have a clear view of the new moon, but we must realise that we are in broad daylight and there is only the unlit side of the moon turned to us. We are therefore not likely to see anything of it.

As the moon moves towards the first quarter day by day we will begin to glimpse a little of its right-hand side lit up in the early evening, and gradually more and more of it further and further into the night. We cannot see the last quarter in the diagram for it is obviously behind the earth, as shown in the diagram. We can, however, imagine it and work out that it would be visible during the second part of the night and most of the morning after.

But there is one very important feature of this diagram. Because of the tilt of the earth's axis, the new moon in the diagram lies below the equator line (see dotted extension) and the full moon lies above it. In this situation, therefore, the new moon describes a very low arc in the sky while the full moon describes a very high one. The diagram therefore is illustrating the situation of the northern winter which we have seen by actual experience to be when the moon 'rides high'.

Before we leave this diagram let us in imagination follow the path from 'x' as though we were on a rotating earth. 'x' itself must obviously be at noon-time for it is on the halfway point between light and dark. From noon to entering the dark half is not a very long journey, but the part in the dark is very long. If we continue our imaginary journey round the other side of the globe, we shall appreciate that the night is very long and the day very short in the latitude we are in, which is approximately that of the British Isles and that we know to be real in the depths of our winter.

In the remaining diagrams we have pulled the North Pole towards us so that we can see all the four phases of the moon, its track being also slightly tilted. The Arctic Circle is seen almost complete, and the equator line has become curved, seen from this angle. In each one we have indicated an observer by 'x' and the line along which he would be taken by the rotation of the earth.

Against each moon phase is put the transit time in hours/minutes, calculated from the rising and setting times in Whitaker 1986 for 52° latitude.

Figure II shows the full situation of the northern winter. The new moon is riding low, which accounts for its few hours of transit time though, as we have already realised, it would not be visible. First quarter would be seen as an afternoon feature and then for the first half of the night. Full is 'riding high' and rises early in the evening and goes through the night well into the following morning, enjoying more than 17 hours in transit. Last quarter has a similar transit time as the first, but it rises in the second half of the night and goes into the following morning.

Figure III shows the northern summer situation. The transit times are similar to those of the northern summer but the phases are different. It is the new moon which enjoys the long transit but, since this is in daylight, it is not noticeable. Full moon is 'riding low' and has a very short transit time.

These two diagrams show the two extremes. Let us have a look at intermediate points, the obvious ones being the equinoxes in March and September.

Figures IV and V show these but, as can be seen, the situation is different in that the earth, as we have described it earlier, is sideways on to the sun so that the inclination of the axis lies on the shadow line. In both equinoctial situations the times for each phase show the same sort of transit hours, but the longest and shortest (i.e. riding high and low) are those of the quarters, the average times being taken by the new and full moon.

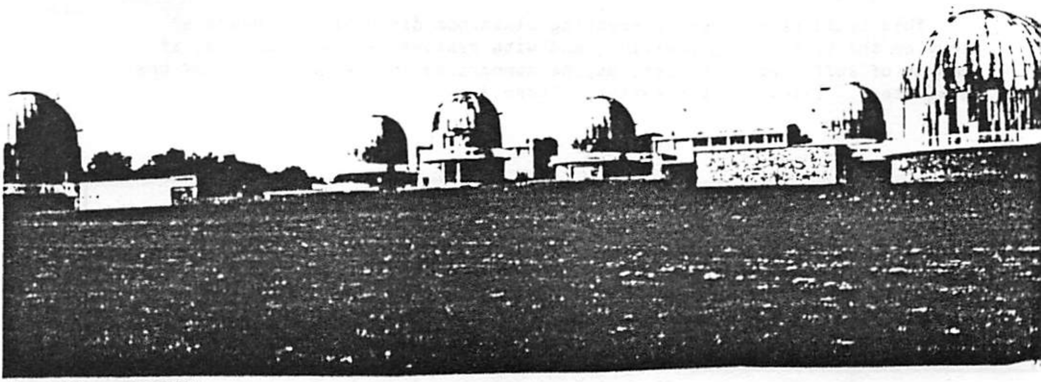
The full moon of the September equinox is as we all know called the harvest moon. Its particular feature is that its rising more or less coincides with the sun's setting, so maintaining a continuity of light which was evidently helpful at one time for harvesting.

If we compile a table of the transit times of the four quarters at the four main points of the year starting with the September equinox, we get a very intriguing pattern. The pattern is caused by the relation positions of the bodies involved, a sequence which is maintained year by year.

	New	First quarter	Full	Last quarter
September	13-58	6-31	11-11	17-31
December	6-36	11-22	17-28	11-26
March	12-02	17-29	11-04	6-42
June	17-48	12-45	5-27	13-48

We have, of course, been looking at the moon's behaviour as inhabitants of the northern hemisphere. It is a little difficult at first to try to visualise the heavenly phenomena from the point of view of our antipodean cousins but, if we turn our diagram sheet upside down and look at the first diagram and imagine ourselves standing at the point 'z', we can see that again the new moon would be a daylight feature and so not be visible. At the time of the first quarter we would see an illuminated half on the side which we have been used to seeing as the last quarter. The full moon would appear to be 'riding low' and we would only see it for a few hours just as we see it in the north in summer. Last quarter would, of course, appear as we know the first quarter. The rotation of the earth would, if we stood with our backs to the South Pole, take us in a direction which would make the moon rise on our right hand and set on our left.

