

**COMMISSION 46
THE TEACHING OF ASTRONOMY**

Newsletter 49 - October 1998

The mandate of Commission 46 is "to further the development and improvement of astronomy education at all levels, throughout the world".

Contributions to this newsletter are gratefully received at any time.

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<http://physics.open.ac.uk/IAU46/newsletter49.html>

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RECEIVE THIS NEWSLETTER SOLELY VIA THE WWW.**

EDITORIAL

It was an honour to be asked to become editor of this newsletter, and in John Percy I have a difficult act to follow. Nevertheless I look forward to the task, and I hope that the unknown number of editions for which I will be responsible will be as useful and informative as have been past editions.

Though several of you know me, most of you will not, so let me introduce myself. I am Senior Lecturer and Director of Teaching in Physics and Astronomy at The Open University in the UK, where I have worked for 26 years. Before I joined the OU I spent 3 years at Cornell University in the USA, and before that I was in the UK at Bristol University. Whereas Bristol and Cornell are conventional universities, the OU is a distance learning institution, and with some justification can claim to be the premier institution of this kind in the world. Our astronomy course enrolls about 1300 students per year - this is a very large number for a university course that is at a "higher" level than a liberal arts course.

My interests in astronomy education go back a long way. I am presently concerned with spreading distance teaching methods, on and off campus. Such methods can help the rather small numbers of astronomy educators serve the needs of diverse audiences, sometimes very large ones. I am also concerned to promote astronomy as a means of attracting students into physical sciences, at school and university. Of course, the scope of Commission 46 is much broader than my particular interests, and I look forward to helping to further its multifarious activities through editing and (with your help) producing this newsletter. BWJ

MESSAGE FROM THE PRESIDENT

I want to thank Professors Armando Arellano, Barrie Jones, and Andy Norton for working so hard in order to make this Newsletter electronic and hence available to the world.

Being President of Commission 46 has been an exciting and challenging experience. It has made me aware of the great needs of astronomy education throughout the planet and has convinced me of its unique appeal; it can certainly be used in order to improve the public understanding of science. I have met many outstanding teachers and learned from them, not only practical ways to convey knowledge, but also many other human qualities.

I went to Panama to a meeting of central American countries who have joined forces in order to work together - their aim is to promote science in their area. I think it was a wise decision. Maria Cristina de Carias is in charge of the Honduras Telescope and is offering a Master's Degree from the Honduras National University. She has had the support of Dr Donat Wentzel during the past years. Nicaragua is hosting the next teaching of astronomy meeting. The central American countries are in need of astronomy books of all levels. I wish to acknowledge the support of Dr Darrel Hoff who has provided much teaching material to them. Central American countries could also benefit greatly from astronomers who would be willing to spend a few months in Honduras teaching formal courses.

I spend a few days in Jordan during the First Conference on Astronomy and Space Science. I was amazed at the number of universities that are spread throughout the country. Here again I witnessed that the Arab World wants to work together in order to improve astronomical knowledge that will lead to more research. They are about to edit a popular magazine on astronomy in the Arab language.

I attended a workshop for elementary school teachers (see p6), and a conference for instructors of college level introductory astronomy, sponsored by the Astronomical Society of the Pacific (ASP), whose current president is Professor John Percy. The ASP has put together a great amount of high quality teaching material for all levels. I strongly recommend teachers to contact the ASP if they wish to begin an educational program in astronomy.

I was also in South Africa where I attended a workshop for teachers. I think this kind of activity is essential for proper teaching of science and particularly of astronomy. In all the countries where I have travelled I have met extremely good teachers. Many have not had proper training in science and do not have easy access to good teaching materials. Teacher workshops expose educators to many new ideas and allow them to make contacts that not only provide them with tools they need but encourage them to keep up with the good work they are trying to achieve.

