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REPORT ON THE SEVENTH UNITED NATIONS/EUROPEAN SPACE AGENCY WORKSHOP ON BASIC SPACE SCIENCE: SMALL ASTRONOMICAL TELESCOPES AND SATELLITES IN EDUCATION AND RESEARCH, HOSTED BY THE OBSERVATORIO ASTRONÓMICO DE LA UNIVERSIDAD NACIONAL AUTÓNOMA DE HONDURAS, ON BEHALF OF THE GOVERNMENT OF HONDURAS

(Tegucigalpa, 16-20 June 1997)

CONTENTS

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INTRODUCTION

A. Background and objectives

1. The General Assembly, in its resolution 37/90 of 10 December 1982, decided, upon the recommendation of the Second United Nations Conference on the Exploration and Peaceful Uses of Outer Space (UNISPACE 82), that the United Nations Programme on Space Applications, *inter alia*, should promote greater cooperation in space science and technology between developed and developing countries, as well as among developing countries.

2. The Committee on the Peaceful Uses of Outer Space at its thirty-ninth session, held in June 1996, took note of the activities proposed for the United Nations Programme on Space Applications as set out in the report of the Scientific and Technical Subcommittee at its thirty-third session (A/AC.105/637, paras. 26-36).[1] Subsequently, in its resolution 51/123 of 13 December 1996, the General Assembly endorsed the activities of the Programme for 1997, as proposed to the Committee by the Expert on Space Applications (A/AC.105/625, sect. I).

3. In response to General Assembly resolution 51/123 and in accordance with the recommendations of UNISPACE 82, the Seventh United Nations/European Space Agency Workshop on Basic Space Science: Small Astronomical Telescopes and Satellites in Education and Research was organized within the framework of the activities of the Programme on Space Applications for 1997, particularly for the benefit of Central American countries.

4. The Workshop was organized jointly by the Office for Outer Space Affairs of the Secretariat, the European Space Agency (ESA), the Observatorio Astronómico de la Universidad Nacional Autónoma de Honduras and The Planetary Society (TPS).

5. The objective of the Workshop was to assess the achievements of the series of United Nations/ESA workshops on basic space science held from 1991 to 1996 and to inaugurate the Astronomical Observatory for Central America at Tegucigalpa. The programme of the Workshop included presentations on the following: (a) the solar system and life on Earth; (b) front-line research with small telescopes; (c) astronomical satellite missions and the results from their databases; (d) international and regional cooperation in basic space science; (e) programmes and projects in

the context of the forthcoming Third United Nations Conference on the Exploration and Peaceful Uses of Outer Space (UNISPACE III); and (f) the inauguration of the Central American Astronomical Observatory in Honduras.

B. Organization and programme of the Workshop

6. The Workshop was held at the Observatorio Astronómico de la Universidad Nacional Autónoma de Honduras at Tegucigalpa from 16 to 20 June 1997. The holding of the Workshop marked the continuation at a series of annual United Nations/ESA workshops on basic space science (see table), which had been held in India in 1991 and in Sri Lanka in 1996 for Asia and the Pacific (A/AC.105/489 and A/AC.105/640), in Colombia and Costa Rica in 1992 for Latin America and the Caribbean (A/AC.105/530), in Nigeria in 1993 for Africa (A/AC.105/560/Add.1), in Egypt in 1994 for western Asia (A/AC.105/580) and in Germany in 1996 for Europe (A/AC.105/657). The workshop held in Germany had analysed the results of all the previous workshops on basic space science and charted the course to be followed in the future.

7. The Workshop held at Tegucigalpa was attended by 80 astronomers and space scientists from the following 28 countries: Australia, Austria, Canada, Colombia, Costa Rica, Cuba, Egypt, El Salvador, France, Germany, Guatemala, Honduras, India, Indonesia, Italy, Japan, Mexico, Morocco, Nicaragua, Panama, Poland, Slovakia, Spain, Sri Lanka, Tunisia, United States of America, Uruguay and Zambia. The United Nations and ESA provided financial support to defray the cost of air travel and living expenses of 24 participants from developing and eastern European countries. The expenses of other participants were defrayed by the following co-organizers of the Workshop: the Austrian Space Agency, the Centre national d'études spatiales of France, the National Aeronautics and Space Administration (NASA) of the United States, and TPS. Facilities, equipment, and local transportation were provided by the Observatorio Astronómico de la Universidad Nacional Autónoma de Honduras.

8. The programme of the Workshop was developed jointly by the Office for Outer Space Affairs, ESA, the Observatorio Astronómico de la Universidad Nacional Autónoma de Honduras and TPS.

9. Opening addresses were made by the President of Honduras, C. R. Reina-Idiaquez, on behalf of the Government of Honduras; M. C. Pineda de Carias, on behalf of the Observatorio Astronómico de la Universidad Nacional Autónoma de Honduras; H. J. Haubold, on behalf of the Office for Outer Space Affairs; W. Wamsteker, on behalf of ESA; and L. Friedman, on behalf of TPS.