One final point: the closeness of the rising and setting points of the December moon in the northern sky suggests the possibility of a 'land of the noonday moon', just as there is a 'land of the midnight sun'. This indeed is true but it is not such a spectacular feature since the non-setting moon might be a full one but it might also be at any one of the other phases. In Figure II, for instance, it is clear that the full moon does not set in the Arctic Circle.



DOMESDAY

SKYLINE AT HERSTMONCEUX (see p.13)

A 'Satellites in Education' coordinating committee has been set up to advise schools. It can be contacted via Ron Broadbent, 94 Herongate Road, Wanstead Park, London, E12 5EQ.

I would be happy to provide other details or provide extra information. 'Phone 051-207-0001, ext. 225, or write to the Liverpool Museum, Liverpool, L3 8EN.

A PROBLEM OF SITING

A member would like to have some advice on the best position for his 8½" Newtonian telescope. Once in position, the telescope is 'fixed', as it is too heavy to move around.

A section through the member's garden is shown in Fig. 1 but, for the purposes of this exercise, it may be regarded as Fig. 2.

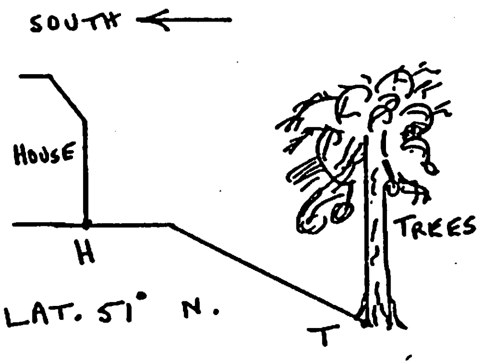


Fig. 1

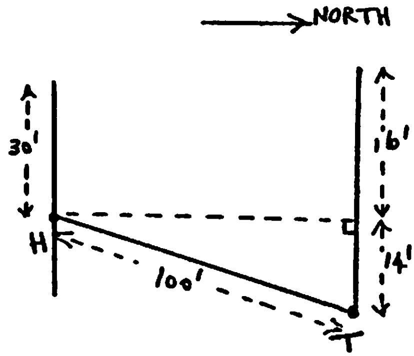


Fig. 2

Where, on the lines joining H to T, should he site his telescope, remembering that at T he cannot see the north polar region of the sky but he has a good view south, and at H his view south is obstructed but he can see Polaris?

This could provoke an interesting classroom discussion. Readers' views on the best siting position, and with reasons, are welcome and, if thought of sufficient interest, may be summarized in the next issue of the Newsletter. (Views to the editor, please.)

Acknowledgements. The photographs on the cover and page 11 are reproduced by kind permission of the RGO. The photograph on page 14 is reproduced by courtesy of the Liverpool Museum. The drawings and photographs on pages 17, 18 and 19 are reproduced by permission of the Jodrell Bank Radio Astronomy Laboratories.

THE FUTURE OF THE ROYAL GREENWICH OBSERVATORY

The Science and Engineering Research Council (SERC) announced after its meeting on 18th June that the Royal Greenwich Observatory (RGO) should be moved from its home at Herstmonceux Castle in Sussex to Cambridge. This decision followed several months of "vigorous opposition" or "lively public debate" (depending on your point of view) after the Council announcement in March that RGO would be moved to Edinburgh, Cambridge or Manchester. At the time of writing (July 1986) the matter is still not finalised as it is conditional on approval from the Department of Education and Science and from the Treasury that the receipts from the sale of the Castle can be used to finance the move. However, to quote Mr. George Walden, Parliamentary Under Secretary of State for Education and Science, in the House of Commons on 8th July: "Apart from these financial approvals there is a longstanding practice over many years, observed by Governments of both complexions, not to overturn a decision by a research council made on scientific grounds". If Government approval is given it is expected that the move will take place by 1990.

The activities preceding this announcement included several questions in Parliament, a debate in the House of Lords, numerous letters to the Times, Nature and other newspapers and journals, discussion and representation at county level in all four regions affected and three strongly-worded resolutions passed at a public meeting in London organised by Patrick Moore. A petition to support the case for keeping the RGO at Herstmonceux attracted more than 17,000 signatures. However, only a small minority of members of the Council of SERC have ever visited Herstmonceux and even fewer (2, I believe) have been to the observatory at La Palma.

Many of the staff are bitterly disappointed at the decision, feeling that Council have not been able to demonstrate convincingly that a move would really benefit the RGO or UK astronomy. The Council states that its policy as contained in its Corporate Plan is to operate its establishments in support of university and polytechnic science, but, as Professor Roger Tayler at Sussex University says: "It appears to be assumed that, if the RGO is moved, it will automatically acquire more satisfactory links with the astronomical and general scientific community than those which will be severed by the move".

However, life goes on at Herstmonceux in spite of the disruption that has already occurred. In the field of education, in recent years we have recognised the enormous interest young people have in the universe around them and have helped to encourage the teaching of astronomy in schools. As the Secretary of State for Education and Science, Mr. Kenneth Baker, said recently on Radio 4, if we can develop the interest of youngsters of 8 or 9 years old in science, we are well on the way to keeping them interested into their teens and producing the scientists of the future which the nation so desperately needs. Astronomy is an excellent science to start with as so much children's literature is about space, and children can appreciate why we are trying to understand the universe, and the excitement we feel as a new class of objects is discovered.