JF

A SIMPLE METHOD OF DETERMINING STAR MAGNITUDES

1 Background

The fact that the stars in the night sky have different brightnesses must have been apparent to the earliest observers. But these differences were quantified for the first time by Hipparchos only in 2 BC, when he assigned magnitudes to stars. The brightest stars were designated as first magnitude stars and the faintest visible to the naked eye as sixth magnitude. Since these were naked eye observations the scale so established depended on the response of the human eye to varying intensities of light. As is well known this is logarithmic in nature and is based on the Weber-Fechner law of the response of the eye to light. Subsequently William Herschel established a formal definition of the visual magnitudes through the relation

$$m_1 - m_2 = -2.5 \log_{10}(L_1/L_2)$$

where m_1 and m_2 are the visual magnitudes of stars 1 and 2, and L_1 and L_2 are their visual luminosities. Thus a sixth magnitude star is 100 times less luminous than a first magnitude star. Visual magnitudes given in modern star catalogues are based on this definition. Today the accurate knowledge of star magnitudes is vital in many important areas of astronomy research.

The experiment outlined below is a quantitative visual method of determining visual star magnitudes of naked eye stars. This experiment requires no special equipment and can be performed by an individual or a group of students as a senior school project. Along the way the student is introduced to skill in observation, the response function of the eye to light, changes in transparency of the sky, and of course stellar magnitude determination! The same star is viewed through a sequence of decreasing hole sizes until the eye is just not able to detect it. The brighter the star, the smaller is the limiting hole size. If d is the limiting hole diameter for star of magnitude m , then the relation between star magnitude and limiting diameter is

$$m = 5k \log_{10}d + c$$

where k and c are constants that depend both on the observer and the prevailing sky conditions.

2 Equipment and Procedure

The only equipment needed for this experiment is a sighting tube 40 to 50 mm long that fits snugly over the eye and a rectangular plate of 3 to 5 mm thickness with a set of 10 holes with diameters 7 mm to 0.5 mm that can be slid at one end of this tube (Figure 1). The inside of the tube must be black as also the plate with the holes. These holes are separated from each other by the diameter of the cross section of the tube; this is not absolutely essential, but increases the ease of comparison. Typically a 35mm film container works very well.

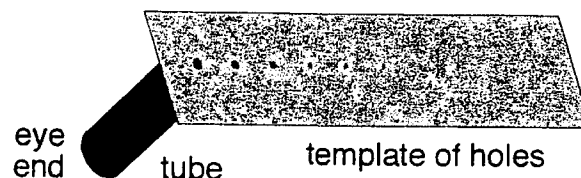


Figure 1 The observational set up

The following are the observing steps.

- 1 Select a part of the sky around the star whose magnitude is to be determined.
- 2 Select a set of stars of known visual magnitudes from this part of the sky, ranging from the brightest to the faintest visible to the naked eye, as the standard stars.
- 3 Fit the sighting tube over one eye and position the largest hole in the plate at the centre of the sighting tube.
- 4 Close the other eye and view the standard star.
- 5 Change the size of the viewing hole to smaller values until the standard star is no longer visible. Note the diameter of the hole through which the star becomes just invisible. *This is the limiting hole diameter.*
- 6 Repeat steps 3, 4 and 5 for the other standard stars.
- 7 Plot $5 \times \log_{10}(\text{limiting hole diameter in mm})$ versus the corresponding known visual magnitude to get a calibration graph. An average set of observations is shown in Figure 2. Fit a mean straight line through the points and find the slope and intercept. Alternatively calculate the same with linear regression analysis software.
- 8 Repeat steps 3, 4 and 5 for the star whose magnitude is to be determined. Use the limiting hole diameter so obtained with the calibration graph to find the visual stellar magnitude.

