

URSI CORSENDONK CONFERENCE

REPORT



INTERNATIONAL UNION OF RADIO SCIENCE
AVENUE ALBERT LANCASTER 32-B-1180
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**COVER DESIGN
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PREAMBLE

The Conference on URSI's future held on 8, 9 and 10 March 1987 at the fifteenth century abbey at Corsendonk, some 100 km away from Brussels, was in response to the increasing feeling that URSI's functions and goals need to be reassessed; that its links with telecommunications organizations need strengthening; that its visibility with scientific and technical organizations as well as with administrations, UN bodies and lay public must be considerably more than it currently is, that its international and global perspectives should include interests of scientists in developing countries; that its internal structure needs revitalization. To allow free and uninhibited discussion we decided to gather in a place where there will be no distraction, and where all participants can stay together. The choice of Corsendonk was Professor Van Bladel's.

The second important criterion was that the discussions should be externalized. What are the views of organizations outside URSI about URSI? How would they like to strengthen linkages, utilize the very large talent bank of the URSI community, provide the vistas for the future? We decided, therefore, to invite heads of operational agencies like CCIR, CCITT, ESA, IEEE, Popov Society, COMSAT, ESTEC, etc. URSI's linkages with many of these organizations have been longstanding, both direct and indirect; the indirect linkage occurring through the same community of scientists who are or have been active in both.

There was a third category of organizations that we believed we should intimately interact with: IPDC of UNESCO and Third World Academy of Sciences (TWAS) - a relatively new organization but with infinite promise; these provide the vital channel for bringing world developments in science and technology to the developing world. In addition, of course, we had the Chairmen and/or Vice-Chairmen of URSI's nine Commissions, the Officers of URSI and the Chairman of the Steering Group for Coordination of URSI Scientific Programme.

We are happy that most organizations responded by sending their senior people. There was thus a gathering of some thirty URSI and non-URSI people: all very distinguished and with widely different backgrounds and perspectives.

It was clear that URSI's future activities should be directed towards two broad goals:

- I. Geophysics and Probing
- II. Telecommunications

Two Discussion Groups were set up on these two broad goals under the Chairmanships of Dr. M. Petit and Professor W.E. Gordon. The discussions on I were enriched by the views of Prof. Gendrin representing IAGA perspectives and the question of overlap between activities of URSI Commissions G and H and IAGA, and inputs from Chairmen of Commissions A, G, H and J. In Gr. II, inputs came from CCIR, CCITT, ESA, COMSAT, IEEE as well as the relevant URSI Commissions B, C, D, E, F and G. Reports of the deliberations of these two groups are given in pp. 5-10 and pp. 11-13, and the initial inputs from Commission Chairmen and the non-URSI bodies are given as Appendices.

In addition to these purely scientific and technological goals, the discussions were centred on three other major areas:

- Relations of URSI with External Organizations
- URSI Publications
- URSI Internal Matters

In addition to the relations of URSI with other members of the ICSU family (IAU, IUGG, COSPAR, COSTED) and with ICSU itself, and with telecommunications organizations like CCIR and CCITT, a totally new and highly promising relationship is emerging between URSI and UNESCO's IPDC and URSI and TWAS. I have always believed that a major role of a truly global scientific body must lie in supporting, nurturing and encouraging the fragile scientific communities of the developing countries. URSI should be able to convey directly or through organizations like UNESCO and TWAS to scientists, technologists and administrators of these countries its firm belief that science is indeed an instrument for national development. This new relationship promises to bring in a new dimension to URSI's role for developing countries. TWAS programmes on providing libraries in developing countries with standard scientific text books and scientific journals and providing spare parts for scientific equipments in developing countries will strike a chord in the hearts of many URSI scientists who have for years been searching for mechanisms for donating books and equipments.

URSI's publications have in recent years been rather few: the *Review of Radio Science* and *URSI Information Bulletin*. To this meagre list has now been added, for the first time, the proposed volume on Tutorials and General Lectures to be released during the next General Assembly at Tel Aviv. The effectiveness, mechanisms for preparation and distribution of these volumes were discussed at great length: the results of these discussions are summarized in pp. 21-25. New questions raised included on whether URSI should bring out or sponsor a journal and whether it should bring out an additional (scientific) newsletter in addition to

the *URSI Information Bulletin*.

Like any old organization URSI has developed a set pattern of operation which some feel is unduly bureaucratic. I have heard statements that URSI in fact operates like a club. The internal structures and operation mechanisms and possible options were intensely discussed, including the periodicities of General Assemblies and autonomies of commissions. These are summarized in pp. 27-32.

URSI has had, in recent years, a very exciting experience with young scientists. The programme was started in 1981 at the Washington General Assembly, expanded in 1984 in Florence Assembly and is proposed to be continued with the same vigour at the Tel Aviv Assembly next August. There are two major guiding principles: one, young scientists are selected from *both* developing and developed countries (roughly in equal numbers); second, they are put up together so that they can calibrate each other and develop friendships. We believe this has brought in elements of self confidence in scientists from the developing countries with incalculable potential benefits. Professor Cullen's writeup (pp. 65-68) gives a short background of this exciting experience.

To elicit advance responses from the National Committees, a very preliminary (and I repeat very preliminary) account was circulated in March last. The persons quoted in the text had no chance of proofreading it. We have had several responses from National Committees, from Commission Chairmen and from one Past President of URSI. There is general support towards reorientation towards telecommunications, increased involvement with developing countries, on maintaining the currently existing URSI logo (but with different suggestions on including telecommunications in title), and the image of URSI. There were also comments from several URSI scientists, as inputs to Corsendonk discussions, and later in response to March preliminary document, made *purely in their personal capacities*. We acknowledge these remarks with gratitude.

The present volume is intended to be primarily a base paper for discussion at the next General Assembly in Tel Aviv. Given the constraints of time and resources, it is bound to fall short of expectations. Our sincere apologies for such shortcomings.

If it serves as the beginning of a new URSI, the Corsendonk meeting will be worth while.

To the distinguished non-URSI participants, we owe a special debt of gratitude. Their appreciation of URSI's activities and genuine desire for interactions with URSI are specially welcome. Professor Van Bladel and Professor Delogne had little time to organize this Conference: that they could do

so and with such effectiveness is a tribute to their ingenuities and exuberance. Mme Stevanovitch was as always, charmingly everywhere.

To Professor Gordon, with whom I had first discussed the idea of holding such a Conference, and who was the guiding spirit of the Conference, I can only say: thank you.

A. P. MITRA
PRESIDENT, URSI

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PARTICIPANTS

ABBREVIATIONS

BIH	Bureau International de l'Heure
BIPM	Bureau International des Poids et Mesures
CCIR	International Radio Consultative Committee
CCITT	International Telegraph and Telephone Consultative Committee
CISPR	International Special Committee on Radio Interference
COMSAT	Communication Satellite Corporation (U.S.A)
COSPAR	Committee on Space Research
COSTED	Committee on Science and Technology in Developing Countries
CPEM	Conference on Precision Electromagnetic Measurements
ESA	European Space Agency
ESTEC	European Space Research and Technological Centre
ETH	Eidgenossische Technische Hochschule
IAGA	International Association of Geomagnetism and Aeronomy
IAEA	International Atomic Energy Agency
IAMAP	International Association of Meteorology and Atmospheric Physics
IAU	International Astronomical Union
ICSU	International Council of Scientific Unions
ICTP	International Centre for Theoretical Physics
ICWISP	International Commission on Waves in Space Plasmas
IEE	Institution of Electrical Engineers
IEEE	Institution of Electrical and Electronics Engineers
IETE	Institution of Electronics and Telecommunication

Engineers

IGU	International Geophysical Union
IGY	International Geophysical Year
IPDC	International Programme for the Development of Communications
ISDN	Integrated Services Digital Network
ISY	International Space Year
ITU	International Telecommunication Union
IUCAF	Inter-Union Commission on Frequency Allocations for Radio Astronomy and Space Science
IUGG	International Union of Geodesy and Geophysics
IUGS	International Union of Geological Sciences
IUPAC	International Union of Pure and Applied Chemistry
OECD	Organization for Economic Cooperation and Development
QUASAT	Quasar Satellite
SCAR	Scientific Committee on Antarctic Research
SCOPE	Special Committee on Problems of the Environment
SCOR	Scientific Committee on Oceanographic Research
SCOSTEP	Scientific Committee on Solar-Terrestrial Physics
SEE	Societe des Electriciens, Electroniciens, et Radio Electriciens
TWAS	Third World Academy of Sciences
UNESCO	United Nations Education, Scientific and Cultural Organization
URSI	International Union of Radio Science
VDE	Verband Deutscher Elektrotechniker

ADDRESS BY A.P. MITRA, PRESIDENT, URSI

Let me welcome you on behalf of the URSI in this beautiful Abbey away from normal interactions of the city in an environment that would hopefully allow us to think on the questions: where should URSI go to in future, and how should we restructure it for this new goal? The idea for having such a get-together came from ICSU's Ringberg Conference held in 1985, providing a long-term perspective for this apex non-governmental scientific body.

The URSI, as you know, is one of the 20 scientific unions under the ICSU. It is one of the earliest to be formed: it was formed in 1919 along with the International Union of Geodesy and Geophysics (IUGG), the International Union of Pure and Applied Chemistry (IUPAC) and the International Astronomical Union (IAU). Over the years, its interests, activities and emphasis have evolved in tune with the world progress in radio science. It has been instrumental in encouraging and sometimes in providing the forum for the first announcement of major discoveries in the areas of radio science. When it was created in 1919, it succeeded the earlier International Commission on Scientific Radio Telegraphy which was active at a time when, the only existing type of radio communication system was radio telegraphy.

The objectives of the URSI, which have been periodically reviewed and modified, are to stimulate and to coordinate, on an international basis, studies in the field of radio science and within these areas:

- a) to promote and organise research requiring international cooperation and the discussion and dissemination of the results of this research,
- b) to encourage the adoption of common methods of measurement and the intercomparison and standardisation of the measuring instruments used in scientific work,
- c) to stimulate and coordinate studies of the scientific aspects of telecommunications using electromagnetic waves, guided and unguided."

The work of the URSI is operated through a number of Commissions for which the composition and programmes are under periodic review at meetings of the General Assembly and currently consist of nine Commissions as follows:

Commission A:	Electromagnetic Metrology
Commission B:	Field and Waves
Commission C:	Signals and Systems
Commission D:	Electronic and Optical Devices and Applications

Commission E:	Electromagnetic Noise and Interference
Commission F:	Wave Propagation and Remote Sensing
Commission G:	Ionospheric Radio and Propagation
Commission H:	Waves in Plasmas
Commission J:	Radio Astronomy

That the use of radio waves is a major tool in the many areas of science - astronomy, geophysics, space science, radio communication - is well known. Radio telecommuni-cations is perhaps the most visible area of activity over several decades.

There are currently 41 member committees in URSI. The member committees belong to scientific academies, associations and other equivalent non-governmental bodies. In contrast, the total membership of the ICSU is currently 71, of IAU 51 and of IUGG 78. A number of countries have, therefore, not shown interest in the URSI activities. Membership is largest for IUGG, IGU and IUGS, i.e. in the areas relating to earth sciences, a point worth pondering about.

Another point to note is that while telecommunication is an activity of critical interest to all developing countries, the number of developing countries whose scientific bodies adhere to URSI is very small. In the Asian, African and Latin American Regions, these are: Argentina, Brazil, China, Egypt, India, Iraq, Nigeria, Peru and Thailand.

URSI's scientific deliberations occur primarily through its nine scientific Commissions. These organize workshops, symposia and training courses on matters of major or emerging interest in different parts of the world and at different times between the General Assemblies as well as during General Assemblies. General Assemblies are held at intervals of three years: the last one held in Florence in 1984 and the next to be held in August 1987 in Tel Aviv. The Board of Officers and the Chairmen and the Vice-Chairmen are elected by the official representatives of the Member Committees. Unlike the representatives of the governmental bodies, those elected to function in various official capacities in URSI or the participants in the symposia, workshops or conferences are there purely in their personal capacities.

URSI is now 68 years old, an organization that has seen all major milestones of development in radio science and has a long and distinguished tradition. Then one may ask: why this meeting? What is the rationale behind this special effort of bringing in senior people from the URSI community as well as from organizations outside? The main reason is that as URSI grew, and new areas of radio science emerged, its linkages with organizations concerned with the

operational and implementation aspects of radio science (especially on telecommunication) began to dwindle. This is an inevitable consequence, I believe, of a situation where both science and technology are developing rapidly. In a gathering of this kind one need not point out the symbiotic relationship between science and technology and the dangers of ossification in both from lack of rapport and linkage. This is particularly unfortunate in the case of developing countries where telecommunication is a vital part of development and frequently operates on borrowed technology without appropriate and adequate scientific backup. This, therefore, raises two questions: (1) how does one restore the symbiotic relationship that existed in the past between science organizations of the kind that URSI represents and the technological organizations of the kind that ITU or the professional bodies like IEEE represent. (2) what can organizations like the URSI do in clear terms that would enhance original scientific thinking in developing countries that would help in its national and technological development?

In regard to the first, we already have several existing mechanisms such as the URSI-CCIR Committee, URSI-CCITT Committee, co-sponsorship of symposia initiated by professional telecommunications organizations. The question is : is this enough? I have come across very distinguished electronics experts who have never heard of URSI. In my own country, IETE and URSI national committees do not have any common platform. There is an information gap here.

Now about the second question concerning developing countries. On many occasions, I have been told that basic research is a luxury in a developing country. I would like in this connection to briefly mention our own experience in India. Much of the excellence of Indian radio science owes its origin to the efforts of a number of distinguished original scientific thinkers years before India commenced technological development in this area. The first major event was a series of classic experiments in Calcutta at the turn of the last century by Sir J.C. Bose on the generation and use of microwaves. Then 30 years later with the setting up of a Wireless Laboratory in Calcutta in 1923 by S.K.Mitra, a strong group on Ionospheric Research emerged. These two formed the foundation of radio science in India. The Indian renaissance in the pre-Independence times was not limited to science and technology but extended to all areas of human endeavour and it is important to note that during the 30s and 40s India produced *at the same time* a galaxy of high quality people in diverse areas of human activity: in science, in philosophy, in religion, in politics, in literature. Tagore, Bose, Vivekananda, Gandhi coexisted. One lesson we learn from this is that excellence in one area encourages excellence in another. This symbiotic relationship between science, development, society, religion, philosophy occurs only rarely in the history of nations, whether developed or developing. Can URSI

help in such symbiosis?

The ICSU has also gone through an introspection of this kind very recently. Some of the consequences of such introspection will take time to develop but one effort in which URSI has also been involved relates to programmes such as Global Change, in which mankind's concern is increasing and the role to be played by the developing countries is yet unclear. To what extent should URSI involve itself in programmes of this kind and also in enthusing young scientific minds?

URSI is an old organization and an old organization begins to become bureaucratic. There are criticisms within the URSI that URSI is dominated by senior scientists; that the General Assemblies are held too frequently or too infrequently; that there is a tendency of major meetings or workshops being held mostly in the western world: that the tradition of holding alternate General Assemblies in the western world and elsewhere is anachronistic and in the present age of quick air travel inappropriate; that although young scientists are now being recognized, this has come rather late and even now their participation is limited to workshops and symposia and not in the decision-making process of the URSI. We should debate on this matter.

There are other matters of organization, of membership of a country, of subscription, of information flow, of the Commission structures and their operational autonomy, of relationships between URSI and other scientific bodies like IAGA, IAU, COSPAR, that should be looked at from an overall perspective during the discussions to be held in this gathering. I would only like to urge you to think and discuss mechanisms and processes by which a body like URSI can be made truly global, imaginative and forward-looking.

Thank you.

REPORT OF GROUP I : GEOPHYSICS AND PROBING

Chairman: M. Petit

The discussions were divided into two parts, one dealing with the specific problems of the URSI Commissions concerned, and the other dealing with the problems of interest to all the Commissions of URSI.

PART I

Commission A

The situation is more or less satisfactory. The draft terms of reference, as presented in the written report by Prof. Hahn, will be discussed within the Commission in Tel Aviv, and then submitted to the Council for approval.

Regarding the cooperation with other bodies, the relations with BIPM and CPEM are adequate. The Commission has a representative in the Executive Council of CPEM, and a scientific body will be formed, with representatives of the Unions concerned (IAU, IUGG and URSI) within BIPM, to look after the problems of TAI, which is now the responsibility of BIPM.

Keeping within URSI an activity on the interaction of EM waves with biological systems was considered as valuable both for URSI and for the scientists concerned with this subject. URSI should concentrate on experimental aspects which fall within its field of competence. Commission A is willing to maintain its support to this activity, but would not object to any other solution.

Commission G and H

Dr. Gendrin gave some explanations about the structure of IUGG, COSPAR, SCOSTEP, and SCAR.

The Divisions of IAGA with which URSI has common interests are Divisions II and III (Aeronomic Phenomena and Magnetospheric Phenomena respectively). Dr. Gendrin presented a possible division of scientific fields.

1. Fields in which IAGA needs URSI:

PHYSICS of radio wave propagation and interaction with matter. Physics of the interaction between waves and plasma (G, H) or between waves and the atmosphere (F). Plasma physics in general (B, H). The equipments to study this physics or to diagnose the environment characteristics: antennas, detectors, radar

systems, signal analysis, active WAVE experiments.

