

UNION RADIO-SCIENTIFIQUE INTERNATIONALE
INTERNATIONAL UNION OF RADIO SCIENCE



Rapports des Assemblées Générales de l'URSI
Records of URSI General Assemblies

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INTRODUCTION

ACKNOWLEDGEMENT

The XXVIth General Assembly of URSI was held at the University of Toronto, Toronto, Ontario, Canada, from 13 to 21 August 1999. In introducing this account of the proceedings, it seems appropriate to offer the warmest thanks of the Union to :

- the Canadian Committee for URSI;
- the Canadian Academy of Sciences;
- the Canadian Organising Committee;
- the Coordinator and the Associate Coordinator of the Scientific Programme;
- the Chairs and Vice-Chairs of URSI Commissions, who planned the scientific sessions, and to the session Chairs and speakers;
- the organisations which provided funds in support of the Young Scientist Programme: ICSU and UNESCO, the URSI Member Committee in Japan, the United States National Committee, the Royal Society of London and the European Space Agency;
- to the sponsors of this meeting : Lucent Technologies Canada, Motorola Canada Limited, Clearnet Inc. and Sinclair Technologies Inc.

You may have noticed that the title of this publication has changed from “*Proceedings of URSI General Assemblies*” to “*Records of URSI General Assemblies*” and in French from “*Comptes Rendus des Assemblées Générales de l’URSI*” to “*Rapports des Assemblées Générales de l’URSI* “. This decision was taken by Council during the Toronto General Assembly, in order to better reflect the content of this publication.

OUTLINE OF THE ASSEMBLY

The URSI Council, which is composed of the official representatives of the Member Committees, met in Toronto on five occasions between 15 and 21 August 1999. The Resolutions and Recommendations adopted by Council and by the URSI Commissions are reproduced at the end of this volume. Summary accounts of the business transacted by Council and the Commissions are given elsewhere.

An abundant scientific programme, consisting of 1748 papers (971 oral communications and 777 posters), had been prepared for the 1488 registrants (among them 118 official “Young Scientists”). The programme consisted of 3 General Lectures, 1 Historical Session, 10 Tutorials, 72 Commission Sessions, 32 Joint Sessions and 5 Workshops.

The General Lectures, of interest to all participants, were entitled :

- Engineering Issues in Space Weather
- Space-To-Ground Interferometry for Radio Astronomy
- Future Generations of Mobile Communications, the Scientific Aspect

The Historical Session was entitled : The Past, Present and Future of Satellite Communications

Each Commission had been asked to provide a Tutorial Lecture in its own sphere of interest. The titles of these Lectures were as follows :

- EM Metrology Issues in Wireless Communications (Commission A)
- Electromagnetic System Design Using Genetic Algorithms (Commission B)
- Intelligent Antennas for Future Wireless Communications (Commission C)
- High-Impedance Electromagnetic Surfaces (Commission D)
- ELF Sferics and Lightning Effects on the Middle and Upper Atmosphere (Commission E)
- Remote Characterisation of Geophysical Phenomena Using EM Waves (Commission F)
- Radar Systems for Ionospheric Research (Commission G)
- Wave Distribution Functions in Magnetospheric Physics (Commission H)
- Radio Stars: The High Sensitivity Frontier (Commission J)
- An Assessment of the Bioeffects Induced by Power-Line Frequency Electromagnetic Fields (Commission K)

The Inter-Commission Working Group had a tutorial entitled : Spectrum Congestion

LIST OF URSI OFFICERS AND OFFICERS OF MEMBER COMMITTEES

Following the elections at the XXVIth General Assembly in Toronto, Canada, the Officers of the Union and the URSI representatives on other Organisations are as given below. This list of Officials is based on information available at the URSI Secretariat up to the time of going to press.

HONORARY PRESIDENTS

Prof. W.N. Christiansen (Australia)
Prof. W. Dieminger (Germany)
Prof. W.E. Gordon (U.S.A.)
Prof. F.L.H.M. Stumpers (Netherlands)
Prof. J. Van Bladel (Belgium)

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Secretary General: Prof. Paul Lagasse (Belgium)

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Vice-Chair : Prof. Quirino Balzano (U.S.A.)
Commission B:
Chair : Prof. Staffan E.G Ström (Sweden)
Vice-Chair : Prof. Makoto Ando (Japan)
Commission C:
Chair : Prof. Ernst Bonek (Austria)
Vice-Chair : Prof. Masami Akaike (Japan)

Commission D:

Chair : Prof. Alwyn J. Seeds (U.K.)

Vice-Chair : Prof. Peter Russer (Germany)

Commission E:

Chair : Dr. Robert L. Gardner (U.S.A)

Vice-Chair : Prof. Pierre J. Degauque (France)

Commission F:

Chair : Dr. Yoji Furuhashi (Japan)

Vice-Chair : Prof. Martti T. Hallikainen (Finland)

Commission G:

Chair : Dr. Phil Wilkinson (Australia)

Vice-Chair : Prof. Christian Hanuise (France)

Commission H:

Chair : Dr. H. Gordon James (Canada)

Vice-Chair : Prof. Umran Inan (U.S.A)

Commission J:

Chair : Prof. Jackie N. Hewitt (U.S.A)

Vice-Chair : Prof. Makoto Inoue (Japan)

Commission K:

Chair : Prof. Shoogo Ueno (Japan)

Vice-Chair : Prof. Bernard Veyret (France)

Scientific Committee on Telecommunications :

Chair : (to be decided)

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Standing Finance Committee

Chair : Prof. Susan K. Avery (USA)

Standing Publications Committee

Chair : Dr. W. Ross Stone (USA)

Standing Committee on Developing Countries

Chair : Prof. Sandro M. Radicella (Italy)

Standing Committee on Young Scientists

Chair : Prof. A. David Olver (United Kingdom)

Long Range Planning Committee

Chair : Prof. Tatsuo Itoh (USA)

Scientific Programme for the next URSI General Assembly

Coordinator : Mr. Martin P.M. Hall (United Kingdom)

Assistant Coordinator : Prof. Gert Brussaard (the Netherlands)

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- COSPAR (Committee on Space Research) :
Dr. Z. Klos (Poland)
- COSTED (Committee on Science and Technology in Developing Countries) :
Prof. Z. Sha (China, CIE)
- FAGS (Federation of Astronomical and Geophysical Data Analysis Services) :
Dr. H. Rishbeth (U.K.) and Prof. R.S. Booth (Sweden)
- ICSU (International Council for Science) :
Prof. H. Matsumoto (Japan)
- ICSU Panel on World Data Centres (Geophysical and Solar) :
Dr. D. Bilitza (U.S.A.)
- ISES (International Space Environment Service) :
Dr. K. Marubashi (Japan)(Director), Dr. S. Pulinets (Russia), Dr. P. Wilkinson (Australia)
- IUCAF (Inter-Union Commission on Frequency Allocations for Radio Astronomy and Space Science) : Dr. K. Ruf (Germany, Chair), Dr. W.A. Baan (the Netherlands), Dr. M. Davis (USA), Dr. T. Tzoumis (Australia), Dr. W. Van Driel (France), Dr. A.P. van Eyken (Norway)
- SCAR (Scientific Committee on Antarctic Research) :
Dr. A.J. Smith (U.K.)
- SCOR (Scientific Committee on Oceanic Research) :
Prof. M.T. Hallikainen (Finland)
- SCOSTEP (Scientific Committee on Solar-Terrestrial Physics) :
Prof. S.K. Avery (U.S.A.)
- S-RAMP (Solar-Terrestrial Energy Programme) :
Dr. Su. Basu (U.S.A.)

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Assistant Secretary General : Prof. F. Olyslager
Secretary : Mrs. I. Heleu

OPENING MEETING

The Opening Meeting was held on Sunday 15th August 1999 at 4.30 p.m. Originally, it was intended to hold the Opening Ceremony in Convocation Hall, on the campus of the University of Toronto, but, due to unforeseen circumstances, Convocation Hall was not available and the Opening Ceremony was relocated to Ryerson Theatre at Ryerson Polytechnic University.

The Ceremony started with an interesting six-minute video about radio science, after which the Honorary Presidents, Officers of the URSI Board and primary speakers took their seats on stage.