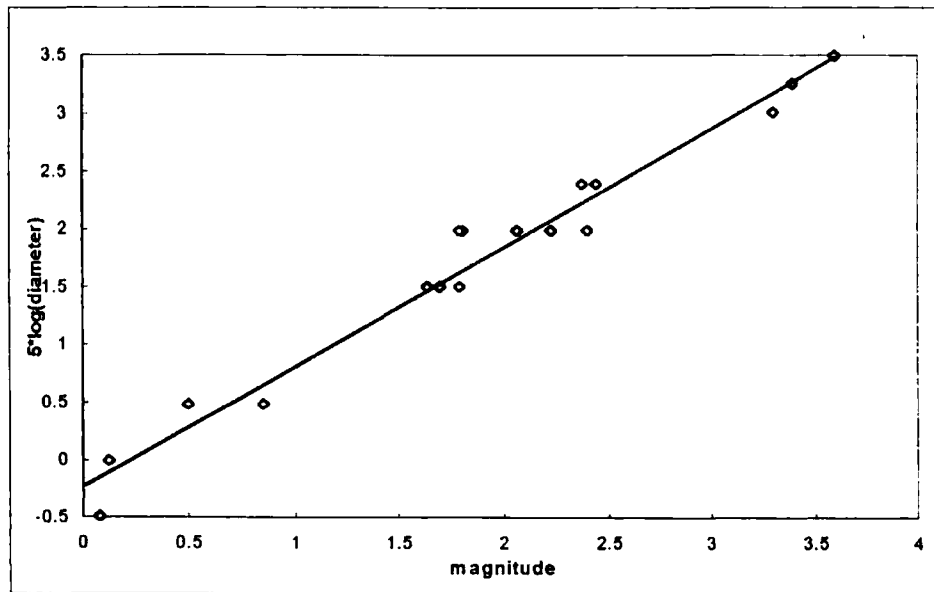


Figure 2 $5 \times \log_{10}(\text{limiting hole diameter in mm})$ vs the corresponding known visual magnitude

It will be seen that the calibration graph is linear. The procedure can be repeated on different nights to find that indeed the calibration graphs are different! It is important to centre the hole with respect to the eye so that the vision is direct. Indeed the inability to do so consistently is the major source of the observed scatter. Another source of the scatter is the inaccurate measurement of the hole sizes - the scatter is considerably less if these are known accurately. Comparison of the magnitudes predicted from the calibration graph obtained from a set of 16 standard stars can have a standard deviation as low as ± 0.01 magnitudes but is typically ± 0.05 magnitudes. The test observations were made in the city skies with the limiting visible magnitude being 4.

The most obvious type of extension that this method lends itself to is in obtaining the light curve of the well known variable star Algol. The stars of the Perseus constellation alpha,

delta, epsilon, zeta, eta, and rho Perseii can be used as the standard stars to obtain the calibration graph. A new calibration graph can be obtained for each epoch of observation, compensating for variations in the sky conditions and altitude of the stars. Several students can participate, each obtaining their own calibration graph (this aspect has not been field tested yet).

A second way in which this technique can be applied is to use the same set of standard stars at the same altitude and estimate the relative transparency of the sky on different nights, or at different locations on the same night by different observers.

The authors would be grateful to receive comments from anyone who tries this activity.

We thank Mr Sanath Kumar for making a confirmatory set of observations. This work has been supported by the Jawaharlal Nehru Memorial Fund.

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1819: A CURIOUS MANUSCRIPT

As mentioned in the last issue of the Newsletter, T Cadefau-Surroca and M A Català-Poch, of the Departament d'Astronomia i Meteorologia, Universitat de Barcelona, Spain (tcadefau@pie.xtec.es), have come across a manuscript written in Catalan in 1819 that includes astronomical content. In particular, the manuscript describes an approximate, simple method of determining for any particular date the phase of the Moon and the times between which the Moon is above the horizon.

T Cadefau-Surroca and M A Català-Poch have translated the article into English. They have also designed activities based on the article, some suitable for 14-15 years old, some for older students. For further details please contact T Cadefau-Surroca and M A Català-Poch.

BWJ

AWARD FOR J E KENNEDY

Professor J E (Ed) Kennedy, a long-time member of Commission 46, received a Special Lifetime Service Award of the Royal Astronomical Society of Canada on 21 June 1998 at the RASC General Assembly in Victoria. This is the first time that such an award has been given. The award recognises Professor Kennedy's exceptionally long and devoted service to the RASC, and for his untiring efforts to promote and preserve the historical record of the development of astronomy in Canada. Professor Kennedy has also made significant contributions to university teaching and administration.

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TO THE MEMORY OF A FRIEND

I became only now aware of the death more than two years ago on 2 August 1996, of an Indian friend, Professor Narayan C Rana of the Inter-University Centre for Astronomy and Astrophysics (IUCAA) in Pune, India.