2. Other environmental problems of use to URSI:

ENVIRONMENT

Consequences of the environment on problems posed by the Telecommunications Sciences:

- auroral propagation, ionospheric scintillation (G, H)
- boundary layer physics, rain effects (F)

3. Fields which are more relevant to IAGA:

GEOPHYSICAL PROCESSES PER SE

Variation of electron content, interactions between ionosphere and thermosphere, ionospheric convection, auroral processes, magnetospheric structure, etc.

Such a distinction, clearly established, could probably solve the conflicts that actually exist in the participation of scientists and the organization of Assemblies.

It may also help refocusing the activities of URSI towards Radio Science and Communications.

The discussions showed that it was unwise for Commissions G and H to compete with IAGA in organizing scientific sessions on geophysical problems, and that the activities of the two Commissions should cover the following areas:

- propagation in ionized media,
- development of probing techniques,
- active experiments using waves or generating wave phenomena,
- waves in plasmas,
- computer simulation.

Regarding the possible merger of the two Commissions, which has been a subject for discussions since the Assembly in Washington, D.C. in 1981, no consensus was possible.

According to a suggestion made by Prof. Dowden, Chairman of Commission H, URSI should be reorganized into "international commissions", each of which

would be divided into sections. One of these Commissions would consist of the present G and H (International Commission on Waves in Space Plasmas). Such international commissions would meet at General Assemblies, as well as between the Assemblies, possibly at the same place as sister organizations.

Dr. Rishbeth, Vice-Chairman of Commission G, proposed a scheme aiming at a merger in 1990 (see Appendix).

Commission J

There is a very strong support for keeping Commission J in URSI. This is a favoured place for discussion of technical projects and developments of instruments. The scientific results are discussed in IAU.

One point of concern was that young scientists seemed more interested in presenting their results in IAU symposia, rather than in URSI.

Two new developments are likely to provide Commission J in the near future with exciting problems: (a) VLBI from space (project QUASAT in ESA, and project RADIO ASTRON in the USSR), which will require an appropriate liaison with COSPAR, and (b) optical interferometry where the approach is directly inspired by the conventional radio astronomy techniques.

While a review on geodetic measurements using the VLBI technique might be useful in one of Commission J sessions, it was not felt appropriate to open Commission J to geodesists. This does not mean that the experimental problems encountered by VLBI are outside the scope of URSI, but Commission J would not like to lose its present identity. In the same spirit, radio astronomers attending an URSI meeting do not expect to discuss there the physics of pulsars and, therefore, organizing joint sessions with Commission H on plasma phenomena of astronomical interest would not be successful, as the astronomers most concerned would not be present.

Commission F

The terms of reference of the Commission, as adopted in 1984, are adequate for the future. They cover communications and remote sensing.

In the field of communications, the topics dealt with by the Commission are well identified. The cooperation with Study Group 5 of CCIR is satisfactory.

Regarding remote sensing, there are two difficulties: it is a new topic for URSI, and it is dealt with by the professional societies.

The Commission has established cooperation with IEEE (IGARSS) and the Radiation Commission of IAMAP. It organized four symposia in the last 3 years and has tried to establish, within URSI, a favourable environment for looking at fundamental problems of interactions of waves with media. Outside experts in the field will present invited papers at the Tel Aviv Assembly and have been involved in the preparation of the scientific programme. Taking into account these activities of the Commission, the usefulness of the inter-commission working group on remote sensing is doubtful, and its discontinuation will likely be proposed in Tel Aviv. However, an effort should be made to inform the remote sensing users of the expertise of URSI for solving some of the scientific problems they are faced with.

PART II

1. Review of Radio Science

The Group felt that the whole procedure for the preparation of the Review should be reconsidered. It was suggested that each Commission should subdivide its field into topics which could be covered by a single person having the necessary expert knowledge to write a critical review of the topic. However, the mechanism for collecting the information should be investigated further.

2. Preparation of General Assemblies

The lead time for submitting papers (10 months) should be reduced, possibly to 5 months. It was felt that, in general, guidelines should be issued setting out the whole procedure. Dr. Bauer, as Chairman of the Steering Group for the coordination of the scientific programme, should be asked to write a first draft of rules for consideration by the Commission Chairmen and the Board.

3. Membership of Commissions

The majority of those attending the meeting were in favour of a change in the membership of the Commissions. These would no more consist of Official Members appointed by Member Committees. All scientists actually attending business meetings of the Commissions should have the same voting power. Regarding the election of the Vice-Chairmen of Commissions, this will continue to be the prerogative of the Council where all Member Committees are represented.

4. Working Groups in Commissions

Working Groups should be formed (or maintained) only in cases where a specific task has to be fulfilled. Working Groups should not be created on the basis of a given scientific topic only.

The question was posed as to whether a Working Group can be formed with the task of organizing a meeting. In the opinion of the participants, this could be done, but such Working Groups should be very restricted in size.

5. Definition of the scientific programme

Suggestions for topics for Open Symposia should be made by the Commissions. Activities involving several Commissions should be preferred, and Commissions should be encouraged to select such areas.

6. Relations with other organizations

It was recognized that important events were organized outside the Union in general by organizations having considerable financial resources. Contacts should be established with such organizations, at least to ensure that URSI is informed of the conferences they plan to organize.

7. Radio geodesy, bio-effects and remote sending

Regarding radio geodesy, the interaction of electromagnetic waves with biological systems, and remote sensing, the Group agreed to recommend that *ad hoc* groups including experts taken from outside URSI should be set up to examine whether and how URSI should reinforce its activities in these domains. These groups should report to the Board of Officers, which will then consider the actions to be taken.

DISCUSSION CONCERNING COMMISSIONS G AND H

A discussion was held in Group I from 21.00 to 22.10 on 8 March 1987. The following is a *personal report* based on this discussion and on subsequent conversations.

I believe Commissions G and H should merge. This would be good for the science and create a strong URSI body that could run good programmes at General Assemblies, and in between. This should help URSI to develop in its areas of expertise, distinct from those of IAGA, SCOSTEP, etc.

Objections to the merger include: the existing structure works; the present G and H are among the largest Commissions and merging would be unwieldy; the

present Commission Chairmen are against a merger; some scientists will cease to support URSI. These arguments are quite strong, but not compelling. I believe a merger should come in 1990, but is unlikely to be achieved smoothly in 1987. However, I think it necessary to consult the Commission H Vice-Chairman, Dr. Matsumoto, whose views must be taken into account. I would like to do this quickly.

I realize that many individuals will find that there are some topics of interest, and some topics of no interest, in a combined G+H programme. With careful timetabling, this should not be much more of a problem than it is now.

I suggest for consideration the following:

1. Any working groups that are set up or re-established in 1987 should be labelled 'GH' or 'HG', as a matter of policy.
2. All symposia involving G and H at the 1990 Assembly should be labelled 'GH' or 'HG', similarly as policy.
3. All events, meetings or symposia during the period 1987-1990, that Commissions G or H wish to sponsor in modes 'A', 'B', or 'C', should be jointly sponsored by G and H.
4. It should be anticipated that a Chairman and Vice-Chairman for the merged Commission should be elected in 1990.
5. The contribution to *Review of Radio Science* should continue as 'G+H'.

It is important for Commissions G+H to seek contacts with other Commissions, especially joint symposia, at the next General Assembly.

I look forward to a strong G+H Commission in a strong URSI.

9 March 1987

H.RISHBETH

REPORT OF GROUP II: COMMUNICATIONS

Chairman: W.E. Gordon

There is an ever-increasing pressure to make pure as well as applied science serve the needs of today. The mission of science, however, is to serve the prospects of tomorrow. The policy of URSI must be to persuade the public, the governments, and the industrial organizations that radio science has been a source of ideas that paved the way for electronics in all walks of life. However, the time between a discovery and its practical application is getting shorter dramatically. The transistor drastically changed the form of radio receivers within three years, and ten years later it instigated the birth of planar technology and silicon microelectronics. The physical limits of integration on the silicon chip have not yet been achieved. All this has brought the world to the threshold of a revolution in communications. The day is approaching when single transmission links will bring to millions of users all kinds of information by means of integrated services digital networks. This includes telephone, data transmission between terminals and computers, access to data bases and expert systems, and provision of high-quality colour television programmes.

All this entitles the URSI community to take pride in radio science that has been the source of unprecedented progress in the field of information transmission and that has helped provide the means for understanding between individuals, nations, and states. On the other hand, this inevitably necessitates a revision of the current forms of URSI scientific and organizational activities. The academies and universities represent only a small fraction of the world's creative potential in the strategic fields of technology in which radio science, electronics, informatics, and optoelectronics dominate.

The combination of satellite links, television, fibre optics, and high-speed information transmission has revolutionized communication over the past two decades and has an enormous future potential. To put this in an historical perspective, the combination has and will have an impact on society greater than the invention of the printing press by Gutenberg. It is clear that society needs help in putting to good use the opportunities that the new communication offers. Organizations like URSI, the Institute of Electrical and Electronics Engineers, the International Telecommunications Union and its committees - the International Radio Consultative Committee and the International Telegraph and Telephone Consultative Committee - and the Popov Society must provide the guidance that society needs.

The Communications Group made a sustained effort to predict what telecommunications in the coming decades might be. With some allowances for

fixing the time schedule of the evolution, it was generally agreed that telecommunications in the 1990s would use digital networks with computers as elements of the network and as terminal equipment. The networks would integrate in a compatible way voice, data, and video services, and would use a combination of fibre optic cables, satellite links, and microwave links in high-capacity networks. Low-capacity circuits including satellite links, coaxial cables, wire lines, and radio will fill in the gaps.

Given the integrated services digital network as the backbone of the high-capacity system, the Group considered the respective roles of the relevant technical societies, agencies, and industry. Collaboration of URSI with the ITU, in particular, is essential if URSI wants to play a role in telecommunications. In the past, although there existed an official URSI-CCIR-CCITT Liaison Committee, collaboration had mainly been informal and occurred through individuals simultaneously active in URSI and in CCIR. URSI should have an official representative in the CCIR Plenary Assemblies, whose task would be to "collect" questions addressed by CCIR to URSI, and to initiate action within URSI. At present time, CCIR puts much emphasis on mobile communications, satellite communication using the geostationary orbit, and changing technology in broadcasting. The radio frequency range considered by CCIR extends up to optical frequencies. The main themes of concern are the increase of the communication capacity, the limited bandwidth, and the reduction of interference.

In CCITT, much attention is paid to local networks. The trends are towards increased complexity with integrated service digital network (ISDN) and optical fibres as major ingredients. Future networks of the ISDN type will not be based exclusively on optical fibre systems. In some areas, satellites will remain adequate.

The chairman of each commission must redefine the role of the commission in studies related to future communications.

The chairman of *Commission F on Wave Propagation and Remote Sensing* noted that his commission had studied and will continue to study the propagation effects relevant to microwave links (use of higher frequencies and wider bandwidths, multipath effects), the exploitation of satellite links, interference between services, and mobile communications.

The chairman of *Commission C on Signal and Systems* and of *Commission D on Electronic and Optical Devices and Applications* realized that their groups had carried a major weight in the increased emphasis that URSI must put on telecommunications. Commission D, in particular, will continue services to the

other URSI commissions by reviewing the new developments and technological trends. Given its interface with professional societies, the commission believes that it should concentrate on specialized workshops and tutorial conferences suitable, for example, for scientists from developing countries.

The field of scientific activity of both Commissions C and D has one common feature. It is the worldwide hunger for efficient, prompt, and economically lucrative utilization of new knowledge, inventions, and discoveries in the radio and electronic technologies. According to the published forecasts, the overall production of information processing (56%), communication (20%), and industrial electronics (6%) will in 1987 reach the amount of \$ 500 billion. Exponential growth seen during the whole post-war period will continue. The fact that the ideas born within radio science have played the primary role in creating this colossal market gives URSI a moral right to benefit from it. It is our duty to use the authority of one of the oldest scientific organizations for creating a favourable climate for promotion of research in every field pursued by URSI.

It would be of benefit if Commission D could somehow become an initiator of progress in its own field, both within and outside URSI and in the general electronic community. One method of doing this might be to shift the emphasis of Commission D towards more fundamental matters, including new materials and the physics of rapidly emerging technologies. The precise topics to embark on are not obvious and require careful thought.

Commission E on Electromagnetic Noise and Interference has an extensive list of study topics and feels that it functions well. The same is true for *Commission B on Fields and Waves*, but each is encouraged to restudy the situation.

The conclusion is that the inputs of the commissions will be crucial for URSI's contribution to the communication revolution. The scope and operations of all the commissions should be re-examined, and in particular those of Commissions C and D. the commissions are challenged (1) to deal with higher frequencies, broader bandwidths, a more crowded spectrum, and increased interference, (2) to consider transmission media for radio and optical signals, hardware and software for the network and terminal devices, and (3) to anticipate and develop the scientific basis for the technology in information systems.

REPORT ON EXTERNAL ACTIVITIES

J. Van Bladel, Secretary General, URSI

I. Introduction

The discussions in Corsendonk showed that URSI's vocation is both *multi-disciplinary* and *international*. Such a statement implies that URSI should be the strongly preferred link between "radio scientists" working in all parts of the world, independently of the political system and state of industrial development of the country where they live and work. As a corollary, URSI must be a *scientific* body, untouched by commercial interests, and endowed with a special responsibility towards developing countries.

In the external contacts resulting from this policy, the title of the Union must be clear and unambiguous. Quite a few Corsendonk participants had some negative remarks to make on this point. As mentioned in the preliminary report published in the March 1987 issue of the *URSI Information Bulletin*, the title of the Union is a recurrent problem, as the word "radio" does not seem to describe adequately the activities of URSI in the eyes of most communications people. There was a general consensus that the logo should be kept, but that the official name might contain words such as electronics, communications science, and telecommunications. A few proposals: International Union of Electromagnetic and Information Science; International Union of Electromagnetic and Communication Science; International Scientific Union of Radio and Electronics; International Union of Radio and Communication Science.

Prof. Dowden comments as follows:

"While most know that QANTAS is Australia's airline, few know what the acronym spells out. Australian states other than Queensland and Northern Territory do not worry about not being in the acronym. Thus URSI *does* stand for Radio, Electronics, Communications, etc. Provided "URSI" remains, I do not think the full title matters".

Prof. Dieminger, former URSI President, writes:

"Considering the not-too-well established meaning of the term "radio", I should advocate the addition of the term "telecommunications", retaining however the term "radio" for reasons of tradition"

Dr. Martin Pascual suggests one of the following titles:

“International Union on Electromagnetism”

“International Union on Teledetection and Communications”.

II. UCSU and National Societies

(a) ICSU

ICSU can help its constituent Unions by providing centralized services, e.g. in the areas of publications and legal advice concerning tax problems and non-profit status. ICSU can also catalyze collaboration between Unions. Illustratively, a meeting of the Treasurers of Unions was held in Paris in 1986 to compare notes and streamline policies.

URSI has a long tradition of participation in large international multi-disciplinary programmes, e.g. the 1957 International Geophysical Year. Prof. Gordon drew the attention of the Corsendonk participants to two new important projects:

The ICSU Global Change (Geosphere-Biosphere) Programme. This effort will run until the turn of the century. Prof. Delogne and a small *ad hoc* group follow the development of the programme for URSI. The conclusion is that URSI can have a (rather secondary) role in bringing its expertise to bear on fields such as radio science techniques for remote sensing of the atmosphere, the ground and sea surface, and the subsurface medium. The follow-up will be discussed in Tel Aviv.

The International Space Year (ISY), scheduled for 1992. Preliminary programming has started under the chairmanship of R.M. West. URSI has expressed an interest in participating in that programme.

(b) Other Unions

The Unions with which URSI has special contacts are those of Astronomy (IAU) and Geodesy and Geophysics (IUGG). The problems of interfacing with these organizations, and in particular with IAGA, are discussed elsewhere in this report.

(c) National Societies

The contacts with national societies are normally smooth, partly because URSI people are often involved in their local Society. National Societies and URSI live, in fact, somewhat “in parallel”. Efforts to increase contacts and collaboration will require a clear definition of the respective goals and ambitions

of the partners, the purpose being to avoid duplication and overlapping. To help achieve this goal, representatives of two large national societies, the Popov Society and IEEE, were invited to Corsendonk.

III. UNESCO

UNESCO is a natural partner for an organization such as URSI, which has international ambitions and stature. UNESCO has a very elaborate structure, evidencing vertical columns and horizontal layers. At the present, our main contacts have been with the Directorate for Science (Dr. Kaddoura), and IPDC. Through Dr. Kaddoura, support has been obtained for the attendance of Young Scientists at the General Assemblies of Florence and Tel Aviv. The basic purpose of IPDC, the International Programme for the Development of Communication, is to create infrastructures, both technical and human, in developing countries. The IPDC has contributed in a major fashion to the publication of our “Handbook of Radio Propagation for Tropical and Subtropical Countries” (see Section on Publications). A request of IPDC support has been filed by URSI in April 1987 with respect to a 4-week graduate level basic course on the techniques of telecommunications. The course, to be given in January 1989, will be attended by about 40 scientists from developing countries. Partial support is also sought from organizations such as ITU and the various Broadcasting Unions.