Professor Keith G. Balmain, Chair of the Canadian Organising Committee, welcomed the attendants and the primary speakers and he gave the floor to Dr. A.J. Carty.

WELCOME BY THE PRESIDENT OF THE NATIONAL RESEARCH COUNCIL OF CANADA

Dr. Arthur J. Carty

Bonjour et bienvenu à vous tous.

Thank you, Professor Balmain. Distinguished guests, ladies and gentlemen, good afternoon, and thank you for that warm welcome. On behalf of the National Research Council of Canada, welcome to Toronto and the 26th General Assembly of the International Union of Radio Science.

As the sponsoring organisation for the Canadian National Committee of URSI, the National Research Council of Canada is delighted to be participating in hosting this prestigious international symposium.

J'ai le très grand plaisir, en ma qualité de président du CNRC, d'être parmi vous aujourd'hui pour cette cérémonie d'ouverture. Je sais que vous attendez beaucoup de cette assemblée générale. Je n'ai cependant aucun doute qu'elle sera aussi profitable et productive que vous le souhaitez.

The organising committee has devoted a great deal of time and effort to developing the conference program, and I would like to take this opportunity to recognise their work. In particular, I want to acknowledge Professor Keith Balmain, chair of the organising committee, and his colleagues here at the University of Toronto. Thanks in large part to

their energy and commitment; the Assembly has attracted many leading experts in the field and some 1,500 radio scientists from around the world. Congratulations on a job well done.

I also want to recognise and thank our co-sponsor – the Institute of Electrical and electronics Engineers, Canada (IEEE Canada) – which has made an important contribution to the planning of the General Assembly. The National Research Council’s Herzberg Institute of Astrophysics and Institute for National Measurement Standards have also supported this event, and our Conference Services Office has done much of the organisational work for the Assembly.

I would be remiss today if I did not also thank the many executives whose companies have made donations to the General Assembly. Your contributions have enabled some 120 young radio scientists to attend the symposium in what we hope will be the first of many such pilgrimages in the years ahead. These undergraduate students are taking part in a radio science competition, and I understand the winners will be announced later in the Assembly. Good luck to all of you.

The theme of the 26th General Assembly is “One Hundred Years of Radio Science”, and, as this afternoon’s historical session so vividly portrayed, the past century has been a period of remarkable discoveries and continuous innovation. And I am proud to say that Canadian contributions to the field of radio science are impressive indeed.

For example, Canada has its own father of radio – Canadian Reginald Fessenden. While Marconi unquestionably sent a wireless telegraph signal one-way across the Atlantic in 1895, Fessenden was the first to achieve two-way voice transmission by radio. He also made the first public broadcast of music and voice.

The launch of the Alouette I satellite in the 1960s was another Canadian breakthrough and will long be remembered as a significant event in radio science research and development. In the intervening years, the use of radio satellites has made it possible for us to instantly contact friends, family and colleagues around the world. And, how many of us made the trip here this week with a cellular phone in our cases or pockets? Such is the impact of radio science.

Remote sensing is another area where Canadian leadership is strong, as evidenced by the invention of geographic information systems and other technologies that are changing the way we explore and develop resources, monitor the environment, navigate, and manage infrastructure like pipelines and electricity grids.

At the National Research Council, we are proud of the role our organisation has played in the development of radio science, particularly in the early years leading up to World War II. But the real promise for radio sciences lies in the future, with its boundless opportunities for new products and technologies, new applications and new jobs and businesses. It is these untested frontiers that have brought all of you together in Toronto this week.

It has been 30 years since the URSI General Assembly was last held in Canada, and we are honoured to again be your hosts as we approach the new millennium. Radio

science is an area where international dialogue and co-operation is essential. It is a tremendously diverse field, as illustrated by the breadth and depth of the Assembly program.

URSI plays a critical role in providing a bridge over international boundaries, and I want to assure you that Canada will continue to be an active member of this important science body.

In closing, let me congratulate the recipients of the prestigious radio science awards that will be presented later this afternoon. Your exemplary contributions to this evolving field of study have earned the respect of your colleagues around the world, and these awards are extremely well-deserved.

Best wishes to everyone here this afternoon, thank you again for joining us.

Je vous souhaite une conférence fructueuse, un agréable séjour au Canada et un bon voyage de retour.

Professor Balmain then gave the floor to the following distinguished guests :

- *Mr. Gerry Turcotte, President, Communications Research Centre*
- *Mr. Bruce A. Archibald, Assistant Deputy Minister, Ontario Ministry of Energy, Science and Technology*
- *Mr. Adel S. Sedra, Vice-President and Provost, University of Toronto*

REPLY BY THE PRESIDENT OF URSI

Prof. T.B.A. Senior

Honoured Guests, Colleagues, Ladies and Gentlemen

On behalf of URSI I wish to thank the previous speakers for the welcome they have extended to us. We are indeed grateful to the National Research Council of Canada and to the Canadian URSI Committee for inviting us to hold our XXVIth General Assembly here, just 30 years since we last met in Canada. For almost 50 years Canada has played a major role in URSI, and many of us remember fondly such Canadian scientists as Georges Sinclair who were so prominent in our Union. We are delighted to be here in this fascinating and vibrant city, and hope that even our crowded scientific program will allow us some time to explore the city and the surrounding countryside. It is also nice to find ourselves back on a university campus again for most of our activities, and we are grateful to Dr. Sedra for allowing us to use the facilities of the University of Toronto. We are also grateful to the University for covering some of the extraordinary costs that have arisen in the last few days.

To arrange a meeting such as this requires a great deal of effort by many people. On the technical side, our conference co-ordinators, Joel Hamelin and Maria Stuchly, and the chairs of our 10 Commissions, have worked hard to put together an outstanding

scientific program, and I should also acknowledge the work of the editors of the two books you have all received, Maria Stuchly and Ross Stone. But inevitably the major burden falls on the people from the host country, and for the past year and more, Nicole Sarault from the NRC Conference Service, Keith Balmain, Emilie van Deventer, Doug Jones, and all the members of the local Organising Committee, have devoted endless hours to assure the success of this meeting. Thank you all.

There are a few other people here that I would like to recognise. We are honoured to have with us Mr. Balthasar van der Pol and his family. He is the grandson and namesake of one of our esteemed founders, and will present the van der Pol gold medal later in the program. It is good to have with us two of our Honorary Presidents, Bill Gordon and Jean Van Bladel, who was just elected to this position. Congratulations, Jean ! Unfortunately, our other three Honorary Presidents, Professors Christiansen, Dieminger and Stumpers could not be present, and our best wishes go out to them.

It is now my pleasure to declare the XXVIth General Assembly of URSI open.

REPORT OF THE SECRETARY GENERAL OF URSI

Prof. P. Lagasse

Ladies and Gentlemen,

It is the traditional duty of the secretary general to present a concise report of the scientific activities, the finances and the general administrative situation of the Union.

Supporting the organisation of scientific conferences is one important way for URSI to serve the further development of radio science all over the world. During the past triennium URSI sponsored or co-sponsored 75 meetings. For 10 of those meetings the initiative belongs to URSI. At this point I would like to express my profound gratitude to all scientists who devoted so much of their precious time to ensure that the scientific quality of the URSI conferences remained outstanding. It is only thanks to the untiring efforts of many experienced scientists that high quality conferences such as this General Assembly can be organised. Next to the scientific quality, another aim of our union is to support conferences all over the world. This is more specific to URSI than to national professional societies, since our membership extends over 47 countries and territories. Providing support to scientists whom otherwise would be unable to attend the conferences and symposia is still another way in which URSI attempts to provide a service to the radio science community. Our Young Scientist program, which for example supports 120 persons at this General Assembly, is a perfect example of this.

The second way in which URSI reaches out to the radio science community is by means of its publications.

