WORLDWIDE DEVELOPMENT OF ASTRONOMY
THE STORY OF A DECADE OF UN/ESA WORKSHOPS ON BASIC SPACE SCIENCE

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Basic Space Science

With the establishment of the United Nations Committee on the Peaceful Uses of Outer Space\(^1\) (COPUOS) in 1959, the Office for Outer Space Affairs\(^1\) of the United Nations Secretariat was assigned the responsibility for implementing decisions of the Committee, its Legal Subcommittee and its Scientific and Technical Subcommittee related to the promotion of international cooperation in outer space matters. Among the primary tasks carried out by the Committee is the development of international treaties, conventions or legal principles governing the activities of Member States in the peaceful exploration and use of outer space and the provision of technical assistance and information on space science and technology to interested Member States.

Following the decision of COPUOS to take upon itself the promotion of international cooperation in space science and technology, the United Nations Programme on Space Applications\(^1\) was established in 1969 with the objective, inter alia, to provide scientists from developing countries with educational programmes in remote sensing, satellite meteorology, satellite communications, and basic space science. The activities of this programme are subject to the annual review and approval of COPUOS. Because of the increasing importance for developing countries to be actively engaged in space science research, the United Nations and COPUOS have, from the beginning of the 1990s, begun to place an increased emphasis on promoting education and research in space science and technology, as well as planetary studies under the common denominator “Basic Space Science”.

Of the 185 Member States of the United Nations, nearly 100 have professional or amateur astronomical organizations. Only about 60 of these countries, however, support their astronomical community and scientific interests through a membership in the International
Astronomical Union (IAU) (Percy and Batten). The distribution of first rank astronomical observatories has shown strong change over the past 50 years, since many of the high quality observing sites, required for the major facilities, are located in developing countries and also the utilization of space observatories to overcome the limitations of the Earth atmosphere, have introduced new parameters and supply previously unavailable possibilities and mechanisms for the participation of developing countries in Basic Space Science.

**UN and ESA Initiated Workshops on Basic Space Science**

In 1990, as part of the United Nations Programme on Space Applications, the United Nations, in cooperation with the European Space Agency (ESA), initiated the organization of annual Workshops on Basic Space Science (Jasentuliyana) for developing countries as shown in Table 2. These Workshops were originally planned to be held as a unique series in each of the following five regions of the world: Asia and the Pacific (ESCAP), Latin America and the Caribbean (ECLAC), Africa (ECA), Western Asia (ESCWA), and Europe (ECE). This subdivision by region follows the United Nations principles to assess the relevance of space activities to worldwide economic and social development.

At the time of this writing, six UN/ESA Workshops on Basic Space Science have been held, respectively in India (1991), Costa Rica and Colombia (1992), Nigeria (1993), Egypt (1994), Sri Lanka (1995), and Germany (1996) (cp. Table 2). An assessment of the achievements of this series of Workshops was made during the sixth Workshop held in Bonn (Germany) in 1996; the region of Europe does not comprise developing countries but the Government of Germany made it possible to organize at least once such a Workshop in a highly industrialized country. The seventh Workshop will be held in Tegucigalpa, Honduras and there is an indication of interest on part of the Government of Tunisia that the Workshop in 1998 will be organized in Tunisia. Based on a decision of the United Nations General Assembly, the UNISPACE III Conference will be held at Vienna, Austria, in July 1999 as a special session of COPUOS, open to all Member States of the United Nations. This conference will provide the opportunity to undertake a final assessment on what the UN/ESA Workshops on Basic Space Science have accomplished in making a contribution to the worldwide development of astronomy and space science. In 1992, The Planetary Society joined the organization of the UN/ESA Workshops in order to establish a more equivalent emphasis on planetary science and exploration in the programme of the Workshops. Other organizations joined in the support on these UN/ESA Workshops, and taking into account the status in 1997, the Workshops are co-organized by the German Space Agency (DARA), the National Aeronautics and Space Administration (NASA), the Institute for Space and Astronautical Sciences (ISAS), the International Centre for Theoretical Physics (ICTP), the
Austrian Space Agency (ASA), and the French Space Agency (CNES) (Haubold et al.4).