To this end we have been working closely with the Education Department of East Sussex County Council. For example, we have held workshops for teachers preparing to use a BBC series on astronomy, and last year organised various events to mark the reappearance of Halley's Comet. We also offer, on a regular basis, guided tours of the RGO at two different levels: a junior guided tour for children up to about 15 years and a full guided tour for A-level students in appropriate subjects - and remember, we not only have telescopes and an exhibition to show. For educational groups we can arrange demonstrations of computers in use, of engineering and electronic workshops, and of the different stages of instrument design and development. For those interested in the history of science we have records stretching back more than 300 years. However, I must emphasise that, although the Equatorial Group of telescopes is open throughout the summer to visitors, a guided tour round these or any other part of the RGO must be booked in advance.

At university level our close links with Sussex University Astronomy Centre are well known. During the 21 years of this link nearly half of the students obtaining D.Phils in astronomy at Sussex have been supervised by RGO staff. We also have a summer vacation course for undergraduates from any university which, this year, is celebrating its 30th anniversary. Students, usually entering their final year, spend 6-8 weeks at the RGO, during which time they work on an observatory project and attend daily lectures on astronomy or related subjects.

If the RGO has to move, we all hope that these important activities will be continued in our new home. We believe that our role in the education of astronomers of the future is healthy for the RGO and for astronomy in this country.

Margaret Penston, RGO.

THE EARTH FROM THE METEOSAT WEATHER SATELLITE. 21.2.78. (see p. 15)

WEATHER SATELLITE RECEPTION IN SCHOOLS

by Martin Suggett (Liverpool Museum)

Useful access to the majority of satellites is confined to professional ground stations, but a few satellites have potential for schools and resource centres. The 'television' satellites have at present negligible educational content, but the University of Surrey satellites, for instance, were built expressly for schools' use. The weather satellites also offer an interesting way of introducing satellite technology and principles to schools. Equipment costs are still high but cheaper systems are becoming available, capabilities are being expanded and reception is free. Although interesting for children at primary and junior levels, satellite systems find most application at secondary level.

Weather satellites fall into two groups as defined by their orbits. The 'polar-orbiting' satellites (such as the American NOAA series) pass over this country three or four times during a school day, but these times change daily. A timetable can be calculated but this is fairly complex. Alternatively, software exists for the BBC computer or timetables can be obtained at intervals from various institutions. Reception of polar satellites is cheaper than for geosynchronous satellites (see below), but their use is limited for schools. These low-Earth orbiting satellites may be useful in schools for investigating the physics of satellite orbits but are practically less useful for their weather pictures. Country outlines are not superimposed on the picture and reception is not 24 hours a day.

'Geosynchronous' weather satellites orbit our planet at the same angular velocity as the Earth and so appear to be stationary in the sky. Of these satellites, the European Meteosat 2 provides a 24-hour service. New views of Europe in both visible light and thermal infra red are transmitted twice hourly throughout the daylight hours. Equipment costs are higher but the advantages are high. Scans of the whole hemisphere are transmitted every couple of hours in visible light and infra red, as well as close-ups of other parts of the hemisphere. Coastlines are marked in on the received image, which is useful when the UK is wholly immersed in cloud! The timetable of transmitted images is usually the same day after day.

Although the ASE intends to publish a review of equipment and applications in the next six months, little has yet emerged beyond the experiences of existing users. Justification for purchase would rely upon applications in geography, meteorology, physics, electronics and information technology awareness, but there are related astronomical applications of interest. Although expensive, a colour print-out facility enables high-resolution pictures to be stored permanently and extends applications immensely.

It must be stated that full analysis of these pictures is complex and meteorologists do not have years of training for nothing! But most children can soon begin to forecast whether it will be cloudy or not a few hours ahead by checking the satellite pictures and the wind direction outside.

It must also be said that the present state of satellite launching and the limited working lifetimes of existing satellites do not guarantee anything to look at!

With weather satellites, the Earth can be looked at as an astronomical object and compared with pictures of our neighbours in space. Applications that have been suggested to me, that I have seen in use or I have used with pupils myself (in a museum and planetarium context, it should be added) include the following. It is merely a guide.

Observation that the Earth is round.
Comparison of Earth's clouds with pictures of those on other planets.
Comparison of sea and land cover with other planets.
Evidence of the movement of clouds from day to day.
Comparison of cloud cover from live satellite pictures and outside the classroom - is the satellite right?
What could extra-terrestrials find out about our planet if one of their robot spacecraft sent back these pictures?
The difference between identical cloud patterns in visible light (thick and thin) and in thermal infra red (cold and very cold - high and low cloud).
Radiance from the planet - temperatures and thermal capacity of oceans and dry land compared.
Varying temperatures of land at equatorial and temperate latitudes - comparisons throughout the seasons.
The existence of cloud belts - comparison with Venus and the gas giants.
The dynamics of cloud systems - the development of cyclonic conditions, fronts and comparisons with published weather charts.
Calculation of the orbital radii of geosynchronous satellites; comparison with the moon and its period.
Calculation of the orbits and passes of the polar NOAA satellites.
Development of interfaces for various computers.
Appreciation of the scanning methods used by satellites.

Much is gained from repeated watching of the display. The siting of the receiver in a main corridor will allow the children to see the display several times a day, although security considerations may prevent this. The ability to see the 'raw' weather pictures before they are seen on TV (where they have been highly processed) enlivens the effect on the children.