Other UNESCO officials with whom very preliminary contacts have been established are:

Mr. G. Holoster (Director, Division of Technology, Science Sector),
Mr. Lopes (Director, Culture and Communication),
Messrs Goodchip and Dupont (IDMC, responsible for means of communication).

URSI's goal is to be recognized as the natural scientific and pedagogical adviser on Telecommunications for international bodies such as UNESCO and TWAS.

IV. TWAS and ICTP

Two remarkable organizations, the Third World Academy of Sciences (TWAS) and the International Centre for Theoretical Physics (ICTP), are located in Trieste, Italy. Both bodies are in the process of establishing closer relations with ICSU. The areas of collaboration, which are also appropriate for URSI, are enumerated in a recent *ICSU Newsletter*. They are:

1. Directory of Institutions

ICSU will cooperate with TWAS in the establishment of a computerized data bank on major scientific institutions active in the Third World, to be published and regularly updated by ICSU and TWAS. A request will be made to ICSU members asking them to contribute information as to their scientific contacts in developing countries as an input to this Directory.

2. Lectureship Programme

An ICSU-TWAS lectureship Programme will be developed by jointly establishing a roster of scientists willing to travel and to lecture on both specialized and general subjects. The availability of these persons will then be communicated to ICSU and TWAS members in developing countries. Host institutions will be asked to cover local expenses while ICSU and TWAS will pay for the lecturer's travel.

3. Provision of Books and Journals to Developing Country Libraries

The Third World Academy of Sciences already has an ambitious and important scheme of donating scientific material (books, journals and some equipment) to identified needy institutions in developing countries. In this programme TWAS buy new books and journal subscriptions (\$175,000 were spent in 1986) and accepts donations for these from individuals and / or institutions.

4. Membership of ICSU of Least Developed Countries

The TWAS will provide information about the benefits of membership in ICSU to those Third World countries with which ICSU has little contact. TWAS will also examine ways in which it could assist in paying ICSU dues for these.

Point 1 is already on URSI's programme (see section on Publications).

In Corsendonk the activities of the Trieste groups were presented by Dr. Dalafi. He drew URSI's attention to a few interesting TWAS programmes, to which the URSI community could contribute efficiently:

Provision of scientific books to libraries in Third World countries (as described in 3 above),

Provision of spare parts for scientific equipment in Third World countries.

Information on these two projects will be published soon in the *URSI*

Information Bulletin. The TWAS also gives research grants to Third World scientists, provides grants for scientific meetings held in developing countries, and gives awards for research and training in Italian laboratories.

The ICTP is supported by the IAEA (International Atomic Energy Agency), UNESCO and the Italian government. It has an extensive programme of courses and seminars. For 1987, for example, the list mentions 32 workshops and "colleges". Quoting at random:

- An International Workshop on Remote Sensing and Resource Exploration (4 weeks)
- A Workshop on the Path Integral Method with Applications (4 days)
- a College on Soil Physics (18 days)

Some 4000 scientists per year are involved in the ICTP programmes. Initially the Centre concentrated its activities on nuclear and plasma physics, but it has now broadened its sphere of interest to include applied and experimental physics, physics teaching and mathematics ("Pure" and "applicable")

V. CCIR, CCITT, Space Agencies

The interventions of Mr. Kirby and Dr. Bigi, summarized in other parts of this report, show clearly that the Telecommunications emphasis which URSI wants to implement requires close cooperation with both Committees. This also holds for space organizations such as COMSAT and the European Space Agency, a point which became clear after Mr. Bartholome's interventions. There exists, for the moment, an official CCIR-CCITT-URSI Liaison Committee, the action of which is described in Prof. Delogne's report. The resulting collaboration has mainly been informal, and occurred through individuals being simultaneously active in URSI and CCIR. Prof. Stumpers commented as follows on this Committee:

"Unfortunately during the last few Assemblies we have forgotten that originally the Committee had members nominated not only by URSI, but also by CCIR and CCITT. I remember a meeting in Geneva, where Dr. Minnis, Dr. Saxton and I represented URSI, but where there were also representatives of CCIR and CCITT, usually members of the permanent staff. Now Dr. Struzak has told me that he will be one of the CCIR representatives on this Committee. It would be nice, if before the Tel Aviv meeting, both CCIR and CCITT could give us two names."

The Secretariat in Brussels intends to put much time and effort in helping

develop the CCIR-CCITT contacts in the 1987-1990 triennium. Quite a few members of the URSI community are willing to increase their contacts with CCIR and CCITT. Commission B, in particular, has already welcomed CCIR suggestion for increased collaboration in the area of antennas.

REPORT ON PUBLICATIONS

J. Van Bladel, Secretary General, URSI

I. Introduction

The publication programme of URSI should take the following boundary conditions into account.

- (1) The impossibility to organize a large-scale publishing effort with the present secretarial staff.
- (2) The need to avoid duplication of the extensive publication programmes provided by national organizations such as the Popov Society, IEE, IEEE, SEE, etc. These organizations have excellent collaborators, backed by impressive staff and facilities. Our own efforts should, therefore, be devoted to projects which URSI can do better than other bodies, in particular because of URSI's multidisciplinary and international vocation.
- (3) The need for URSI to keep its non-profit character.

II. The Review of Radio Science

- (a) The main publishing effort of URSI is *Review of Radio Science (RRS)*. This publication fits URSI's goals particularly well, as it provides multidisciplinary coverage, and achieves international impact. It is a source of very valuable information, in particular for scientists in countries where Radio Science is not fully developed. It may be said that the continuation of the Review is a must, an axiom of our programme.

The Review was often criticized in Corsendonk. The criticisms centered on:

- (1) form and contents;
- (2) distribution.

- (b) Form and Contents

The contents of *RRS* are obtained from "filtered" inputs originating from Member Committees, and provided by the Official Members of the Commissions. Papers written in any language are acceptable for reference in the Review. If not written in English, they should be provided with an English title and an English summary. The comments made in Corsendonk showed that the system did not work perfectly. It is not uncommon to encounter Commissions where at most two-thirds of the Official Members send in their inputs. In the case of

Commission D, for example, two of our most important Committees did not react, although their members are known to have extensive activities in the areas concerned. Some Corsendonk participants remarked that the material of the Review had to be compressed to an unreasonable degree. They suggested that doubling the present volume of *RRS* might be advisable in 1990.

To remedy the sketchy input referred to above, suggestions were made to abandon the "Official Members system", and to replace it by the appointment of a series of experts, chosen by the Commissions according to a suitable procedure. These experts would select the papers they consider most significant, without reference to national boundaries. If the new structure is approved, attention should be drawn to the following points:

- (1) the need for completeness; the system must ensure that all important languages are covered;
- (2) speed: the new structure must be installed by the end of the Tel Aviv General Assembly.

(c) Distribution

The production of *RRS* represents an enormous collective effort, and the long-suffering collaborators of the Review often have the impression that the product remains too confidential. As a consequence, volunteers for the editing work are sometimes hard to find. In the present set-up, to be applied in Tel Aviv, some 2500 copies are produced, distributed as follows:

- about 1000 for the participants to the General Assembly,
- about 1000 for free distribution to libraries throughout the world (this distribution is taken care of by the American Geophysical Union),
- about 500 for sale after the General Assembly, at cost.

The problem of increasing the distribution requires collaboration with organizations enjoying an important distribution network. Commercial firms are a possibility, but the product must have sufficient commercial appeal to justify their interest. In the sixties, the Books of papers read out at the General Assembly were published by a commercial firm. This effort did not last more than a few years, as the operation turned out to be unprofitable. An obvious partner for URSI is the ICSU Press. This fairly young organization may soon reach the "critical mass" which justifies the existence of a specialized staff, something which most Unions cannot afford. In addition, the ICSU Press could

develop a uniform policy in areas such as the distribution of royalties or the protection of the non-profit character of the Unions.

A few preliminary steps have already been taken to improve the distribution of *RRS* in 1990 by seeking the help of *ITU* and, in the case of developing countries, *TWAS*.

III. **Book of Tutorials and General Lectures**

This book will be produced for the first time in 1987. Its contents should be of interest to a wide public. Publications of this nature fit the ICSU Press programme. Prof. Cullen endeavours to have the Press, which has experience in the mechanics of production, legal aspects, etc., help with the distribution of the Book. This first collaboration is, in fact, a pilot operation, which may have an important impact on our future publication policy.

IV. **URSI Journals**

The publication of a journal is a vast enterprise, and URSI should not enter this area without being sure that top quality is achieved, and that the effort fills a real, existing need. At the present moment, URSI should not go farther than *sponsor* a journal, watch over its scientific level, and leave the "footwork" (printing, editing, distribution, financial problems) to other organizations. A proposal for such an operation is under consideration by the URSI Committee in Czechoslovakia, which proposes to launch a journal on "Systems, Signals and Electronics" under the URSI logo.

Professor Dieminger provides the following comment:

"I do not favour the publication of an own periodical. Having been editor of a scientific periodical (*Journal of Geophysics - Zeitschrift fur Geophysik*) for almost 30 years, I know from experience the problems of such a periodical. There are already too many scientific journals and the tendency of libraries is to restrict the number of periodicals. As a consequence, articles published in journals other than the well-established ones are read by relatively few people and authors are reluctant to publish good articles in journals which have only a restricted publicity.

"Furthermore the effort to be spent in publishing a periodical of high standard is very big".

V. Newsletter

The present *URSI Information Bulletin*, a rather "administrative" publication, is mainly distributed, through the efforts of the Member Committees. Some Corsendonk participants thought that publishing a (more lively) Newsletter would be a good move. A few obvious problems arise:

- (a) The coexistence of the Newsletter and the Bulletin. Should the latter disappear? Should Newsletter and Bulletin be distributed together?
- (b) The contents of the Newsletter. Is it possible to find interesting items on a recurrent basis?
- (c) The editor. Can a devoted and inventive editorial group be formed?
- (d) The distribution of the Newsletter. The audience of the latter should be wider than that of the Bulletin, but how much wider? The problem is linked to the creation of individual URSI members, a point which is discussed in Prof. Delogne's report.

Prof. Dowden offers the following comment:

"If even very small organizations can run a successful newsletter, surely URSI can. It would need an imaginative editor and a dedicated sub-editor from each Commission (elected at Tel Aviv?). Advertisements appropriate to radio science (equipment, computer hardware and software, etc.) would help pay for it and make it more useful to radio scientists. It could replace some or all of the Bulletin."

A comment by Prof. Mostafa:

"URSI should have a Magazine in a similar or modified fashion to that adopted in IEEE societies."

VI. Publications for Developing Countries

URSI has a fairly long tradition here. The *Review of Radio Science* and the Book of Tutorials and General Lectures are obviously of interest to developing countries. More specific examples are:

- (a) The Directory of Radio Scientists in Developing Countries, a new version of which is being prepared with the assistance of the TWAS.

- (b) The Handbook of Propagation in Tropical Countries, to come out in the spring of 1987. It is published with the support of UNESCO and ICSU.
- (c) The Directory of Calibration Facilities in the Asia Pacific Region (under preparation).

VII. Publications Committee

The Corendonk discussions showed that the Publications Programme would be a major topic in Tel Aviv, and that the Publications Committee, traditionally disbanded at the end of the General Assembly, should become a standing one.

REPORT ON INTERNAL MATTERS

P. Delogne, Assistant Secretary General, URSI

I. Introduction

The Corsendonk meeting has shown the need to reinvigorate URSI on the basis of the following main ideas:

- It is necessary to increase and improve the role of URSI in the study of scientific problems in the field of telecommunications, including all aspects of integrated and wideband services and systems, in close collaboration with CCIR and CCITT.
- URSI's action in the field of probing should be continued and improved in several respects.
- The visibility of URSI should be increased through publication of scientific journals and, maybe, of a widely diffused URSI Newsletter.
- The membership of URSI should be widened by admitting:
 - national associates (countries without voting rights),
 - affiliate members (research organizations and industrial companies),
 - individual members.
- URSI should play an increased role towards developing countries.

The present report is concerned with several internal URSI matters in relation to these plans. The aim is to determine whether or not the URSI structures are adequate, and which additional structures and means may be necessary.

II. Telecommunications, CCIR, CCITT

- (1) Increasing the role of URSI in telecommunication starts with reinvigorating the collaboration with CCIR and CCITT, and namely, the action of the URSI-CCIR-CCITT Liaison Committee. The role of the Liaison Committee might be to identify scientific questions which are submitted by the CCI's to URSI for study.

The procedures which have been followed in the past have proved successful. The questions are officially submitted by the CCI's to the URSI

Secretariat, which addresses them to one or several Commissions. Normally a working group is set up to handle the problem. A condition for efficiency is that the terms of reference of working groups, and, namely, a delay for answering, should be clearly defined. The work plan of the working group should be established in close collaboration with the Chairmen of the Commissions involved. Whereas the work should be done essentially by correspondence, it may also include the organization of workshops and sessions during URSI symposia. The final report is an official URSI contribution and is sent to the relevant CCI through the URSI Secretariat.

The procedures do not require any adaptation of the URSI structure. The main implication is some increase of work for the Commission Chairmen and for the URSI Secretariat. There may be a moderate increase of expenses if, occasionally, URSI needs to support the attendance of working group members to workshops.

- (2) Another way of increasing the role of URSI in telecommunications is through the organization of truly URSI recurrent scientific meetings. The problem exists mainly in the fields of Commissions C and D, where this kind of meeting does not exist. Again, this action would have no other implication than an increase of work for the Commissions and the Secretariat, and maybe of expenses in support of these meetings.
- (3) URSI should also undertake some action toward developing countries, e.g. the organization of telecommunication courses. The relevant expenses are in general high, and well beyond the possibilities of the normal URSI budget. It is clear that the organization of any activity of this kind requires a lot of efforts for:

- collecting funds from external sources,
- organizing the course itself, i.e. defining a programme, establishing a lecturing staff, recruiting and selecting students, and making all logistic arrangements.

It is clear that URSI cannot undertake this kind of action without a substantial involvement of an international governmental organization. But even in this case, there remains a considerable administrative charge for URSI. The Committee for Developing Countries, though being concerned with the problem, has no adequate administrative structure. The normal place for handling these matters is the Secretariat, but the existing staff is overloaded and unable to undertake new extensive tasks. An alternative solution might be to appoint a

special organizing committee provided with the required budget resources for each specific action.

III. Probing

Besides the still pending question of merging Commissions G and H, the conclusions reached in Corsendonk have no important implications on the URSI structures.

IV. Membership

(1) National Associates

National associates are defined as Committees which cannot pay the URSI membership contribution, or are in the process of considering membership. National associates would not have voting rights in the Council. Their representatives in the Commissions should have the same rights as individual members (see below).

It does not make sense to admit national associates if they do not enjoy service close to those offered to Member Committees. They should at least receive the basic URSI publications, e.g. Bulletin, Newsletter and all correspondence addressed to Member Committees.

This implies some increase of work at the level of the URSI Secretariat. In addition, the administrative cost would increase by about \$100 per year for each national associate.

(2) Affiliate members

Affiliate members are typically research organizations, scientific publishers and industrial companies. Affiliate members would participate in the Council meetings without voting rights.

The reasons for attracting members in this category and their motivations to join URSI have not been clearly identified. The objectives for URSI may not be restricted to financial considerations, but may include scientific interest and broadened collaboration. The motivations of potential members may range from philanthropy and commercial interest to a serious wish to collaborate in scientific matters. Fundamental questions which should be examined before launching this operation are: what does URSI offer to affiliate members? What will the role of affiliate members be in URSI? How should the operation be started to guarantee success?

It is suggested to establish a temporary working group to elucidate these questions during the General Assembly in Tel Aviv; the group would report to the Council.

Whatever the issue, it seems clear that starting the operation will require a considerable amount of work, mainly in the URSI Secretariat.

(3) *Individual members*

Several reasons have been put forward in favour of admitting individual members.

- Each Member Committee has its own rules and restrictions about the admission of individuals as members.
- There have been complaints from some Commission Chairmen about the low activity level of some Official Members of the Commissions.
- The work of scientists who are active in the area of the Commissions while holding no official position in their Member Committee should be recognized.
- Scientists from countries where there is no Member Committee should be encouraged to participate in the URSI activities.

The procedures for becoming individual members of URSI and the rights of individual members have not yet been clearly defined. It has been suggested that all attendees to a General Assembly should automatically become individual members for a triennium, the relevant expenses being covered by a slight increase of the registration fee. This is rather unrealistic since attending a General Assembly does not necessarily reflect a standing, active interest in URSI.

A first question to be answered is whether individuals become members of URSI or of URSI Commissions. A reasonable solution is that members of a Commission automatically be members of the Union. The rules for being a member of a Commission are to be defined, e.g.:

- upon proposal of a Member Committee;
- upon request submitted by the candidate. The request should be accompanied by a curriculum and be supported by two members of the

Commission (either official or individual);

- the admission of individual members is decided by the Board after consultation of the Commission Chairman, and in case the candidates live in a country where there exists a Member Committee., of that Member Committee.

Whatever the case, the admission of individual members will require a considerable increase of administrative work in the Secretariat, namely for;

- processing candidatures,
- bookkeeping the list of individual members, sending membership cards, checking the payment of membership fees, informing the Commissions, etc.;
- processing requests of individual members.

However, the possibility should be considered to ask the Member Committees to help the Secretariat in these tasks.

