INTERNATIONAL ASTRONOMICAL UNION

Commission 46 - Teaching of Astronomy

N E W S L E T T E R

No. 5 June, 1979

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NOTE COMMISSION 46 CIRCULAR LETTER N5 CONCERNING SESSIONS IN MONTREAL, FOLLOWING PAGE 14 OF THIS NEWSLETTER.

EDITORIAL

Once again the General Assembly is almost upon us. At this General Assembly we, as a Commission, are giving ourselves the opportunity of discussing Teaching Astronomy at University. The meeting is slanted towards the teaching of astronomy to scientists though, inevitably, the teaching of astronomy to non-scientists will also find a part of that discussion - not least because some of the problems of teaching astronomy are common to both groups.

It therefore might be useful if I were to set down some background thoughts on this topic. I make no pretence of setting down a balanced picture but will try to include some of the factors which I think are relevant.

Astronomy is by its nature a research subject. It is not a subject which runs all through the school science curriculum in a basic way like Mathematics, Physics or Chemistry. There is therefore no need to educate people at all levels for qualifications in astronomy. Technicians, Teachers, Engineers, Medics, all need basic physical science but that basic training is not in astronomy. The training astronomy must offer

/contd on p.2

Editorial continued from front page

to its serious students is high level courses with a strong trend in the direction of preparation for eventual astronomical research.

If it is accepted that serious students of astronomy must be offered high level courses, certain implications follow. Students for these courses should have excellent university entry qualifications and should have their motivation for candidature thoroughly investigated. Many students will claim that they have been interested in astronomy from childhood. But that only demonstrates that they have been "interested" for a long time. What have they done about that interest? Has it evolved from the "cor! it aint 'alf pretty aint it" stage? Is there any sign of more scientific understanding of the subject? There is a class of student who sees astronomy, not as a rigorous scientific discipline, but in the same way as a collector of butterflies or a railway engine spotter (if such creatures exist outside the confines of the U.K.). This category of student does not gain from a high level course, nor does he make a contribution to it. They are easily identified and need to be rigorously excluded. The slothfully minded student is less easy to spot. He makes all the right responses and uses all the right words and "in phrases" in the correct way, but regards astronomy as a rather nice way to spend a comfortable few years in university, get a degree with very little work and in the process acquire a little social one upmanship. After all physicists and chemists are ten-a-penny but an Astronomer is somewhat rare and therefore needs to be treasured. It takes all our wits to out-manouevre this category who bubble with enthusiasm all through the selection interview and all too often escape detection and arrive in class a pricked balloon with no trace of that early ebullience.

By the time one has whittled down the queue of applicants one is left with the hard core of those interested in astronomy. It is the treatment of this favoured band that we hope to discuss at our meeting in Montreal. Part of this band will be our successors - alas the smaller part. A larger part will seek professional activities elsewhere but we hope will carry with them a love of astronomy which will infiltrate the practitioners of physics and the

menace of mathematics.

What do these people need? They need a secure background of mathematics and physics first and foremost. Astronomy trades heavily on the concepts and techniques of physics and mathematics. An astronomer who is not a competent physicist and mathematician is useless to his profession. But an astronomer cannot live on a diet of physics and mathematics alone. What has inspired him to study astronomy is astronomy. Had he been inspired by particle physics he would have studied physics. Had he been inspired by the curiosities of differential equations he would have studied mathematics. It is a poor university which says to its students of astronomy - you must have bread and butter until you graduate in mathematics or physics and then you can taste the jam of astronomy. Puritanical astronomers are also known to take this view. To keep up motivation, one must include the astronomy from which that motivation is derived. If one knows why one is learning some particularly turgid piece of mathematics and that it applies to some interesting astrophysics, one puts up with the grind, cheerfully. The student needs his rewards which mark his progress towards his goal of becoming an astronomer. The astronomy should inform his physics and mathematics and vice versa.