Basic components of a system

Each may be sold separately. Apply to manufacturer for details. A full display system will comprise the following:-

Antenna for geosynchronous satellites (Meteosat) and pre-amp.
Down converter (from Meteosat's 1690 MHz to VHF 137 MHz).
Antenna for polar orbiting satellites (NOAA) and pre-amp.
Receiver, controller and scan-converter.
Picture store.
Video display monitor.
Accessories; interfaces, disk stores, etc.

Suppliers

1. *Feedback Instruments Ltd., Park Road, Crowborough, E. Sussex, TN6 2QR (08926-3322). Feedback produce professional equipment for meteorologists. More expensive but with excellent facilities.*

2. *Microwave Modules, Brookfield Drive, Aintree, Liverpool, L9 7AN, Merseyside (051-523-4011).*

3. *Timestep Products. Obtainable through Griffin and George, Bishop Meadow Road, Loughborough, Leicester, LE11 ORG (0509-233344).*

(2) and (3) sell cheaper systems for the school market.

Advice

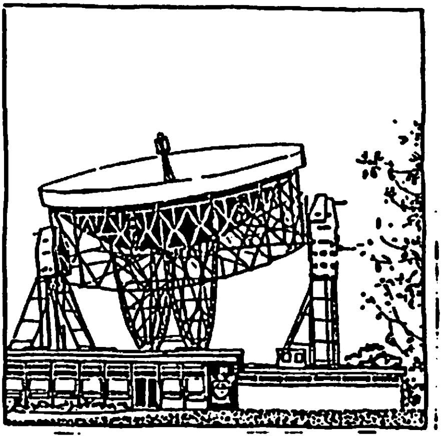
All manufacturers will, of course, be happy to help. Schools will be particularly interested in how satellite data can be stored and printed, interfaced to existing computers, what back-up facilities are available, how easy the system is to operate and where an existing user can be contacted.

The Times Network Systems (TTNS) contains a small but growing database on Space Sciences and Satellites in Education. It contains advice, a list of users, contacts, glossaries and a satellite digest.

RADIO ASTRONOMY AT JODRELL BANK

THE RADIO OBSERVATORY

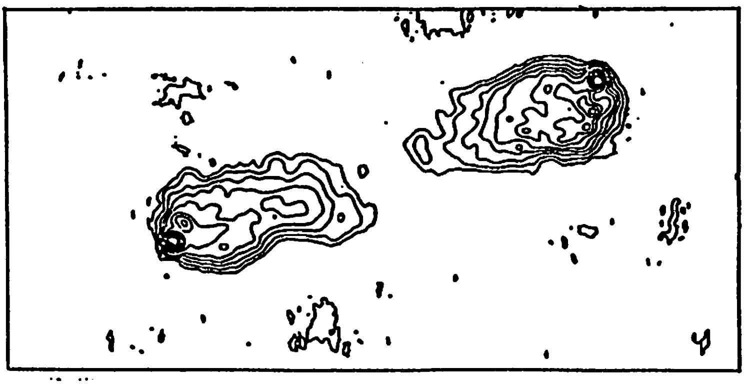
This article was written by Dr. Anne Cohen.



A visitor to Jodrell Bank cannot fail to be impreseed by the sheer size of the MarkIA radio telescope. The bowl is 250 ft in diameter and the maximum height of the whole structure is over 300 feet, towering over the control buildings and the Visitor Centre.

There are no optical telescopes here; the professional astronomers make their observations at radio wavelengths only, receiving the faint radio emissions of stars, gas clouds in our Galaxy, and distant radio galaxies.

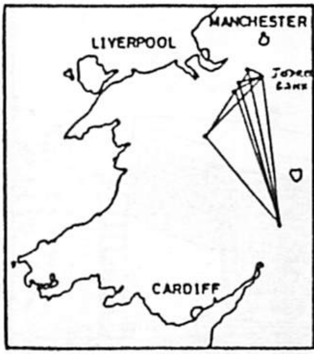
Radio maps of the sky look like Ordnance Survey contour maps where the highest contour levels represent the areas in the sky emitting the most radio energy.



Radio map of a galaxy in Cygnus

Why do radio telescopes have to be so big? The ability of a telescope to reveal fine detail to the observer is known as the telescope's "resolving power". This depends on the ratio of the telecope's diameter to the wavelength of the radiation it picks up. The shortest wavelength at which radio telescopes operate (a few cm) is still ten thousand times longer than that of ordinary visible light, so that even the giant Mark IA radio telescope on its own cannot distinguish finer detail than the human eye. So to match the ability of an optical telescope , which reveals detail down to a limit of about one arcsecond, a radio telescope would have to be many miles in diameter!

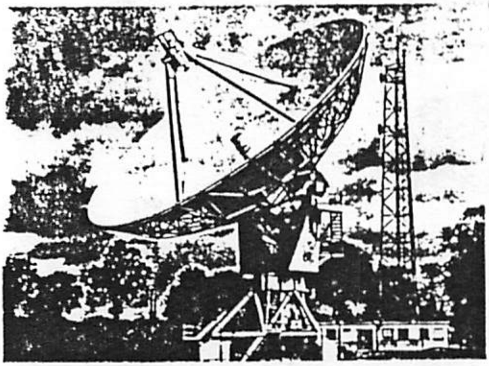
At Jodrell Bank this is achieved by linking together a network of dishes spaced across the West of England.