Mesdames et Messieurs,

En ce qui concerne les publications de notre union, permettez moi ici en premier lieu d'exprimer au nom de l'URSI mes remerciements au professeur Delogne pour avoir durant plusieurs années exercé la fonction d'éditeur du Radio Science Bulletin avec autant de compétence. Grâce à son dévouement le Radio Science Bulletin est établi comme une publication ayant comme but de forger un lien entre les chercheurs par la publication d'un ensemble équilibré d'activités de l'URSI, de nouvelles personnalités et d'articles scientifiques d'un intérêt général pour la communauté de l'URSI. Je tiens également à remercier le professeur Sobieski pour avoir gracieusement accepté de prendre la relève du Professeur Delogne en tant qu'éditeur du Radio Science Bulletin. C'est aussi en son nom que je voudrais ici lancer un appel pour soumettre vos contributions pour publication dans le Radio Science Bulletin. Comme pour toute publication scientifique le futur du Radio Science Bulletin est entre vos mains. Ce n'est que grâce à un apport constant de nouveaux papiers qu'une publication peut survivre et continuer à se développer.

Ladies and Gentlemen,

As I feel strongly about this you will allow me to repeat the very last item which I mentioned in French. Please do send your contributions for publication in the Radio Science Bulletin. It is your publication and it can only survive and flourish if we receive enough submissions. As you know we are looking for reports from member committees and scientific commissions and for papers that are of general interest to the whole URSI scientific community. Currently the Radio Science Bulletin is airmailed directly to 2071 URSI correspondents around the world. In addition 42 bulk mailings are sent to member committees which prefer to distribute the bulletin themselves to their local URSI community.

The second part of the publishing activities of URSI consists essentially of the books "Review of Radio Science" and "Modern Radio Science", which you received here at registration. For this last book we are indebted to Professor Maria Stuchly, who as editor managed to provide us with an archival record of the general lectures and the tutorials of the commissions.

For the third consecutive time Ross Stone graciously accepted the heavy burden of editing the "Review of Radio Science". In the name of the whole URSI community I would like to again express my warmest thanks to Ross, who knowing very well from previous experience how difficult and arduous the task would be, brought his fantastic skill and patience to bear in order to edit again on time this very complex compilation of contributions from the URSI commissions.

Like many organisations URSI has increasingly made use of Internet in the past triennium. As the world enters the information age in general and the Internet age in particular it is obvious that this will have a profound influence on the way science is conducted and scientific information is exchanged. At the secretariat we have done our best to make our website into a tool that provides useful services to the URSI community.

We are aware that much can be improved and should be improved. Please visit our website and let us know your suggestions for enhancing its usefulness to you.

In an age where, we scientists are forced to spend an increasing part of our time looking for funding for our research activities, I think that it is fitting that I should spend some minutes explaining a few basic facts about the finances of URSI. Basically URSI has two sources of income : the contributions from the member committees and to a lesser extent revenues from the General Assembly. A third source which used to be quite modest, but which during the past two triennia has been substantial is the return on the URSI reserves, invested in low risk mutual funds. The main components of expenditure for URSI, averaged over a triennium are : support for the scientific activities accounting for 52% of budget, of which the general assembly represents approximately half; publications accounting for 22% of URSI's expenditure and the administrative costs which amount to 24% of the budget. Thanks to the wise and prudent management of our treasurer, Professor Peter Clarricoats, and also thanks to the strong performance of the stock market, the URSI finances have remained quite healthy during the last triennium. Faced with a slow but steady erosion of the income from member committee contributions a careful management of the finances coupled with a strict cost control of administrative expenses was necessary in order to maintain and even expand our support for the conferences, scientific commissions and the Young Scientist Programme. It will be necessary for URSI to look for new sources of revenue, if we wish to safeguard the continuation of our scientific action into the next century.

Ladies and Gentlemen,

Since this is the last GA of this millennium, you will allow me to close by reflecting and speculating briefly on the future role and evolution of URSI. The history of URSI almost completely spans this century. The roots of URSI lie in attempts at long distance communication using radio waves. The success and rapid development of radio communication, observation and sensing in the first half of this century coincided with a growing importance of URSI and its scientific activities. The second half of this century saw the emergence and explosive evolution of information technology. Although the scientific commissions of URSI cover a very wide field, the propagation of electromagnetic waves and their use for communication, observation and sensing has remained until now the core theme of the scientific research activity of our union. At the end of this century we currently witness the emergence of the information society under the impulse of the convergence of information and communication technologies into a ubiquitous digital communication infrastructure, more and more dominated by the Internet protocol and its applications. It is obvious that this will have an influence on URSI, not only on its operations, but also on the scientific activities of our union. On the first issue, I am confident that we will manage to carefully adapt our publication and conference activities to the new ways of the information society. Two aspects will however require proper consideration: the fact that the information society infrastructure does not develop at the

same pace all over the world and the financial implications. On the issue of our scientific activities, it is my conviction that tremendous opportunities are opening up for URSI. Electromagnetic wave propagation will again become a major issue in communication and information technologies. The ability to reach out over large distances used to be the main reason for this. Next century the driving force behind electromagnetic wave communication will be the universal demand for mobility in communication and computing.

Let me therefore conclude Mr. President that our union is in excellent shape to tackle the challenge of providing the scientific basis for the enormous problems posed by the provision of universal information mobility in harmony with the scientific observation and sensing uses of the electromagnetic spectrum.

MESSAGE FROM THE INTERNATIONAL TELECOMMUNICATION UNION (ITU)

Robert W. Jones
Director, Radiocommunication Bureau

Mr. President, Mr. Secretary General, Distinguished guests, Ladies & Gentlemen

It is indeed an honour to be addressing you at the opening session of this 26th General Assembly of URSI. I must confess that I was somewhat sad to learn from Professor Balmain just last week that Convocation Hall, like many of us, is showing signs of its age and, as a result, we are not able to be there for this opening ceremony. The reason for my slight disappointment is that it would have been the first time I would have been back in that famous Convocation Hall since I received my undergraduate degree there in that hall some 34 years ago. Yes, the University of Toronto holds special memories for me. Not only did I do my undergraduate studies at The University of Toronto but also postgraduate studies in the field of antennas and electromagnetic theory under the supervision of that famous pioneer in this field, the late Dr. George Sinclair. I can remember when, during my graduate studies, the chairman of your organising committee, Professor Keith Balmain, another The University of Toronto graduate, arrived back at The University of Toronto in 1966 from the University of Illinois. It has been good to see him. The old Engineering Skule house at The University of Toronto is gone but I understand that the anechoic chamber up in the top of the Galbraith building is still there. I still remember well the seemingly endless days and nights that I spent in that quiet sanctuary trying to obtain a match between my experimental and theoretical results. Professor Balmain in his letter of invitation to you asked that we speakers at this Assembly try to bring in some element of historical perspective. I am not so sure if these brief personal remarks was what he had in mind, however!

The association between the ITU and URSI has been a long and fruitful one. Since the 1920's, both URSI and the ITU, through the former CCIR, have enjoyed close links.

URSI's role has been to promote radio science - something that it has successfully accomplished since those early days of radio experimentation through to today's wireless access systems of the so-called global information infrastructure. In the light of current developments, URSI finds itself more and more involved with issues of spectrum usage. On the one hand, URSI is an active user of the spectrum with involvement in experiments undertaken within Commissions F, G and H; on the other hand, URSI is increasingly concerned with the passive use of the spectrum which is threatened by spectrum congestion and unwanted radiation. Here, the work of Commission J is very evident. The ITU, however, is concerned with the overall use of radio and with optimising spectrum utilisation for the benefit of all potential services. This is an increasingly demanding challenge in the light of the growing number and variety of applications of radio, particularly those requiring higher and higher data-rates, greater bandwidth and often global coverage. The ITU does not involve itself in research *per se*, but rather benefits from the scientific work and spectrum engineering undertaken by its members and discussed within ITU meetings such as those of its Study Groups. It is in this context that URSI can fulfil a significant role in complementing the activities of ITU.

There are several examples of fruitful liaison between the two organisations. The 1997 World Radiocommunication Conference dealt with several issues concerning the sharing of frequency bands allocated to passive services. URSI's effective participation, through IUCAF, in ITU-R Study Group 7 which deals with Science services, helped lead to internationally agreed sharing criteria which limited the potential interference to sensitive services such as those of Radio Astronomy. The results of further studies associated with passive services will be discussed at the forthcoming World Radiocommunication Conference in May, 2000. Spurious emission limits is yet another area in which URSI has been involved.