10. The present report, which covers the background, objectives and organization of the Workshop, in addition to giving a summary of observations, recommendations and selected presentations made at the Workshop, was prepared for the Committee on the Peaceful Uses of Outer Space and its Scientific and Technical Subcommittee. The participants reported on the knowledge acquired and the work conducted at the Workshop to the appropriate authorities of their Governments, universities, observatories and research institutions.

Overview of the series of United Nations/ESA workshops and other activities on basic space science

Year	*City*	*Target region*	*Hosting institution*	*Participants*	*Par-ticipating countries*	*Topic or sub-topic*	*Follow-up project (United Nations document symbol)*
1991	Bangalore, India	Asia and the Pacific	Indian Space Research Organization	87	19	Basic space science	Establishment of an astronomical facility in Sri Lanka (A/AC.105/489)
1992	San José, Costa Rica; Bogotá, Colombia	Latin America and the Caribbean	University of Costa Rica and the University of the Andes	122	19	Basic space science	Establishment of an astronomical observatory for Central America; establishment of a radiotelescope in Colombia (A/AC.105/530)
1993	Lagos, Nigeria	Africa	University of Nigeria and Obafemi Awolowo University	54	15	Basic space science	Establishment of an inter-African astronomical observatory and science park in Namibia (A/AC.105/560/Add.1)
1994	Cairo, Egypt	Western Asia	National Research Institute of Astronomy and Geophysics	95	22	Basic space science	Refurbishment of the Kottamia Telescope; participation of Egypt in the United States/Russian Mars Mission 2001 (A/AC.105/580)
1996	Colombo, Sri Lanka	Asia and the Pacific	Arthur C. Clarke Centre for Modern Technologies	74	25	From small telescopes to space missions	Inauguration of an astronomical facility in Sri Lanka (A/AC.105/640)
1996	Bonn, Germany	Eastern and western Europe	Max-Planck-Institute for Radioastronomy	120	34	Ground-based and space-borne astronomy	Assessment of the achievements of the series of United Nations/ESA workshops and foundation of a working group on basic space science in Africa (A/AC.105/657)
1997	Tegucigalpa, Honduras	Central America	Obervatorio Astronómico de la Universidad Nacional Autónoma de Honduras	75	28	Small astronomical telescopes and satellites in education and research	Inauguration of an astronomical observatory for Central America in Honduras (A/AC.105/682); first light at the Kottamia telescope expected in September 1997; first issue of the newsletter *African Skies* distributed
1999	Vienna, Austria	All regions	United Nations Office at Vienna	..	..	Basic space science (UNISPACE III)	..

I. OBSERVATIONS AND RECOMMENDATIONS

A. Basic space science, the Third United Nations Conference on the Exploration and Peaceful Uses of Outer Space (UNISPACE III) and the World Space Observatory

11. The importance of the opportunities offered by the forthcoming UNISPACE III were clearly recognized by all Workshop participants. As a consequence of the accomplishments of the six workshops on basic space science, regionally identifiable activities had been initiated worldwide. The activities in Central America had culminated in the inauguration of the Telescopio Rene Sagastume Castillo in the Suyapa Observatory for Central America. The new observing facility, established in Honduras and open to all scientists in Central America, was clear evidence that the participation of developing countries in basic space science could be accelerated.

1. Public outreach programmes

12. It was noted that, to continue and further stimulate basic space science activities in the developing countries and maintain the impetus achieved, it was critical to ensure not only that the research activities were stimulated, but also that a broad base of support for basic space science was developed among the general public through a public outreach programme. Such support would make it possible to develop and sustain the direct participation of developing countries in front-line activities. That could only be done with a three-phase approach involving the following issues:

(a) Basic space science education;

(b) Further development of locally (and regionally) identified research and educational facilities, such as networked modern observatories of moderate size;

(c) Direct access to facilities for front-line basic space science.

13. Since the three issues clearly defined a practical and well-structured road to the accelerated participation of developing countries in the activities of basic space science, identifying the ways and providing the means of creating an environment to enable such participation on a regional and worldwide basis presented an important challenge for the next decade.

14. The progress made in communications and other space-associated technologies had created an environment in which such optimistic plans could be translated into reality, as long as Governments and space agencies were willing to collaborate.

15. Recognizing that for sustainable development in basic space science to take place in the next millennium a broad educational effort with a strong public outreach component was required, the Workshop participants recommended that activities should be associated with the preparations for UNISPACE III:

(a) Educating educators;

(b) Establishing general higher educational courses;

(c) Recognizing the career needs of scientists.

16. It was clear that such far-reaching goals could not be accomplished without overall coordination recognizing the regional nature of the task (cultural, linguistic etc.). That should involve the education process at all levels.