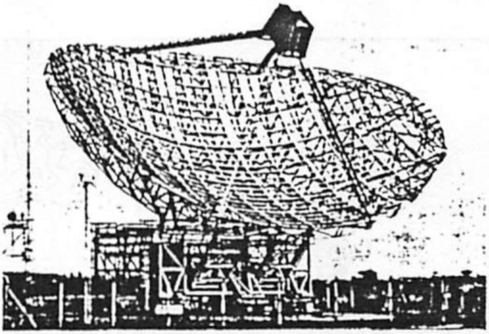


This network is known as MERLIN, which stands for "Multi-Element Radio-Linked Interferometer Network", and it extends 134 Km from North to South.

Five outstations are operated remotely from Jodrell Bank. Either the Mark IA or the smaller Mark II telescope can be used as the home station. All telescopes are pointed at the same area of sky.

The observations are finally reduced by a VAX computer which converts the received radio signals into a contour map. Details as small as a fraction of an arcsecond can be mapped using this network.





The Mark III radio telescope at Wardle, near Nantwich, Cheshire.

Radio telescope at Knockin in Shropshire

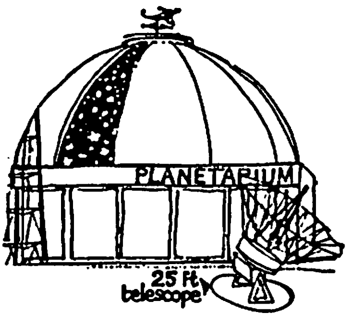
THE VISITOR CENTRE

Beside its radio observatory, Jodrell bank has an extensive exhibition of astronomy and a planetarium. It is a major resource centre for schools.

The exhibition itself covers not only radio-astronomy but also stars, galaxies, planets and comets. A working 25 ft. radio telescope may be operated by visitors themselves, and is equipped to receive the Sun's radio waves. There is also plenty to interest the younger groups, including a display on the Space Shuttle, an Apollo space suit and a "hunt the planet" model of the Solar system.

The techniques used in radio astronomy are also used in satellite telecommunications and are perhaps more easily understood in this everyday form. Moscow Television and Weather images are received direct from satellites and displayed in the exhibittion. Visitors are invited to make their own weather forecast!

The Planetarium boasts a 40 ft. dome and seats 134 . The projector, a Spitz A4, has been recently overhauled with the result that the star images are much improved. During winter weekdays, when we are open to pre-booked school parties only, sessions in the planetarium can be geared to the age-range and specific requirements of the class.



Classes on celestial co-ordinates can be given for older students, or at the other end of the age range, shorter sessions on the Sun, Moon and stars are presented for the five-to-eight year olds. We have even given highly successful mini-star-shows for nursery groups, who are inclined to think they are seeing the real sky!

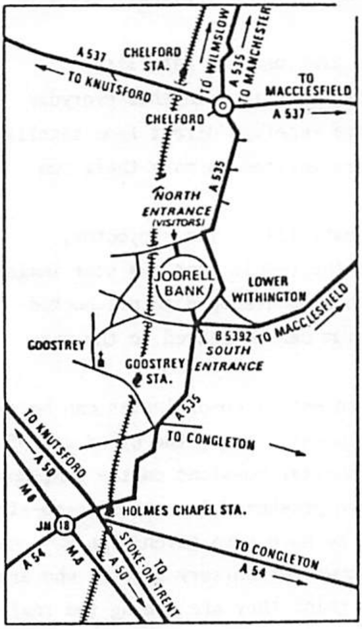
Half-hour shows for the general public run throughout the day during our Summer season. Recent show titles have been "Halley's Comet" (of course) and "Summer Nights".

A teachers' pack, free to all schools, is currently being developed. It will include information about astronomy and radio telescopes to help teachers prepare their classes before a visit, and also worksheets for the individual child to take around the exhibition with them.

The Visitor Centre also includes a 30-acre arboretum with maturing trees, shrubs and heather gardens, perfect for a scool picnic in fine weather, but definitely a welly-boot job during the winter.

Looking to the future, we have received a substatial sum from the Gatsby Foundation to create a new "interactive "science exhibiton. Visitors will explore the forces of gravity and electromagnetism by doing experiments themselves and actually feeling the effects of the forces. A separate part of the exhibiton will be devoted to the reflecting and focussing properties of the curved mirror, and will include models of radio telescopes and optical telescopes, as well as mirrors and refectors of all kinds.

This new area should be ready in about 12 months time, providing an exciting addition to our Centre.



All visitors are made welcome at Jodrell Bank, and we have special facilities for the disabled.

Opening times are :

10.30-5.30 daily during Summer

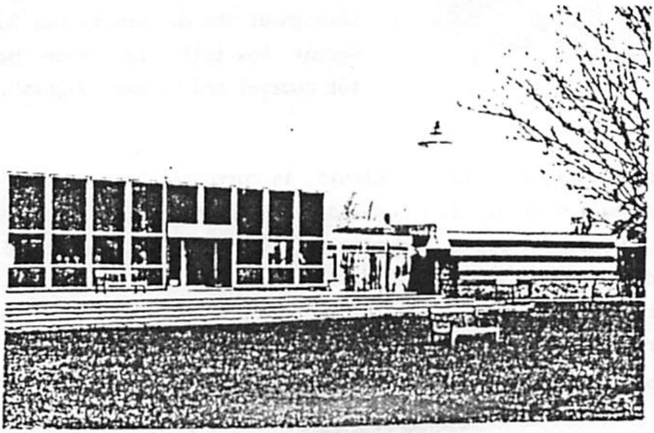
(mid-March to Oct 31)

2.00 - 5.00 p.m. Winter weekends only

Schools may also book visits during winter weekdays.