Another topic of close liaison is that of radiowave propagation. Without a doubt, the close ties between Commissions F and G and the propagation Study Groups of ITU-R have accelerated mutual progress over the years. The long-running series of triennial open symposia organised by Commission F have often provided material upon which internationally agreed prediction procedures have been built. In addition, the more recent series of symposia, known as CLIMPARA, have been stimulated by the need for improved data on the climatic effects that drive the propagation prediction procedures used for terrestrial and space services. It is important that both URSI and ITU strive to maintain this liaison and even to strengthen it.

Perhaps the most important means by which URSI/ITU liaison can be strengthened is through the direct involvement of URSI scientists in ITU activities. It is clear that the interests of URSI, and of IUCAF, are already evident in the activities of ITU-R Study Groups 1, 3 and 7, and in the World Radiocommunication Conferences themselves on issues concerning science services. But perhaps URSI could look to widening its scope of involvement to include other Study Groups and conference-related activities. I appreciate that there may be logistic and financial difficulties for URSI to represent itself under its

independent Sector Member status at ITU meetings. Perhaps a more practical approach would be for URSI members to become even more involved in national and regional preparations for ITU meetings and, if possible, be part of a Member State's delegation. Firstly, however, for such an approach to be effective, URSI representatives should be encouraged to work closely with their national administration in order to gain support for their work. With strong endorsement at the national level, URSI's impact in the international arena will be all the stronger.

In summary, the ITU continues to see URSI as playing a major role in supporting and promoting radio science. It is clear that continuing liaison between the two organisations is highly desirable for the well-being of radiocommunications in the future. I believe this can be achieved in a number of ways all of which will help to bring together experts from both disciplines. URSI's participation in ITU activities is to be welcomed and can only enrich the technical discussions which lead to the development of the complex solutions needed for today's spectrum utilisation.

In closing, I would like to thank you very much for inviting me to speak this afternoon and, on behalf of the ITU, I wish you a most successful General Assembly.

PRESIDENTIAL ADDRESS

Prof. T.B.A. Senior

Thank you, Mr. Jones, for your words of greeting, and also for participating in our Council debate earlier today.

It is now my honour to present the Presidential Address.

Unfortunately, my first task is a sad one, and that is to record the death of colleagues during the past triennium, three of whom, M. Jean Voge (of France), Dr. A.K. Smolinski (of Poland) and Professor James R. Wait (of the US), were strongly associated with our Union. Jean Voge was well known for his work on tropospheric propagation and had been active in URSI from 1952 on. He served as vice-president and treasurer from 1969 to 1975, and president from 1975-1978. His wise counsel and leadership helped guide our Union through a difficult period in our history, and our present success owes much to him. Dr. Smolinski served as chair of Commission D from 1975 to 1978, and then as vice president of our Union from 1978 to 1984. Jim Wait was an inspiration to scientists in Canada, the U.S. and throughout the world, and his productivity was outstanding. He was the founding editor of the journal *Radio Science* and its predecessor journal, and served in that position for 9 years. He also served as the secretary of the US National Committee for URSI from 1975 to 1978, and was a long time member of our Editorial Advisory Board. I might add as a footnote that he received the first Ph.D. in electrical engineering from this university, and his advisor was George Sinclair.

Others whose death has been reported and who were active in URSI are :

Prof. Lucien Bossy (of Belgium)
Prof. Raymond Coutrez (of Belgium)
Prof. Georges A. Deschamps (of the US)
Prof. Oystein Elgarøy (of Norway)
Prof. Ralph E. Kleinman (of the US)
Prof. Ken-Ichi Maeda (of Japan)
Prof. Robert E. McIntosh (of the US)
Baron Marcel Nicolet (of Belgium)
Prof. Victor Twersky (of the US)

I ask that you stand in silence for a minute in memory of these scientists.

A General Assembly takes place every three years, and provides the opportunity for reviewing developments that have taken place during the past triennium, describing new results and discoveries, and making plans for the future. In a discipline that has the wide variety of applications that ours has, the cross-fertilisation of ideas that can result from private conversations as well as the formal presentations is an important outcome. We invite the participation of all radio scientists, regardless of whether their countries of origin adhere to our Union, and I should like to welcome in particular those who may be attending a General assembly for the first time.

The format of this Assembly is different from the one employed in recent years in that the scientific activities are confined to a single calendar week. It is actually a return to the format of the 1938 Assembly held in Italy, and is being tried to make the most efficient use of your time here, recognising the many demands that all of you have on your time. But it does make for a very crowded schedule, and as the coming week progresses, we will be interested to hear from you whether we should do this again in the future. The schedule is crowded because of the large number of papers submitted – about 188, which is 50 percent more than ever before. Approximately half of these will be presented orally in sessions of our 10 Commissions, and many of these sessions are joint between 2 or more Commissions. The rest have been scheduled for poster sessions. At the meeting of our Coordinating Committee in Toronto a year ago, we did our best to minimise the conflict in subject matter between parallel sessions, and we hope we were reasonably successful in this. In addition, we have our Commission Tutorial Lectures and 3 General Lectures, and the manuscripts of these, together with that of our Public Lecture given by John Evans earlier this afternoon, are published in the book “Modern Radio Science” which you have all received. The General Lectures are by 3 distinguished scientists, and will take place at 11.30 a.m. tomorrow, Wednesday and Friday. I encourage you to attend them.

No organisation such as URSI is so good that it cannot be improved, and any organisation that rests on its laurels will soon cease to be effective. Some of you may remember the Corsendonk conference that was held in 1987 to examine where URSI was

going and how it could better fulfil its mission. There were many ideas generated, some of which have been implemented, and at a Council meeting in Lille in 1996 it was suggested that a future conference was in order to review the changes that had taken place during the past decade, and make new plans for the future. In line with this, a mini-retreat was held in conjunction with the meeting of the Coordinating Committee last year. A key role was played by our Long Range Planning Committee chaired by Hiroshi Matsumoto, and they are now exploring some of the ideas that came out of the discussions. This must be a continuing process, and we should always be looking for ways in which we can better serve radio scientists and the discipline of radio science throughout the world.

One of those ways is through our Young Scientist program, which had its start back at the General Assembly in Ottawa 30 years ago. Since then the program has expanded enormously, not only at General Assemblies, but also at other meetings and symposia sponsored by URSI. Out of more than 200 applicants at this Assembly, 121 scientists were chosen for awards. A criterion was that each must have a paper in our program, and we are grateful to Ed Jull, François Lefevre and Jean Van Bladel for overseeing the selection process. The awards include living expenses here in Toronto provided by our Canadian hosts, and we are grateful for this generosity. For those young scientists from developing countries or countries with serious economic problems – and that is almost 50 percent of the total – their travel costs are also paid, most of it by URSI, but with assistance from UNESCO, the Japanese and US URSI Committees, the Royal Society of London, and the European Space Agency. We thank these organisations for their support. In addition, the Indian and US URSI Committees provide Young Scientist Fellowships in memory of J.S. Bose, S.K. Mitra and H.G. Booker. All these programs are important in enabling young scientists to participate in our meetings and thereby become acquainted with URSI, and in helping to promote radio science throughout the world. Of course, the rest of us also benefit from the new ideas and enthusiasm that they provide. We welcome all these young scientists to this General Assembly, and I now ask that they stand up for a moment so we may congratulate them on their awards.

In many parts of the world, the economic situation makes it difficult for more senior scientists to attend meetings which are as far away as this. Until the situation improves, we must explore ways to maintain contact with them, and give them access to what we are doing. One way is through our Network of Correspondents, consisting of almost 2500 scientists who receive the Radio Science Bulletin directly, and we hope to build up the scientific content of this publication. How can we increase the size of the Network bearing in mind the costs involved, and should it be converted to some form of individual membership in URSI like that in other unions such as IAU and IUPAC? This is a continuing topic of discussion in the Long Range Planning Committee. Another way to maintain contact might be to hold focused scientific meetings in different parts of the world, each directed at scientists in a particular geographical area, but which might also be attended by some people from outside. The series of COMMSPIHERE meetings which were initiated by our Vice President, Joe Shapira, could be a model for these.