The rights of individual members should also be defined. Individual members should normally receive the basic URSI publications (Bulletin, Newsletter) without charge and benefit of reduced tariffs for other publications. Individual members should have voting rights at business sessions of Commissions. It may be adequate to authorize the Chairman to restrict the vote to Official Members either for administrative matters or when there is no clear majority.

The membership fee should be high enough to cover all resulting expenses incurred by the Union, including the increase of the staff in the Secretariat. A rough estimate is that the fee could not be lower than \$25 per year in standing conditions (more than 1500 members). In the transient phase, where the number of individual members will be lower than 1000, the policy of admitting individual members may cause serious financial losses.

V. **Visibility of URSI, Publications**

Some actions may increase the visibility of URSI without having an impact on the structures, e.g. by systematically enhancing the name and logo of the Union in all sponsored scientific meetings.

The question of URSI publications is treated elsewhere. Depending on the solutions which are adopted, it may be necessary to increase the staff in the Secretariat.

VI. General Conclusions

All actions contemplated imply some increase of work from the URSI Officers, namely from Commission Chairmen, but particularly from the Secretariat. There is furthermore a considerable increase of expenses.

Providing the Commission Chairmen with some budget should be considered.

It is not realistic to think that the existing staff in the Secretariat can start the actions envisaged. It will be necessary to increase the staff by one full-time employee. More involvement of scientists may furthermore be needed. In addition to this, there will be a increase of administrative expenses.

The initial phase of the re-organization will be particularly critical from the financial point of view, since the additional expenses will not yet be covered by income.

SUMMARY OF RECOMMENDATIONS

1. URSI's role is primarily in:
 - communications;
 - radio probing of land, oceans, atmosphere, biological systems, extraterrestrial objects.
2. In communication, integrated services digital network will be the backbone of the high-capacity system. In this:
 - contributions from Commissions C and D will be critical;
 - reinvigoration of liaison between URSI and CCIR/CCITT is essential;
 - future scenario must keep in view requirements of other scientific efforts, especially radio astronomy.
3. In geophysics and probing areas, the following recommendations were made:
 - suggestions regarding the division of scientific fields between URSI and IAGA in areas of interest to Commissions G and H;
 - two new exciting areas for Commissions J;
 - (a) VLBI from space, requiring liaison with COSPAR;
 - (b) optical interferometry with approach inspired by radio astronomy;
 - ad hoc* groups to be set up on
 - (a) interaction of electromagnetic waves with biological systems,
 - (b) remote sensing,
 - (c) radio geodesy.
4. For strengthening the (i) internal operation, (ii) international role, and (iii) visibility of URSI, the following recommendations were made:
 - (i) guidelines for the time schedules and procedures for Commissions should be prepared by the present Chairman of the Steering Group;

- (ii) the *Review of Radio Science* should be prepared by designated individuals, on subtopics to be decided upon in advance by the respective Commissions at the time of the preceding General Assembly;
- (iii) the existing concept of Official Members for Commissions might have to be dropped;
- (iv) the possibility of introducing non-voting "personal membership" should be examined;
- (v) to strengthen URSI's activities for developing countries, ICTP and TWAS offered opportunities for organizing (a) training courses, (b) roundtable discussions, (c) distribution, cost, of books and journals sent to ICTP by URSI or scientists from any of the member countries, and (d) provision of spare parts for equipment;
- (vi) while the URSI logo should not be changed, the explanatory title could include "electronics", "information science" and/or "communications";
- (vii) to enhance the visibility of URSI, actions are recommended in the following aspects:
 - (a) introduction of an URSI journal (a suggested journal was on "Signals, systems, and electronics"),
 - (b) introduction of an URSI Newsletter;
 - (c) distribution of existing URSI publications to selected non-URSI agencies (including CCIR, CCITT, professional societies, etc.).

APPENDIXES

1 INPUTS FROM URSI COMMISSION CHAIRMEN

A. 1. THE ROLE OF COMMISSION A ON ELECTROMAGNETIC METROLOGY IN URSI

S. Hahn, Chairman of Commission A

Electromagnetic Metrology is a vast and highly interdisciplinary domain of electrical and radio science. A single Commission is of course unable to cover the many branches of Electromagnetic Metrology. The choice of the branches actually cultivated by Commission A is determined by the personal fields of activity of important representatives of the Commission, actual important trends and unsolved problems, suggestions from other Commissions of URSI and other organizations, Unions or bodies.

The division of Electromagnetic Metrology into various sub-domains can be done by use of many criteria and can never be complete or objective. Instead of proposing such a division, let us quote the present terms reference of Commission A.

Terms of Reference

- Time and frequency measurements and standards, including infrared and optical frequencies.
- Time domain measurements.
- Frequency domain measurements.
- Laser measurements.
- Quantum metrology and electrical methods in fundamental constants.
- Microwave to submillimetre measurements and standards.
- Bioeffects measurements.

Problems of frequency standards and the generation of dissemination by use of radio methods of precise time scale and of standard frequencies were cultivated in Commission A (and its predecessor Commission I on Radio Measurements and Standards) for many years. URSI played, and I hope will play, a significant role in the standing progress in this field. Let us recall that the frequency, stability and reproducibility of various frequency standards are improving at the rate of about one order of magnitude per decade due to cumulative efforts in various countries, laboratories and companies. In this field the ties between URSI and international bodies and organizations like BIPM, BIH, CCIR are very strong. For an actual example following recommendations made by the international unions interested (including URSI), BIH was transferred from the Paris Observatory to BIPM at Sevres.

An important field of activity of Commission A is Quantum Metrology, especially with application to the realization of electrical units. While length is not an electrical unit, its recent redefinition based upon the velocity of light makes both length and time dependent upon the frequency standard. One of the outcomes of the activity of Commission A in the domain of basic units in the edition of the "URSI Register of National-Standard Laboratories".

Laser measurements are also cultivated in Commission A since many years. Already in 1968, following the initiative of Commission I, URSI organized in Warsaw, Poland, a special conference entitled "Laser Measurements".

Sometimes, at the business meetings of Commission A, the opinion was expressed that telecommunication measurements were inadequately represented in the activity of URSI. Now there are signs of change. At the next General Assembly of URSI in Tel Aviv, two Symposia of Commission A will be devoted to this field ("Telecommunication Measurements" and "Optical Fibre Measurements"). Other symposia are indirectly involved.

The digital revolution of the last decades has, of course, a big influence upon electrical and radio measurements. New ideas in automation of measurements can be implemented. There is a need, however, to reduce the cost of automated instruments. Presently, for example, spectrum analyzers or network analyzers are very expensive. If much cheaper instruments were on the market, many new fields of research and new application could grow up.

A2. SOME THOUGHTS ON URSI AND COMMISSION B

J. Bach Andersen, Chairman of Commission B

1. Present state of affairs and level of activities

Commission B has the broad working title "Fields and Waves", which is generally understood as analytical and numerical research in wave propagation in different complicated (but usually tractable) media in the frequency or time domain, in scattering and diffraction by complicated structures both for forward and inverse cases, in radiation from all types of antennas, and in EM problems concerning microwave components and guiding structures in general, such as optical fibres. In general, principles and methodologies are more important than results in concrete cases, these being often of more interest in the other Commissions.

The people attending Commission B meetings form a mixture of mathematically oriented electrical engineers, applied mathematicians and physicists. It seems to be a somewhat self-sufficient group of people, there not being a great need for contact or exchange of information with other Commissions or agencies outside URSI. The greatest event in Commission B is the tri-annual symposium which has been taking place since the 50s and continued to draw a few hundred participants. Proceedings from the meetings are published locally and no special continuity in the publications exists, such as common publisher or availability of back issues. In the last few times a special issue of *Review of Radio Science* has contained condensed versions of a limited number of papers. Normally Commission B through URSI Board sponsors other meetings such as the European Microwaves Conferences but in general no special duties or honours are involved. An exception where the Commission was heavily involved was with the recent Beijing meeting on Antennas and Electromagnetic Theory, August 1985, where we helped promote the event.

It is my impression that the 1950s and 60s were the exciting years for the Commission; a lot of new ideas in antenna theory and diffraction theory meant genuine breakthroughs in those areas. No similar creations have appeared in the 80s, so the work has more the character of a mature field, where lots of useful work is produced but where the novelty is modest. This means that it is difficult in many places to attract new young scientists into the area; even computational electromagnetics seems to be losing some of its steam. If the vitality shall stop dropping it is necessary that new areas with growth potential are covered actively by the Commission, otherwise we shall end up being a historical society of old boys commemorating Maxwell. To be fair, new areas have appeared. Transient techniques seem to be one, especially in connection with structure or media

identification, and inverse techniques in general seem to interest a major part of the Commission B community. In order further to promote this area a special Commission Committee was formed recently and an Open Symposium in Tel Aviv is in the programme, but it is too early to judge the effect of these measures.

2. Personal views and experiences

Life of a Commission Chairman is like living in a vacuum or rather in a perfect absorber since reflections or reactions back from the members are almost non-existent. This is no doubt partly the fault of the Chairman himself, but is probably also related to the nonpersonal, hierarchical character of the Union. The outward flow of information reaches one person in each member country, and it is my impression that it often stops there for various natural reasons. For that reason also the inward flow is extremely limited. The fact that something only happens every third year, except for the few who take part in General Assemblies, is also contributing to the reason why URSI finds itself at the lower levels of consciousness in the minds of most people.

On the positive side, the truly international character of URSI is a great asset, separating it from the various national societies which have different goals and objectives. I believe that the presence of an international conference in any part of the world is helpful in stimulating the local scientific activities, and international politics are almost absent in URSI, so the Union is a force in helping scientists independent of where they live.

Relating to the enormous growth in computer science and telecommunications systems it is probably true to say that URSI has no profile or image in these areas. Maybe this is as it should be, maybe not; it is a choice to be made, if it is not too late. Some of the elements of modern telecommunications lie certainly within Commission B's domain. Consider the advances in reflector antenna technology for satellite multibeam antennas, a very important development, but it is a subject that only very few people participate in, and they do not need URSI. In a dynamically changing area three years is too long to wait for a report, so they find other ways of communicating. There is no lack of events to participate in, maybe even too many competing events. Maybe this is a difference to URSI's early years, where there was a need for international coordination and a need to meet. Today there are a great many national organizations competing for the scientific traveller with a healthy travel budget. I believe that an organization can only be truly effective if there is a need for its existence. Is there a need for URSI?

3. Ideas for the future

Considering the narrow viewpoint of Commission B, I think there is a need for its existence. There is no other organization internationally which is considering theoretical electromagnetics, and the number of people working in the area is not declining, but, as mentioned above, some revitalising is necessary.

The coupling to the individuals is too weak. Some sort of personal membership should be considered, as it does occur in some countries. A stronger involvement of active persons is needed, may be formation of working groups, etc., so that URSI does not appear as such an anonymous organization. In relation to the remarks above these activities should not be made for the sake of URSI, but because there is a need for them. If such areas can be identified both URSI and science will benefit.

In order to make URSI visible in a literal sense, a stronger publication programme is needed, with a much wider distribution of the publications. Unfortunately publishing is expensive, but still some companies make a profit! I see no reasons why URSI could not join force with a professional publisher, so that scientists do not spend their time with matters they are not good at. Recently, a new commercial journal has appeared with the title *Electromagnetic Waves and Applications* with no page charges, etc. Are there any reasons, except that it is probably too late, why an URSI Commission could not be sponsoring a journal like that and at the same time use it for announcements? It would also benefit a number of scientists in a number of countries if publishing was less expensive. In fact, it would be a proper job for an international scientific union to guarantee free publishing for any scientist anywhere, if his work is worth publishing.

If the need exists, groups under the Commission or the whole Commission should meet more often than every three years. This would help tie the group together socially and scientifically and would place URSI in their minds as a necessary and important organization.

A3. COMMISSION C ON SIGNALS AND SYSTEMS

K. Geher, Chairman of Commission C

1. Scope and Activity

The subjects with which Commission C is concerned at any given time vary in accordance with current progress in the whole field of radio science, communications and electronics. At present the main areas are:

- signal processing,
- circuit theory
- information theory,
- radio communication,
- optical fibre communication,
- communication networks.

The scope of Commission C is closely related to the electronic and optical devices and to the computer-aided design of electronic circuits and systems.

In the last three years our basic activity was concentrated primarily on the following areas:

- co-sponsoring international conferences,
- preparing the scientific programme of the 1987 General Assembly,
- writing the Signals and Systems chapter of the *Review of Radio Science*.

We proposed to co-sponsor 12 meetings since 1984, e.g. the Digital Signal Processing Conference in Florence and the European Conference on Circuit Theory and Design in Prague. I hope, the Commission C symposia and the joint symposia will be successful in Tel Aviv. It is a great task of writing a chapter for the *Review of Radio Science* and the Commission Editor can only hope that the national reports are reflected in the scientific and geographic balance of the text.

2. Relation with other Organizations

The relation of Commission C with other organizations are mostly informal. The Commission C is represented officially in the URSI-CCIR-CCITT Liaison Committee. The traditional cooperation between URSI and CCIR was established by the late Prof. van der Pol. The Signals and Systems studies hold the promise of greater communication capacity of the frequency spectrum. All aspects of signal processing, transmission and the detection are very important

for terrestrial, satellite and optical channels.

With the national professional societies the relations are informal as well, IEEE (USA), Popov Society (USSR), IEE(UK), VDE-ITG (FRG), SEP (Poland) and so on are very active in organizing international and national conferences. IEEE has a series of excellent conferences in the area of Commission C:

- International Conference on Acoustics, Speech and Signal Processing,
- International Conference on Circuits and Systems,
- International Symposium on Information Theory,
- International Conference on Communication.

There are many other successful conferences as well;

- European Signal Processing Conference,
- GLOBECOM,
- European Conference on Optical Communication,
- International Teletraffic Conference,

which cover the scope of Commission C.

The official national members of URSI Commission C play a great role in the organization of these conferences. The URSI activity depends on the individual interest of the person involved. In some cases the national engineering societies and the URSI member committees work very closely together, e.g. FRG, and Poland. The people are working at the universities, at national laboratories or at PTT's and they create an informal network of cooperation. We have to recognize that sometimes instead of co-operation competition is dominant.

3. Management and Public Relations

The administrative structure of Commission C is identical with that of the other Commissions. The member committees are represented by an official member. The Commission has a Chairman and a Vice-Chairman. Six out of 40 member committees have not designated an official member to Commission C. On the occasion of missing official member the circular letters were sent to the President of the member committee.

The people are working on voluntary basis. All the official members are of high scientific calibre and many of them have the necessary administrative skill. It is a difficult task for the President and the Secretary of the member committee to find a suitable expert for this job. I would like to underline that an URSI

Commission has only a very limited management power.

The main advantage of being a member of the URSI family is the publicity for the country. Therefore the URSI publications have paramount importance. It is highly recommended to improve the circulation of the *URSI Information Bulletin*, *Review of Radio Science*, and so on. These publications prove the wide range of the scientific activity of URSI, the international character and the multidisciplinary nature of our Union.

4. Conclusions

From the foregoing follows the present activity of Commission C on Signals and Systems and the circumstances of its present management. Finally I want to make some proposal for the future.

- Triennial conferences in Signals and Systems between the General Assemblies (Commission B on Fields and Waves has a very successful series of this type).
- Continuation of cosponsoring of international conferences with special respect to the newest areas (e.g. picture coding, local area networks).
- Improvement of the management of national member committees.
- Improvement of the public relations of URSI.

A4. COMMISSION D ON ELECTRONIC AND OPTICAL DEVICES AND APPLICATIONS

W. A. Gambling, Chairman of Commission D

The range of activities covered by Commission D is very large and is of concern to all other Commissions to a greater or lesser extent. An illustration of the breadth of interest is given by a selection of the topics covered at recent General Assemblies. These include; large-scale integration of microelectronic circuits on silicon; high-speed integrated circuits on gallium arsenide; computer-aided design of circuits and systems; microwave and millimetre wave devices and circuits; active and passive components; lasers; detectors; integrated optical circuits; optical fibres; optical amplifiers; mixers, multiplexers; optical logic and switching.

With such a wide variety of topics it is clear that the target audience for URSI via Commission D is equally broad. Furthermore, the application of these techniques is very much more widespread than radio science, whilst the techniques themselves are, on the whole, advancing rapidly. The result is that the workers in each of the topics tend to form close-knit groups that are inward-looking rather than outward-looking. Often, before a new technique or device finds application in a field such as radio science, some new ideas emerge and the inward-looking research race is on again.

As a result, the role of Commission D in URSI has traditionally been that of a service commission in providing reviews and discussion of the state-of-the-art in electronic and optoelectronic technologies and in outlining possible future trends as they would affect the work of other commissions. It would be difficult for Commission D to provide a source of major conferences in its own right, in its field of electronic and optical devices and applications, because there are already so many major organizations and series of conferences carrying out this work already. It would be impossible to compete with existing events. The service role, while not being very exciting, can provide a useful function if properly carried out.

On the other hand, it would be of benefit if Commission D could, somehow, become an initiator of progress in its own field, both within and outside URSI and in the general electronics community. One method of doing this might be to shift the emphasis of Commission D towards more fundamental matters, including new materials and the physics of rapidly-emerging technologies. The precise topics to embark on are not obvious and require careful thought.