We will be glad to offer further information:

Jodrell Bank Visitor Centre
Lower withington
Macclesfield
Cheshire Tel: 0477 71339



ASTRONOMY IN SCHOOLS

An interim report from the AAE curriculum working group.

The curriculum working group emerged from the 1985 AGM. The group's formation was in response to general feeling within the Association that, in a time of curriculum change and innovation, we should take the initiative and provide an enriching input via astronomy.

The group - Derek McNally, Ken Creamer, Tim Metham, Geoff Endacott, Ivor Stott and myself - have had six meetings throughout the year. Our deliberations have resulted in a draft document, circulated at the recent AGM, which when re-written will be sent for a 'trials' stage in September.

The group realised its limitations, members having their own professional commitments, and decided to aim at a positive but modest outcome. We were aware that a GCSE astronomy syllabus had been written and that O-level astronomy had an existence, albeit rather thinly spread. We realised that, whilst as a group we shared an interest in astronomy, the majority of schoolteachers felt uncomfortable tackling a new area for which they were not trained or educated. We were also aware of the direction of school courses, especially the growing need for teacher support material for short 'modules' of work which would form part of a general science course in both primary or secondary school.

Through the Secondary Science Curriculum Review (SSCR) we were introduced to John Baxter, a teacher from Somerset, who was working on pupil misconceptions of common ideas, especially gravity and time. John had a limited knowledge of astronomy but had uncovered a real need for material which could help correct children's misunderstandings of what, after all, are the cornerstones of astronomy, gravity and time.

The group set out then to produce some teacher materials, mainly in the form of ideas for activities, which would hopefully influence good practice in schools and help to change the ways in which children thought about things astronomical. Because such ideas are formulated in the early years of learning and because lower school curricula have more room for the inclusion of such an input, we decided to target our work at the late primary/early secondary years, ages 10 to 13.

The draft in its present form includes ideas for daytime and nighttime activities, for group and individual work, for teacher demonstrations and class practical activities. It does not intend to be a course or a prescribed set of lesson plans, rather a set of resource materials which are teacher-friendly and which will serve to introduce astronomy to a wide audience in a non-mathematical, experiential way.

Included so far are:

<u>Gravity</u>
- How strong is gravity? - forces.
- Free-fall - parachutes and ticker tape - meteors
- Overcoming gravity - kites, balloons and stairs
- Satellites - observational suggestions
- Using gravity - power, slopes, clocks.

<u>Time</u>
- Measuring times - clocks, sundials
- Shadows - sundials, eclipses, phases
- Seasons - sunshine and the horizon
- Scales of time - history, events, hours, seconds, centuries
- Daytime/nighttime - observational suggestions.

The first draft is currently being re-written to incorporate suggestions made by members of the group and interested AAE members. If you would like to make some suggestions to the group or see a rough copy, feel free to contact me at home:

Bob Kibble,
34 Acland Crescent,
Denmark Hill,
London, SE5 8EQ.

PRIMARY SCHOOLS - Journey by loo-roll

Nowadays words like loo are quite acceptable to adults but to children there is still a hint of naughtiness attached, and therefore the use of it is certain to claim attention and interest. Why not, then, use loo-rolls to demonstrate distances in the universe or at least part of it, always providing that we have sufficient stocks. For instance, taking an average roll, say, of 240 pieces, we can start off at the sun and journey outward.

From this huge mass of burning gases, a yellow star that we call Sun, two sheets, end to end, will take us as far as the planet Mercury. An extremely barren and very hot little planet, no water or life, so let us continue our journey; 4 sheets and we arrive at that very mysterious planet covered with clouds of gas, Venus. This planet is also extremely hot and, if it had seas on its surface underneath those clouds of gas which are CO_2 (that's the stuff we make the bubbles with in fizzy drinks), just imagine they would be seas of soda-pop. Well, we will leave Venus and, after another two sheets (that's six from the sun), we arrive at Earth - just six sheets from the whole roll.

Continuing on, and now nine sheets from the sun, we arrive at Mars. Look down there; we can see the Viking Lander that we sent from Earth in 1976 and after it landed we received lots of pictures of the Martian surface from it. Yes, it looks just like the photographs - all barren, mountains, plains and valleys. No life here either. No little iddy biddy green men floating up and down the canals of Mars in their little yellow submarines. The photographs have shown us that there really aren't any canals at all - just an illusion.

Whizzing onward we now come to sheet 18. What was that? A barren rock with lots of smaller rocks floats past us in space. We have reached the belt of asteroids which orbit about the sun, but halfway between Jupiter and Mars. Jupiter is 32 sheets out from the sun and, after a long journey, we arrive at this, the largest of all the planets. Made of frozen gases, because it is so cold and far from the sun, this planet is 86,000 miles in diameter, whereas the Earth is only 7,600 miles. It also features a famous large red-coloured patch on its surface which is known as Jupiter's Red Spot. Passing this huge planet, we see its four largest (satellites) moons, two of which are larger than our own moon and one of which has volcanoes, we continue to unroll our paper out into space.