17. The inclusion of basic space science education in programmes of the United Nations Educational, Scientific and Cultural Organization (UNESCO) was seen as an effective means of ensuring that the current strong drive for educational efforts would be sustained in a more organized way and as such would open the way into the third millennium.

2. Networks of telescopes for research and education

18. It was noted that important research topics had been identified for studies requiring the rapid response capability that could be provided by networks of small telescopes. As the implementation of internationally and regionally networked telescopes would further the development of advanced techniques and management practices, such activities would directly benefit the development of the scientific infrastructure of developing countries and would indirectly benefit the general population. Such telescope networks would also represent an important mechanism for supporting and stimulating the above-mentioned educational activities.

19. The research topics referred to in paragraph 18 above were as follows:

(a) Stellar structure and evolution through long-term variability studies of eclipsing binaries and monitoring intrinsic variables;

(b) The detection and study of near-Earth objects;

(c) The detection and study of comets, asteroids and other small bodies in the solar system;

(d) Sustained weather studies of planets other than Earth;

(e) Discovery and study of short duration events in the universe such as supernovae, novae and other explosive phenomena;

(f) Space debris;

(g) Space weather forecasting through solar observations.

20. Since all tools required for the activities had a wide application in many other areas of human activity in a technologically advanced world, the resulting strengthening of the knowledge base of a country represented an important extension of the educational effort.

21. The participants, recognizing the threat to optical astronomy posed by unbridled growth of artificial night sky background illumination, noted that astronomers needed to make strong joint efforts to educate the public and local governments in order to ensure the preservation of the night sky for such investigations. The incomplete knowledge of certain kinds of celestial objects (for example, small bodies of the solar system) was a consequence of the lack of observatories at southern latitudes. It was therefore important for astronomers from developing countries to coordinate their efforts with their counterparts in the northern hemisphere in order to achieve a more complete view of the universe.

3. The establishment of the World Space Observatory

22. It was noted that the World Space Observatory would present an excellent possibility to enable basic space scientists in developing countries to work and collaborate on an equal basis with their counterparts in the developed world. Besides providing important new information on the evolution of the universe, the World Space Observatory would help to ensure that the efforts described in paragraphs 15-21 above would improve career opportunities for the technologically well trained and educated.

(a) World Space Observatory: a challenge for the new millennium

23. It had become clear from the operation of astronomical space observatories during the previous 25 years that much of the information needed to attack the major problems in astrophysics and cosmology could only be obtained if access to all wavelength domains was available to the entire astronomical community. That was needed not only to establish the nature of the nearby universe at redshifts corresponding to the current epoch, but also to gain more insight into the early stages of the evolution of the universe. Unless a detailed knowledge of the current stage of evolution of the universe was established, all determinations at high redshifts would be based on extrapolations.

24. It had also become clear that many aspects of the study, at widely different observation wavelengths, of the behaviour of objects in the neighbourhood of the galaxy, even within the confines of the solar system, had important implications with respect to more fundamental problems. The need for more critical testing of theoretical models meant that astrophysical observations would have to cover a broader range of wavelengths. One important aspect to be considered was the fact that, although astronomy would always be a serendipitous science, the current level of understanding was such that it was not possible to even come close to being able to predict the complete cosmic experiment of which the universe was made up.

(b) Importance of enhancing international collaboration on a worldwide scale

25. As a consequence of the discussions held in the context of the workshops on basic space science, there had been a significant increase in the participation of persons from developing countries in the scientific activities associated with space science, particularly in the areas of astronomy and planetary exploration. It was emphasized in the workshops that, unless a new mechanism was brought into being that would result in an accelerated approach to the development of science in those countries, together with a strong public outreach effort, there would be no possibility to bridge the existing gap in knowledge and its applications. A direct consequence of that would be that the developed world would continue to benefit from the “brain drain” in the developing world.

26. Consequently, there would be a continuation of the vicious circle where backlogs could only be overcome by direct technology transfer, a process that had been shown over the decades to be inefficient, as well as unsuitable in a free-market world, where cultural diversity represented a fact of life. To ensure that developing countries could participate in a self-identifiable way in the adventure of scientific development and also to create among young people an interest in seeking gratifying careers in basic space science, alternative approaches had been identified. One possible strong contender for an efficient tool for such stimulation was the World Space Observatory, referred to in the report on the workshop on basic space science held in Sri Lanka in 1996 (A/AC.105/640, paras. 10 and 11) as follows:

> “... Considering the increase in the participation of the developing countries in astronomy and space science and taking into account the foreseeable rapid increase of the participating professionals in the developing countries, it was important to establish the tools for their participation at the most advanced scale. Since access to smaller telescopes and the use of archival data in astronomy would result in an expanding and professionally competent astronomical community in the developing countries, it should be recognized that access to front-line facilities would be required for many scientists. As the costs associated with major ground-based facilities would often pose excessive economic burdens for the developing economies, such conditions would give rise to an unproductive conflict cycle in which many of the best trained scientists would tend to travel elsewhere for their professional lives, which would remove an important asset for their countries: highly trained people.
>
> “In a world where concentration of first-scale astronomical facilities is an unstoppable trend, a technologically attractive solution could be supplied by a World Space Observatory. That would also stimulate industrial development, enhance and improve communications infrastructure and allow ... local access to a prime astronomical facility.”