Although the general content of the UN/ESA Workshops was chosen to highlight the interest and importance of Basic Space Science in a rather broad context, some special aspects were normally addressing the interests of local organizers and the ongoing research activities in the respective region. The topics included the following fields:

- International cooperation in basic space science;
- Education for space science;
- Solar terrestrial interaction;
- Planetary science;
- Space astronomy and astrophysics;
- Cosmology; and
- Data bases and on-line data in astronomy.

The Workshops were hosted by the Government of the respective country in which they were held; Government representatives were actively involved in the organizational and scientific preparations for the Workshops which helped to enhance awareness and interaction between the Government and the local scientific community. This ultimately proved crucial to the achievements of the Workshops’ objectives. A vital part of the programme of each Workshop were the Working Group sessions which provide all participants with a common platform to make critical observations and recommendations addressing the development of Basic Space Science in their specific region. These observations and recommendations are available in the published Workshop Proceedings5−10 and are also contained in United Nations reports11 on each Workshop (carrying a UN documents number A/AC.105/...). These reports are available for distribution to governments (particularly through COPUOS and its Scientific and Technical Subcommittee), national, regional, and international organizations as well as concerned scientific institutions and universities. This collection of observations and recommendations constitutes a unique international framework for the development of astronomy covering five major regions (and almost all developing countries) of the world, especially highlighting the commonality of the problems and their possible solutions. To prepare the Workshops on a regional basis, the United Nations invited astronomers to submit studies on the current status of astronomy in the regions, which will be published in a separate booklet titled “Developing Astronomy and Space Science Worldwide”.
Follow-Up Projects Benefit Astronomy

Although a number of large facilities for front-line research are located in developing countries, these large, and often internationally funded projects will not necessarily contribute to the overall scientific development of the country where it is located. Unless a sufficiently qualified and educated population exists in the host country, such institutes may not significantly stimulate the overall participation in Basic Space Science. These facilities take often mainly advantage of the climatological and geographic attributes of any country in the world, particularly in developing countries, without necessarily generating a culturally identifiable activity in the host country. On the other hand it has been strongly emphasized that the establishment of networks of existing small scientific facilities could be a much more efficient means to strengthen international cooperation, particularly in geomagnetic studies, electrojet current measurements, solar photometry, astrometry, galactic mapping, and optical astronomy (the 1996 Workshop in Germany even addressed the question of the worldwide distribution of locations of facilities for neutrinos, gravitational-wave, and cosmic rays astronomy). Such Basic Space Science activities, which have their direct interest associated with the climatological and socio-economic conditions of the developing countries, can probably generate a considerably stronger support for the Basic Space Science in the developing countries and may therefore be much more efficient.

As an example the international, electronically-linked observing programmes (similar to the 'Whole Earth Telescope' project, the value of which has become evident through successfully observing runs involving tens of globally distributed telescopes in recent years), present possibly very efficient means to stimulate the scientific development. Such programmes could be expanded to include more active participation of developing countries at relatively low cost to them.

In addition to the common direct benefits of an international scientific workshop, the UN/ESA Workshops have stimulated a number of follow-up projects which have been implemented through the Workshops or will be implemented on a long-term basis.

Astronomical Telescope Facility in Sri Lanka\textsuperscript{5,12,13}

The Government of Japan took the initiative to support the establishment of national astronomical centers for astronomical education and observational studies in the Asia and Pacific region (ESCAP) through the provision of moderate-sized astronomical research telescopes or planetaria. Over the past several years, Singapore received a Mitaka-kokhi 40cm reflector for its science centre of public education, and Malaysia started operating a Minolta Planetarium at its space science education centre. Through the Japanese Cultural Aid Grant Programme, Thailand was able to install a Goto 45cm reflector at the Department of Physics of the Chulalongkorn University Bangkok, and at the Bosscha Observatory (Hidayat\textsuperscript{14}) in
Lembang, Indonesia (the latter one is mainly used for astronomical research). As a result of
the UN/ESA Workshops, Sri Lanka has also received a 45cm astronomical telescope, which
has been installed at the Arthur C. Clarke Centre for Modern Technologies at Katubedda
Moratuwa, Sri Lanka. Such moderate-sized optical telescopes, set up at appropriate loca-
tions on Earth, can contribute in an important way to astronomical research. The 45cm
Goto telescope is equipped with a photometer, a spectrograph and a photographic cam-
era. Although the telescope was designed primarily for photometric observational studies of
variable stars, it also allows observations of comets and asteroids as well as studies of inter-
stellar, interplanetary, and atmospheric dust. A network of telescopes of this type, equipped
with modern charge coupled devices (CCD) detectors and the appropriate small personal
computer systems, throughout a region, or even worldwide could form an very powerful net-
worked tool for many types of astronomical research (Warner\textsuperscript{10}, Budding\textsuperscript{10}). Such a system
could foster regional and international cooperation in astronomical research as in the case
of the ‘spacewatch’ programme.