57 sheets from the sun, we close in on perhaps the most remarkable planet of all. Where Jupiter was majestic, so Saturn is spectacular because of its ring system. Other planets such as Jupiter and Uranus have rings around them but not nearly as pronounced as Saturn. All those stones, some as large as rocks, are orbiting around this very large planet which, like Jupiter, is made of frozen gases. However, a little too dangerous for our space ship, we might bump into one and be damaged, so we will carry on our journey outward into space. 100 pieces come and pass then at 120 pieces of paper we arrive at the mysterious planet Uranus. Like Jupiter and Saturn this planet is composed of hydrogen and helium. However, it's

a mystery because it is the only planet in the solar system which "lies on its side" and nobody really knows why! Its name is after the Greek god of the skies; maybe that's why it is different.

Neptune, who is named after the Roman god of the sea, is at a distance of 180 sheets from the sun and takes 164 years to circle it. The sign of Neptune is a three-pronged fishing spear.

I hope you are unrolling the paper because we should by now be halfway through it. On we go into the dark void of space towards what looks like a star, just a pin-point of light. It grows larger as we approach and is seen to be the last planet in the solar system, Pluto. It is a small planet, not much larger than Mercury. We know very little about it because it is so tiny in a telescope when we view it from Earth. It takes 248 years to orbit the sun, which from Pluto will only look like a very bright star. Our total sheet distance is exactly one roll from the sun.

FOOTNOTE: Based on the velocity of light (186,000 miles per second), the following table gives the time taken for light, starting at the sun, to reach these bodies:

Mercury - 3 min.; Venus - 6 min.; Earth - 8 min.; Mars - 12.7 min.;
Centre of Asteroid belt - 22.4 min.;
Jupiter - 43.4 min.; Saturn - 1 hr. 19.4 min.; Uranus - 2 hr. 39.8 min.;
Neptune - 4 hr. 10.3 min.; Pluto - 5 hr. 29.3 min.;
Nearest star (Proxima Centauri) - 4 years 54 days.

Peter Richards-Jones
(adapted from George Reed).

KEW GARDENS NEW SITE FOR RGO?

The following advertisement appeared in a recent issue of "Friday Ad.", a free newspaper circulating in East Sussex:

"Astronomy lectures open to the public at the White Hart Hotel in Lewes, Saturday, 28th June. Astronomers from the Royal Greenwich Conservatory and the University of Sussex will be speaking. Bar food available. £1 for the day."

ORDERS OF MAGNITUDE

At the Polytechnic of North London a few years ago, a random sample of passers-by were asked if they could state, approximately, some basic astronomical distances, such as that from the Earth to the Moon, the Earth to the Sun, etc. The replies were interesting:

Earth - Moon distance	From 10 miles to 1 million miles
Earth - Sun distance	From 20 miles to 1 million miles
Diameter of the Earth	From 100 miles to 1000 miles
Circumference of the Earth	From 100 miles to 25,000 miles

As far as the last two questions are concerned, no person interviewed gave the ratio of circumference to diameter as π . One person did know the correct circumference as she had flown several times to Australia, but she gave the diameter as 800 miles.

Is there something to be learnt from this survey?

NOTE: The majority of those questioned were architects. But, on recounting this story recently, it was suggested that the same kind of answers could well be elucidated from some *astronomers*!

E.Z.

REVOLUTION OF THE POLE - A CORRECTION

The period of revolution of the celestial poll was wrongly given (on the cover of the last issue of the AAE Newsletter) as 23,000 years. This should have read 26,000 years.

FROM THE TREASURER

This copy of the AAE News is being sent to all members for the year 1985/6 as well as to members who have joined the Association for the first time for 1986/7.

If you were a member last year and have not renewed your subscription yet, would you please do so now, in order to continue receiving the AAE News from January onwards. It would be helpful if the pro forma inserted in the April issue (see pp.5/6) were to be used.

R.V.J. Butt,
Hon. Treasurer, 126 St. Stephen's Road, Canterbury, Kent, CT2 7JS.

ASTRONOMY RESOURCES PACK

In 1982 the Hatfield Polytechnic Observatory and the Astronomy Working Group of the Hertfordshire Science Centre produced an astronomy resources pack for use in Hertfordshire schools. The pack was sold to schools at cost price - £25 in 1982.

Some ten schools participated in this venture, and the packs were considered to be a worthwhile investment; indeed, the materials are still being used in most of the schools involved. The contents of the original pack are itemised in the appendix below.

The Astronomy Working Group intends to produce a revised version of the pack to take account of recent developments in astronomy and to respond to recent developments in education, notably the advent of the GCSE. Our initial intention is to tailor the new resources pack more specifically - but not exclusively - towards the Nuffield 13-16 "Out of this World" unit, as this is being adopted quite widely in Hertfordshire. However, the Group intends to take a broad look at opportunities for astronomy teaching within the new examination syllabi to see what form of resource pack would have the widest application. The possibility of producing a nationally available resources pack may well be considered if the response in Hertfordshire is favourable.

We should be most grateful to receive any suggestions which AAE members might care to make as to the scope, content, market and optimum/maximum price of the proposed new resource pack. As we hope to finalise the content of the pack during the autumn term of 1986, any suggestions and advice would be welcomed as soon as possible and should be directed to:

Iain Nicolson,
The Hatfield Polytechnic Observatory, Bayfordbury, Hertford, Herts., SG13 8LD
Telephone: Hertford 558451, ext. 334.