The astronomy offered to such a student should lead him to the frontiers of modern research by graduation. Once graduated, the student should be clear to embark on research. This means that the student must be exposed to high level course work. Initially, in his first years as an undergraduate this will not be the case. But in the early years the student should be introduced to an atmosphere of research and to the attitudes of the research worker. Once in a while a course could wander along some topic of current research interest. A new and exciting paper could be discussed within the context of the course. Even first year students should be encouraged to attend research seminars to hear current work in astronomy. In this way they begin to see what is considered important, the way professionals test the hypotheses being presented and, not least, to look over possible research

supervisers. The fact that the first year student will not be able to understand all that is going on in a research seminar is no reason for not attending. Gradually he will build linkages between on-going research and his formal degree studies. Students in later years will profit increasingly from attending research seminars.

If the ethos of a degree course in astronomy is to be geared towards professional research then it follows that the course material should be of a matching standard. It is not my purpose to write a detailed syllabus here for a complete degree course but there are several aspects which need stressing. The basically astrophysical courses I will mention only briefly since astrophysics is the dominant side of astronomy. All that needs to be said is that the astrophysics courses are matched with suitably supporting courses in physics and mathematics. A wide range of physics courses based in atomic physics and quantum mechanis is essential as is contact with nuclear and particle physics. A sound knowledge of mathematical methods is also required demanding in its turn a basis of pure mathematical training. The elementary courses in any degree should try to be as comprehensive as possible covering instrumentation to cosmology, but apart from courses in stellar structure, stellar atmospheres and solar physics the final year course of study should reflect the research interests of the teachers. This will provide stimilation and a research atmosphere for the students.

There are three aspects of astronomy teaching which need to be stressed. The first is the role of astrometry. Unfortunately, the slog of astrometric measuring and reduction has given astrometry a bad name by comparison with astrophysics. It is the astrophysics who are scraping up the astronomical cream while the astrometers have to work hard for, by comparison, small returns. However, digitisation and computer control have taken the pain out of measuring and the same computer (or its big brother) has taken the pain out of reduction. There is a new generation of astrometric facilities available capable of

extracting even more refinement out of precise measurement of position and time. We are not training students to take full advantage of the opportunities now available in this area. Students should be made aware of the potential that could be exploited. What is true for astrometry is also true of celestial mechanics. The space age has enlivened celestial mechanics but little of that finds it way into student courses. We need to look again carefully at the balance between astrophysics and astrometry.

The second conflict which gives me cause for concern is practical astronomy. In the past, attitudes to laboratory work in the sciences has fluctuated violently from placing great weight on laboratory skills to placing no weight on them. The fashion in other sciences has been duly reflected in laboratory and observational work in astronomy. Astronomy, in certain areas of the world suffers from climate difficulties which makes the scheduling and management of observational sessions less easy than in the completely roofed over and thermally enclosed laboratory. In some situations an astronomer can gain a degree having been only formally introduced to a telescope (of any kind). It is my firm conviction that all astronomers (apart from the ultra accident prone),even theorists, should have some experience of observational work. In a theorist such experience may lead to a more sympathetic understanding of what is, and what is not, observationally possible. There are several elements which conspire against adequate observational training. The first of these is civilisation. Civilisation is a generator of random photons, heat and highly absorbing molecular species. Universities are usually near the centres of excessive civilisation (in order to catch students). Consequently one can expect poor observing conditions. Secondly, the number of astronomy students compared with chemistry, physics or engineering students is low (you will remember the instructions above on student selection) and the capital expense of good observing equipment is high. The cost per student will strike any administration as being high (if not astronomical). There is a tendency to equip the university observatory with poorer quality equipment than

