COMMISSION 44 : ASTRONOMICAL OBSERVATIONS FROM OUTSIDE THE TERRESTRIAL ATMOSPHERE (OBSERVATIONS ASTRONOMIQUES AU-DEHORS DE L'ATMOSPHERE TERRESTRE)

PRESIDENT: R. M. BONNET

During the course of the XVIIth General Assembly in Montreal, Commission 44 was involved in 5 Joint Discussions (over 8), 5 Joint Meetings :

1 - "Coming Solar Maximum", with Commissions 10, 12 and 14 ;
2 - "The M.H.D. of Sunspots", with Commissions 10 and 12 ;
3 - "The Search for Life in the Universe", with Commissions 16 and 40 ;
4 - "Close Binaries and Stellar Activity", with Commissions 10, 27, 40, 42 and 48 ;
5 - "Space Astrometry", with Commissions 8, 20, 24, 25, 26, 30, 33, 37 and 45.

The reports of Joint Meetings 1 and 2 are to be found in the general report of Commission 10. That of Joint Meeting 4 is to be found in the general report of Commission 42 and that of Joint Meeting 5 in the general report of Commission 24.

14 August 1979

BUSINESS MEETING

The President opened the meeting by briefly summarizing the major events which occurred in Space Astronomy since the last General Assembly, i.e. the launches of HEAO-1, IUE, HEAO-2 (Einstein Observatory) and the successful continued operations on Copernicus, COS-B and OSO-8. He then described the activity of the Commission in the past 3 years : the edition of 4 issues of the Commission 44 Newletter, its involvement in the Middle Atmosphere Program (MAP), in the work of the International Radio Consultative Committee (CCIR), of the Scientific Ballooning and Radiation Monitoring Organization (SBARMO), in the COSPAR Panel on Potentially Environmentally Detrimental Activities in Space (PEDAS), etc...

He pointed out that Space Astronomy was more and more integrated in the general field of Astronomy as evidenced by the large number of Joint Discussions and Joint Meetings in which the Commission was involved either as principal or as co-organizer.

He then reviewed the activity report of the Commission. He initiated a discussion on the membership of the Commission. A letter had been sent to every member in the Commission asking whether he was willing to remain a member, to resign, or to become a consultant member. In parallel more than 40 new applications had been received. The meeting was then asked to express an opinion as to the necessity of keeping the membership large by,in particular not screening out the new applications and keeping those members who even did not reply to the President's circular letter.

The participants then proceeded to the election of the new Vice-President after nominations were proposed from the floor. M. Oda was elected by written ballot and his name was consequently submitted to the Executive Committee.

17 August 1979

SCIENTIFIC MEETING (Jointly with Commissions 16 and 40)

This meeting on the Strategies for the Search for Life in the Universe was opened with a brief welcoming address by M. Papagiannis who chaired the Organizing Committee.

Session I : Alternative views on the value of N.

I. Shkovsky and P. Morrison were the co-Chairmen of this section. N is the number of technologically advanced civilization currently present in our galaxy.

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M. Hart, supported the view that N is very small based on the lack of any evidence for extraterrestrial presence on earth. T. Kuiper suggested that N is probably very large, because life seems to be able to operate an inverse 2nd law of thermodynamics, i.e., to use available energy to locally reduce entropy and th thus progressively build organisms and societies of high complexity and sophistication. F. Drake defended the view that N is neither very small nor very large based on the analysis that interstellar travelling would be prohibitively expensive. However the energy problem might not seem as severe after a few centuries in the light of future technological advances. M. Papagiannis supported the thesis that N is either very small or very large and that intermediate values are quite unlikely.

In addition to the above speakers, V. Troitsky dealt with the technological requirements of a radio antenna that could broadcast a beamed signal to a distance of 10,000 light years, and found that these requirements are formidable, if not prohibitive. Finally, P. Morrison gave an articulate summary of the different views on the value of N and the directions we ought to proceed in the future in view of the alternatives discussed. These directions, ought to include both the continuation of radio searches, as well as the further exploration of our solar system.