I first got to know him when I went on my second visit to India, and paid a short visit to the Tata Institute for Fundamental Research, TIFR, in Bombay, to the astrophysics group of Professor Jayant V Narlikar. It was at the end of December 1987/beginning of January 1988. When I arrived at the airport in Bombay it was young Dr Rana who has been waiting for me, and kindly took me in a car across the whole city, to the southern part, where TIFR was located. During my stay of a few days, Dr Rana was extremely helpful, explaining the organization of the Institute, telling about Indian life, as

well as about his own scientific interests. But he told me also that he must be extremely careful because of serious heart troubles.



Professor Narayan C Rana

At the time of my visit Professor J V Narlikar was developing projects for the forthcoming Inter-University Centre for Astronomy and Astrophysics in Pune, not far from Bombay. I saw the Institute under construction in 1991, and everything was finished when I went again in 1993. During my stay in 1993 I again met Dr Rana, who had come from Bombay to live and work in Pune. Once again we spent some time speaking about educational work conducted at the IUCAA, about many future popularisation plans.

And then I was very happy to find Professor Rana at the IAU Colloquium 162 in July 1996 in London, where he presented an invited lecture on "Astronomy Education in India". He was very happy, because he was also planning to attend some other conferences and symposia, which were to take place elsewhere in Europe. I remember too how we talked once

again about his work in India, over coffee during the breaks, in the spacious halls of University College London. At that time Professor Rana was the National Representative of India to IAU Commission 46, and he had prepared a long National Report which was printed in Commission 46 Newsletter 45. Now I am wondering, was it the strain of having to travel to many places attending European conferences during the summer of 1996, that became too much for the weak heart of Professor Rana, because he died only about a month later?

I feel I have lost one of my Indian friends, I shall remember Professor Rana as a kind man, who was devoted to astronomy teaching, who was so keen, as he told me himself in his London lecture "to show to the students of all levels the fascinating celestial phenomena".

Cecylia Iwaniszewska

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NEWS OF MEETINGS

ASP WORKSHOP ON THE TEACHING OF ASTRONOMY

I recently attended a workshop on the teaching of astronomy organized by the Astronomical Society of the Pacific and chaired by Dr Andrew Fraknoi. It was an extremely interesting meeting. I would like to comment on one of the things I learned about teaching that might help other instructors.

Historically, teaching has proved to be one of the great successes of humans as a species. During its development, institutional education has experimented with different projects. For a long time it was thought that formal lectures were adequate to convey knowledge. This system has the disadvantage that pupils tend to remain passive, and experience has shown that in order to learn one must participate. An obvious example is learning how to ride a bike - even if we watch the best audiovisual materials on how to do it we will not learn until we actually exercise on it.

Other ways of teaching were proposed, allowing pupils to experiment on their own and to look for information using libraries. Sometimes, students were led astray and other times this sort of learning reinforced their misconceptions. More recently, working in groups was put forward as a great way to teach. The instructors collaborated with their pupils so that they could construct their knowledge by confronting ideas. This pedagogical approach was not practical for large school groups. Now, the new pedagogical tendencies show that people learn in different ways, so a good strategy is to teach by using several methods.

including the ones we have described, in order to guarantee that the most is obtained out of teaching: formal lecture, experimentation, and working in groups.

This is still not enough. It is essential to allow pupils to structure their knowledge; this can be achieved by teaching them how to construct conceptual maps. In order to be able to do this they must be literate, since language provides thinking skills and is needed to associate different ideas. When pupils learn how to think on how they think - metacognition - they are able to structure their knowledge. They will no longer have to memorize information that is completely out of context, nor to spend so much time trying to find out what the teacher will ask during the examinations, because they will have successfully learned by understanding.

I will end this brief note by mentioning that some of the latest trends of pedagogy mention that "less is more" in the sense that it is wiser to spend time making sure that students master certain skills, such as thinking, creating, concluding tasks, learning how to learn, etc, rather than trying to get them to memorize lots of information which is now so widely available.

Julieta Fierro

TEACHING ACTIVITIES AT THE XXIVth ANNUAL MEETING OF THE BRAZILIAN ASTRONOMICAL SOCIETY

The XXIVth Annual Meeting of the Brazilian Astronomical Society (Sociedade Astronomica Brasileira – SAB) was held at Hotel Estancia, Barra Bonita, SP, Brazil, 2-6 August 1998. The meetings of SAB have as their main objective the provision of a view of the scientific activities developed in Brazil in the field of astronomy, and give the opportunity of a meeting of the scientific community and the creation of conditions for a better interaction between its associates.