\textit{Colombia\textsuperscript{7} and Honduras\textsuperscript{8}: Taking the Initiative in Central America}

An international cooperative programme for the Galactic Emission Mapping project (GEM) formed by Brazil, Colombia, Italy, and the United States of America is now operating
a radio telescope in Colombia in order to survey the galactic emission at long wavelengths
(de Amici et al.\textsuperscript{7}). The GEM project is funded by the United States National Science Foundation and by COLCIENCIAS in Colombia. Accurate and complete maps of the diffuse
galactic emission in the range of 0.5 - 10 GHz are required in order to study cosmic ray
electrons in the galactic disk and the galactic magnetic field. The galactic signal is also the
most relevant foreground contamination in cosmic microwave background radiation (CMBR)
experiments. Improving the understanding of galactic emission at long wavelengths is there-
fore an essential task for extracting cosmological information contained in present and future
generations of CMBR experiments. The Galactic Emission Mapping project is carrying out
observations from a number of sites at different latitudes. The instrument consists of a
5.5-metre parabolic reflector and receivers at 408, 2,300 and 5,000 MHz. Taking data at
several frequencies allows for the determination of spectral indexes of the different emission
processes. Preliminary analysis and prototype tests indicated that a substantial improve-
ment over the existing maps will be achieved within a few years from the beginning of the
observing programme. A first observing campaign from the White Mountain Research Sta-
tion in California, United States, has been completed in November 1994. Observations from
an equatorial site in Colombia started in February 1995. Because of its equatorial latitude
and the presence of high peaks in the Andean mountain range (higher than 4000 metres),
Colombia is an ideal location for astronomical and radio astronomical research. Access to
the northern and southern celestial hemispheres with the same instrumentation opens a window of opportunity for research in astronomy. Currently, scientific opportunities and the feasibility of establishing an astronomical observatory in Colombia are being pursued.

The establishment of an Astronomical Observatory for Central America in Honduras, as well as the Central American Association of Astronomers and Astrophysicists (Pineda de Carias\textsuperscript{8}), are very important for the scientific development of the region as discussed extensively during the UN/ESA Workshops on Basic Space Science. Building an astronomical observatory for the six Central American countries has been initiated in Honduras at the beginning of the 1990s. The establishment of the observatory has already been achieved, following a strategy based on regional cooperation involving national universities in Central America and at an international level, by making contact with astronomers and prestigious astronomical research centres. Since 1994, the astronomical observatory is operating at Tegucigalpa, at the Universidad Nacional Autonoma of Honduras. This academic unit has been equipped with a 42cm computerized telescope with a CCD and other supporting facilities. In 1995, the observatory hosted the first Central American course in astronomy and astrophysics and, jointly with other European and Latin American universities, is currently promoting a regional training programme for astronomers of Central America. Several important cooperation agreements are in the process of being signed in order to contribute to the development of Basic Space Science in the region. The observatory will host the seventh UN/ESA Workshop on Basic Space Science in June 1997 (cp. Table 2).