than the corresponding physics laboratory. Any university observatory teaching undergraduate students should have at least a 60 cm telescope reserved for final year students. Many university observatories do have telescopes of this size, formerly research instruments, endowed through the foresight and generosity of a generation now long dead. Many such instruments need modernising and that, too, costs money. But a word of cheer for administrators - a telescope can be written off over 50 years unlike today's flashy microprocessors which will be obsolescent 2 years from the date of order. That could just make astronomical equipment look cheaper in terms of depreciation per student per year. Again, not all astronomy needs to be done at the telescope. A well equipped laboratory can provide, at relatively little expense, experiments both optical and radio which reflect everything an astronomer needs to do except guiding the telescope. Former research material can find its way into the teaching laboratory for realistic experiments. The flashy microprocessor, unnecessarily disparaged above, can play an important role in simulation, instrument control and data analysis in the laboratory. Although a great deal is achieved in the astronomical laboratory now, and much more could be done, any teaching observatory must have a telescope if only for psychological reasons. Student astronomers have come to study astronomy. Telescopes are the primary observing tool. There must surely be nothing more disappointing to a student as being told that he can learn his technique in the lab. and a telescope is unnecessary. It is like being told that it is better to study how a brewery works than satisfy the longing to imbibe a large, cooling pint! And it is not only for the mental welfare of the students - it is marvellous for his/her parents, the taxpayers. Just think of the parental pride when John or Mary brings home that first glossy print of the Andromeda Nebula or the Large Magellanic Cloud which John or Mary photographed themselves, developed themselves and printed themselves! Just for the moment the Hale telescope becomes small beer.

The final point which gives me cause for concern is the level of

numerical awareness of our students. At a time when computer power has never been cheaper, it is distressing to realise that numerical ability has never been lower. I was at a Parents' Evening at my son's school a few evenings ago and while I was waiting to see a particular master, I had a long conversation with the Head of Mathematics, who was on hand to explain an interesting course on the "Use of Computers". The course was designed for boys not in the top flight of mathematical ability. It sounded very good, just the thing for boys who will have to encounter and use computers in their daily work. It was a slow queue and it was a long conversation and not a single parent was inconvenienced by my monopolising the Head of Mathematics! I also learned during that conversation that it was entirely possible for a scientifically well educated boy or girl in the U.K. to arrive at University not having met a logarithm. It was pointed out to me that the computer revolution had dispensed with the need for log tables and that printed graph paper obviated the need to look up logs or even calculate them. I now realise why my first year class looks so bleak during my little homile on the eye and the system of stellar magnitudes. But be that as it may (and it is hard to take) we have got to see to it that students studying astronomy reach a high standard in numerical awareness. At the same time as they are acquiring a good background in mathematical methods they must also obtain a sound experience of numerical methods. They must learn about accuracy, the effects of error accumulation, instability in a solution of a differential equation. They must learn how to handle data, to be aware of both statistical and real errors. By the last, I mean that there is no point in expressing 90% confidence in a certain result if the data from which the result was deduced is only known within a order of magnitude. At the same time a student must know how to retain precision in calculations where there is a need for the ultimate in precision. Again the display of numerical information is undergoing a revolution. My generation was brought up with a high regard for printed output. But the advances in both quality and cheapness of graphical display is changing that. Cheap desk top calculators

come complete with VDU, often now in colour. Graphs, histograms, etc. now present no problem of display. A good graph will quickly reveal as much as a lengthy inspection and analysis of rows of figures. We need to be training students in these techniques now. The microprocessor is a boon to the astronomer as it offers a wide range of activity not previously available. A floppy disc can contain a respectable catalogue. Catalogue comparison, searching for specific items, display as histograms, etc. are all readily available. Instruments can be interfaced to micros and data measured at more points than was possible by hand and more refined methods can be applied to the analysis of such data. A vast new field of endeavour is opening up. The cheapness of the micro means that what was the preserve of the most up to date, the most expensive, the most technologically well endowed institutes, is now available to all of us to experiment with and develop so that the standard of innovation is kept up.

If we are to teach the best students of today to replace us as tomorrow's top astronomers, it is surely not too much to ask that we devote facilities of equal excellence to the job. Teaching is not the poor relation of research. Without research teaching would lose its point. Without teaching there would be no researchers. The relationship is symbiotic. While an argument can be sustained that all that really matters is good teaching - equipment is secondary - the use of the most up to date techniques in the hands of able teachers means that subsequent generations are well motivated and know how to execute their ideas.