Mention of COMMSPHERE brings me to a matter of great concern to URSI, and that is spectral congestion and the reservation of selected frequency bands for scientific purposes such as radio astronomy. We all benefit from the new types of personal and other communications systems that are becoming a feature of our lives. By their nature, these flood the earth and the surrounding space, and they are now placing enormous economic pressures on the usable parts of the electromagnetic spectrum. Someone once said to me "You'd better buy some of land now, 'cos they aren't making it any more". So it is with electromagnetic frequencies. These are a precious resource, and the task before us is to see how we can make available the scientific expertise that resides in URSI to assure the wisest possible use of the electromagnetic spectrum. It will happen only through co-operation and collaboration with ITU, with national regulatory agencies, and with industry. Thanks to the initiatives taken by Joe Shapira, Paul Delogne and others, we have begun to make some progress, and the Council debate this morning was very helpful.

These and other initiatives will require some financial support, and the Board has been looking at possible sources of revenue other than member dues. One asset that we have is a General Assembly such as this, but instead of being an income provider, it presently eats up as much as 20 percent of our gross revenue. In order to at least break even, we are therefore considering taking a more direct financial responsibility for future General Assemblies.

In conclusion, let me assure you that URSI continues to be a vibrant organisation serving the needs of radio scientist's world wide, and providing a unique international forum.

With your help and support, this will continue in the future. Thank you.

AWARDS CEREMONY

Dr. Pierre Bauer, immediate Past President of URSI and Chairman of the Awards Panel, presided the third part of the Opening Ceremony, namely the Awards Ceremony. Dr. Bauer gave the floor to Mr. Balthasar van der Pol, a Grandson and namesake of the famous Professor Balthasar van der Pol.

PRESENTATION OF THE BALTHASAR VAN DER POL GOLD MEDAL

Mr. Balthasar van der Pol (Grandson)

Thank you very much Dr. Bauer for your introduction and kind words. I was very honoured to be asked by Professor Senior to be here today to present the van der Pol Gold Medal at this 26th General Assembly.

I am very grateful that my wife, my mother and my two sons could also be here today. This is a very special occasion for us and one that I am sure my sons will remember for the rest of their lives.

My grandmother, the late Mrs. Pietronetta van der Pol – Le Corbeiller initiated the van der Pol Gold Medal in 1963 where at the 14th General Assembly in Tokyo she presented it for the first time. As my grandmother stated and I quote “the purpose of the medal is to keep alive the memory of my husband and to stimulate, especially the younger scientists among you, to work patiently and seriously with the Officers of URSI for radio science in its widest scope.”

Throughout his life, my grandfather, Balthasar van der Pol, had a long association with URSI. As one of its founders he served as Vice President from 1934 to 1952 and at the time of his death in 1959 was Honorary President.

My grandfather was born in 1889 in Utrecht, the Netherlands and died in 1959 at his home in Wassenaar, also in the Netherlands. He graduated cum laude in physics from the University of Utrecht in 1916. The next three years were spent in England working under Ambrose Fleming at the University of London and later under J.J. Thompson at Cambridge in the famous Cavendish laboratories. It was here that he developed his thesis entitled “The Effect of an Ionised Gas on Electromagnetic Wave Propagation and its Flow Discharge Measurements”. He had created an artificial ionosphere in the laboratory

and proved that it had a refractive index of less than one for short radio waves. The implication of this was that short waves would reflect back to the ground when contracting the earth's ionosphere. This was an important discovery at that time as long distance transmission and reception of short waves had not been realised. This thesis earned him the degree of Dr. of Physics from the University of Utrecht in 1920.

Later he went on to receive Honorary Doctorate degrees from the Technical University of Warsaw and from the University of Geneva.

From 1919 to 1922 he served as theoretical assistant to the great H.A. Lorentz in Haarlem, the Netherlands.

In 1922 he became head of the Philips Research Laboratories in Eindhoven, a position he held until his retirement in 1949. In that year he was appointed a Director of the International Consultative Committee on Radio Communications and moved to Geneva, Switzerland. He loved Switzerland and considered it his second home, after Holland. In a lecture he once compared Switzerland to the element Helium, he said it was stable and neutral, just like Helium. He also alluded to some other countries but diplomatically declined to make any analogies.

He returned to Holland in 1956 and during the last three years of his life he was invited as a "Visiting Professor" at the American Universities of, Berkeley and Cornell.

In the 1930's he published a paper on "Relaxation Oscillations" the resulting equation of which he developed became known as the van der Pol equation. He realised that the beating of the human heart was in fact a relaxation oscillation and this prompted him to construct an electrical artificial heart. As he put it "the mathematical equation showed me the way." In studying possible deviations in relaxation circuits he compared them with heart diseases and even predicted some physical heart irregularities that had not yet been recognised or understood by physicians at that time.

Although known primarily as a physicist he had a great interest in and passion for mathematics. He was fascinated with prime numbers and developed a solution to the problem of complex prime numbers. This solution was in the form of a graph that illustrated that all prime numbers are not indivisible in the same sense. A Dutch textile manufacturer was so taken with the design of this chart that he had the design woven into linen tea towels. To my grandfather the greatest beauty in the tea towels was in their ability to reveal the properties of prime numbers.

My late father, also named Balthasar van der Pol used to tell the story of how whenever the family went on a car trip, my grandfather used to bring along pencil and pad of paper to record any license plate numbers that he suspected of being prime numbers. Upon returning home he would disappear into his study only to emerge minutes later to exclaim that indeed they were prime numbers.

Another great passion of my grandfather was music. He possessed "absolute pitch" meaning that he could identify a pitch in absolute value. He used to test this every morning at the Philips laboratory by singing middle C and having it checked electronically. He lectured and prepared a number of papers on the relationship between music and

mathematics. In particular he recognised the mathematical nature of the music of Johann Sebastian Bach. He was an accomplished musician, being proficient at the piano, violin and cello. He used to say that “music was the most beautiful of the arts and that mathematics was the most beautiful of the sciences.”

My grandfather was also known as a great lecturer and educator, he was knighted in Holland for his work as President of Temporary University at Eindhoven, that was set up in Holland during the war.

At Philips he was known as “The Grand Old Man of Radio” but to me, he was always known as “Opa”. Unfortunately I was only four years old when my grandfather passed away, so although I didn’t get to know him personally, I grew up hearing many stories about “Opa”.

My father described my grandfather as, and I paraphrase, one of those deeply involved men, whose mind was active all the time. During what little time he afforded himself for leisure, one was always aware that he was thinking of something new and intriguing. On many occasions during the family dinner hour he would take out a pencil and slide rule and then scribble a few mathematical symbols on the beautiful white linen tablecloth, then exclaim, “isn’t that elegant!” To my father’s dismay he was quickly reprimanded by the lady of the house when he attempted the same, this was to be my grandfather’s privilege only.

My grandfather often spoke of living in an ivory tower where he could work undisturbed at his mathematics and research. Fortunately for my father ivory towers are hard to find in Holland, instead my grandfather found the needed tranquility and inspiration he desired in his study at home and my father assured me that he spent many hours there.

Ladies and Gentlemen, it is with great pleasure and respect that I present the Balthasar van de Pol Gold Medal to Professor Shlomo Shamai for “*For contributions to the basic understanding of the potentials for and the limitations to information transfer through various communication channel models*”.

REPLY BY PROFESSOR SHLOMO SHAMAI

I am deeply honoured to be selected the recipient of the van der Pol gold Medal. A medal named after the great scientist Balthasar van der Pol, who has been closely associated with URSI and contributed immensely to the development of Radio Sciences.

It gives me great pleasure to thank the grandson and namesake of this eminent scientist for presenting the Medal. My deep gratitude is extended to URSI Board of Officers for bestowing upon me this prestigious recognition. My thanks go also to the President, Professor Senior, Past President and Chair Dr. Bauer, the Secretary General, Professor Lagasse, and Vice President Dr. Shapira for his continued support and leadership.