\textit{A Large Astronomical Facility for Africa?\textsuperscript{8}}

A proposal for an Inter-African Astronomical Observatory and Science Park on the Gamsberg in Namibia was endorsed by the United Nations as a result of the UN/ESA Workshops. Because of its unique geographic location, southern Africa can make an immense contribution to Basic Space Science. For time-critical phenomena in astronomy, 24-hour coverage can only be obtained through astronomical observatories in continents (excluding Antarctica) south of the equator. The Gamsberg has been identified as one of the most suitable sites for an observatory in southern Africa. It is a table mountain 120km south-west of Windhoek above the Namib desert at an altitude of 2350m above sea level. It experiences a large number of cloudless nights, a dark sky, excellent atmospheric transparency and low humidity, equal to the well-known astronomical sites in Chile. The mountain top is owned by the Max-Planck-Society of Germany and a small astronomical station was established there in the 1970s (Elsaesser\textsuperscript{8}). Besides astronomy, the mountain is of considerable interest to other scientific disciplines such as cosmic ray physics, atmospheric research and meteorology. The huge plateau of about 250 hectares offers enough space for various independent installations. The Max-Planck-Institute for Astronomy at Heidelberg, Germany, made ef-
forts to initiate the development of a new scientific centre on the Gamsberg. This can only be achieved, however, with strong international collaboration and support in kind and cash. South Africa had expressed an interest in operating the astronomical observatory on behalf of the international community. The ideal solution would be an Inter-African Science Park. The Government of Namibia, as well as the Windhoek University, had also expressed support for this project. If established in the future, this facility could become an important focus in the development of Basic Space Science in African countries (Okeke and Onuora8). If the facility is established with a viable infrastructure, it is possible that it would be attractive to northern hemisphere countries as well, especially those wishing to establish facilities in the southern hemisphere. The United Nations has been informed in 1996 that current circumstances do not allow to further pursue the project.

The Kottamia Observatory: The Largest in Western Asia9,10

The Kottamia Observatory, housing a 74-inch reflecting telescope, is located in the north-eastern Egyptian desert, 80km from Helwan, Egypt, on the Cairo-Suez road. Because the Kottamia Observatory telescope facility can supply major observational capabilities for Basic Space Science in the region, its importance cannot be underestimated. Hence, to safeguard the importance of this telescope facility, further development was needed (Mikhail9,10). Mindful of this, deliberations of the UN/ESA Workshops noted with great satisfaction that there is a willingness to cooperate on a regional basis in this effort. This has in the meantime resulted in a more formal collaboration between scientists in the Western Asia region to enhance the Kottamia Observatory and at the same time share the other existing astronomical facilities in the region. This represents a very important new scientific collaboration initiative in Western Asia. It is the intention of the Government of Egypt to open the Kottamia Observatory to scientists from the entire region in order to allow access to the observational opportunities for Basic Space Science. The plans of astronomers from other countries, both in Western Asia and Africa, to share in the future development of the Kottamia Observatory, will contribute to the future development of Basic Space Science in the region and will enhance significantly the opportunities for cooperation among astronomers in the region. It was finally decided in 1994 to contract the refurbishment of the Kottamia telescope after the evaluation of several submitted tenders. The National Research Institute of Astronomy and Geophysics (NRIAG) at Helwan and the Ministry for Science and Education of Egypt entered into a contract financed completely by the Egyptian Government. The task includes the design and manufacture of a new optical system for the 74-inch telescope tube. The mirror materials are made from Schott Zerodur to ensure superb optical quality in the respective temperature range for observations. In order to achieve a high-quality optical surface in working conditions, i.e. in all applicable positions of the telescope, a new support or
mirror cell for the primary mirror was necessary. Therefore a new 18-point support instead of the old 9-point support was proposed and was part of the project. The new optics is integrated in the nearly 30-year-old Kottamia telescope and first light is expected in June 1997. In July 1995 the representatives of NRIAG accepted the test results of the blanc for the primary mirror at Carl Zeiss in Germany. The mirror is still being ground and polished, resting on an 18-point support just as in the future telescope cell. The procedure has taken several months, first creating a spherical surface of already high surface quality and then gradually approximating the required spherical shape. Preliminary tests of the mirror shape showed excellent results, and the preliminary acceptance tests were accomplished according to schedule in 1996. As part of this collaboration also plans are under consideration for the identification of a high quality astronomical site in the region for completely new state-of-the-art modern large astronomical telescopes.