"Ah well", I hear you saying, "the man's an elitist. Does he not realise that he is talking about the high flyers. 90% of all the university students we see would be hopelessly lost under such a regime. What happens to them?" In universities we should be seeking the best to carry on the academic tradition. But, some will argue quite correctly, "what matters in our country is not maintaining an airy fairy academic tradition but getting measurable improvement in educational standards - we want to improve the quality of education and broaden

the outlook of our graduates - all your message is so much pie in the sky". I am still unrepentant. Whatever is being done, should be done at the highest attainable level. This, I think, is very important for it establishes the ethos. We would all agree that a slovenly ethos is worse than no ethos at all, yet we shrink a little from seeking quality in academic standards. It sounds the antithesis of an egalitarian society. However, let us come back to the point. We are talking about the education of astronomers. An egilitarian society is not the professional area of competence of an astronomer. The astronomer is enquiring the nature of the universe. That his astronomy may influence his views on the nature of society is undoubted, but when an astronomer enters that field he is not then speaking as a professional but as yet another citizen. When dealing with astronomy he is a professional. It is a fact of life that we all cannot operate at the same level - we can do nothing about that particular manifestation of thermodynamics. However, we can hope to operate with professional competence. What I have been arguing is that in educating astronomers we should aim to produce astronomers who are as able and as well trained as possible within the immutable (or quasi-immutable) constraints of our existence.

However, another lot of attackers will immediately jump into the arena saying that the implication of all this harangue is that we should not try to teach astronomy to non-astronomers. Rubbish! Of course we should. Not everyone wants to be a specialist. Some, perhaps the majority, want a broad education and want to look at a science over a wide range of aspects and applications. Astronomy is one way of applying physics and mathematics in a realistic way. The appeal of astronomy is centuries old and that appeal can be exploited to interest students in science through astronomy, students who would flee in undisguised haste from pure, undiluted physics, chemistry and the like. However, a second need is now being identified, namely the needs of those who are not going to specialise in a particular subject. This is a broad area and would require a Newsletter to itself to do it justice. I will not enter

that discussion here.

But it raises a thorny point. Should specialist subjects like astronomy be reserved for those dedicated to maintaining the profession? The corollary of this would be - is such capital expenditure on so few worth it? The answer to the first question must be a resounding no. The question presupposes that all those taking a specialist training must be intending professionals in that specialism. I do not think that such a presupposition is in any way realistic. Indeed, it almost assumes that people are fools - a situation which is patently and demonstrably untrue. There is no doubt that many people like the opportunity to study a subject in depth. They have a clear interest of some standing in the subject. In this respect they resemble the intending professional astronomer. Indeed, many will have the same ambition. However, they clearly realise that not all who enter the degree course will have the opportunity to take up the subject professionally. But they want to study a science in depth and they choose a science which appeals to them at that time. Contact with generations of students indicates that about 70% of all entrants to our degree course in astronomy would like to study astronomy professionally. Of these, about 10% only, do not realise that they may not make the grade. The remaining 30% have no prior intention of staying in astronomy beyond graduation. Most of the 70% quickly re-assess their chances and make realistic career choices - usually on the fringes of astronomy, e.g. in the aerospace industry, computer industry, etc. It is a very small minority who are wholly disappointed that they cannot continue further. However, the thing that marks these people out is their interest in astronomy. They give it their attention and enjoy study in depth. They also profit from the applied science outlook. The people who are idle are frequently, but not entirely, in the ranks of the 30% who had no intention from the first of looking towards a career in astronomy. They have come to enjoy a "fringe" science.

If the answer to the first question is no then the second question

becomes irrelevant. There are sufficient numbers of interested students to spread the cost and carry those who will become the professionals. But a further question rears its head - is a degree in astronomy valuable for anything else? This is a practical question. The answer is simple - any good professional training has its value. If the training is realistic for the professionals, it is good for others. They learn professional values and judgement. They are exposed to real professional situations which, though not identical to those they may encounter in their subsequent careers, will require a similar approach. The peculiar value of astronomy is the way it develops an applied approach in using the techniques and knowledge of physics and mathematics.