Workers in the electronics community do not think of URSI as an

organization of use to them since it is generally thought to confine its activities to radio science. At the last General Assembly, Commission D therefore raised the question of whether it might be advantageous to change the name of URSI to include a reference to electronics without changing the well-known URSI logo and image. One possibility was to change the name to "International Union of Radio and Electronic Science" with the French equivalent of "Union Radio-Scientifique et Electronique Internationale". After debate by the officers it has been decided better, all things considered, to retain the existing title. The problem remains how to draw the attention of the electronics community to the existence and activities of URSI.

A second suggestion was to hold meetings on electronics topics, sponsored for URSI by Commission D, between General Assemblies. An attempt was made to launch three such events but only one was successful, namely that held at Glasgow in the United Kingdom, 15-16 September 1986, and entitled "Non-Linear Guided Wave Optics and Fast Optical Switching". The conference was organized by the UK National Delegate to Commission D in association with the British National Society for Radio Science and was funded by The Royal Society. Perhaps more such meetings should be held although the difficulties should not be underestimated. Commission D is active in sponsoring meetings in collaboration with other bodies, such as the annual European Conferences on Optical Communications, and should seek opportunities to do so rather than taking a passive role as at present.

The role of Commission D has traditionally been a difficult one because, although the electronics community is large, its loyalties lie elsewhere and a unique role for URSI seems difficult to find.

A5. ELECTROMAGNETIC NOISE AND INTERFERENCE

F. L.H.M. Stumpres, Chairman of Commission E

1. The present terms of reference of this Commission are:

- (a) Terrestrial and planetary noise of natural origin; man-made noise
- (b) Composite noise environment
- (c) Effects of noise on system performance
- (d) Lasting effects of transients on equipment performance (including NEMP)
- (e) Scientific basis of noise and interference control
- (f) Spectrum utilization.

2. Comments

- (a) Lightning has always been prominent in the studies of Commission E, one of the original four Commissions of URSI. In Tel Aviv (1987) we have sessions on: Lightning - predischage processes and associated radiation; Lightning - cloud-to-ground discharge, I and dI/dt, radiation; Lightning interaction with aircraft. In our tutorial session, Dr. Hamelin will treat modern lightning research. Notwithstanding major efforts in many countries there are still many problems.

Each year, international aerospace and ground conferences on lightning and static electricity are organized (Orlando 1984, Paris 1985, Dayton 1986). The Scientific Committee on Solar-Terrestrial physics has this and other problems in common with us. Furthermore, there is an International Commission on Atmospheric Electricity (Secretary: Dr. A.J. Illingworth, Manchester). It mentions under its interests: Atmospheric electricity on other planets. I wrote to Dr. Illingworth to suggest cooperation between his commission and URSI, but got no answer.

Planetary noise will be treated in our session: Satellite and planetary noise environment. We had a very interesting session on this subject in Florence (1984), but with new scientific satellites further results can be expected. Several planets and moons of planets have lightning and other atmospheric discharges.

In temperate regions, man-made noise is the main cause of interference to broadcasting and communications. Statistical descriptions were studied by Middleton and Spaulding. In the study of man-made noise, the International Special Committee on Radio Interference has defined methods of measurement for radiation and conducted interference, for immunity, also standard instruments (like the MdS clamp) and limits for permissible interference. There were always

strong personal contacts between CISPR and URSI. Prof. van der Pol was one of the founders of CISPR and its first Vice-President for methods of measurement. These personal contacts were thought to be sufficient. It would be difficult for CISPR to review its methods of measurement, and to use the amplitude probability distribution instead of the quasi-peak method. It is also not sure that its limits, usually the best available compromise between the industries that produce sources of interference and the radio, television and communication industries, PTT's and Broadcasters, would not have to be changed after a thorough scientific examination. We expect to have a session on man-made noise, limits and statistics at the General Assembly in Tel Aviv.

Apart from lightning, whistlers were a subject of study in my Commission since 1952. In 1963 there came a separate Commission on the Magnetosphere, and terrestrial noise got only a Subcommission. This situation was reversed again. We expect to have a session on radio-location of whistlers and of other sources of interference (with Commission H).

- (b) The composite noise environment is usually built up by many sources, with statistical distributions of sites and times. It is, as usual, the subject of a session.
- (c) In temperate regions man-made noise may be the main source of interference, but in tropical regions natural noise may be prominent. Studies of URSI in many countries made it possible to change the noise levels, given in relevant CCIR reports. The predicted values of atmospheric noise relate to the necessary transmitter power, and affect the planning. Therefore the CCIR meeting in Dubrovnik hesitated to use the new values, and rather waited for confirmation by further experiments. We have a session (with Commission A) on man-made noise measurements - limits - statistics.
- (d) The lasting effects of transients on equipment performance became a subject of study in our Commission around 1982. Mr. Scuka (Sweden) is Chairman of a Working Group on this subject. He is the organizer of a session in Tel Aviv, which includes the effects of the nuclear electromagnetic pulse on which a Committee, with Mr. Wik in the chair, produced a report that was adopted unanimously by the URSI Council in Florence in 1984. This work is being continued too. Destructive effects of lightning on cables, aircraft and satellites belong to that Commission, as well as damage done by electrostatic discharge.
- (e) The scientific basis of noise and interference control is the subject of a Working Group under Dr. Carl Baum, who gave interesting contributions to the study of electromagnetic topology. He is the organizer of a session on

this subject, and of a session on Coupling and Shielding.

- (f) Spectrum management and frequency allocation is an important subject to which a special session, organized by D. Struzak and with Mr. Kirby in the chair, will be devoted. The interests of the Inter-Union Commission for Frequency Allocation for Radio Astronomy and Space Science (IUCAF) will be represented by Dr. Horner.

Many phenomena in the field of electromagnetic pulses, geomagnetic storms, interaction of waves and plasmas, solitons, lightning, cannot be described by linear models. For this reason we have a special session on nonlinear effects, with Prof. Kikuchi in the chair. He already organized a symposium on this subject in Tokyo, the papers of which were reproduced in a 383-page book by Elsevier.

A new item on the agenda of our Commission is the relation of electromagnetic phenomena to earthquakes. It is well known that animals get restless before an earthquake, and Gokhberg (USSR) looked, in his own country and in Japan, for related electromagnetic phenomena. He indeed sometimes found a sudden increase in electromagnetic noise, half an hour before the earthquake. Yoshino even could correlate the noise reception in different stations with the location of the earthquake. One can imagine that, after the breakdown, the motion of numerous particles can lead to electromagnetic noise, but it is not yet very clear why the building up of a high mechanical tension before the earthquake should lead to this effect. We have a session on this subject, on which further study may be necessary, before it is formally added to our terms of reference.

Time domain waveform measurements is a joint symposium, in which all Commissions are interested. Experience shows that always several Commission members give papers there. I remember giving a contribution to such a session in 1954, when Prof. Chapman was Chairman.

Interaction of waves with biological systems is a joint symposium of Commission A, B and E. In most of our URSI-sponsored EMC symposia, there is also a session on this subject.

3. EMC Symposia

Since about 12 years, URSI cosponsors symposia on electromagnetic compatibility (EMC). This is a new title, invented in the USA, for what used to

be called radio noise and interference, but it also covers a wider domain. The Swiss symposia were organized in Montreux (1975, 1977), Rotterdam (1979), Zurich (1981, 1983, 1985, 1987). The Polish symposia are in between these years, so far in Wroclaw. I participated since 1975 in both series of symposia, and one always meets quite a number of people interested in URSI Commission E there. In the last few years, URSI has helped with subsidies for young scientists in both places.

Apart from the yearly URSI-sponsored symposia, there are EMC symposia in the USA (sometimes in Japan), and biannual symposia in France and the United Kingdom.

4. Closing Remarks

Having seen Prof. Kikuchi's contribution to the *Review of Radio Science* on behalf of our Commission (to which 21 people sent in contributions), I have the impression that quite a lot is going on, and that the Commission is full of life. I would not know where to change. We expect to have an informal meeting of the Commission during the Zurich EMC Symposium (1-4 March 1987). If any proposal for change comes out of it, I will let you know.

A6. COMMISSION F ON WAVE PROPAGATION

F. Fedi, Chairman of Commission F

1. Terms of reference

The terms of reference of the Commission approved by the URSI Council in 1984 are:

- 1) to study all aspects of wave propagation at all frequencies in a non-ionized environment:
 - wave propagation over the Earth's surface,
 - wave propagation in, and interaction with, the neutral atmosphere,
 - wave interaction with the Earth's surface, oceans, land and ice,
 - wave propagation through, and scattering by, the sub-surface medium,
 - characterization of the environment as it affects wave phenomena;
- 2) to encourage the application of the results of these studies, particularly in the areas of remote sensing and communications;
- 3) to develop the required cooperation with other URSI Commissions and other relevant organizations.

It is felt that these terms of reference are adequate for the future work of the Commission.

2. Applications of results and cooperation with other organizations

As stated in the terms of reference the main applications of the studies of Commission F can be identified in the areas of communications and remote sensing.

Communications

Problems connected with the applications of wave propagation to communications have been traditional subjects for the Commission.

Cooperation with Study Group 5 of the CCIR (Radio propagation in non-ionized media) has always been very efficient.

A very good example of this cooperation was the CCIR request for

theoretical investigations put forward before the Helsinki URSI Assembly in 1978. This led to the formation in Helsinki of two *ad hoc* URSI Working Groups which prepared two reports for CCIR. The reports were discussed during the traditional inter-Assemblies Commission F Symposium held in Canada in 1980 and particularly focused on the problems proposed by the CCIR.

The continuous excellent URSI-CCIR cooperation is also mainly due to the fact that most scientists are active in both organizations. It is sufficient to recall how many URSI Commission F Chairmen have or have had CCIR responsibilities (Smith-Rose, Saxton, Misme, Fedi). The recognized different nature of the scientifically-oriented URSI studied and the application-oriented CCIR activities helped avoid any possible overlapping .

Remote sensing

In the last years the interest of the URSI radio propagation community towards the problems connected with the applications of wave propagation to remote sensing increased noticeably.

A considerable number of successful symposia have been organized by the Commission in the last years on remote sensing aspects of wave propagation.

Close cooperation with remote sensing bodies and organizations was established whenever possible.

A list of the major cooperations established is:

- IEEE - GRS (Geoscience and Remote Sensing Society) with particular regard to the annual IGARSS (International Geoscience and Remote Sensing Symposium)
- IUGG-IAMAP-RC (International Union of Geodesy and Geophysics - International Association of Meteorology and Atmospheric Physics - Radiation Commission)
- ISPRS (International Society of Photogrammetry and Remote Sensing)
- COSPAR (Committee on Space Research)
- SCOR (Scientific Committee on Oceanic Research)

The role of URSI Commission F in these cooperations is restricted to the study of the interaction of EM waves with the medium, including the related

instrumental problems. The applications (meteorology, climatology, oceanography) are left to the relevant bodies concerned with geophysics.

3. **Inter-Assemblies Symposia**

A single important traditional symposium, covering the entire field of interest of the Commission, is organized in the period between two General Assemblies. Particular topics are dealt with in workshops organized on an *ad hoc* basis.

4. **URSI Assembly and Commission F Scientific Sessions**

The Commission regards the General Assembly as a "cultural" occasion to favour the interaction between the two "communications" and "remote sensing" communities.

Instead of duplicating the many (sometimes too many) congresses and symposia available, the scientific sessions have been organized on the basis of invited papers on the most important topics of interest to the Commission (1 general, 3 on remote sensing, and 3 on communications).

5. **Title of the Commission**

The chairman recalls that at the last General Assembly the Commission was in favour of deleting "remote sensing" or any other reference to a particular application from the title of the Commission.

A.7. PAST, PRESENT AND FUTURE OF COMMISSION G ON IONOSPHERIC RADIO AND PROPAGATION

J. Aarons, Chairman of Commission G

1. The past

The original focus of Commission G was the propagation of high-frequency radio waves reflected or guided by the ionosphere. This has included radio frequency transmissions from 16 kHz to transmissions to 50 kHz.

The ionosphere was used in two ways. The earth-ionosphere acted as a waveguide for the transmission of low-frequency energy. Navigation signals ranging from phase measurements to delayed pulses were of interest to users. The D layer for its waveguide characteristics and phase changes was studied by radio scientists in order to ensure good propagation. The second use of the ionosphere was to serve as a reflector of radio waves. The E layer supported short-distance transmissions. The F layer at altitudes from 200 to 600 km supported long-distance communications.

The users found that knowing the characteristics of the medium would allow them to forecast usable frequencies for transmissions. The heights of the layers and the critical frequencies as a function of many parameters were of interest. It was clear that models could be set up of strictly utilitarian design that could assist in the forecasting. Models initially consisted of observations meshed through interpolation and extrapolation. The physics while interesting could be studied but it was not the essential part of the forecasting. While models were set up the users of ionospheric propagation depended a great deal on experience of the technicians involved in transmissions. Experience would allow those actively using transmissions to change frequency, to increase transmitter power where possible, and to explore alternative routes.

Perhaps the peak use of ionospheric radio propagation came in, during and immediately after World War II with HF transmissions - a vital part of most operations. There was also in navigation full use of the LF and VLF ranges.

Essentially for this period the ionosphere served as a black box, as an integral part of the communication system with characteristics poorly known compared to the other black boxes of the system, the transmitters, receivers, antennas, etc.

After WWII the interest in the ionosphere grew and the study of layer formation, the high-latitude ionosphere, the equatorial ionosphere, etc. grew. The

origin of sporadic E, the development of the trough in electron density, and the morphology of equatorial irregularities were some of the interests pursued. Using rockets and satellites for research studies as well as ground measurements in addition to radio methods, the science of aeronomy developed. With the development of this science there was a growth of the division between those interested in the basic physics of the ionosphere and those interested in the use of the ionosphere for various purposes. The separation of these interests led to a division of areas where the physics of the ionosphere was essentially handed over to organizations such as IAGA and the American Geophysical Union, the European Geophysical Union, etc., while the technical aspects of ionospheric radio propagation were kept in URSI.

2. The Present

With the advent of the satellite and the enormous capabilities it developed for communications and now for navigation the role of the radio scientists changed. The need for high-frequency communications diminished (more on that later). Radio scientists developing satellite communications considered the ionosphere to be only of nuisance value. The ionospheric irregularities produced fading at high and equatorial latitudes, the ionosphere produced time delay errors in communications equipment, the ionosphere at frequencies in the HF band acted like the iris of a lens shutting down low-angle transmissions, etc.

3. The Future: A Personal View

There is a role for traditional ionospheric propagation studies. There is still heavy use of the HF band, primary for industrial and military uses. There is use of the lower frequencies for navigation. The areas still poorly understood in this category are the high-latitude regions for normal transmissions and the occurrence of E- and F- layer irregularities at a variety of latitudes. There is therefore still a great deal to be learned about the physics of the ionosphere. The formation and development of many of the high-latitude characteristics ranging from E layer auroral returns to the trough in electron density are related to developments within the magnetosphere. The interrelationship between the ionosphere and the magnetosphere is being studied by a variety of methods including magnetic observations, *in-situ* observations from both low-altitude and high-altitude satellites as well as by radio techniques such as digital sounders, satellite beacon observations, and coherent and incoherent radars at HF, VHF and UHF. The radio scientists should now work more closely to those involved in geophysics and aeronomy.

Lower atmosphere studies should be integrated into radio propagation. While there is a great deal of work in radar observations of the lower atmosphere

there is only the beginning of work relating D-layer characteristics found by this technique and radio propagation of low-frequency waves.

It is my personal belief that the future of Commission G must be to relate characteristics of the ionosphere such as critical frequency, presence of E-layer aurora and the other measurements to other geophysical measurements. It is therefore imperative that Commission G expand its horizons to add more time and effort to the physics of the ionosphere-magnetosphere. The way to do it is to take back some of the areas given to IAGA through full participation in global programmes. In the international Geophysical Year in 1958 and 1959 many measurements were taken and a great deal of interest was shown by the radio scientists in the physics of the ionosphere. There was close coupling between geophysics and radio wave propagation. The close coupling of science and technology could be present in the coming years if URSI people fully participate in the World Ionosphere and Thermosphere Programme. It is here that I believe the Commission programme can grow and mature.

A.8. THE PRESENT TASKS OF COMMISSION H

R. L. Dowden, Chairman of Commission H

Most of us see URSI at the crossroads. Some may see URSI in a sick state and some may even query the need of URSI's existence in the future.

URSI was one of the first international unions and has been in existence for nearly seventy years. Over most of that period URSI has had an importance considerably greater than that which it enjoys now. I believe this state of affairs has occurred because the needs of the radio science community have changed rather faster than has URSI. The big question is: "What are the needs of the radio science community?"

One could ask the various Academies of Science or Research Councils of our membership why they belong and remain affiliated to URSI. This could be a dangerous question to ask. Most became members of URSI when it was more important to do so and so some may disaffiliate to save costs if they were to reconsider their membership. Clearly we should be giving thought to making URSI membership more important.