Session II : Strategies for SETI through radiowaves.

B. Oliver and J. Jugaku were the co-Chairmen of this section.

B. Oliver opened this section with a brief summary of the advantages of radio communications and the rapid progress that is being made in electronic support equipment, especially in the construction of multichannel analyzers. Analyzers with 10^6 channels are within the capabilities of current technology, he said. B. Zuckerman gave an extensive review of the six radio searches that have been performed up to now in the United States and Canada. V. Troitsky gave a similar, but less detailed summary of the several searches that have been going on in the Soviet Union and finally S. Gulkis discussed different alternate possibilities, both small and large, for the future.

Session III : Search for early forms of life both in our own solar system and in others.

J. Greenstein and N. Kardashev were the co-chairmen of this section.

G. Soffen gave an overview of the search for life in our solar system. He discussed the Viking mission to Mars and he noted that finding another independent origin of life would be of immense importance in our efforts to understand the mystery of life.

T. Owen discussed how we hope to use spectroscopic observations, in particular those revealing the presence of water and oxygen, to search for life in other solar systems.

Searching for signs of life in other solar systems, however, is still a task for the future because we have not yet been able to detect any planets even in the nearest stars. Great progress, however, is being made in this area, and many new techniques were discussed by experts in the field. G. Gatewood described the astrometric methods and said that the recent replacement of the photographic process by photoelectric techniques has led to a dramatic improvement in the sensitivity of astrometric methods which are looking for minute changes (1.0-0.1 milliarc sec) in the position of a star produced by the rotation around it of one or more planets.

Dr. Currie described the interferometric methods where efforts are being made to develop a two aperture set-up, like a radio interferometer. Single aperture techniques, using speckle interferometry, have already made it possible to measure the diameters of some large red giants stars. I. McLeon of the laboratory of K. Serkovski at the University of Arizona, described the progress being made in developing the sentitive spectroscopic techniques needed to measure the orbital velocity (10-20 m/sec) of a star about the common center of mass of the star and a large planet orbiting around it. W. Baum described the advantages the space telescope will have in this area since it will be able to detect objects up to a magnitude of 28 by avoiding the airglow and the smearing of a star's image by atmospheric seeing. It seems that the combination of the space telescope and the new photoelectric astrometric technique might be able to provide some impressive results in the next 5-10 years. Finally D. Black gave an excellent summary of the advantages and disadvantages of the different presently available methods for the detection of planets and their prospects for the future. He also discussed some direct methods that are currently being proposed, including occulting disks, apodized images and the infrared space interferometer proposed by R.N. Bracewell, which might hold a great promise for the future.

Session IV : The different manifestations of advanced cosmic civilizations.

S. von Hoerner and M. Rees were the co-chairmen of this section.

W. Sullivan discussed the possibility of eavesdropping on other neighboring civilizations by considering what could they have learned by doing the same to the earth. Since strong narrow-band signals, such as the carrier frequencies of TV stations, come from discrete locations on the earth, it is possible from the Doppler effects to determine the rotation of the earth and its orbital period around the sun. From the mass of the sun, which one could figure out from its luminosity, one could then determine the distance of the earth from the sun and hence also its average temperature. S. von Hoerner summarized astroengineering projects that advanced civilizations might undertake.

He discussed also the possibilities for interstellar travelling. Theoretical computations have shown that it is possible to propell a spaceship over interstellar distances even with present day technology.

Conclusion

An Open Evening Session, chaired by L. Goldberg, was held on August 16, in which the discussions and the conclusions of the Joint Meeting were summarized for the general membership of the IAU.