There were about 300 participants. The programme consisted of 5 revision talks, 31 oral communications, 214 poster presentations and 2 exhibitions devoted to the following themes: Astrometry, Celestial mechanics, Solar System, Physics of the Sun, Stars, Interstellar medium, The Galaxy and Magellanic Clouds, Plasmas and high energies, Extragalactic astronomy and cosmology, Relativity and gravitation, Instrumentation, Teaching and history. Among the oral communications, one had the topic "Qualification of graduated students from the Universidade Federal do Rio de Janeiro (UFRJ) course: Time of formation and vocational development" by Lilia Arany-Prado. Among the posters, 10 were on the teaching and popularization of Astronomy.

There was a short course from 3-5 August for 35 previously enrolled and selected teachers, from the schools of Barra Bonita and surrounding cities, with the following content: Galaxies (Mariangela de Oliveira-Abans); Errors of astronomy in school books (Joao B G Canalle); Sun - our mother star (Andre Miloni); Theories on the formation of the Universe (Luiz C Jafelice); Observation of the sky (Paulo S Bretones); The gnomon (Oscar T Matsuura); Possibilities of life in the Solar System (Gustavo F P de Mello); Stellar evolution (Lilia Arany-Prado).

From 3-5 August the Museum of Astronomy and Related Sciences (MAST) set up a portable planetarium in the city's sports gym, and received about 1560 students from the schools for 8 shows a day. These students also saw exhibitions about the Sun and pictures of the comets Hyakutake and Hale-Bopp. In the gym's yard was set up a coelostat to observe the Sun, and a presentation of simple and inexpensive solar telescopes by Oscar T Matsuura who also gave a public lecture to about 200 people at the Municipal Theatre on the theme "New planetary systems".

There was a meeting of the Teaching Commission (CESAB) to discuss many projects, and the coordinator of the commission, Joao B G Canalle, presented a report to the general assembly of the Society on the activities from August 1996 to the present day.

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THE SALT/HET WORKSHOP, CAPE TOWN 2-6 March 1998

The SALT/HET workshop held in Cape Town, South Africa, 2-6 March 1998, though focused on the proposed 10m South African Large Telescope (SALT) and the new 10m Hobby-Eberly Telescope (HET) in Texas, also included a half-day session on education and public outreach. The proceedings of the meeting will be published. The website for the meeting is <http://da.sao.ac.za:80/~salthet/>

I thank Mary Kay Hemenway for drawing this to my attention.

BWJ

SAAO PROMOTES ASTRONOMY EDUCATION IN SOUTHERN AFRICA

Each year in January the South African Astronomical Observatory (SAAO) runs a highly popular summer school in astronomy and astrophysics. The summer school is aimed at senior undergraduate and early graduate level students in the physical sciences. The programme of the summer school comprises lectures in a variety of astronomical topics as well as participation in a variety of research projects under supervision of SAAO faculty. Almost all of the summer school research projects involve observing on the telescopes of the SAAO at Sutherland.

Traditionally, the role of the SAAO summer school has been to provide prospective astrophysics students with some exposure to the profession to allow them to decide whether to embark on postgraduate studies. However, the summer school can also be used as a vehicle to promote introductory astronomy education in physics departments with no traditional astronomy component in their curricula.

During 1997 the Working Group on Space Sciences in Africa (WGSSA) sought to identify university physics educators in Africa who were interested in introducing astronomy in their curricula, but felt hampered by their lack of exposure to the subject at a professional level. Among the individuals identified were Dr Francis Podmore (University of Zimbabwe) and Adrian Habanyama (University of Zambia). The WGSSA then arranged through SAAO for these two educators to participate in the 1998 summer school.

The experiment was a great success. Both were active, enthusiastic participants in all summer school activities, and both returned to their home institutions with well-defined ideas for introducing basic astronomy into their undergraduate courses. Their exposure to the culture of astronomy and their participation in astronomical research provided both of them with the confidence to include astrophysical examples in their undergraduate teaching, and perhaps eventually to introduce introductory astronomy courses at their institutions.