The Present Problems

Most people see "URSI" as the General Assembly and perhaps other national and international conferences which have "URSI" in the title. Unfortunately the latter have scarcely existed in Commission H and so I have concentrated on the reason why radio scientists in the field of "Waves in Plasmas" might attend or not attend URSI General Assemblies. I chose about 350 scientists in this field mainly from the cited authors in the Commission H section of the last three issues of *Review of Radio Science*. Thus, all of these scientists have been active in research in this field over the last ten years. A special effort was made to get a rather wider representation of different countries than would result from simply choosing the 350 most prolific authors. The questionnaire is shown attached to this report. The numbers, and sometimes comments, in square brackets have been added in the analysis of the answers. About 40 answers were received by the stated deadline (mid-December) with a further ten since then. Although this represents only a 15% return, the geographical representation was quite good. Since exactly 50 replies have been analyzed the numbers in square brackets can be doubled to give percentages.

1. The vast majority (86%) nearly always expect to present papers. Many commented that it was difficult to get travel funds unless they presented papers.

2. Over 90% would like more than half the papers to be *contributed*. Many wrote in suggesting ratios of about 70% contributed papers to 30% invited papers. Only one of the 50 would like invited papers only. Although this question was directed only at scientists in the Commission H field other URSI Commissions which have only invited papers in their sessions should see if in fact this is what their members want.
3. Although not invited to do so, six circled either 20 or 10 minute "oral" as well as "mainly poster". Only one thought that contributed oral papers should be 30 minutes long, as is present practice. There is a very strong preference for oral, contributed papers to be between 10 and 20 minutes long (several wrote in "15 minutes") and some 40% felt that contributor's papers should be mainly or all posters. Although the present practice of Commissions G and H is to make all contributed papers 'posters' the message from these answers is that at least some contributed papers should be oral.
4. This question invited "one or two" selections and all but four made more than one. Three chose three, and one or two chose them all (my analysis programme could only handle up to three choices and so the latter were ignored). A large majority (66%) see one of the main purposes as an opportunity to present their own unpublished and recent work for peer response. This is in contrast to the relatively few who saw the review as important. This is in line with the answers to the first three questions: scientists come to General Assemblies to talk rather than to listen! Only about 10% saw the formal adoption of standards and the co-ordination of research as important although these represent Objects (b) and (c) of URSI as listed in the Statutes. One the other hand, over half saw an important purpose to organize international co-operative research ventures. This is one of the main activities of SCOSTEP but has been largely neglected by URSI Commission H in recent years. It is interesting to note that these answers are in general in line with Object (a) of the Statutes, which is 'to promote and organize research requiring international co-operation and the discussion and dissemination of the results of this research'.
5. The relatively long preamble to this question was to "justify" the longer intervals between the abstract deadlines and the General Assembly. Many felt that vetting of contributed abstracts was unnecessary and many were prepared to pay increased registration fees if faster printing was to cost more (these were clear from written-in comments). Over half of those who answered this question chose five months, which is in fact the lead time of the deadline used by IUGG this year.

- 6,7,8. These last three questions concern URSI's relationship (and competition with) IAGA and COSPAR. Until the Lima URSI the fields of URSI Commission IV, Commission H's predecessor, and IAGA Division III were virtually identical. Since then Commission H has become restricted to waves in space plasmas, as opposed to morphology, mainly but not always at frequencies above ULF. IAGA generally avoids waves in the magnetosphere above ULF but has a very strong interest in ULF waves. Some within this group resent URSI Commission H running sessions including ULF waves in URSI General Assemblies. A Commission H conference in 1983 to bring these two groups of waves scientists together showed that the ULF/VLF split was a deep one and that the physics of the interaction of VLF and ULF waves was not important enough to heal this split. There are several reasons for this separation but in any case it is perhaps best to recognize that the split exists and that it is a reasonable boundary between the science of URSI and that of IAGA to reduce the degree of overlap. Papers at COSPAR meetings used to be restricted to those involving space vehicles or balloons. In recent years this restriction has largely disappeared. A field of overlap is that of active experiments in space plasmas. Both URSI and COSPAR symposia in this field consider all such experiments, including "radio" ones like artificial radio frequency heating of the ionosphere, and VLF wave injection from the ground, and "non-radio" ones like chemical releases from spacecraft. This policy can be justified in that seemingly different experiments have strong interactions (radio frequency heating of the ionosphere can produce morphological changes, chemical releases in space plasmas can change radio wave propagation). If, on the basis of this, it is not appropriate to separate COSPAR and URSI activities into non-radio and radio aspects respectively, it would be logical to form an inter-union working group in this field between URSI and COSPAR. Attempts are under way to do this though little interest has been shown by COSPAR scientists.
6. If a choice had to be made through fund or time limitations, about two-thirds would choose IAGA or COSPAR ahead of URSI. Several commented that they would have chosen URSI in the past. Some even queried the need for URSI in this field.
7. The main reasons given for this choice were that fields and topics discussed suited them better and that they met more of their colleagues. If these figures are representative, it is disappointing that only about a third of those scientists whose work was cited as radio science by URSI would choose URSI ahead of IAGA and COSPAR, and of *these*, 20% choose URSI because they hold office in URSI. It is encouraging that relatively few choose URSI on the basis that the other meetings are better organized or

have better structure. The surprising revelation from many comments was that many scientists do not know what URSI Commission H does. One gave his interest as "waves in space plasmas" and complained that this wasn't dealt with much by URSI! Clearly, we need a higher profile in Commission H.

8. About two-thirds prefer three years between URSI General Assemblies as at present. The other third preferred either a two-year or four-year interval using even years to avoid clashing with IAGA meetings. It was suggested that URSI General Assemblies be held every four years, with purely scientific meetings of the Commission in the intervening years, rather like the IUGG/IAGA pattern. Several of those advocating the present three-year interval suggested a similar arrangement for IUGG and COSPAR so that all would meet every three years in a three-phase pattern. Unfortunately this would require a big change for IUGG and for COSPAR (which until recently met every year) and since both IUGG and COSPAR are numerically large and cover a wide range of fields, it is most unlikely that they would agree to change to this triennial pattern.

organizational role of URSI, and of Commission H in particular, and so enhance the value of national URSI membership.

The Tasks Ahead

I feel that these problems require solutions by URSI in concert rather than by Commission H acting alone. Here are some suggestions for discussion:

1. Reorganized URSI into about four "International Commissions", each divided into Sections with appointed Chairmen. The IC's would have names such as the "International Commission on Waves in Space Plasmas" (consisting of present G and H), or "ICWISP". Such acronymic names would be better known and remembered than the letters "G", "H", etc. as now. These IC's, like the Associations (IAGA, IAMAP, etc.) of IUGG, would meet *between* as well as *at* URSI General Assemblies at the times and sites of sister organizations (thus in conjunction with COSPAR or IAGA in the case of ICWISP).
2. URSI sponsorship of international conferences with financial support should be only of the "Chapman Conference" (American Geophysical Union) type for which the sponsor (URSI) provides considerable organizational service and retains control (e.g. the name "URSI" should always appear in the conference title).
3. Commission Working Groups should fill *real* needs. Pre-GA reports (published in the URSI Bulletin) should be required, meeting time slots should be prearranged during GAs, etc. This is to enhance the

QUESTIONNAIRE

Please circle your choice. Use "COMMENTS" for other answers (refer to question number). Use enclosed sticky label to past your reply back to me----- many thanks in advance! (R.L.Dowden). [50 had replied by 12th January, 1987]

1. Do you expect to present papers at conferences you attend:
always?[12] usually?[31] sometimes?[61] rarely?[0] never[1]
2. What ratio of invited to contributed papers would you like at URSI meetings?
invited only[1] mostly invited[3] 50:50[23] mostly contrib.[23] all contrib.[0]
3. Given that the time available is limited, should contributed papers be:
30min.oral?[1] 20min.oral?[18] 10min.oral?[15] mainly poster?[18] all poster[3]
4. Should the scientific purpose of a General Assembly be mainly (circle bullet of one or two):
[7] - to review the work in each field since the previous G.A. (i.e., over the previous three years)?
[26] -to organize international cooperative research ventures (like IGY)?
[4] - for formal adoption of standards, nomenclature, etc.?
[5] - to coordinate research among different groups?
[18] - an opportunity for scientists to meet informally for discussion?
[19] - to allow researchers to present for peer response their own unpublished and recent work?
[0] - other (use "COMMENTS")
5. Given that extra time (2-3 months?) is required if you feel that contributed abstracts should be vetted before acceptance, that printing times shorter than 6 months might increase costs (increased registration fee) and that very short times would mean no printed abstracts, how many months before the General Assembly should abstracts to required (the deadline date for submission)?
9[3] 7[13] 5[24] 3[5] 1[0]
6. If you were able to attend only one of the following in a given year, which would you choose?
URSI?[16] IAGA?[19] COSPAR?[12]
7. Circle the bullet (•) of the main one or two reasons for your choice above:
 - I hold an office in that body[7]
 - The invited speakers are more important to hear[2]

- The field and topics are closer to my speciality [27]
- other (use "COMMENTS")[15]
- More of my colleagues attend [12]
- Better organization and conference structure[4]

8. At present URSI meets every three years (84,87, 90) around August, IAGA meets in odd years (85, 87, 89) around August and COSPAR meets in even years (86, 88, 90) around June. What is your preferred interval between URSI General Assemblies?
1 year[0] 2 years[6] 3years [33] 4 years [7] 5 years[1]
9. COMMENTS (any you care to make, whether on specific questions above or general):
[28 made no comments
22 made comments varying in length from 2 lines to a full page]

A.9. COMMISSION J ON RADIO ASTRONOMY

R. Wielebinski, Chairman of Commission

1. General

The purpose of Commission J is to give radio astronomers throughout the world a podium to present recent advances in their field. The reason why URSI gives us this opportunity is the fact that other Commissions use similar methods of radio science and hence give radio astronomers the necessary contact to adjacent fields of research. Radio astronomy grew up from small beginnings basing a lot of the techniques on the war-time radar developments. The quest for higher angular resolution meant that new technological developments were necessary. Giving away any hope to achieve sufficient angular resolution through the construction of even larger, filled apertures, radio astronomy moved to the development of interferometry. This development was consequently pursued from two-element interferometers, through aperture synthesis arrays to intercontinental very long baseline interferometry (VLBI). This technique gives now an angular resolution down to 0.0001 arc-s. This is a factor of more than 1000 better than the best earth-bound optical telescopes. Another development in radio astronomy was to extend the frequency coverage. From early metre-wave radio telescopes the developments went first to cm-wavelength, more recently to mm-waves, and are at present going to short sub-mm waves - which meet the far-infrared spectrum. This enormous frequency coverage requires the use of different techniques. Great progress was made in the construction of precise telescopes. Another significant development was the quality of detectors. Starting with valve (vacuum tube) preamplifiers we now use detectors (like the SIS mixer) which reach quantum noise limit. Great work was done in the understanding of phase stability of receiving systems (including clocks). Digital processing and the use of computers are a 'must' in radio astronomy.

2. Radio astronomers and other Unions

Astronomy is covered by the activities of the International Astronomical Union (IAU). There is a Commission No.40 (Radio Astronomy) in IAU. However, it is customary to discuss all technical developments within Commission J of URSI. Sessions of Commission 40 of IAU usually deal with astronomical results. There is no competition between the two organizations but clear supplementary activities. Radio astronomers who are active within URSI seek the contact with the more technical colleagues. Some radio astronomers also participate in the activities of the local professional (engineering) societies. However, here the competitive aspect is even less obvious. Each country has also different functions for URSI national meetings. In many countries there are no strong national

activities. In some countries, regular URSI meetings take place. In numerous discussions during business sessions of Commission J, all the present radio astronomers expressed the need to continue the activities of this Commission in the existing framework.

3. Activities of Commission J

The main highlight of the activities is the General Assembly. Here every three years people who build radio telescopes, receivers, and data-processing systems meet. Here the contacts are kept, plans exchanged, and new ideas discussed. Between the General Assembly many of the radio astronomers attend the IAU General Assembly and discuss progress with their 'customers' - the observers. Co-sponsorship of IAU symposia is also practiced, bringing in the technical aspects of a new field. Occasionally, URSI organizes an international conference - on mm-wave techniques or image processing. The organization of an only URSI-sponsored conference is immediately hampered by the shortage of funds. It is easier for organizers to bring IAU, URSI and a local research organization together to finance a joint symposium. Recent space activities which require international discussions could have involved URSI. In the case of space VLBI it was COSPAR which gave the necessary forum. Also, frequency protection activities, a joint URSI-IAU-COSPAR initiative, were of historical importance to the well-being of radio astronomy.

4. Future

Radio Astronomy should stay as a Commission of URSI. Commission Chairmen and the Official Members (designated by Member Committees) bear the responsibility for the functioning of the Commission. There is a great need to bring in enthusiastic young people to become involved in URSI. Every three years technically-oriented radio astronomers will travel to the URSI General Assembly to meet each other, to discuss their work and to learn what else is going on in radio science.

B. INPUTS ON EXTERNAL ACTIVITIES

B.1. EDUCATION, PUBLICATION, AND YOUNG SCIENTISTS

A. L. Cullen, Vice-President, URSI

General Introduction

All scientific societies have an educational role insofar as they organize conferences in which scientific advances are reported to those wishing to learn about them, and URSI is no exception to this general rule. Another aspect of this function is the publication of scientific papers, and again, URSI conforms to this general rule. In this sense, no age limit is implied. However, we do instinctively have the young in mind when education is mentioned, and it is entirely appropriate that URSI, like some other members of the ICSU family, has in recent years paid special attention to the needs of the young with its Young Scientists Programme. But it is important to remember that education, formal or informal, through lectures or self-taught, will continue throughout the working life of any scientist worthy of the name.

In what follows, I want to demonstrate how URSI has contributed to the spread of knowledge of radio science throughout the whole world, and to draw attention to one or two special aspects of this work which URSI regards as particularly important.

I hope that as a result of this outline of URSI's activities, our special guests will be able to suggest ways in which our limited resources may be used to the best possible advantage; our ideas on what ought to be done in the future are by no means set in concrete.

Education

The origins of URSI, resting as they do on the essential need for international co-operation in certain aspects of radio science - radio wave propagation, radio astronomy, and standards of measurement, spring to mind - URSI has a long tradition of genuinely international activities. Thus, it is in a good position to spread knowledge of these and related matters throughout the world.

Moreover, an URSI General Assembly has a character somewhat different from that of most international conferences, in that the *whole* of radio science is covered. I well remember my own first experience of URSI; it was a revelation to be able to move from Commission to Commission, and to hear experts reviewing the state of the art in their own particular areas of expertise. I gained

much from this opportunity. I know from having spoken to every one of the young scientists who attended the 1984 General Assembly in Florence that this aspect of URSI, namely the opportunity to *broaden* as well as to deepen one's understanding, is greatly valued. I know that the Board of Officers of URSI attaches great importance to this, and has now instituted at its General Assemblies two new types of lecture to further this aim.

The first type is Commission-based. Each Commission is responsible for organizing a Tutorial Lecture, in which the objective will be to describe the outstanding problems of the moment in such a way as to facilitate understanding of the later lectures in the Commission's programme.

The second type is the General Lecture. These are intended to be lectures on topics of great current interest and importance, not necessarily central to URSI's terms of reference.

Both of these types of lecture seem to have found favour with those who attended the recent General Assemblies in which they were first introduced, and both are primarily educational in their objectives.

Apart from these General Assembly activities, URSI has been involved in specific educational activities in its own areas of expertise. For example, a workshop on radio propagation in the tropics was organized by the International Centre for Theoretical Physics in 1982, co-sponsored by URSI with additional financial help from UNESCO. Dr. A.P. Mitra was the Director, and the course provided an opportunity for scientists and engineers from developing countries to learn about the upper atmosphere and its effect on radio wave propagation in tropical regions. About 75 people from all over the world, mostly from developing countries in Latin America, Europe, Africa, Middle East, South East Asia and Asia (including China), attended the workshop, illustrating again the international aspect of the work of URSI.

Finally, it must not be forgotten that, increasingly, the Member Committees of URSI are organizing meetings in their own countries which often have a tutorial component, and to which young scientists are frequently invited.

Publication

The main source of information about the activities of URSI is the quarterly Information Bulletin. This contains announcements of forthcoming meetings and symposia, news from Member Committees, ICSU, etc., and also provides from time to time up-to-date lists of officers of URSI with their addresses. This publication is of course principally of interest to the Member Committees of

URSI; it is unlikely to be read by more than a small proportion of those attending a General Assembly for example, so that URSI must rely on other means of publicising its scientific meetings and symposia to radio scientists in general.

For many years now, URSI has produced the *Review of Radio Science*. This is a major effort which appears triennially, and which reviews progress in the period since the previous Review. It is compiled from reports on progress submitted by the Member Committees. These are necessarily drastically reduced in length, but the end result highlights the major advances in a way which many radio scientists find useful, particularly since extensive bibliographies are included.

More recently, other more specialized publications have been produced. These include:

Handbook of Radio Propagation in Tropical Countries

Directory of Radio Scientists and Laboratories in Developing Countries

Register of National Standards Laboratories

International Reference Ionosphere

It is intended now to add to this list a book, provisionally entitled *Modern Radio Science*, which will contain the Tutorial Lectures and General Lectures associated with each General Assembly. This book would be issued to each participant in the General Assembly, and it is hoped that arrangements will be made for a wider distribution subsequently, hopefully by its inclusion in the ICSU Press Symposia series.

Finally, there are of course occasional publications of URSI for special purposes; however, it seems unnecessary to provide full details of these. It is the regular on-going publishing policy of URSI which needs to be considered.