The meeting focused strongly on the controversy of the colonization of the galaxy and on the progress being made in the search for planets in other stars. The possibility of galactic colonization seems to call for a careful search inside our own solar system and for the parallel study with radio antennas of all nearby stars. These tasks, as well as the search for planets, can be comfortably weaved into the current goals of space exploration and astronomical research for the 80's. Thus it seems that the proper strategy at this time is to amalgamate the Search for Life in the Universe into normal scientific research and space exploration, keeping always a keen eye and an attentive ear for opportunities that might advance the cause for this quest.

17 August 1979

SCIENTIFIC MEETING : International Space Programmes and Future Needs of Space Astronomy.

SESSION I on International Space Programmes was organized and chaired by D. Walsh.

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1. ESA Program

The program of the European Space Agency was presented by E. Peytreman. He first described the satellites already in orbit :

a. COS-B which studies the sky in Gamma rays and has been very successful in obtaining the first map of gamma-ray emissions from the galactic disk and detecting 29 point sources including 2 new gamma-ray pulsars.

b. IUE (see also § 3 below) in which ESA participates for one sixth of the total observing time.

He then described the projects in preparation and their associated experiexperiments.

c. EXOSAT (scheduled for a launch in November 1981) whose aim is twofold :

- determine the position of galactic and extragalactic X-ray sources ;
- study the spectral characteristics and time variations of individual X-ray sources.

d. SPACELAB-1 on which astronomy experiments make use of the pallet is a mission in cooperation with NASA. It is scheduled to fly in April 1982.

e. ISPM or Out-of-Ecliptic Mission (scheduled for a launch in 1983) is also a cooperative program with NASA. ESA participates in building one of the two spacecrafts, and several experiments.

2. NASA Program

N. Roman gave a complete description of the NASA program with a summary of its status. She started by the satellites already in orbit : COPERNICUS, HEAO-A and B (EINSTEIN Observatory) which has an excellent imaging quality in the X-ray regime. She then described the other projects :

a. HEAO-C, to be launched in September 1979 and which has a strong international component with the C_2 Koch and Peters experiment.

b. SMM, due to be launched in early 1980, contains 7 instruments devoted to the coordinated study of the next solar maximum :

- a Gamma Ray Spectrometer ;
- a Hard X-Ray Spectrometer ;
- a Hard X-Ray Imaging Spectrometer ;
- a Soft X-Ray Polychromator ;
- an U.V. Spectrometer and Polarimeter ;
- a Coronograph Polarimeter ;
- a Solar Constant measuring and monitoring instrument.

c. SPACELAB-2, a pallet only mission, contains :

- an Infra-Red Telescope to study individual sources ;
- four Solar instruments :
  - . the High Resolution Telescope/Spectrometer of NRL ;
  - . a Solar U.V. irradiance monitor in the near U.V. ;
  - . an experiment to measure the He/H abundance ratio in the solar corona built in the U.K. ;
  - . a magnetic and velocity field experiment.

d. The SPACE TELESCOPE is a truly international program with a 15% participation of the European Agency. The ST is a shuttle launched-and-operated satellite, scheduled for a launch in 1983, with an anticipated 10 year lifetime. It contains five focal plane instruments operating from the far ultra-violet (λ > 1200 A) to the near infra-red (1 μm) :

- the Faint Object Camera (under the responsibility of the ESA) ;
- the High Resolution Spectrometer ;
- the Faint Object Spectrograph which will reach the 24th-25th magnitude ;
- the High Speed Photometer to the construction of which Canada participates.

All these projects, she said, have a strong international implication through Guest Observers Programs.

She mentioned the non yet aproved programs envisaged for the mid 1980's or the second half of the decade :

- the Solar Optical Telescope (SOT) a 1.25 m instrument with associated focal plane instruments ;
- the Gamma-Ray Observatory (GRO) ;
- the Shuttle Infra-Red Telescope Facility (SIRTF) a 80 cm cryogenically cooled telescope.