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MEETINGS IN THE UK

The UK National Astronomy Meeting (NAM) is an annual event, lasting several days, and aimed at professional astronomers and research students. NAM for some years has included a parallel session on education on one of the days, and in the past this has been focused on schools. The 1998 NAM was held at the University of St Andrews, Scotland, and for the first time the education day was part of the main programme. Moreover, university level education was included. The programme (on 31 March) was

- 1100-1230 "Urgent issues in university education" (Chair, BWJ)
- 1400-1530 "Eclipse 1999" (Chair, Steve Bell)
- 1600-1730 "Ask an astronomer" (i.e. ask J Brown, A Lawrence, K Horne)
- 2000-2130 "Imaging the cosmos" (a lecture by Ron Hilditch)

In the 1100-1230 session there were four talks, all of them most interesting and well presented

- Astronomy in higher education: possibilities and problems Dave Clarke
- The use of self study materials as a replacement for lectures Bob Lambourne
- The internet and multimedia in astronomy courses and projects Mark Jones
- The use of robotic telescopes in astronomy courses and projects John Baruch

The integration of education into the main programme is surely a welcome sign that education, in all its varied aspects, and at all levels, is being taken ever more seriously by the profession.

Another indication of this trend is the forthcoming Royal Astronomical Society discussion meeting "Crises and opportunities in undergraduate astronomy", to be held at the Scientific Societies Lecture Theatre, Savile Row, London, 8 January 1999, 1030-1545. This meeting, being organised by Derek McNally and me, will focus on two issues

- 1 the role of astronomy (and allied disciplines) in attracting more students to the physical sciences
- 2 the changing demands on university teachers, and how to meet them.

BWJ

PROPOSED IAU COLLOQUIUM ON ASTRONOMY EDUCATION

Julieta tells me that the proposed IAU Colloquium on Astronomy Education, 12-16 July 1999, Sydney, Australia was not supported by the IAU Executive Committee, and therefore will not take place. I do not know whether there will be a more local event. BWJ

THE 1999 TOTAL SOLAR ECLIPSE

On 11 August 1999 the first total solar eclipse for some time will cross the heavily populated areas of Europe. The last such eclipse on the UK mainland was in poor weather on 29 June 1927. It is therefore not surprising that this eclipse is already receiving a good deal of publicity in the UK. Of general interest is a set of eclipse activities being developed by a group of people under the coordination of Professor John H Parkinson. For details contact him at Sheffield Hallam University, City Campus, Pond Street, Sheffield, S1 1WB, UK, fax +44 (0)114 253 3066, j.h.parkinson@shu.ac.uk. The activities are many and varied, with versions for primary (=elementary) school children, secondary school students, and adults. Several activities do not require clear skies, and some do not even require the observer to be in the path of totality. BWJ

PROCEEDINGS OF THE 1996 C46 COLLOQUIUM

IAU Colloquium 162 "New trends in astronomy teaching" was held in the UK in July 1996. The proceedings, edited by Lucienne Gouguenheim, Derek McNally, and John R Percy, have recently been published by Cambridge University Press, UK, ISBN 0 521 62373 1. Participants should by now have received a copy. The proceedings contains a huge variety of interesting papers, covering most aspects of astronomy education. BWJ

POSSIBLE MERGER OF NEWSLETTERS

At the IAU General Assembly in Kyoto it was suggested that there should be a merger between this newsletter and the annual newsletter of the Working Group for the Worldwide Development of Astronomy (WGWDA). Alan Batten, editor of the WGWDA newsletter, has canvassed opinion among his readers, and there has been no groundswell of opinion either way. He says "We certainly do distribute to many of the same people, and there can be too many newsletters. On the other hand, it is good for each group to have something that is identifiably their own." The second sentence reflects the fact that, though the scope of the WGWDA includes education, it includes much more besides.

Alan Batten also says "... I think the possibility of electronic transmission reduces the strength of arguments in favour of a merger. I did send out the more than half of the [100 or so] copies of the last one by email, thus reducing our mailing costs. Although I still have to fight the too easy assumption ... that email reaches everywhere, it is penetrating farther all the time."

Please send me your opinion on this matter. I would certainly be prepared, with Alan's help, to handle a merger, perhaps with the two newsletters in the same document, but as distinct parts. This would only affect one issue per year of the C46 newsletter. BWJ