**Participation of Egypt in Future Mars Rover Mission**

The Planetary Society, a major cosponsor of the UN/ESA Basic Space Science Workshops, is following up the suggestion that Egypt participate in the US-Russia Mars Rover mission in 2001 through involvement in the design, building and testing of a drill for obtaining subsurface samples. The Planetary Society informed the Space Research Institute (IKI) of the Russian Academy of Sciences about the idea, and they, in turn, formally invited the Egyptian Ministry of Scientific Research to study the concept for potential use on the US-Russia Mars 2001 mission. Of the many important scientific objectives of the Marsokhod mission, among the most interesting, is the analysis of sub-surface samples. Inclusion of some sort of drilling mechanism in the payload of such a mission would assist scientists in the investigation of volatiles, organic materials and mineralogy. Twenty years ago, the arm on the Viking Mars lander was able to obtain samples from depths up to 10 cm. Today, a drill with the capability of boring at least an order of magnitude deeper (more than one metre) would be essential to further research and investigation. Egypt has expertise in drill development. Many years ago, as part of the archaeological exploration of the pyramids, a sophisticated drilling system was developed to drill into and deploy a camera into a sub-surface chamber without allowing air into the chamber. The drill perforated the limestone to a depth of 2m without the use of lubricants or cooling fluids that might have contaminated the pit’s environment, and successfully collected (six) samples. This experience as well as more common terrestrial applications suggest that the necessary technology base for a drill development can be brought together. In the proposed application for the Mars 2001 mission, Egypt would assume the financial responsibility for the drill as part of their Marsokhod participation. A study team of Egyptian scientists, collaborating with American, Russian, and European scientists, is now pursuing the project.
World Space Observatory

In all UN/ESA Workshops on Basic Space Science, it was stated that, considering the increase in the participation of the developing countries in astronomy and space science and taking into account the foreseeable rapid increase of participating professionals in the developing countries, it is important to establish the tools for their participation at the most advanced level. 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 are required for many scientists. As the costs associated with major ground-based facilities often pose excessive economic burdens for the developing economies, such conditions give rise to an unproductive conflict cycle in which many of the best trained scientists 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 the communications infrastructure and allow independent local access to a prime astronomical facility.

A Worldwide Network of Telescopes for Observing Near-Earth Objects?\textsuperscript{15,16}

The recent impact of the comet Shoemaker-Levy 9 on Jupiter has renewed the interest in the small bodies in the inner solar system “Near Earth Objects” (NEOs). Pursuing the understanding of the Near-Earth Objects has become an issue of global interest. The Explorers Club and the United Nations Office for Outer Space Affairs organized an International Conference on Near-Earth Objects (Remo\textsuperscript{15}). Researchers in the fields of astronomy, planetary science, astrophysics, paleontology and astronautics joined in a multi-disciplinary forum to discuss related topics. Among the topics addressed by the conference was the establishment of observational facilities dedicated to NEO studies. As a first step, these facilities could be associated with existing small astronomical observatories, also in developing countries. Observational programmes could be coordinated with activities of amateur astronomy groups and organized on an international scale which may lead to the establishment of a network of moderate-sized astronomical telescopes as discussed in the UN/ESA Workshops on Basic Space Science.

Usage of Archival Data

As a consequence of the UN/ESA Workshops, scientists have also become much more aware of the importance and availability of archival data, especially from space observatories, and their importance for educational purposes as well as the capabilities to do front-line
science even with modest means. One of the most widely spread archives of space data is the archive of the International Ultraviolet Explorer satellite (IUE). The concept and design of its distribution system ULDA (Uniform Low Dispersion Archive) has made the distribution of these data to many sites where no previous experience with space data could be foreseen a practical reality (Wamsteker et al.17). Figure 1 illustrates the worldwide distribution of the IUE/ULDA. To show how the usage of the data in the developing countries compares with that in the ESA Member States, Table 1 show the usage statistics over the past 8 years. It becomes evident from these data that these facilities are an important research tool also for scientists in developing countries.

Conclusions

The observations and recommendations made during the past six UN/ESA Workshops on Basic Space Science can be summarized in the following topics which need to be addressed urgently on a regional and international level: (i) promotion of the advancement and dissemination of the knowledge of Basic Space Science and its application to human welfare, (ii) provision of on-line databases and electronic mail services, (iii) provision of abstracting and indexing services in Basic Space Science, (iv) dissemination of reliable information on Basic Space Science to the public, (v) collection and analysis of the statistics on the profession and education in Basic Space Science, (vi) encouragement of the documentation and study of the history and philosophy of Basic Space Science, and (vii) cooperation with national, regional, and international organizations on educational projects at all levels.