3. The International Ultra-Violet Explorer (IUE)

R. Wilson gave a complete description of the spacecraft and the instrument, together with the characteristics of the orbit and the two ground stations. He also described in detail the allocation of observing time in the various scientific areas. A list of 12 countries besides ESA countries, the U.K. and the U.S.A. was given including 2 Eastern countries clearly showing the genuine international character of the program. This presentation was followed by a discussion during which the need for a better distribution of the information on already accomplished observations, was stressed.

4. The Infra-Red Astronomical Satellite (IRAS)

The IRAS was presented by R. van Duinen. It is a cooperative venture between the Netherlands, the U.K. and the U.S.A. The scheduled launch year is 1981. IRAS will make a survey of more than 95% of the sky in four spectral bands between 5.5 μm and 120 μm. It will have pointing and rastering capatilities allowing the study of individual sources. Spectrophotometry with moderate spectral resolution will be possible. The sensitivity of the instrument will be 100 to 1000 times that of presently available systems. The lifetime will be limited by the on-board cryogenics to 1.5 years. The satellite will be placed on a circular polar orbit.

Van Duinen also described the operations of the instrument and the division of work between the three countries involved. It is expected that a survey catalogue will be available one year after completion of the survey itself. 40% of the observing time outside the survey will be allocated to Guest Observers.

5. Discussion

N. Roman then introduced and led a discussion on the problems and procedures for selecting experiments. She first described the in-house NASA procedure (Announcement of Opportunity, Peer Group Review, NASA in-house Review and Recommendation, Selection by the Associate Administrator for Space Science). She also reviewed the procedures for selection of Guest Observers Programs and indicated that for the case of SPACELAB Instruments, the policy is to compose payloads of 80% reflown instruments.

The discussion then focused mainly on how to disseminate the information on Space Programmes to the largest community. The release of information through Scientific Journals and the system of Newsletters was mentioned as one possible efficient way.

SESSION II : Scientific Needs for Space Astronomy

This Session was chaired by R. van Duinen. The topic was introduced by L. Goldberg. The text of his presentation being reproduced in its integrity on page of the present volume, it is not summarized here.

A discussion ensued on the rationale for Space Astronomy. The question : "Can we do the same things from the ground ?" should be the first to be raised before initiating a complex and expensive program of space astronomy. R. C. Catura stressed the need for an all-Sky X-Ray Survey, using an imaging Telescope, as a resource in itself for astronomy and in guiding future large X-Ray observatories already in the planning stage in various agencies. H. Smith mentioned that up to now Radio Astronomy has not really taken advantage of observations from space and that, as a return of the of large space structures it might become cheaper in the future to build large antennas offering interesting possilities for astronomy.

SESSION III : Potentialities for Space Astronomy of the New Generation of Space Transportation Systems and Platforms.

The Session was chaired by R.M. Bonnet and was introduced by K. Pinkau. He presented the subject in continuity with the discussion of Section II. E. Peytreman kindly served as secretary. In essence, Professor Pinkau said, all presently planned or already available systems are sufficient to carry into orbit most of the envisaged scientific payloads. He identified however 3 main areas where the needs are not generally yet fulfilled and where the technology or the policy followed by the various space agencies should be improved and changed :

- there are requests for carrying many small size experiments in contrast to the availability of few large observatories ;
- the technology is not yet ripe to generally allow the external users of an instrument (in contrast to the Principal Investigator) to make use of the data which may be made available to them ;
- large observatories become more and more costly and within the fixed ceeling of the national or international budgets this means that flight opportunities tend to become more and more scarce. The question arises then of how to keep the groups alive and of how to maintain their know-how in space technology.

Concerning the first point, SPACELAB should allow for carrying small size type experiments at rather frequent intervals provided that the cost of integration, flight and operation be kept in reasonable limits. There seems to be no technical limitations at present to carry out any kind of astronomy instruments into space but there are strong money limitations instead, and it is in the direction of making space vehicles and experiments cheaper that all efforts should be made.

Following this presentation the discussion focused on two main questions :

1. Is there a need for and means to carry into space small payloads, as opposed to large observatories ?

A. Underhill said that the answer varies according to the degree of sophistication already achieved in certain disciplines.