(c) Why the ultraviolet domain should be the first component of the World Space Observatory

27. It was noted that, in the programmatic outlook of the major space agencies, the observing facilities for the astronomical community in the ultraviolet domain were projected to face a severe lack of capabilities for the first 25 years of the next millennium. That would pose a serious problem to future generations in terms of the transferral of acquired knowledge and the related experience obtained through the educational systems. The Workshop participants considered the ultraviolet domain to range from 100 to 350 nanometres (nm) in the electromagnetic spectrum. The short wavelength limit set at 100 nm was determined by the point where specialized technologies had to be applied to obtain reasonable efficiency in the instrumentation. The long wavelength end set at 350 nm was associated with the atmospheric cut-off by the atmospheric ozone absorption and other issues affecting the efficiency of ground-based instruments. That wavelength domain was solely accessible from spacecraft, as not even stratospheric balloons could rise above the level where the ozone absorption was located. The main instrument that had opened up and served the needs of the international astronomical community in that wavelength domain had been the International Ultraviolet Explorer (IUE), a joint project of NASA, in the United States, ESA in Europe and the Particle Physics and Astronomy Research Council, launched in 1978, in the United Kingdom of Great Britain and Northern Ireland. IUE had been turned off on 30 September 1996, after over 18 years of successful orbital science operations for a wide community of astrophysicists.

28. The only observing capability in that wavelength domain, for the foreseeable future, could be supplied by the Hubble space telescope (HST). However, due to its multi-purpose nature, HST only support a limited amount of observations and with its exceptional optical quality, should only be used for investigations requiring its unique capabilities. It was also an important facility for the near infra-red and was vital for the direct imaging of cosmic sources.

29. The programmatic structure of the major space agencies did not currently include any project that would supply the general ultraviolet capabilities needed by the astronomical community. It had become clear in recent years that the major space agencies were not well placed to support the long-term needs of a scientific community on a global scale. The budgetary constraints of the major space agencies were often such that long-term operations of successful projects would be hampered by simultaneous pressure to develop new, technologically more interesting projects.

(d) Concept of the World Space Observatory

30. The basic idea behind the World Space Observatory was that general facilities for astronomical observations in the windows that required satellite observatories were better done through a project with worldwide support, participation and contribution than with specific projects defined in a more confined national configuration. There were various reasons for that, including the following:

(a) The needs were essentially similar in most countries, while specific study areas tended to show regional trends of equivalent scientific value;

(b) The needs for the stimulation of intellectual capabilities in developing countries could not be supported in their national environment alone with any other possible astronomical facilities (e.g. ground-based or otherwise) at economically viable costs;

(c) The continued need for studies bearing on the relevance of the place of humankind in the universe required continued support and could not be driven by addressing currently popular questions with prestigious projects only;

(d) A large community of astrophysicists (45 per cent of the active members of the International Astronomical Union (IAU) had been associated with IUE) would continue to demand support for their science, as an extensive interruption of that support over a period of more than a generation would have drastic effects on the evolution of knowledge, which would be an essential part of the cultural environment in the twenty-first century.

31. The World Space Observatory concept could in the long run include space observatories for different wavelength domains, including X-rays and gamma rays, even taking over the operations of projects launched by major space agencies with funding for limited duration.

32. The World Space Observatory should be conceived not as technology development projects for developed countries but as low-cost projects where the main emphasis would be on the required observation sensitivity and the stability of operations. Since many aspects of the necessary observatories might not involve the development of the most advanced technologies, but would rely on well-established technologies (such as communications satellites), the projects could be developed in a more cost-effective manner than projects normally undertaken by the major space agencies.

33. The current climate was especially suited to the initiation of such a concept for the following reasons:

(a) The concentration of facilities in astronomy: the limited number of high-quality facilities was an unstoppable trend;

(b) A mechanism for the indigenous development of science was a prerequisite for the developing world;

(c) The technology available for communications was sufficiently developed for the concept to be implemented without placing heavy economic burdens on all the parties involved;

(d) The spacecraft technology required for such an observatory had matured;

(e) The overall technological capabilities required to develop in the ultraviolet domain an orbital telescope 2 metres in size, with image quality in the range of 0.5 arcsec, could be envisioned as a project of limited costs;

(f) The chance to develop local capabilities with the direct and essentially local participation of all countries presented an enormously attractive possibility in terms of stimulating the interest of all levels of society in the exploration of the universe, especially if it were combined with a strong public outreach programme;

(g) A scientific community that had been shown to be thriving appeared to be left without observational opportunities.