In conclusion, therefore, I make no apology for my elitist approach to the training of astronomers. It is a hard task which they have and they need the best university training that can be afforded to equip them to tackle the problems posed by the universe. A rigorous training produces an appropriate atmosphere for in depth study. That atmosphere also carries over to courses for the non-specialist who then feels that he is gathering his information from the fountain head and not at second hand. The benefits of such an atmosphere are impossible to quantify and hard to define. That such benefits do exist is clear. While there are pressures which can deflect from a clear cut path we should try to retain the virtues which exist in being able to clearly identify who is being taught and the ultimate purpose of such teaching.

I am looking forward to a vigorous debate in Montreal on what and how we should be teaching our student astronomers. There is plenty to be debated. After Montreal - I look forward to further debate within the Newsletter.

D. McNALLY

Editor

AT MONTREAL

August 13th — An all day meeting will be held before the General Assembly begins with Canadian Teachers of Science. The teachers will come principally from schools in the province of Quebec. Some of the proceedings will be in French. It is hoped that a Workshop devised by Dennis Schatz will be held in the afternoon of that day continuing, if there is enough interest, into the evening. Any Commission members in Montreal on August 13th should feel free to come and participate. This will be the 3rd such meeting held by the Commission, the others being in Sydney in 1973 and Grenoble in 1976. The teachers get a great deal out of these one day stands since it provides a focus of activity from which teachers can develop their own activities.

At a date to be arranged during the General Assembly — The Commission, in addition to its business meetings, is arranging an all-day meeting on Teaching Astronomy at University Level. This meeting will take the form of invited papers, contributed papers and discussion. We are looking for vigorous, hard-hitting, only lightly controlled discussion led by the authors of the invited papers. If you have a short paper (i.e. 10 minutes) to contribute contact Dr. David Du Puy, Department of Astronomy, St. Mary's University, Halifax, Canada B3H 3C3 now! The invited papers will be given by Abell (California), Clarke (Glasgow) Eichorn (Florida), Verschuur (Colorado). Abell will give the introductory paper, Eichorn will lead the discussion in astrometry, Verschuur on the use of the planetarium and Clarke on observational work. We hope to mix discussion and contributed papers.

Dr. Du Puy is doing a very commendable job in co-ordinating the organisation of both these meetings and any success they achieve will in large measure be due to his efforts.

PIAGET

Dennis Schatz has recently contributed to the Newsletter (No. 3) a paper on the relevance of the work by Piaget to teaching Astronomy. Not everyone agrees with him as this extract of a note by Jay Pasachoff shows. Any one else prepared to join the battle?

" The psychological theories of Jean Piaget have been much discussed in education circles recently, and are being applied to teaching of astronomy and other sciences. Workshops (such as the ones on the teaching of astronomy organised by the Task Group on Education in Astronomy of the AAS) have been devoted to the application of the theories of Piaget.

Piagetian psychology in its basic form holds that all individuals go through four stages of development. From birth to about 17 months, they are in the sensory motor stage. From 18 months to about 7 years they are in the preoperational stage. From about 7 years they are in the concrete operational stage, up until the age of 11-15. Then they go into the formal operational stage. The question now widely asked is whether most American college and university students have progressed beyond the concrete stage. If not, many of the logical processes that we often use in physics and astronomy (such as proportionality)are not within the grasp of most of the students in the class.

Often, however, the theories are applied in a simplified form. Sometimes the last two of Piaget's four stages are the only ones discussed, and from the conclusion that most students reason at only the third "concrete", level instead of the fourth, "formal", level, it is suggested that teaching methods or the type of material presented should be modified.

It is not so often realised by astronomers and physicists that the views of Piaget are controversial in the psychological community, and that other viable theories are in conflict with Piaget's. D.C.Phillips of Stanford University and Mavis E. Kelly of Monash University in their article "Hierarchical Theories of Development in Education and Psychology" (Harvard Educational Review, Vol. 45, No. 3, August, 1975, pages 351-375) conclude

that their examination of "the much-touted hierarchical theories of development" has shown that "their underlying assumptions have not been adequately examined". Ralph A. Goodwin, a physicist at the U.S.Naval Academy, expresses skepticism in "Talk and Chalk", The Physics Teacher, September 1978, pages 367-371. (He also discusses the Keller Plan there).