It is an everlasting joy and pleasure to be active and contributing to such exciting

and rapidly evolving fields of wireless communications and information transfer, which are embraced in full by the URSI Commissions, and in particular Commission C (Signals and Systems). In this discipline, theory and practice act in full synergy to continually extending the frontiers of Radio Sciences and provide new information processing and transfer capabilities, facilitating world-wide international co-operation to the benefit of mankind. International scientific collaboration in Radio Sciences and related domains should serve as a model for other human endeavours. In fact, it is the close international interaction which has played a central factor in the astounding achievements of our fields so far, and it is even more essential for further expediting the progress of Radio Sciences. I acknowledge with pleasure my colleagues and co-workers world-wide, particularly at Technion, Bell Laboratories, Princeton and MIT, to whom I express my profound appreciation for incessant fruitful scientific collaboration and friendship.

My gratitude is extended to my institute, the Technion-Israel Institute of Technology, and the Electrical Engineering Department therein, for providing an amicable, vibrant and stimulating research environment.

Last, I thank all members of URSI, primarily the Israeli URSI section, and you, attendants of the Twenty Sixth URSI General Assembly, for sharing with me this special and precious moment.

PRESENTATION OF THE JOHN HOWARD DELLINGER GOLD MEDAL

Prof. Susan K. Avery, President of the URSI Committee in the United States

The John Howard Dellinger Gold Medal honors a scientist that demonstrates not only outstanding scholarship but also a devotion to science in public service. Such was the emphasis of Dr. Dellinger's work, a physicist who performed research in many of the areas of radio science that form the foundation of URSI. He combined interests in radio science with pragmatic radio engineering issues. These interests led to the development of the radiosonde, which is still used today as a fundamental observing platform for weather observations, as well as radio aids for navigation. The correlation between visible solar eruptions and sudden radio fadings was first discovered by Dellinger and opened the field of solar-terrestrial research. Dr. Dellinger's committed service to URSI is an example to us all of what can be achieved through leadership and work in a professional organization.

The 1999 Dellinger Gold Medal is awarded to Professor Akira Ishimaru, an individual who exemplifies the qualities of Dr. Dellinger. Professor Ishimaru began his education at the University of Tokyo where he received his B.S. degree in Electrical Engineering. He was awarded a Ph.D. from the University of Washington in 1958 and spent his faculty academic career there as well. He is known for his work in wave propagation and scattering in random media. His scholarship has resulted in many seminar papers and a two-volume treatise used

by scientists, engineers, and students. These works address a broad range of engineering problems in communications, remote sensing, and imaging.

Professor Ishimaru's first observations of photon localization, exhibited as backscattering enhancement, was noted as a major discovery in *The Decade of Optics*. His work on scattering from dense random media describes and predicts the many applications used in today's polarimetric radar. Approximately 40 students have been fortunate to receive their Ph.D.'s under the tutelage of Professor Ishimaru. Many of these students have gained international recognition in their own right. Although he has retired from his faculty position, he continues to be active in his research and in the mentoring of students.

Professor Ishimaru has been active in the United States National Committee of URSI and in the Antenna and Propagation Society of IEEE. He has served as editor of three outstanding journals and was founding editor of the international journal, *Waves in Random Media*. He has received many honors for his work.

It is my pleasure to award the John Howard Dellinger Gold Medal to Professor Akira Ishimaru for: "*Contributions to the theories and applications of wave propagation and scattering in random media and backscattering enhancement.*"

Please join me in warm congratulations to Professor Ishimaru.

REPLY BY PROFESSOR AKIRA ISHIMARU

I am greatly honoured to receive the Dellinger Medal, and I am grateful to the URSI Board and in particular, USNC, for the recognition of my work. My main interest is in the theory and application of wave propagation and scattering in random media. Random media refers to the many natural and man-made media whose characteristics vary randomly in space and time. Examples are air and ocean turbulence, particulate matter in the atmosphere, ocean surfaces, terrain, and geophysical media. It also includes biological media where tissue characteristics may vary randomly and must be expressed by their statistical characteristics. Another example is composite materials composed of various elements.

Wave propagation and scattering in such a medium can be formulated in several ways. Examples are the Booker-Gordon formula for wave scattering in the troposphere, ionospheric scintillations, atmospheric optics, thin phase screen theory in astrophysics, Feynmann diagram method, path-integral formulations, and Dyson and Bethe-Salpeter equations. Also important is the radiative transfer theory or transport theory which has much in common with the neutron transport theory. Partially coherent waves in optics can also be viewed as part of this general field. In addition, wave scattering by rough surfaces and applications to polarimetric radars, SAR, and active and passive remote sensing are also important parts of this field.

My interest in this field started in the 1960's when considerable activities in microwave and optical propagation in the atmosphere were taking place together with the emerging field of partial coherence in optics. At that time I was involved in a study of

optical beam propagation in the atmosphere and microwave scattering in the planetary atmosphere. In the late 1960's and early 1970's, bioengineering programs were initiated at many universities. I was very much involved in a study of optical diffusion in blood and tissues, and this became an important basis for many other studies in tissue optics which are continuing today. This also naturally led to the study of radiative transfer and diffusion theories.

Since the 1980's, I have been very much interested in the general topic of multiple scattering in random media. In particular, there were some interesting studies reported on the enhanced backscattering from turbulence in the early 1970's. Together with my former Ph.D. student, Professor Yasuo Kuga, we conducted optical experiments on backscattering from discrete particles to see if we could observe phenomena similar to the turbulence case. Our experimental data showed a very narrow peak in the back direction within a fraction of a degree. This initial study was then quickly recognised as an optical equivalent of the weak Anderson localisation of electron diffusion in disordered media. This enhancement phenomenon has attracted considerable attention not only in optics but also in microwave scattering by planetary surfaces, imaging through the ionosphere, and high-slope rough surfaces.

The enhanced backscattering is outside the radiative transfer theory and must be studied starting with Maxwell's equations rather than the heuristic transport of power. Rough surface scattering and low-grazing angle scattering are other examples of analytical multiple scattering theories. It should also be mentioned that this whole field of waves in random media is now being re-examined with various computer Monte-Carlo simulations and numerical solutions which promise to be an important tool of the future.

At this time, I would like to thank the URSI Community. URSI is my professional home, where I interact with many scientists and learn new and exciting research. I am particularly grateful to the USNC for this recognition and to all my URSI colleagues for their friendship.

I would also like to thank my co-workers at the University of Washington for their encouragement and friendship. In particular, I would like to thank all my graduate students who have given me inspiration and stimulation and have performed most of the work.

Finally, I would like to thank my family, particularly my wife Yuko, for their constant support and encouragement. Thank you.

PRESENTATION OF THE APPLETON PRIZE

Prof. A. David Olver, President of the URSI Committee in the United Kingdom

The Appleton Prize is awarded to a distinguished scientist in the field of the Ionospheric Physics by the Council of the Royal Society on the recommendation of the Board of officers of URSI. The prize commemorates the life and work of Sir Edward Appleton, who was a former president of the URSI.

Sir Edward first demonstrated in 1924 the existence of the ionosphere by measuring the time of arrival of radio waves reflected by the layers of the ionosphere. His highly significant discoveries led to his being awarded the Nobel Prize in 1947 for his work in Ionospheric Physics and Radio Propagation. He worked on ionospheric propagation all his working life, even as he held increasingly distinguished posts. His contribution to URSI was immense where he valued interaction with radio scientists throughout the world. He once said, “the big things in science occur when an adventure takes place in the mind of an individual.” Since the creation of the Appleton Prize, URSI has awarded it to distinguished scientists who fulfill Sir Edward’s dream.

This year’s recipient, Professor Ronald Woodman fulfills this criteria well. He is an enormously creative scientist who has made major contributions to a wide range of topics related to radar probing of the upper atmosphere. He is one of the few scientists, active in South America, who has made major contributions to a wide range of topics related to radar probing of the upper atmosphere. He is one of the few scientists, active in South America, who has made major contributions to many areas of URSI interest. Professor Woodman was born in Peru and after graduating from the National University for Engineering went to the USA and obtained his PhD Degree from Harvard University on the subject of incoherent scatter. He then embarked on a distinguished career which has combined radio science with management of ionospheric and atmospheric research, notably Head of the Atmospheric Physics Group at the Arecibo Observatory and Director of the Jicamarca Observatory in Peru. He is now Executive President of the Institute of Geophysics in Peru.