The discussion then centered on the use of SPACELAB and its cost. Everybody agreed that SPACELAB was a good way of carrying small payloads in particular in that it offers a longer observing time than rockets. S. Jordan said that SPACELAB flights and seven day missions are sufficient for most solar physics payloads and Dr. Carruthers said that SPACELAB offered capabilities that do not exist elsewhere. According to N. Roman, the cost of an experiment is two to three times more expensive on SPACELAB than on a rocket, therefore the cost should be evaluated considering what flight time is indeed required. Dr. Brueckner expressed the optimist point of view that we are now in a learning stage and that the situation should normally improve and experiments tend to become cheaper.

In conclusion, the need for small/cheap short duration frequently flown experiments was clearly identified.

2. Are the available technical means sufficient ?

The discussion focused on platforms. Dr. H. Smith said that there are several arguments in favour of platforms provided the latter be kept simple. Pr. Pinkay said that the concept of platforms was lacking flexibility. The advantage of revisitable payloads was stressed in the discussion.

The Chairman concluded the Session in pointing out that the cost of space astronomy experiments should be kept low in as much as possible. The tendency of increasing costs makes space astronomy less and less popular and the experimental groups are faced with increasing difficulties in getting funds and flight opportunities frequent enough. He said that the whole astronomy community should be aware of this situation since space astronomy is now an indispensable segment of astronomy in general.

17 August 1979

BUSINESS MEETING Secretary : E. Peytreman

1. Commission 44 Newsletter

Four issues of the Newsletter have been published between 1976 and 1979. Y. Kondo who served as editor could not continue his task and the question of whether we should continue the edition was discussed. The Commission thought that the Newsletter was useful in conveying the information on International Space Astronomy Programmes and that this purpose at least should continue to be served.

The President asked volunteering editors but no one in the room thought he had the necessary administrative and financial support to take over the job. The question of whether the information Bulletin could be used was discussed. This solution was seen as offering the advantage of a larger audience. The President said that he would discuss the matter with the General Secretary.

The Commission members mandated the President and his successor to find a solution in the next months.

2. Relation with COSPAR

Dr. L. Peterson reported on the re-organization of COSPAR. He said that space astrophysics was now covered in Commission E itself subdivided into 2 subgroups. He informed the Commission that one concern was to avoid duplication of meetings and that there should not be any Commission E meeting in the year when the IAU General Assembly meets. He also outlined the major symposia of the next COSPAR meetings scheduled for June 1980 in Budapest.

The liaison between Commission 44 and the new Commission E was discussed and it was agreed that the duplication of activities should be avoided by for example, having common members in the organization Committees of both Commissions.

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3. Name and re-organization of the Commission

The question of the renaming Commission 44 was discussed and the Commissi Commission agreed to adopt the new name "Space Astronomy" (Astronomie Spatiale). The suggestion of subdividing the Commission into subcommissions or working groups was discussed but not retained at that stage.

4. Organizing Committee

The President re-opened the discussion on the composition of the Organizing Committee. The Commission members agreed on a list of names which was then submitted to the General Secretary.

It was found that 4 members were also members of COSPAR Commission E.

5. Resolutions

The text of two resolutions was submitted to the Executive Committee.

The first resolution encouraged members of the IAU to support the concept of a one meter class Space Schmidt Telescope. The second expressed a sustained interest in the continuation of coordinated observations of the sun in the next years spanning the period of maximum activity.

6. Dr. Y. Kondo reported to the Commission members the outcome of a meeting of Commission 5 on nomenclature of new sky sources. This matter was found relevant to the activities of Commission 44 and those who had any suggestions were requested to convey them to Dr. C. Jaschek.

7. The Commission complained that it was involved in too many meetings. It was consequently agreed that this situation should be corrected for in the future by for example not accepting too many proposals of joint meetings and discussions and avoiding as much as possible duplications of topics between two consecutive general assemblies.