The validity of Piagetian theory has been examined by H. Daniel Cohen, Donald F. Hillman, and Russell M. Agne, all of the University of Vermont. Prof. Cohen is from the Department of Physics and Profs. Hillman and Agne are from the College of Education and Social Services. They chose 195 students randomly from introductory physics courses and tested them with selected Piagetian tasks. "Though 58% of the sample were rated at the level of concrete operations, the Piagetian level was found to be only weakly correlated with both level of course and with final course grade". They conclude, "that there exist different developmental levels of cognitive ability among college students as determined by Piaget's measures, is clearly demonstrated," but "that these developmental differences warrant new approaches to curriculum, teaching methods and evaluation procedures, does not appear to be supported by our results. Our data show little correlation between Piagetian level and success in physics courses. In particular, the most advanced course, hence likely the most formal, showed no correlation between Piagetian level and final course grade".

I personally agree with the Harvard psychologist Jerome Bruner, who holds that you can teach anything to any child at any age if only you go about it right. I think that we can, and we should, take the time and the effort to teach to our students what we think is important that they learn. Too much application of the theory of Piaget would limit our students' horizons, and I think that, given due care, we can do better for them."

Somewhat extended from the "Teachers' Guide to ASTRONOMY: FROM THE EARTH TO THE UNIVERSE", by Jay M. Pasachoff, published by the W.B.Saunders Co., 1979.

CIRCULAR LETTER N5

TO ALL MEMBERS OF COMMISSION 46 - FROM THE COMMISSION PRESIDENT (A)

The current triennium is coming to its end and this is the time to summarise the experience obtained and start making plans for the future work.

The activity of Commission 46 consists of three main parts:

(i) the organising enterprises such as ISYA, AEM, CP projects etc.,

(ii) some conceptual educational work provided by our meetings, papers etc.

(iii) individual work done by Commission Members according to their plans for national activity.

Up to now our work has been mostly carried out by correspondence. In Montreal many of Commission Members will have a possibility to make personal contacts. Some of them will be for the first time.

It is very important to use these contacts in the most efficient way.

The preliminary programme of Commission meetings in Montreal announced in the previous Newsletter No. 4 met no objections and is therefore accepted as a whole.

The first Commission session of 90 minutes will be a business one. At the outset the President of the Commission will present the main points of the Commission Report. The announcement of the National Reports Compendium which is now printing in Moscow will also be given. After this, a summary of contacts between Commission 46 and other scientific organisations will be presented by Prof. L. Houziaux. Finally the election of new Commission members and Organising Committee members will take place.

The mode of working by the Commission during this triennium was improved by the Newsletter. This project enlarged the communicative ability between Commission members. One must take into account, however, the amount of time necessary for material to reach Commission members through the Newsletter. That is why some deadlines happened to be violated in several cases by delays in receipt of the Newsletter. There is another point of a psychological character. The circular letters inserted in the Newsletter sometimes are considered not as letters, which should be answered, but as simple articles.

(B)

On the whole the Newsletter project was very plausible and the Commission expresses its gratitude to D. McNally and D. Wentzel who carry permanent burden of the Newsletter producing and distribution.

During the second session (also 90 minutes) the remaining Commission projects will be discussed. The International School for Young Astronomers (ISYA) is the most effective among them. Two schools (in Brazil and Nigeria) successfully operated during the last triennium. It is a pleasure to be able to report that ICSU has allocated to the IAU, a UNESCO contract providing $4000 US for the organisation of a Young Astronomers School at the Institutio de Astrophisica de Canarias, Universidad de La Laguna, La Laguna, Tenerif (Spain) from 10 to 22 September, 1979. Dr. F. Sanchez-Martinez has consented to direct the school and Dr. J. Kleczek will be its secretary. The main purpose of the school is Stellar Astrophysics and Solar Physics. The number of students is about 25. The language of the school will be Spanish.