Young Scientists

The Young Scientists Programme of URSI was initiated in 1969, on the occasion of the General Assembly in Ottawa, and was repeated in Warsaw in 1972 and in Lima in 1975. After a lapse of several years, it was reintroduced in a major way at the General Assembly in Washington in 1981, when 25 young scientists attended, 12 of them being from developing countries. It has since developed into one of the most successful ventures of the Union. The key elements of the programme are:

- Young Scientists Awards provide financial assistance to help scientists of age 35 or less to attend a General Assembly of URSI.
- Awards are made to young scientists from developing and developed countries in roughly equal proportions.
- Residential arrangements are such that young scientists from developing and developed countries are encouraged to mix, and to develop pleasant and helpful friendships.

After the General Assembly, the young scientists receive the *Review of Radio Science*, certificates of awards, etc., and where appropriate will be recommended for participation in other URSI events.

At the most recent General Assembly, in Florence in 1984, 43 young scientists attended under the URSI programme coming from 33 different countries. Of those attending, 19 were from developing countries.

In addition to the General Assemblies, young scientists are helped where possible to attend URSI-sponsored (preferably URSI-generated) meetings between Assemblies, and special funds are set aside for this purpose.

All in all, 76 young scientists from 42 countries have been supported to attend either a General Assembly or a Conference as of 15 January, 1986.

Conclusion

The three topics covered in this short paper are clearly interlinked, and, I think, equally of immense importance to the future health of URSI. Insofar as the correct plans are made for the development of these activities, URSI can, I believe, have a major influence on the general understanding of radio science, and on the way it can best be used to benefit mankind.

B.2. THE SCOPE-ENUWAR PROJECT AND THE ROLE AND PURPOSE OF URSI

M. Wik, Chairman, URSI *ad hoc* Committee on ENUWAR

The SCOPE-ENUWAR project (Scientific Committee on Problems of the Environment - Environmental Consequences of Nuclear War) was initiated by ICSU in 1982 and involves approximately 300 scientists from more than 30 countries.

Nearly all scientists belonged to the SCOPE community. However, it was recognized that among the effects of nuclear explosions, information was needed concerning the electromagnetic pulse and associated effects.

In order to include such information URSI was requested to make a contribution. This was performed by an *ad hoc* committee at the URSI General Assembly in Florence in 1984. The URSI interest in producing a statement that should be unemotional, nonpolitical, authoritative and readily understandable was demonstrated by the number of attendants representing many countries at the open meetings of the *ad hoc* committee during the General Assembly.

The statement was unanimously approved (in principle) by the URSI Council. Due to the limited time available during the General Assembly, some editorial work, including some remarks at the Council meeting, was left to be done.

The statement was sent to SCOPE-ENUWAR and also printed in the *URSI Information Bulletin* (No. 232, March 1985). After some minor changes it was also sent to ITU and published in *Telecommunication Journal* (Vol.52, No.X, October 1985).

After this the *ad hoc* committee was requested by SCOPE-ENUWAR to make a draft contribution about the effects of high-altitude nuclear explosions in Chapter 1 of Volume I of SCOPE Report 28 concerning Physical and Atmospheric Effects. This draft was produced early in 1985 and was used when editing the chapter. It was also to some extent used when producing a popular version of the scientific material

A roundtable discussion in connection with the URSI Factual Statement on EMP and Associated Effects was organized at the 6th symposium on Electromagnetic Compatibility in Zurich in March 1985.

The result of the URSI contribution to SCOPE-ENUWAR was presented at

the Nuclear EMP Meeting in May 1986 in Albuquerque, New Mexico, USA.

The work was also referred to at a conference on 'Nuclear Winter' in March 1986 at Virginia Polytechnic Institute and State University in Blacksburg, USA, at a nuclear winter seminar in Stockholm in September 1986 and at a lecture at ETH, Zurich in October 1986.

After the publication of the SCOPE-ENUWAR report some requests have been made about further information. One such request has come from the New Zealand Planning Council about the effects of nuclear weapons-generated electromagnetic pulses on communications facilities.

The URSI cooperation with SCOPE resulted in drawing attention to URSI itself to SCOPE and to ICSU. The great value of this world-wide, non-governmental community has been appreciated by people from the non-scientific community. It appears that steps have been taken to make various groups of people with different background aware of the necessity to be able to communicate with one another in order to better understand complex problems (Blacksburg and Stockholm conferences).

The scientific community has an increasing important object to investigate and make the non-scientific community aware of limitations set by physical and biological laws. Unawareness of such limitations could cause unacceptable situations in the future.

One future role of URSI would be to contribute in broad in interdisciplinary scientific programmes that will produce better fundamental information for high-level decision-making. Such information will also help decision-makers to better understand the importance of a well functioning scientific community and to support it. The significance, however, that this community remains non-governmental and non-political must never be underestimated.

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B.3. THIRD WORLD ACADEMY OF SCIENCES (TWAS)

H. R. Dalafi, Representative of TWAS

President:	A. Salam (Pakistan)
Vice- Presidents:	M.G.K. Menon (India)
	T.R. Odhiambo (Kenya)
	C. Chagas (Brazil)
Secretary:	M. Roche (Venezuela)
Executive Secretary:	M.H.A. Hassan (Sudan)
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The idea of creating a Third World Academy of Sciences was first conceived at a meeting of the 'Pontificia Academia Scientiarum' in October 1981 by members from developing countries.

The foundation meeting of the Third World Academy of Sciences (TWAS) took place in Trieste in November 1983, under the sponsorship of the Trieste International Foundation. The meeting elected Professor Abdus Salam President of the newly established Academy, and nominated Professors Chagas, Menon and Odhiambo Vice-Presidents.

In July 1985, the Academy was officially inaugurated by the Secretary General of the United Nations, Mr. J. Perez de Cuellar, on the occasion of the First General Conference on South-South Cooperation in Sciences in Trieste.

The Academy has united over one hundred distinguished men and women of science from thirty-three Third World countries (among them the Nobel laureates), with the objective of enhancing the health of science in Third World countries, giving recognition and support to scientific research carried out in developing countries, and facilitating mutual contacts between scientists.

With funds generously provided by the Italian Government and financial contributions from the Canadian International Development Agency, TWAS has launched a number of programmes for 1986/87, whereby the Academy is:

1. Providing research grants to young scientists in developing countries,

assisting them in carrying out their research work in their home countries.

2. Providing fellowships to scientists working and living in developing countries, in order to enable them to visit scientific institutions in Third World countries other than their own for the purpose of research collaboration.
3. Awarding grants to research scientists working and living in developing countries, enabling them to visit Italian laboratories for the purpose of pursuing research, learning new techniques, or undertaking other forms of training by working with Italian colleagues.
4. Providing libraries in developing countries with standard scientific textbooks and scientific journals.
5. Inviting scientists of high esteem to give lectures in developing countries.
6. Organizing South-North roundtables on specific scientific topics of particular relevance to the Third World, with the objective of forging links between laboratories and research institutes in the North and in the South.
7. Awarding prizes to scientists from developing countries who have contributed significantly to the advancement of science.
8. Providing space parts for scientific equipment in developing countries.
9. Supporting scientific activities and meetings organized in developing countries, with the aim of enhancing possibilities of mutual contacts among scientists.

The Second General Conference of the Academy will be held in September 1987 in Beijing, China.

C. INPUTS ON INTERNAL MATTERS

C.1. THE STRUCTURE OF THE TRIENNIAL URSI GENERAL ASSEMBLIES: SHORT HISTORICAL CONSIDERATION, EVOLUTION

P. Bauer, Chairman of the Steering Committee
for the Scientific Programme of XXII General Assembly

The General Assemblies of URSI are now held at intervals of 3 years. The General Assembly, in the narrowest sense, is the occasion when representatives of the Members of the Union meet to elect the new Officers and to deal with matters of a largely administrative nature. However, following a long tradition, the General Assemblies of URSI include also a scientific programme consisting of sessions organized by the various Commissions. The concept of this programme has changed over the years and it seems appropriate to consider the evolution of this concept after World War II.

The first Assemblies which followed World War II were small in comparison with the last ones which gathered about 1,000 participants. There was almost no preparation by the Commission Chairmen and the scientific programme was made up on the first day of the Assembly in the light of the people actually attending and the papers they had with them. It may be said that the original work presented made up for the lack of advance organization.

As the Assemblies got larger, this lack of organization created a very unsatisfactory situation. The solution adopted was to devote the scientific sessions during the Assembly to reviewing the progress made over the past three years and to recommending future trends of research. This "review concept" was adopted but the sessions were operated in such a way as to allow the presentation, after the main review paper, of current research and of original contributions.

On the other side, the attendance at Assemblies was restricted to delegates designated by the National Committees and was also restricted in size. As a result, the organization of the scientific programme was not free for all, and people doing the actual research could not always attend. In addition, the open solicitation of papers was ruled out.

During the early 1960s, opinions were expressed that URSI should include in the scientific programme of the Assembly symposia with call for papers and, in consequence, open the Assembly to anyone scientist wishing to participate.

On the other hand, it was felt that the scientific programme should not be a mere collection of sessions of Commissions, but that an effort should be made to develop more interchange among the Commissions. Another objective was to avoid conflicts between administrative and scientific sessions.

During the years 1966-1975, there were many discussions on the general problem of the reorganization of URSI, but also on the advantages and disadvantages of the two following concepts for an URSI Assembly: the "review concept" and the "symposium concept"

The following arguments were made in favour of the "review concept":

1. The scientific sessions at an Assembly should provide an occasion for the examination of progress over the broad field of radio science during the period since the previous Assembly.
2. They should aim to identify the factors which seemed likely to influence the way in which future research should develop.
3. The reviews presenting the main elements of recent and current research and of progress provide a better background for the administrative decisions to be taken up at the Assmebly.

The "symposium concept" received support on two grounds:

1. Research workers would prefer to play a more active role at Assemblies by contributing to a specialized symposium rather than by listening to reviews covering a wide field.
2. Discussions at a symposium are more likely to be lively because the participants will usually be actively interested in the subject.

Following large consultations, the Board of Officers recommended in 1974 that the organization of symposia be a major part of the scientific activities of URSI, and that such symposia should be open to full participation by all interested scientists. These symposia had to be organized both at and in the interval between General Assemblies.

At the General Assembly in Lima, in 1975, three open symposia were organized dealing with wave phenomena in the Earth, ionized environment and with the radio noise environment.

Since then, the scientific programme at URSI General Assemblies includes

scientific sessions organized by the individual Commissions, joint scientific sessions organized by two or more Commissions, open symposia (not exceeding the number of three) , poster sessions, and general lectures. In addition, each Commission is requested to give a tutorial intended for the whole URSI community.

The XXII General Assembly in Tel Aviv is being organized according to the above-mentioned elements. The content of the scientific programme results from the proposals made by the Commission Chairmen and, as far as open symposia are concerned, on the basis of the answers to a questionnaire distributed to all the participants of the XXI General Assembly in Florence.

Two meetings of the Coordinating Committee (URSI Board and Commission Chairmen) with the Steering Committee have allowed to identify possible areas of overlap of the scientific sessions on related subjects, to establish practical rules (timing, timetable, posters, calls for papers) and to shape up the final programme.

URSI GENERAL ASSEMBLIES

T.S.F.S.	1914	Brussels, Belgium
	1922	Brussels, Belgium
	1927	Washington, D.C., USA
	1928	Brussels, Belgium
	1931	Copenhagen, Denmark
	1934	London, UK
	1938	Venice and Rome, Italy
	1946	Paris, France
	1948	Stockholm, Sweden
	1950	Zurich, Switzerland
	1952	Sydney, Australia
	1954	The Hague, The Netherlands
	1957	Boulder, CO, USA
	1960	London, UK
	1963	Tokyo, Japan
	1966	Munich, FR Germany
	1969	Ottawa, Canada
	1972	Warsaw, Poland
	1975	Lima, Peru
	1978	Helsinki, Finland
	1981	Washington, D.C., USA
	1984	Florence, Italy
	1987	Tel Aviv, Israel

C.2. SCIENTIFIC ACTIVITIES: SYMPOSIA

P. Delogne, Assistant Secretary General, URSI

1. General

URSI sponsors a number of symposia between two General Assemblies. Three sponsoring modes are used:

Mode A consists essentially of a moral support, in addition to the service of the URSI Bulletin for purposes like announcing the symposium and publishing a report after the meeting.

In *Mode B*, a fixed sum is granted in addition to the support provided under Mode A. This fixed sum is to be used for supporting travel and subsistence costs of scientists in need, mainly invited speakers and young scientists. The URSI policy is that money made available under this mode should be directed to well-identified individuals.

In *Mode C*, which comes in addition to A and B, a loan is granted and has to be reimbursed to URSI if the symposium balance shows a profit. This sharing of risks implies that URSI has some control on the symposium budget. URSI would in principle not support a meeting with a potential loss. In practice, sponsoring under Mode C is rarely requested.

In any case, the request for sponsorship is processed by the URSI Secretariat, the final approval being made by the Board of Officers, on the basis of some criteria:

1. The symposium should have a widely international character. In particular, there should be an international Programme Committee.
2. The support of one or several URSI Commissions and the agreement of the local Member Committee are requested.
3. The Organizing Committee must ensure that the country in which the meeting takes place adheres to the ICSU rules on the free circulation of scientists.
4. URSI has a representative in the Programme Committee.
5. Financial support is granted with priority to URSI-generated meetings.

The scientific activity of URSI in between General Assemblies is not restricted

to the sponsoring of meetings. URSI also provides a financial support to Inter-Union bodies (IUCAF, SCOSTEP) wherein it is involved and, as far as needed, to its own working groups. URSI can also set up special projects. Examples of these are:

- Autumn College on the Troposphere, the Stratosphere and the Mesosphere, organized at the International Centre for Theoretical Physics, Trieste, Italy, from 10 September to 19 October 1984, for about 60 students from developing countries.
- Production of a Handbook on Wave Propagation over the Tropics.
- Projected Course on Water Prospecting in Dry Lands, India, 1987.
- Projected Course on Telecommunications.

2. Sponsored meetings in the period 1985-1987

As the scientific activity shows a cyclic character related to the period of General Assemblies, it is interesting to analyze the lists of meetings sponsored by URSI in a triennium. Some tables have been derived in order to provide global conclusions.

URSI and non-URSI generated meetings

Table 1 shows the details of symposia per Commission. The columns U and non-U indicate whether or not the meeting was generated by URSI. It is readily apparent that only about 35 per cent of the sponsored meetings are generated by URSI. Some Commissions do not generate any meeting at all.

Recurrent meetings

Another aspect, which is not apparent from the table, is the distinction between recurrent and isolated symposia. It appears that the only recurrent URSI-generated meetings are:

Commission B: Electromagnetic Theory Symposium. Period 3 years.

Commission E: Co-organizer of the series of Electromagnetic Compatibility Symposia, a yearly event alternatively held in Zurich and Wroclav.

Commission F: Wave Propagation and Remote Sensing & Microwave Signatures in Remote Sensing (both with a period of 3 years)

3. Conclusions

Though it cannot be said that the level of scientific activity between General Assemblies is too low, it is spread over a large number of meetings, most of which are not URSI-generated. It is desirable that each Commission should have at least one important recurrent meeting between two General Assemblies. This class of symposia should receive a substantial financial support. One should investigate why the available budget is not completely used.

Table - 1 : Non-URSI and URSI-generated meeting 1985-1987

	1985		1986		1986		Total	
	non-U	U	non-U	U	non-U	U	non-U	U
A Electromagnetic Metrology	1	-	-	1	-	-	1	1
B Waves and Fields	3	1	2	2	2	3	8	4
C Signals and Systems	1	-	2	0	1	2	4	2
D Electronic and Optical Devices and Their Applications	2	-	3	-	2	-	7	-
E Electromagnetic Noise and Interference	-	2	1	1	-	1	1	4
F Wave Propagation and Remote Sensing	2	-	4	1	2	2	8	3
G Ionospheric Radio and Propagation	1	1	5	3	2	1	8	5
H Waves in Plasmas	2	1	2	0	1	2	5	3
J Radio Astronomy	-	-	-	-	-	1	-	1
Total	12	5	19	9	11	10	42	24

C.3. IS THE ORGANIZATIONAL STRUCTURE OF URSI APPROPRIATE FOR THE NEXT DECADE?

S. Okamura, Vice-President, URSI

Is the present organizational structure appropriate for the next decade? Many discussions have already taken place. I would like to point out some of the problems.

1. Membership

The members of the Union are the Committees, and a Member Committee is established in a territory by the Academy of Sciences or the Research Council, or by a similar institution or association of institutions.

We have no individual members at present. In order to increase the activity of the Union, the possibility of having individual membership should be discussed. There are numbers of questions for the individual membership given as follows:

1. Does the individual hold membership in the Union or in a Commission of the Union?
2. What is the relationship of an individual member of the International Union to the national Member Committee? This must be very flexible to allow for each country's situation.
3. What are the qualifications for the membership in addition to form a scientific interest in the Union?
4. What does the member receive? Bulletin, announcements of meetings and symposia (already in Bulletin), Proceedings of Symposia in his area of interest (or perhaps a special rate for the Proceedings), a reduced registration fee for symposia and Assemblies, *Review of Radio Science*, URSI necktie? Others?
5. What does the member pay to URSI? The membership fee must cover the item in (4) and the cost of handling and delivering them.