Among the above topics, the electronic networking of scientific institutions may have the most immediate impact on the situation in developing countries. There exist large data archives in space science readily available at virtually no cost to any astronomer which has established access to the INTERNET and the World Wide Web. Space astronomy missions such as IUE, HST, COBE, ROSAT, IRAS, etc., have made their data archives publicly accessible through electronic networks.10,17 These archives are available to astronomers in any country on Earth as long as they have access to the INTERNET and the World Wide Web. These electronic networks also allow immediate access to electronic mail channels and electronic publications (e.g. the Astrophysical Data System), solving the traditional problem of isolation and obsolete libraries in many developing countries. The combined efforts of individual astronomers and the support of governments and international organizations could realize the concept of a “Global Village” in terms of astronomy and space science education and research worldwide.
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Table 2. Overview on the series of Basic Space Science Workshops

| Year | City           | Country         | Target Region                  | Host Institution                                                                 |
|------|----------------|-----------------|--------------------------------|----------------------------------------------------------------------------------|
| 1991 | Bangalore, India| Asia and the Pacific ESCAP | Indian Space Research Organization (ISRO)                                    |
| 1992 | San José, Costa Rica | Latin America and the Caribbean ECLAC | University of Costa Rica University of the Andes |
|      | Bogota, Colombia |                 |                                |                                                                                  |
| 1993 | Lagos, Nigeria  | Africa           | ECA                            | University of Nigeria and Obafemi Awolowo University                               |
| 1994 | Cairo, Egypt    | Western Asia     | ESCWA                          | National Research Institute of Astronomy and Geophysics (NRIAG)                   |
| 1995 | Colombo, Sri Lanka | Asia and the Pacific | Arthur C. Clarke Center for Modern Technologies (ACCMT) |
| 1996 | Bonn, Germany   | Estern and Western Europe ECE | Max-Planck-Institute for Radioastronomy (MPIfR)                                  |
| 1997 | Tegucigalpa, Honduras | Central America | Astronomical Observatory of the Autonomous National University of Honduras (OA/UNAH) |
| 1998 | Tunis, Tunisia  | Africa           |                                |                                                                                  |
| 1999 | Vienna, Austria | UNISPACE III Conference | UN COPUOS                                                                         |
| Year | Number of Participants/ countries | Topic/sub-topic of the Workshop | Follow-up project/UN Report |
|------|----------------------------------|----------------------------------|----------------------------|
| 1991 | 87, 19                           | Basic Space Science              | Establishment of Astronomical Facility at Sri Lanka Recommended A/AC.105/489 |
| 1992 | 122, 19                          | Basic Space Science              | Establishment of Astronomical Observatory for Central America Recommended Establishment of Radiotelescope in Colombia Recommended A/AC.105/530 |
| 1993 | 54, 15                           | Basic Space Science              | Establishment of Inter-African Astronomical Observatory and Science Park at Namibia Recommended A/AC.105/560/Add.I |
| 1994 | 95, 22                           | Basic Space Science              | Refurbishment of Kottamia Telescope Recommended Participation of Egypt at US/Russia Mars Mission 2001 Recommended A/AC.105/580 |
| 1995 | 74, 25                           | From Small Telescopes to Space Missions | Inauguration of Astronomical Facility at Sri Lanka A/AC.105/640 |
| 1996 | 120, 34                          | Ground-based and Space-borne Astronomy | Assessment of the Achievements of the Whole Series of UN/ESA Workshops Foundation of Working Group on Basic Space Science in Africa A/AC.105/657 |
| 1997 | 75, 25                           | Small Astronomical Telescopes and Satellites in Education and Research | Inauguration of Astronomical Observatory for Central America at Honduras |
| 1998 |                                 |                                  |                            |
| 1999 | open to all                      |                                  |                            |
|      | Member States                    |                                  |                            |
Table 1. National Host De-archival from IUE Uniform Low Dispersion Archive (ULDA)

(Users Community= 1,036 Scientists)

Total de-archiving supported (1988 until 1995) : 219,819 (3.5 spectra/hr.)

| Constituency          | IAU members | ULDA users | IUE/ULDA Use   |
|-----------------------|-------------|------------|----------------|
| ESA Member States     | 2472        | 734        | 107,874 (= 49 %) |
|                       |             |            | Percentage(ULDA Users/IAU members): 35 % Rate: spectra/ astronomer = 44 |
| Developing Countries  | 886         | 116        | 51,879 (= 21 %) |
|                       |             |            | Percentage(ULDA Users/IAU members): 16 % Rate: spectra/ astronomer = 64 |
| Others                | 189         |            | 60,066 (= 30 %)  |
IUE-ULDA Worldwide Data Distribution system
(February 1996)