34. It was noted that, with the participation of the major space agencies, such as NASA, ESA, and the Institute of Space and Astronautical Sciences of Japan and the Russian Space Agency, as well as the acceptance of the participative nature of such a project by all national agencies, the fundamental aspects of a World Space Observatory could easily be seen to be attractive and feasible.

B. Central American Astronomical Observatory in Honduras

35. In Central America, the initiative to establish the first astronomical observatory had begun in Honduras in the beginning of the 1990s, following a recommendation made at the United Nations/ESA Workshop on Basic Space Science held in Colombia and Costa Rica in 1992 (A/AC.105/530). The initiative had been based on a strategy of a continuous regional cooperation among national universities in Central America and strong cooperation with astronomers and prestigious astronomical research centres at the international level. Since 1994, a provisional astronomical observatory had been operating at the Universidad Nacional Autónoma de Honduras at Tegucigalpa. That academic unit, equipped with a 42-cm computerized telescope and supporting equipment, had been used to start a programme for training researchers and technicians in Central America. A number of agreements for cooperation with regional and international institutions were being prepared in order to further develop basic space science in Central America. The Workshop had inaugurated the Central American Astronomical Observatory at Tegucigalpa with the dedication of the Telescopio Rene Sagastume Castillo at the Suyapa Observatory for Central America.

C. Continuation of the United Nations/European Space Agency workshops on basic space science

36. In order to evaluate and study further the proposed activities for UNISPACE III, the co-sponsors had felt that it would be extremely desirable to extend the series of workshops on basic space science for one more year, to complete a process that had started in India in 1991, the aim of which was to evaluate and develop the structures necessary to enhance and accelerate the participation of developing countries in basic space science. If it were possible to establish a balanced programme such as the one proposed above, the accelerated technological development of developing countries would be placed on a firm basis, allowing them to expand their technological capabilities in basic space science in an efficient way.

37. The participants of the Workshop took note of the offer of the Government of Tunisia to host a workshop on basic space science in 1998 for the benefit of the African region. That workshop would present an opportunity to address fundamental aspects of the World Space Observatory in the context of UNISPACE III.

II. BASIC SPACE SCIENCE AT THE THIRD UNITED NATIONS CONFERENCE ON THE EXPLORATION AND PEACEFUL USES OF OUTER SPACE (UNISPACE III)

A. Basic space science in the Committee on the Peaceful Uses of Outer Space and the United Nations Programme on Space Applications

38. It was noted that basic space science could be "subdivided into planetary exploration" and "Astronomy", which were discussed under two separate items of the agenda of the Scientific and Technical Subcommittee. Although the Scientific and Technical Subcommittee had been able to promote coordinated action between countries or action by the United Nations, in the past few years Member States had used the two agenda items mainly to inform each other about national activities. The initiative to hold the series of workshops on basic space science had emerged from a request by Member States to strengthen the development of basic space science worldwide. Many Member States had delegated persons to be participants at the workshops or, like ESA, had co-sponsored workshops. The workshops had been hailed particularly because of the positive impact they had made through follow-up projects. The Scientific and Technical Subcommittee at its thirty-fourth session had taken note of the results of the workshops under its agenda item on the "United Nations Programme on Space Applications" (A/AC.105/672, paras. 23-37). The results had been further discussed under the two agenda items on basic space science. In order to further develop basic space science, the Scientific and Technical Subcommittee might wish to address the subject in a policy-oriented way in addition to exchanging information on the subject. In the field of basic space science, intergovernmental action (i.e. through space agencies) was needed and non-governmental cooperation might not be sufficient.

B. The need for a new approach

39. It was noted that the Committee on the Peaceful Uses of Outer Space had discovered the advantage of multi-year work plans. The Scientific and Technical Subcommittee had initiated a three-year work plan on space debris in 1996 and the Legal Subcommittee would start a three-year work plan on the review of the outer space treaties in 1998. Topics from the field of basic space science, such as those contained in the reports on the workshops on basic space science, could become subjects for work plans in the Scientific and Technical Subcommittee as well. The most prominent topics were the proposal for a World Space Observatory, a small telescope network and the question of greater integration of developing countries in international research. Suggestions on possible future action had been prepared by the Secretariat in 1996 (A/AC.105/664). Additionally, the regional centres for space science and technology education could integrate regional activities in basic space science (A/AC.105/649).

C. The setting of UNISPACE III

40. It was noted that the General Assembly, in its resolution 52/56, paragraph 23, had agreed that UNISPACE III should be convened at the United Nations Office at Vienna from 19 to 30 July 1999 as a special session of the Committee on the Peaceful Uses of Outer Space, open to all Member States of the United Nations. UNISPACE III would also have an exposition and a programme with workshops, seminars and public outreach activities. Thus, UNISPACE III would provide a forum in which Member States could: (a) provide guidelines for the United Nations space agenda and activities; (b) coordinate their national space activities and possibly generate cooperative projects; and (c) demonstrate—also to the public—the benefits of space science and technology for life on Earth.