2. Board of Officers

Among the members of the Board, the Secretary General bears a heavy burden. Is there any method to lighten his burden?

3. Scientific Commissions

Is the structure of the present Scientific Commissions appropriate for the next decade? Even at present Commissions C and D cannot cover the whole activities of the field of radio science which the terms of reference of these two Commissions prescribe. Taking into consideration the future trend of the more and more rapid progress of radio science, flexible reorganization of the Scientific Commissions might be necessary. Is the present Council able to make quick response to the changing situation of radio science in future?

4. General Assembly

There is a proposal to hold General Assemblies every two years instead of every three at present. This is a matter for discussion.

There are two kinds of activities in the General Assembly. One is the business meetings such as Meetings of the Council, the Coordinating Committee, the Board of Officers and Business Meetings of the Commissions, etc. The other is the scientific meetings such as scientific sessions, symposia and general lectures, etc.

How to harmonize these meetings will be a very important problem in the future. Is it not necessary to develop the open symposia for encouraging young scientists to participate in the General Assemblies of URSI?

5. Official Languages

At present, the official languages of the Union are French and English. And in any question relating to the interpretation of the administrative documents, the French text is regarded as authoritative. Is this present rule appropriate?

C.4. FUTURE ASPECTS OF URSI FINANCES

H. J. Albrecht, Vice-President, URSI

These notes refer to some of the aspects which may be of major importance in a long-term financial policy of URSI, in the areas of Income, Assets, and Expenditure, respectively.

1. Main Tasks

Financial strategy should continue to adhere to the following main objectives:

- 1.1 In view of its principal objectives of encouraging and supporting international activities in the field of radio science, URSI, as a non-profit organization, attends to its finances, on behalf of its committees and creditors, in such a way that losses in its assets are avoided or are at least kept to a minimum. Investments should thus concentrate on funds of relatively stable behaviour.
- 1.2 With respect to long-term financial management, continuous consideration should be given to the maintenance of a healthy financial situation and, in particular, to the affordability of membership dues for member committees in any of the categories. In this regard, it should be one of the main objectives to avoid any substantial increase in the unit membership contribution, or, at least, to keep any such increase generally affordable.
- 1.3 With reference to General Assemblies as the main scientific activity, proper financial preparation has to be directed at their success. In periods between assemblies, financial support has to be provided for scientific meetings upon authorization of URSI sponsorship, mode B or mode C. Special consideration has to be given to young scientists.

2. Income

Membership contributions will definitely remain the main source of income, supplemented by interest and dividends on URSI assets as well as by allocations from ICSU and other organizations.

- 2.1 With the view on long-term financial strategy, it may be advisable to examine the entire complex of membership contributions with respect to relevant factors, such as membership structure and categories, methods of adaptation with respect to economic changes, and types of operating currency.

2.2 Referring to membership fees, or the unit of contribution, it may be of interest to note that most of the other unions use a structure of categories similar to the system practiced by URSI, as also became apparent at an ICSU meeting of union treasurers in June 1986.

As has been confirmed by the evaluation of an ICSU questionnaire, the categories are connected to voting right, with the exception of a few cases. Some unions use a per capita method (on the basis of number of members in committees). Associates, affiliates, or "individual members" are allowed by some unions. There are examples of industrial companies being admitted, and also organizations, as non-paying, non-voting members.

Careful consideration should show whether, and to what degree, it would be advisable to open up the membership structure of URSI. In any case, and even if no voting rights would be intended, attention is drawn to possible difficulties for advantages presently being enjoyed as scientific organization, by URSI as a whole but also by its member committees, such as non-profit status and tax exemption.

As an additional aspect, the affordability with respect to increasing membership dues has to be considered. There is concern that an (excessive) increase in dues may cause members to lower their categories, thus leading, in effect, to less income. In other words, a kind of elasticity range may be defined, in some analogy to the elasticity of demand used in economics to describe the limit to which a price may be increased without substantial decrease in demand, and thus in net gain.

2.3 There are consistent problems with regard to predicting dues for periods of two or more years, which are usual intervals with URSI as with most of the other unions.

It will remain difficult to establish a reference for the affordability of units of contribution. Economic predictions of the Organization for Economic Cooperation and Development (OECD) may be useful as a guideline in estimating steps of fee adjustment. In line with the above-mentioned elasticity range, it might be possible to define a kind of limiting growth rate in dues.

2.4 It may also be of interest to note that some unions do not use the US dollar as operating currency. Using the Swiss franc as a well-established reference, and URSI units of contribution from 1967 onwards, an attempt of comparing currency effects has shown that, early in this period, the Swiss currency appeared to be slightly more constant. On the other hand, the

exchange rate of Belgian to Swiss franc indicated a more pronounced fluctuation. The results seem to confirm that the US dollar is the optimum operating currency for URSI.

2.5 With regard to the problem of fund-raising from foundations and corporations, the image of scientific unions, and thus of URSI, as non-profit scientific organizations seems to be an important asset. As was also discussed at the aforementioned meeting of union treasurers, requests look more promising if tied to activities in developing countries and/or to definite projects, rather than to travel money in general.

3. Assets

Referring to the area of URSI Assets, any establishment of general guidelines in relevant long-term policy is hampered by the fact that exchange-rate fluctuations of relatively short-term nature would have to be responded to in order to maintain asset values within satisfactory conditions.

3.1 The most promising approach seems to be the flexible response in use since the US dollar commenced to decrease in value and defined by a change in the ratio the non-\$ to \$-assets in accordance with varying exchange rate.

3.2 A spread of assets up to three predominantly non-\$ funds, in addition to the \$-investment and in conjunction with a flexible response to exchange rates, seems to remain a reasonable method. ECU-funds continue to be of special interest; they permit URSI assets to participate in the relative strength and stability of EMS currencies (ECU= European Currency Unit, EMS= European Monetary System).

3.3 In connection with the subject of tax exemption, ICSU enjoys such a status in the US, besides France. It appears logical to aim at an appropriate and persistent tax exemption for URSI assets.

4. Expenditure

The third, and certainly equally important field of long-term policy, is that of expenditure for scientific and administrative activities.

4.1 A predominant item with both activities is that of travel expenses. In this respect, union treasurers discussed possibilities of reducing travel costs, e.g. by grouping travels to obtain reductions. Although the concept appears to be promising in general, the problems of appropriate coordination would still have to be solved, unless a worldwide travel agency is prepared to

apply eventual discount conditions to any travels made on behalf of a scientific union. Further investigations appear to be necessary.

- 4.2 Guidelines and rules have been established for URSI support to scientific meetings. Although they appear to function satisfactorily from a treasurer's point of view, only experience may have shown, or will indicate in the future, if and in what respect changes may be advisable. It should, however, be emphasized that any increase in relevant administrative tasks on the side of the secretariat should be avoided.
- 4.3 The above item leads to the subject of administrative costs which are largely governed by the operating conditions of the secretariat. Although the costs represent a substantial amount of the overall expenditure, particularly if expressed in US dollars, there does not appear to be much chance of reducing them.
- 4.4 Modernization of office equipment seems to be of paramount importance as a factor in efficient long-term financial policy. Provided that the compatibility range of the intended computer hardware is adequate, advantages are also seen as far as inter-office communication is concerned. A selection of appropriate software should enable some of the accounting to be done on an in-house basis.

5. Concluding Remarks

One of the important conclusions undoubtedly refers to the scrutiny of financial characteristics and appropriate reaction; this aspect remains an essential requirement.

Tasks connected to the long-term financial policy of URSI are characterized by difficult analyses and predictions. It appears absolutely necessary but there is also confidence that they can be mastered, as in the past, with the continuous cooperation between the standing finance committee and the treasurer.

D. OTHER INPUTS

D.1 THE COMMUNICATIONS REVOLUTION, VIDEO COMMUNICATIONS, A 20th CENTURY GUTENBERG

W. E. Gordon, President, URSI: 1981-84

The combination of satellite links, television, fibre optics and high-speed information transmission has revolutionized communication over the past two decades and has an enormous future potential. For convenience, label the combination video communications and consider its impact, its future and ask what are the roles of the technical societies, the regulators and the industry.

I begin by offering two propositions to indicate the impact:

- Proposition 1. Communication efficiency. The introduction of video communication is a bigger step than the introduction of Gutenberg's printing press.
- Proposition 2. Societal impact. Video communication has already a greater influence than printing in spite of a 500-year head start for the press.

There are lessons to be learned from the past. Recall that printing is a crucial invention in modern history. Five centuries have been shaped in profound ways by the press. Invented in Europe, it was a potent instrument in spreading European power and influence. The explosion of print and that other European explosion, the Reformation, belong to the same time and are intricately entangled.

The development of printing in the fifteenth century was inextricable from the whole social and cultural process known as the Renaissance. Gutenberg's printing press was partly a product of the new thinking, partly its instigator. Note again the two propositions above.

Communication has advanced by a series of major steps: learning to talk, to write, to print, to telegraph and telephone, to communicate worldwide at video rates. The switch from stone inscription to papyrus and handwriting signaled new patterns of thought and social organization. The switch from a scribal society to a printing one changed the whole focus of knowledge in the West and created new locations for information in society. The transition from paper to telecommunications systems can hardly prove to be less important, necessitating the development of new skills and new equipment, a new kind of

text and a new method of text storage. The text is generated in video terminals and passed into data storage, to be retrieved and read by those concerned, on other video terminals. Even in this and other comparable micro systems a host of moral, organizational and economic problems are raised by the phenomenon of paperlessness. Technical librarianship is one of the next fields likely to undergo substantial transformation, and from there the change of system can be spread outwards to society as a whole.

Consider a few of the impacts. Printing established authors, standardized written language and produced newspapers, journals and books while video establishes personalities, standardizes the spoken language and produces news and data instantaneously. Both provide relaxation, entertainment and business materials. Both suffer from the poverty and the credibility of the information transmitted. Readers and viewers, swallows of a nonstop flow of words and pictures don't believe a great deal of it, but their lives are affected, their outlook, behaviour, and language are molded in this sea of information.

Communication is the glue that holds society together. Modern communication systems and styles create problems and tensions. Never before in history have mankind's survival and well-being hung so precariously on accurate and swift communications. Television, satellites, laser/optical fibre links are technologies that are less than 50 years old; Marconi did his magic with radio less than 100 years ago. Today we depend on them. People need news of the world (even unedited, undigested news) because what happens in all the world affects them. Corporations have information transmission needs that are far reaching. Governments need to communicate with constituencies and with each other.

The Jules Verne of communication is Arthur Clark whose prediction in 1945 of satellite communication linking any two points on the earth took 25 years to bear fruit but satellites have changed telecommunications in the '80s almost totally.

The convergence of communications and computing technologies is having and will have profound effects.

Finally, we are in year 500+ of the printing press and year 500- of video communication. My judgement is the impact today of video communication is at least equal to that of printing.

I conclude, with our ability to use video communication profitably has a long way to go and should serve as a challenge to us in whatever profession or industry we find ourselves.

In a sense the only choice which history does not make for us is that between optimism and pessimism. Whether we have "big" or "little" government, whether we become a gregarious or a lonely society, individualistic or regimented, is largely a result of the way we choose to use the technology. What the new electronic storage systems for information, interlinked globally, could come to offer is a renewed sense of the unity of the world and the accessibility of knowledge.

It is clear that society needs help in putting to good use the opportunities that video communication offers. Organizations like URSI, IEEE, the Popov Society, CCIR, CCITT and ITU have roles in providing the guidance that society needs. Organizations like the PTT's Comsat and the communication providers have roles in anticipating the needs and delivering the services economically. Our discussions should illuminate these roles.

D.2. FUTURE TASKS FOR COMMISSIONS C AND D

Vaclav Zima, Vice-President, URSI

1. URSI-High-Tech

All over the world there is an ever increasing pressure to make pure as well as applied science serve the needs of today; however, the mission of science is to serve the prospects of tomorrow. The policy of URSI must be to persuade the public, the governments and industrial organizations that radio science has been a source of ideas which paved the way of electronics to all walks of life in human society. However, the time between a discovery and its practical application gets shorter dramatically. The transistor drastically changed the form of radio receivers within three years and ten years later it instigated the birth of planar technology and silicon microelectronics. The physical limits of integration on the silicon chip have not been achieved yet. Today, RAM and ROM memories with a storage capacity of 4 Mbyte are available on the market, 16 and 64 Mbyte systems are being developed. In wafer scale integration technology, 160 Mbyte memories have been projected. The laser and fibre optic technologies, discovered in the sixties and seventies, are developing at the same pace. All this has brought the world to the threshold of revolution in communications. The day is approaching when single transmission links will bring to millions of users all kinds of information by means of Integrated Services Digital Networks (ISDN). This includes telephone connection, data transmission between terminals and computers, access to data banks and expert systems and provision of high-quality colour television programmes.

All this entitles the URSI community to feel proud that radio science has been the cradle of unprecedented progress of human society in the field of information transmission and that it helped to provide the means for understanding between individuals, nations and states. On the other hand, this inevitably necessitated a revision of the current forms of URSI scientific and organizational activities. The Academies and universities represent nowadays only a small fraction of the world's creative potential in the strategic fields of technology in which radio science, electronics, informatics and opto-electronics dominate.

2. Utilization of the primary role of Commissions C and D subjects for world's technological progress

The field of scientific activity of both Commissions has one common feature. It is the worldwide hunger for efficient, prompt and economically lucrative utilization of new knowledge, inventions and discoveries in the radio and

electronic technologies. According to the published forecasts the overall production of information processing (56%), communications (20%) and industrial electronics (6%) equipment will in 1987 reach the amount of US \$ 567 $\times 10^9$. Exponential growth seen during the whole postwar period will continue. The fact that the ideas born within radio science have played the primary role in creating this colossal market gives URSI a moral right to benefit from it. It is our duty to use the authority of one of the oldest scientific organizations for creating a favourable climate for promotion of research in every field pursued in URSI. Let us set ourselves the task of acquiring a microfraction, equalling 10^{-7} , of the annual volume of the world market. This would be by no means a negligible contribution to URSI budget totalling \$ 56,700 a year. Let us take the advantage of the fact that today the world's leading firms consider publication in international forums of original scientific works done in their laboratories a matter of first-rate prestige. Let us therefore introduce a representation membership for firms having a share in the radioelectronics market giving them the right to take part in URSI Council sessions with an advisory vote. Let impose a charge of \$ 1 per employee for this right. Let us arrange the Union status in such a way that it will prevent the representation membership of the firms to be misused for vulgar commercial publicity.

I propose to use the acquired funds for establishing a scientific monthly journal entitled:

SIGNALS, SYSTEMS, ELECTRONICS

Technological progress derived from
Radio Science
URSI

The journal would not have any advertisement section; however, the main contributors would be the member industrial or government laboratories. The journal should resemble *Electronics Letters* in content and length of contributions with a minimum delay between submission of papers and their publication. Let us find the best editor and a few staff. Let us set the editor's office in Bruxelles equipped with computerized text editing processors. It would be a department of URSI Secretariat. I estimate the number of copies per month to be approximately 10,000 and the price per copy about US \$ 5. If we succeed to make the journal self-supporting, there will be no additional administrative expenses for URSI. The national academies would obtain an agreed number of copies free of charge. The journal would provide, especially small and developing countries, with valuable information which they could utilize in forming their scientific policy and in bringing up-to-date curriculums in their universities. Authority of URSI National committees would be enhanced which

could generate interest of other countries to join. Criticisms and doubts about the active role of URSI in the most dynamic field of radio science would be dispelled. Such debates led in the past to suggestions to change the structure and even the name of URSI.

3. Orientation of Commissions C and D activities

Of all URSI disciplines, signals, systems and electronics have the greatest impact on technological progress of human society. It is a paradox, however, that our Commissions C and D have the smallest chance to contribute to the fundamental knowledge within the framework of URSI. When a few hundreds of top scientists accompanied by young enthusiasts work in a narrowly confined scientific field, they usually know each other. They organize their own conferences and workshops where hot discussions often take place. This is the case of our Commissions B, G, H, J. Creative atmosphere in which the meetings take place is an indisputably positive factor. However, critical voices are raised, too. For how long may we continue in traditional directions? This idea was splendidly expressed by Professor Bach Andersen in his document: "..... we may end up as a historical society commemorating Maxwell". As a result, there are pressures to sharply specify URSI orientation. Once it is "Communications", next time "Remote sensing". But URSI is a healthy, tough and experienced society. Its responses to external stimulæ show that it is a dynamic and stable system with quasi-optimal structure whose oscillations are damped at right time.

Hundreds of thousands of excellent scientists and engineers all over the world are engaged in research on signals, systems, microelectronics and optoelectronics. However, the newest results of their work are being jealously guarded and they often even cannot be perceived through the screen of information explosions. Nevertheless, URSI must encourage free exchange of information. For these reasons I propose the following future tasks for Commissions C and D:

- a) In the periods between the Congresses, URSI should take up sponsorships of most of the significant international conferences and symposia organized by other professional organizations.
- b) At URSI Congresses, make invited papers, reviewing the main trends of progress and effects of electronics on modern society, the substantial part of scientific programmes of Commissions C and D. These review papers should be published in *Review of Radio Science* or in the proposed journal "Signals, Systems, Electronics"
- c) Support international research in such fields that have not matured yet for industrial applications, for example, molecular electronics and biocybernetics ("BIOCHIPS).

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