His major contributions included work on incoherent scatter, where he provided the first theory to explain exactly how ion-ion collisions affect the ion gyro-resonance. He pioneered and recently improved the measurement of plasma drift velocity in Peru to permit the better measurement of ionospheric studies. This technique and its more recent extensions to multi-radar imaging are widely used in studies of plasma instabilities at the equator and in the auroral zone. He also created the entire field of mesosphere, stratosphere, and troposphere wind profile measurements with VHF radars. A large network of wind profilers exists throughout the world because of his insights.

His leadership of the radar ionospheric community has been exemplary and this makes him a worthy recipient of the Appleton Prize. The citation reads “*for major contributions and leadership in the radar studies of the ionospheric and neutral atmosphere.*”

REPLY BY PROFESSOR RONALD F. WOODMAN

For a scientist there is no greater satisfaction than receiving recognition from his own peers. You can imagine how honored, happy, satisfied and proud I feel. Receiving the Appleton prize is for me the true culmination of my professional career. I couldn’t aspire to more.

I also think that this year's Appleton prize has a special meaning: For the first time it is being awarded to a scientist from an underdeveloped country. Don't let my name fool you. As my accent probably suggests, I am a Peruvian national. My English grandfather came to Peru more than a century ago. I was born in Piura, Peru, and was brought up in the same city. I mention this for two reasons: first, because of the greater significance an international scientific prize has within my own society, and second, because of what I hope it could mean for the future of science in Peru.

Receiving a prize like this brings a feeling of pride that extends to one's family and beyond, no matter the nationality of the recipient, but I doubt this happens in a well-developed society to the same degree that I have experienced. It is front page news for a Peruvian to get an international scientific prize. Ever since the news was made public, I have continued to receive sincere congratulations from people and Peruvian institutions that want to share with me the honor I brought to them, as well as to myself. This reaction has multiplied by hundreds my feeling of satisfaction and accomplishment. Thus, I have received hundreds of prizes, not just one.

My second point is one I hope will be heard by my countrymen and women in Peru. It can be said very succinctly in Spanish: "¡Perú puede!" (Peru can do it!). Our science and technology is poorly developed, but we are not limited by our culture or basic education. I received my primary and secondary education in typical Peruvian private and public provincial schools. I spent six of my school years at the Santa Rosa School in Sullana, a sister city of Piura, which at that time had only two of its main streets paved. But it was there that I was first exposed to the beauty of mathematics as a perfect example of deductive reasoning through a high school course in Euclidean geometry. My teachers were young Maristas Brothers, Spanish missionaries who sacrificed their lives for the benefit of their fellow men in a truly Christian spirit. I earned my Mechanical and Electrical Engineering degree at the Universidad Nacional de Ingenieria in Lima, Peru. But, on the other hand, I was one of the few Peruvian professionals fortunate enough to receive a postgraduate education, which had to be done abroad, in my case at Harvard. I was also able to return home to a challenging scientific position. These are two circumstances I would like to underline and elaborate on. But, before doing it, I should add that, while at Harvard, I never felt handicapped by my earlier education in Peru.

Nowadays, as in my time, if an ambitious Peruvian professional — of whom there are many— wants to obtain advanced technical and scientific knowledge, he or she has to go abroad. Some do, as I did, if they can find the support, but in most cases they do not return, not for a lack of willingness but because of the lack of opportunities in Peru. I was a fortunate exception, because the Jicamarca Radio Observatory —where I have done most of my research work— existed, and because Jicamarca is one of the only few institutions in Peru where world recognized science is done.

The lesson to be learned by Peru from my experience and my receiving the Appleton prize is that if it wants to develop (and this may hold true, as well, for other developing countries), it should improve its almost nonexistent post-graduate education and research laboratories and programs. We must develop our human resources at the frontiers of

knowledge since, nowadays, the wealth of a nation is found not in the abundance of its natural resources but in the abundance and quality of the knowledge available to its people. Look at the examples provided by Japan, Taiwan, South Korea, Israel and Singapore.

As I said, I was fortunate to have access to the Jicamarca Observatory, one of the most powerful instruments in the world for the study of the upper atmosphere, a facility of the Geophysical Institute of Peru since 1969. But an observatory is more than equipment; it requires people, well-trained scientists, engineers and technicians and the willingness and hard work of all its personnel, which I was also fortunate to have. I would like to share this prize with all of them.

Most of my research work has been done with the repeated collaboration of many colleagues. This can be seen in the co-authorship of my papers. I would like to share the prize with them too.

My special thanks to the colleges who proposed me for the prize; to the URSI Board, the Awards Advisory Panel and to the London Royal Society for their decision; and to all of you for being here with me today.

I dedicate the honor of this prize to my wife, Gladys, and to my six children: Karina, Randy, Pauline, Suzette, Christian, and Elgin.

PRESENTATION OF THE ISSAC KOGA GOLD MEDAL

Prof. Yoji Furuhashi, President of the URSI Committee in Japan

It is a great pleasure for me, as the President of the Japan Member Committee of URSI, to present the 1999 Issac Koga Gold Medal to Dr. Eric Michielssen, Professor of the University of Illinois in the United States of America.

I would like to start by describing briefly the rules for the Issac Koga Gold Medal, as well as the career of the late Professor Koga. The medal is endowed to a young scientist under age 35 who has made outstanding contributions to any of the branches of science covered by the ten Commissions of the URSI. It honours the memory of the late Professor Issac Koga, who was Vice President of the URSI from 1957 to 1963, President of the Union from 1963 to 1966, and Honorary President from 1981.

Professor Koga was born in Japan in 1899. He studied at the University of Tokyo, and became, first, Professor at the Tokyo Institute of technology; later, professor at the University of Tokyo; and finally, Dean of its Faculty of Engineering.

Professor Koga's researches covered a wide variety of topics in radio science. Particularly noteworthy among these was the invention, in 1932, of a piezo-electric crystal oscillator having an almost zero frequency-temperature coefficient. This is widely known as the Koga-cut crystal, and has been used in a variety of applications, in particular to international radio communications and broadcasting.

Professor Koga was a strict educator of young students and researchers, but at the same time a warm-hearted research leader. When he passed away in 1982, the URSI Committee in Japan proposed the establishment of this Gold Medal for young scientists in commemoration of Professor Koga as a great educator as well as a distinguished researcher. The first Koga Medal was awarded fifteen years ago at the General Assembly in Florence, and this is the sixth award.

Let me now mention the distinguished scientific achievement of Prof. Eric Michielssen, for which he is receiving the 1999 Issac Koga Gold Medal today. The citation for the award mentions that *he has made highly significant contributions to computational electromagnetics, in particular the development of fast frequency and time domain integral equation analysis techniques and nature-driven synthesis methods.* Prof. Michielssen, would you accept our hearty congratulations?

REPLY BY PROFESSOR ERIC MICHIELSSEN

President Senior, Dr. Bauer, Dr. Furuhashi, distinguished guests, dear colleagues, ladies and gentlemen, I would like to thank the International Union of Radio Science for the great honour of awarding me the Koga Gold Medal.

During the past six years, I have pursued two rather different research goals: First, the development of robust, genetic algorithm (GA) driven electromagnetic synthesis techniques, and second, the construction of fast multipole method (FMM) based electromagnetic analysis tools. Today, I am both proud and happy to receive this award. I am proud because this award recognises the modest contributions that I have made to the state of the art in computational electromagnetics. And furthermore, I am happy because this award confirms the coming of age of these new design and analysis techniques. I therefore would like to thank the URSI Awards Committee for giving me the chance to publicly recognise some of the people who played a key role in the development of these two areas.