41. It was noted that, where as the First Conference on the Exploration and Peaceful Uses of Outer Space, held at Vienna in 1968, had taken place at the very beginning of the space age and UNISPACE 82 had been held at Vienna in 1982, at a time when the North-South conflict had been most severe and the East-West conflict had been re-emerging, UNISPACE III would in 1999 have an almost ideal international setting: (a) the East-West conflict had vanished and had given way to more cooperation than competition in outer space, as evidenced by the International Space Station; (b) the North-South conflict had been resolved, as evidenced by the adoption by the General Assembly of the Declaration on International Cooperation in the Exploration and Use of Outer Space for the Benefit and in the Interest of All States, Taking into Particular Account the Needs of the Developing Countries (General Assembly resolution 51/122, annex, of 13 December 1996), which had originally evolved out of the conflicting concepts of 13 developing countries under the leadership of Brazil and a German-French proposal; (c) the increasing global interest in basic space science through the exceptional findings on the possible existence of life on other planets, particularly on Mars, and water on the moon Europe orbiting Jupiter; and (d) the inclusion of basic space science on the agenda of UNISPACE III.

D. Basic space science in the draft provisional agenda for UNISPACE III

42. It was noted that, in the draft provisional agenda proposed for UNISPACE III (A/AC.105/672, annex II), basic space science was covered under substantive item 7 (b), entitled "Status and applications of space science and technology" under the topic "Basic space science and secondary applications of space technology". The purpose of dealing with basic space science was first an assessment of the status of research and secondly, an assessment of its benefits. According to the report of the Scientific and Technical Subcommittee, on its thirty-fourth session, "while reviewing the sub-items below, special attention should be paid to the scientific and technological developments that had taken place, taking into account the interests of all countries, in particular the developing countries, with regard to the global, regional and national issues" (A/AC.105/672, annex II, para. 22).

43. Basic space science had also been included in the proposal for workshops and seminars under item 8 of the proposed draft provisional agenda for UNISPACE III (A/AC.105/672, annex II, para. 22). The proposed topic was "Science and education (including astronomy)". The organizations that were to organize the activities included UNESCO, the Committee on Space Research (COSPAR), the International Astronautical Federation (IAF), the International Astronomical Union (IAU) and TPS. Other interested organizations would have an opportunity to provide input.

44. It was noted that all presentations and deliberations on basic space science would be reflected in the report on UNISPACE III. The report on UNISPACE 82 (A/CONF.101/10), contained a chapter dealing with basic space science entitled "State of space science and technology" (A/CONF.101/10, part one, chap. I). The report on UNISPACE 82 also contained a section entitled "The role of the United Nations: an assessment and recommendations"(A/CONF.101/10, part one, chap. III, sect. F), which did not focus on specific projects in the field of basic space science, but emphasized the promotion of greater cooperation in space science and technology between developed and developing countries (para. 430 (b)). That was where the workshops on basic space science had their origin.

E. Proposal on basic space science for the agenda of UNISPACE III

45. It was noted that basic space science should be dealt with in the report of UNISPACE III in a way that was distinctly different from the way in which it had been covered in the report of UNISPACE 82. Besides a part on the status of research, an equally elaborate part on policy should be included that would be based on the findings of the series of workshops on basic space science and would contain recommendations for action by Member States as well as by the United Nations. A proposal for a policy on basic space science is given below.

46. It was noted that basic space science not only reflected the human quest for knowledge of space, Earth and life itself, but was also a natural gateway to building indigenous space capabilities. Investment in basic space science not only increased knowledge but also opened the door for developing technologies of the space age. Those technologies included applications in the fields of telecommunications and Earth observation, many of which had originated in technologies developed for basic space science missions.

47. Member States should foster the educational and academic occupation with basic space science and provide for the necessary infrastructure for information in order to profit from the abundance of available data. Topics to be dealt with, which had been identified in the framework of the United Nations/ESA workshops on basic space science since 1991, included the following: (a) promotion of the advancement and dissemination of knowledge of basic space science and its applications to human welfare; (b) provision of on-line databases and e-mail and/or Internet services; (c) provision of abstracting and indexing services in basic space science; (d) dissemination of reliable information on basic space science to the public and for education; (e) collection and analysis of statistics on basic space science as a profession and as a branch of education; (f) encouragement of the documentation and study of the history and philosophy of basic space science; and (g) cooperation among organizations on educational projects at all levels, in particular in the field of coordination of educational material, as well as in public outreach programmes.