APPENDIX

Astronomy Resource Pack (1982 version)

This package of instructional material includes a selection of visual aids to assist in the teaching of astronomy, either within the teaching of science subjects to O-level or CSE, or as a general study in the VIth form. It is not self-contained and needs to be used in conjunction with appro - priate teaching notes and textbooks.

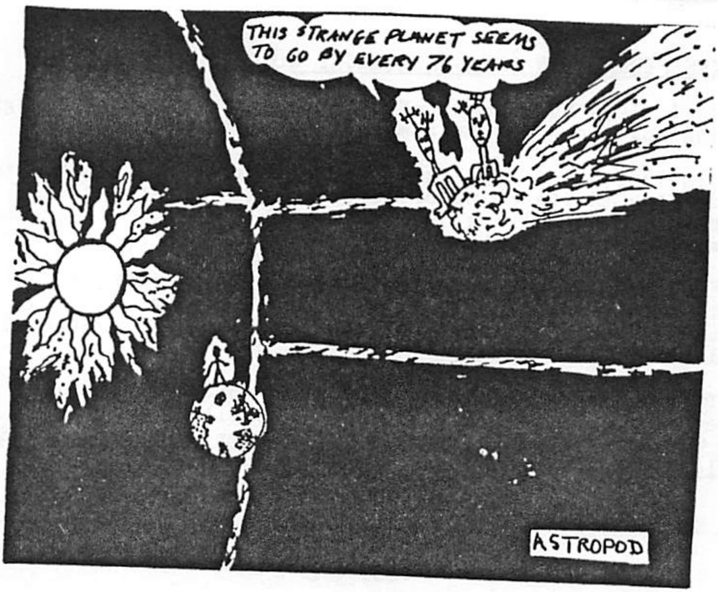
It comprises:

3 folders containing 55 slides
1 map of the Moon
1 planisphere
1 chart of the solar system
1 poster of Saturn encountered
1 poster of Mars - The Search for Life
1 poster of the Jovian System
1 poster of the Solar System
1 poster of the Moon
1 Phillips chart of the stars
list of suppliers, booklists and practical teaching projects.

The slides cover a selection of planets and astronomical objects, in cluding the latest Voyager probes. The constellation slides are in observational sequence. For example, slide No. 1 Cassiopeia is about 0^h RA, slide No. 2 moves an hour or so east, and so on. Some 28 constellations are shown. The slides are not all the same scale - the wider angles allow several constellations to be seen at the same time. They all show stars to about magnitude 6, so the stars should be visible to the naked eye on a clear moonless night. The boundaries of any one slide may be checked by reference to a star atlas such as Norton's Star Atlas.

The whole pack will be reviewed from time to time by the Astronomy Working Group. As with the pack, any additions or substitutions will be supplied to schools and colleges at cost price.

Iain Nicolson.



THE FEDERATION OF ASTRONOMICAL SOCIETIES (F.A.S.)

Formed in 1974 as a union of astronomical societies and groups, working together for their mutual benefit.

Aims include compiling lists of people prepared to give talks; encouraging the teaching of Astronomy in educational establishments; giving advice on problems commonly encountered by astronomical societies.

The FAS produces a newsletter 5 or 6 times a year, and other publications from time to time. The Secretary of the individual society is responsible for making FAS material available to its members.

For further information, contact your local Astronomical Society, or the FAS Secretary (Dave Powell, 1 Tal-y-bont Road, Ely, Cardiff, CF5 5EU), enclosing a stamped and addressed envelope.

AAE COUNCIL, 1986-87

PATRON: Sir F. Graham Smith, Astronomer Royal

Officers:

President	D.J. Gold (HMI, retired)
Vice-President	Prof. A. Roy (Glasgow University)
Secretary	Capt. P. Richards-Jones (London Schools Planetarium)
Assistant Secretary	D. Harris (Bilston Community College, Wolverhampton)
Treasurer	R.V.J. Butt (The King's School, Canterbury)
Public Relations Officer	G. Day (Wiltshire schools)
Editor	E.P. Zucker (Polytechnic of North London, retired)

Members:

Prof. I. Robson (Lancashire Polytechnic)
Dr. D. Clarke (Glasgow University)
Dr. F. Vincent (Dundee Observatory)
Dr. R. Eberst (Royal Observatory, Edinburgh)
Dr. A. Cohen (Radio Astronomy Laboratories, Jodrell Bank)
Miss Undine Concannon (The London Planetarium)
Martin Suggett (Liverpool Museum)
T. Murtagh (Armagh Planetarium)
Dr. V. Barocas (Lancashire Polytechnic)
K. Creamer (secondary schools, Haringey)
G. Endacott (secondary schools, Wiltshire)
C. Goodman (secondary schools, Leicestershire, retired)
R. Kibble (Hammersmith and West London College)
N.E. Freville (primary schools, Northants)

EDITOR: Eric Zucker,
35 Gundreda Road,
Lewes,
East Sussex,
BN7 1PT
(telephone: LEWES 474347).

Contents

	page
Editorial	3
Annual Meeting (7 June 1986)	3
Minutes of AGM	4
Lunar curiosities	6
A problem of siting	12
Future of the RGO	13
Weather satellite reception in schools	15
Radio Astronomy at Jodrell Bank	17
Astronomy in schools	21
Primary schools - journey by loo-roll	22
Kew Gardens : new site for RGO	23
Orders of magnitude	23
Revolution of the pole : a correction	24
Note from the Treasurer	24
Astronomy resources pack	24
Cartoon	25
Advertisements	26

Printed at the Polytechnic of North London