The most important decision the Commission must make during the second session is the final version of the Rules and Guidelines for ISYA operation. It seems reasonable that only principal points should be discussed by the Special ISYA Committee before involving the IAU General Secretary. Otherwise a great amount of efforts may be in vain because of bureaucratic delays.

The Astronomical Educational Material Project will have produced its third Addendum this time. We hope it will appear before the Montreal Assembly For the time being we shall use the same style and format as in previous cases. But two points may be suggested to improve its value. First, up to now, the AEM was supposed to cover only outstanding material. Now we should make it comprehensive. Second, it is necessary to emphasize those items which deserve to be recommended for translation into other languages.

All projects mentioned above are living tools. But we do not know what to do with Project Contratype. It is obvious that astronomy teachers need educational material urgently. But the difficulty of gathering such material and of its dissemination make this project invalid. A good collection of slides ready for distribution exists in France and in the USA but is of little

interest for two reasons.

First, there is a problem of money. Even small sums provide difficulties for developing countries (the developed ones do not need help). We have to discuss various suggestions to solve that problem; for example, the organization of several centers for reproduction and free dissemination of educational material. The areas of such centers would comprise the corresponding groups of developing countries.

Second, the slides can easily be self-made today providing we have a well illustrated book. The type of material we need is not just a picture, but the description of various ways of its possible usage. This means that we need special publications on educational purposes in various well known magazines such as Sky and Telescope, Zemlja i Vselennaja, Mercury, L'Astronomy, etc. We must discuss this possibility, make tentative publications and then co-ordinate different topics to cover the whole course of Astronomy.

Beside these two sessions, Commission 46 plans to have a whole day meeting dedicated to Education in Astronomy at the University level. The Agenda includes invited papers "An Overview of Astronomy Education", "Is the Planetarium A Useful Teaching Tool?" and "Teaching Observational Studies". Contributed papers will deal with "Teaching Astrophysical Concepts", "Teaching Astrometric Concepts", "Audio Visual Aids", "Laboratory Exercises", Observation in Teaching" and other topics.

A good tradition of Commission 46 followed in Sydney and Grenoble and to be carried on in Montreal is a Meeting Between Canadian School Teachers and the Commission. The programme will include the problems dealing with Teaching Astronomy in Canadian Schools, Teaching Astronomy in France, Role of the Royal Astronomical Society of Canada in Teaching Astronomy, Audio-Visual Materials for School Teachers, Observational Activities for High School Students, Laboratory Experiments in Astronomy, Piaget Workshop and other topics.

As a continuation of the work initiated by D. McNally I tried to

investigate the trend to include Astronomical Education at School level. This investigation was based upon answers to a Questionnaire announced in Newsletter N2. A lot of answers, which I appreciate very much, outlined an interesting picture about the nature of the astronomical educational system all round the world. The general opinion is that about 50 hours is necessary to introduce astronomy at school level. The greater part of this time should be used at high school level. The main purpose of astronomy education is thought to be conceptual and outlook development. It is an interesting question whether astronomy will have a tendency to integrate with e.g. physics or to keep the tradition of a separate subject as is now the case in some countries.

Summarising this triennium's work I would like to conclude that, in spite of large efforts and some bureaucracy, the burden of the President contained an enjoyable experience because of your kind letters, suggestions and replies to my numerous questions which I appreciate very much. Our contact was restricted to correspondence. But personal contacts begun during Prague Assembly are still fresh in my memory. They illuminated and colored the papers I had to deal with. Now I would like to see all of you in Montreal to revive and up-date this picture. Looking forward with great pleasure to meeting many of you in Montreal.

E. KONONOVICH

President, Commission 46, IAU

IAU Program: 13 August, 4 x 90 minutes, meeting with Canadian Teachers
14 August, 90 minutes afternoon, relations with ICSU, etc., newsletter
18 August, 90 minutes morning, ISYA, AEM, Contratype
22 August, 4 x 90 minutes, teaching methods at university level.

Note also page 12 of this newsletter.