48. It was noted that since basic space science had not been involved in the trend of commercializing space activities, it remained the foremost field for international cooperation. There had traditionally been an open exchange, be it bilateral or multilateral, in intergovernmental organizations such as the United Nations or in non-governmental organizations such as COSPAR, IAF, IAU and TPS. Most missions in basic space science were conducted through international cooperation and the data and results were distributed almost worldwide. Cooperative networks had emerged not only between countries with space capabilities, but also between them and developing countries lacking such capabilities. That network of international cooperation should be developed further in order to integrate developing countries into the international scientific community. International cooperation should be conducted on the level closest to where it would have its impact. Thus, there would be a system of global, regional or bilateral cooperation that would be able to take particular account of the needs of developing countries. Through their own efforts in the field of education, those countries would be able to participate in international programmes with activities ranging from analysing data to being partners in space missions, as in the World Space Observatory concept.

49. It was noted that the role of the United Nations should be to focus on the needs which would have to be dealt with at the global level and which would require the involvement of Member States. The Scientific and Technical Subcommittee might wish to identify topics that could be dealt with in multi-year work plans in order to find a common understanding among Member States of the need for coordination or joint action. Such topics could include (a) coordination of the observation of near-Earth objects; (b) basic space science education; (c) data analysis and participation in space missions; and (d) utilization of the World Space Observatory concept. The United Nations Programme on Space Applications, with the organization of the series of workshops on basic space science, should act further on as a forum for identifying areas where there was a need for action and as an initiator and accompanying institution for concrete projects such as the follow-up activities of the workshops. The regional centres for space science and technology education (A/AC.105/649) should, whenever possible, be integrated into regional activities.

50. It was noted that Member States should constructively work on finding solutions for topics in basic space science dealt with in the Committee on the Peaceful Uses of Outer Space. They should also support the United

Nations in the implementation of activities in the field of basic space science. They should maintain the cooperative and open spirit prevailing in the field since the beginning of space activities. Member States with space capabilities should focus their activities in the field of cooperation with developing countries on the topics mentioned in paragraph 49 above. All Member States should be called upon to promote basic space science in their educational systems and in their space programmes.

51. It was noted that basic space science was increasingly coming into conflict with other, often commercially oriented space activities, such as in the use of the electromagnetic frequency spectrum. It would also be affected by space debris and light pollution to an increasing extent. While basic space science benefited from various general provisions of outer space law through reference to the international scientific community, no special provision had been made in its favour.

52. Regarding policy-oriented fields of action, it was noted that it had been necessary to integrate basic space science in the proposed draft provisional agenda for UNISPACE III. The presentation of basic space science at such an intergovernmental conference under item 7 (b) would primarily depend on the interests of Member States. They would have to be convinced by the above developed line of policy-oriented action. A prominent place should be given to the follow-up projects of the workshops on basic space science and the possible endorsement of the World Space Observatory concept. Subjects in the field of basic space science could also be discussed under item 7 (d), entitled "Promotion of international cooperation". In particular, the exploration of Moon and Mars as an international task could become a leading theme. In addition, all efforts should be made to reflect as much as possible the fascination of basic space science in the accompanying workshops and seminars and in the public outreach programme. Non-governmental organizations should take the initiative in those efforts.

III. SELECTED PROJECTS

A. Network of Oriental Robotic Telescopes

53. It was noted that, at a time when robotic telescopes were widely used, networks of such equipment constituted a key issue, opening basic space science to numerous countries without large or sophisticated observing facilities. Foreseeing that evolution, the Network of Oriental Robotic Telescopes (NORT) project was proposed, whereby a network of small robotic telescopes would be set up on high mountains (around 3,000 m) located from Morocco to China. The complementarity of other robotic telescopes in developed countries and NORT countries from Africa to Asia would be a valuable contribution to the non-stop observation of variable objects.

54. Many scientific objectives could be achieved with small (60 cm) and medium-sized (1.50 m) telescopes by photometry, polarimetry and spectroscopy technologies, among them the observation of the following:

(a) Intrinsic variables: low-mass red giants with mass loss and irregular red giants or supergiants (e.g. Mira and mu Cep), RR Lyr stars and the Blasko effect, pre-white dwarfs, RV Tau stars (e.g. 89 Her), dust-shell stars in post-AGB phase (bipolar flow), central stars of planetary nebulae and their ejected mass;

(b) Eruptive variables: irregular B and Be stars (Pleione, 5 Dra, OT Gem), Orion variables with diffuse nebulae, T Tau variables, flash stars connected with diffuse nebulae (V 389 Ori), ultraviolet Cet flare-type stars, rapid irregular variables (RW Aur type), novae and supernovae, Haro-Herbig objects with short time variations, RCB-type stars etc.;

(c) Binary stars, mainly with matter exchange (DQ Her);

(d) Meteors and comets: searches, confirmation, behaviour of central condensation and of comet tails, comet flares, comet rotation and comet jets;

(e) Earth satellites and related phenomena: position timings and photometry for orbit equation or physics of the object (volcano on Io), weather and albedo changes, the motion of Jupiter spots, the great dark spot on Neptune;

(f) Near-Earth objects: discovery and follow-up of near Earth objects having a high speed of 2-3 degrees per day;

(g) Planets around nearby stars.

55. The achievement of such scientific objectives by non-stop observation and their interpretation could be a transition into contemporary basic space science for many developing countries. They could initiate collaborations through regional and/or global networks. It was noted that, among those scientific objectives, the best example seemed to be the understanding of the stellar variability owing to stellar interior effects and/or the exchange of matter between the outer layers and/or mass loss in the interstellar medium, due to hydrodynamical model-atmosphere calculations. It was related to industrial challenges such as the application of supersonic flows in space technology (entrance in the planetary atmospheres, turbines etc.). Thus, behind the basic space science challenges opened by telescope networks were other challenges that were technologically and industrially driven.

56. It was noted that, for a decade, coordinated international campaigns had been launched from sites providing sufficient longitude and latitude coverage and/or with instruments working at complementary wavelengths. Such campaigns with existing telescopes were useful for testing the observational techniques and developing data reduction programmes. They resulted in international collaboration and access to multi-wavelength techniques. However, they had significant drawbacks: handling and transportation of the equipment, adapting it to various existing telescopes, lost nights due to cloudiness, high costs restricting the possibility of numerous campaigns per year (usually one or two lasting a week each), problems with data reduction techniques that varied from site to site etc. The pitfalls of coordinated observing campaigns and of reduction techniques were well known. The few monitored stars during a campaign were short-period variables, such as white dwarfs, delta Scuti and RoAp stars, having periods ranging from seconds to hours or days.

57. It was noted that one of the main objectives of establishing networks was to make possible the participation of developing countries actively interested in basic space science and in front-line scientific research and the organization to fulfil it. The progress already achieved in the knowledge of astronomical variable objects with the proposed size of telescopes would be improved by time-variation follow-up. Such a network would also promote a new type of cooperation on variable object research with larger facilities such as optical and infra-red long baseline interferometers: GI3T, ISI, VLTI, or HST, which were mainly required at critical phases of the variability of studied objects, phases to be determined through the permanent follow-up by the networks.

B. Observing near-Earth objects

58. It was noted that the study of near-Earth objects had already been recognized by several international organizations, including the United Nations, as an important scientific and social endeavour. That had been demonstrated by the International Conference on Near-Earth Objects, held in New York from 24 to 26 April 1995, by the adoption by the Parliamentary Assembly of the Council of Europe of its resolution 1080 (1996) of 20 March 1996, on the detection of asteroids and comets potentially dangerous to humankind, and by the recommendations of the workshops on basic space science (A/AC.105/657, paras. 21-22, and A/AC.105/664, paras. 37-39).

59. It was noted that the participation of all countries in near-Earth objects studies was both possible and welcome. Near-Earth objects constituted one of the fields in science where every country could provide a valuable contribution. Near-Earth objects research represented an opportunity for developing countries because:

(a) It could stimulate the development of scientific and technical capabilities in a field at the forefront of science;

(b) It did not require a highly sophisticated technical capability but did require thorough involvement in the scientific problems related to data acquisition and analysis;

(c) It might allow direct and immediate involvement of scientists in a worldwide effort aimed at protecting all countries on Earth from the consequences of disastrous impacts.

60. It was noted that one international organization able to coordinate activities in the field of near-Earth objects was the Spaceguard Foundation, which was receiving increasing support from space agencies (NASA and ESA). The principal goal of the Foundation in the coming years would be to set up around Earth a network of telescopes, in size ranging from small (25-40 cm) to large (3 m and over). Centralized coordination would be ensured by the establishment of a spaceguard central node.

61. Particular attention must be devoted to training and educating professionals, especially in developing countries. Near-Earth objects research required, by its nature, a high level of interactivity among different countries and different observers, thus acknowledging all recommendations put forward by the workshops on basic space science on the subject and representing a good example of international cooperation in the field of basic space science.

62. It was recommended that the topic of discovery, follow-up and physical characterization of near-Earth objects should be discussed at UNISPACE III for the following reasons:

(a) To establish a worldwide telescope network capable of discovering and following objects down to 500 m in size (visual magnitude: 22);

(b) To provide such a network with the necessary computing and connecting capabilities, so that each new discovery could be followed up and its reliable orbit could be computed in quasi-real time;

(c) To ensure the concurrence of all countries in that international effort, to provide training and education in the field to interested developing countries;

(d) To facilitate the establishment of dedicated centres worldwide, especially in the southern hemisphere, where there was a lack of such installations;

(e) To promote and support the coordinating activities of the Spaceguard Foundation.

Notes

[1]*Official Records of the General Assembly, Fifty-first Session, Supplement No. 20* (A/51/20), para. 39.

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