In 1992, when I started developing GAs for synthesising electromagnetic filtering devices, the time was ripe for such endeavours. By that time, it had been three years since Professor David Goldberg of the University of Illinois at Urbana-Champaign published his influential book "Genetic algorithms in search, optimisation, and machine learning," and researchers from many different branches of engineering already had discovered the beauty and power of these nature-inspired optimisers. Virtually at the same time that I ventured into this new area, other researchers in computational electromagnetics started applying GAs to their own synthesis problems: Professor Randy Haupt from Utah State University applied GAs to the design of thinned arrays and Professor Yahya Rahmat-Samii used them to tackle a variety of antenna design problems. Since, many more in our community have joined the bandwagon and recently, GAs have appeared in commercial

electromagnetic design environments. I believe that the role of GAs in electromagnetic design will continue to expand, with future emphasis placed on multiobjective, and “smart” optimisers capable of solving highly computational problems quickly.

In 1995, I turned my attention to the development of fast schemes for analysing electromagnetic phenomena. Again, I was fortunate to find much inspiration in previous work. In 1990, Professor Vladimir Rokhlin from Yale - a mathematician with engineering inclinations - developed a fast scheme for solving electromagnetic scattering problems, namely the FMM. For several years, however, a mathematical shroud rendered all FMM theory virtually inaccessible to the electromagnetic engineering community, until, in 1992, our own Professor Weng Chew from the University of Illinois at Urbana-Champaign - an engineer with mathematical inclinations - re-engineered the FMM; he not only extended it to permit the analysis of very large-scale electromagnetic phenomena, but also unveiled its physical interpretation to the engineering community at large. Others, including Drs. Ben Dembart at Boeing and Stephen Wandzura at HRL soon followed suit. My own efforts in the field of fast solvers recently have focused on extending FMM technology to time domain analysis. We have constructed fast integral equation based schemes for analysing both linear and nonlinear electromagnetic transients and constructed fast global boundary conditions for FDTD simulations. I would like to stress however, that all this work constitutes no more than a variation on the work of the trailblazers I just mentioned: the invention of diagonal translation operators for wave fields was a breakthrough of enormous proportions. While much work remains in the development of quality preconditioners, higher order schemes, and parallelisation, I believe that there is no turning back the clock: FMM technology - possibly hybridised with other computational schemes - is here to stay and will be a component in the majority of future computational electromagnetics tools.

Therefore, I believe that these are very exciting times for all of us working in the area of computational electromagnetics. Indeed, the introduction of GAs and the FMM into the computational electromagnetics arena are only two events in a series of recent developments that I believe will have a lasting impact on our community. I have no doubt that robust electromagnetic analysis and design tools, capable of reliably dealing with not only stand-alone components but also entire systems, are just around the corner. Therefore, I would like to thank all of you, my colleagues, for making electromagnetics research as exciting today as it was a century ago when the foundations for URSI were being laid.

Before I close, I would like to thank several people whom I have been fortunate to be closely associated with over the years. First of all, there is my Ph.D. advisor, Professor Raj Mittra, now at Penn State, who always encouraged me to do research in many novel areas, and that includes GAs. Secondly, there are those who make the Center for Computational Electromagnetics at the University of Illinois at Urbana-Champaign a very desirable place to be. I would like to thank my colleagues in the Center, Professors Andreas Cangellaris, Jianming Jin, and Jose Schutt-Aine, but especially Professor Weng Chew, the Center’s Director, whose keen research insights, dedication to teaching

excellence, mentorship of students and junior faculty, and leadership in running a quality operation serve as a continuous source of inspiration to me and many others. Finally, I would like to thank my postdoctoral associates and former students, Drs. Balasubramaniam Shanker, Jianguo Wang, Daniel Weile, and Vikram Jandhyala, and my current students Kemal Aygün, Robert Chao, Nan-Wei Chen, Arif Ergin, Mingyu Lu, and Nick Schuneman. I owe this award to them.

I am deeply honoured by this award. I will treasure it and forever will strive to be a worthy recipient. Thank you very much.

The Ceremony concluded with a performance of the Soprano Ms. Isabel Bayarakdarian, who has a degree in biomedical engineering from the University of Toronto, but decided to develop a singing career afterwards. In 1995 she won the 1995 National Prize at the Canadian Music Competitions, in 1996 two prizes at the Kiwanis and the metropolitan Opera national Council auditions, and in 1997 the Marilyn Horne Foundation Award.

At 7 p.m. a cocktail followed at Hart House, on the campus of the University of Toronto.

CLOSING MEETING

CLOSING REMARKS BY THE SECRETARY GENERAL

Prof. P. Lagasse

At the request of the President, I am pleased to announce the results of the elections of the Board of Officers and of the Chairs and Vice-Chairs of the Commissions for the next triennium.

The incoming President is Prof. H. Matsumoto (Japan) and the Vice-Presidents are: Prof. K. Schlegel (Germany), Dr. J. Shapira (Israel), Prof. A. W. Wernik (Poland), Prof. P. H. Wittke (Canada).

The election results of the Chairs and Vice-Chairs of the Commissions are as follows:

Commission A:

Chair Prof. Elio Bava (Italy)
Vice-Chair Prof. Quirino Balzano (U.S.A)

Commission B:

Chair Prof. Staffan E.G Ström (Sweden)
Vice-Chair Prof. Makoto Ando (Japan)

Commission C:

Chair Prof. Ernst Bonek (Austria)
Vice-Chair Prof. Masami Akaike (Japan)

Commission D:

Chair Prof. Alwyn J. Seeds (U.K.)
Vice-Chair Prof. Peter Russer (Germany)

Commission E:

Chair Dr. Robert L. Gardner (U.S.A)
Vice-Chair Prof. Pierre J. Degauque (France)

Commission F:

Chair Dr. Yoji Furuhashi (Japan)
Vice-Chair Prof. Martti T. Hallikainen (Finland)

Commission G:

Chair Dr. Phil Wilkinson (Australia)
Vice-Chair Prof. Christian Hanuise (France)

Commission H:

Chair Dr. H. Gordon James (Canada)

Vice-Chair Prof. Umran Inan (U.S.A)

Commission J:

Chair Prof. Jackie N. Hewitt (U.S.A)

Vice-Chair Prof. Makoto Inoue (Japan)

Commission K:

Chair Prof. Shoogo Ueno (Japan)

Vice-Chair Prof. Berard Veyret (France)

I would like to inform you also of a few important decisions taken by Council:

- Council accepted the invitation of the Member Committee in the Netherlands to organise the next General Assembly. The venue will be Maastricht, in August 2002.
- Council has accepted, pending the usual commitment to ICSU rules and the URSI Statutes, the application to membership of the Academies of Sciences of Malaysia.
- Council also approved a Revised Version of the statutes giving voting rights to the Commissions.
- Council General Assembly decided for this time not to select the venue of the 2005 General Assembly.
- Dr. Stone has kindly accepted again the heavy duty of editing the next Review of Radio Science. Mr. Martin Hall will be the Coordinator of the Scientific program of the next General Assembly.

CLOSING REMARKS BY THE OUTGOING PRESIDENT

Prof. T.B.A. Senior

Ladies and Gentlemen,

This has been a hectic week for all of us, but I hope you have found it enjoyable as well as intellectually rewarding. Judged by the attendance and the quality of the scientific presentations, this must rank as one of the most successful General Assemblies ever, and our Conference Co-ordinators and Commission Chairs have very reason to be proud of the programme they put together. We thank all the participants who came and shared their discoveries and expertise, and hope that they were similarly rewarded. We are grateful also to our public and general lecturers, to Clive Oakes and Jim Stratt who arranged our historical and industrial exhibits respectively, and to George Eleftheriades who organised our student competition. Those of us who attended the student presentations last Tuesday noon were impressed with what we saw and heard. All of these activities were part of our outreach to a wider public, and in line with ICSU's celebration of Science in the Year 2000.

There is one group of people who are breathing a collective sigh of relief that their endless hours of work are coming to an end, and that is the Local Organising Committee here in Toronto. To Keith Balmain, Nicole Sarault, Emilie van Deventer, Doug Jones and to all the members of the Committee, that you for your efforts on our behalf, and since many of them are here in the audience, I ask that you join me in showing your appreciation.

Speaking for myself, it has been an honour and a privilege to have served a President for the past three years, and the fact that it has also been enjoyable is because of the support I have received from you all, most particularly from the members of the Board and the Secretariat. There are three retiring Board members : Pierre Bauer, our past president, whose wise counsel has been so valuable; Peter Clarricoats, who served as Treasurer for 6 years and helped in other ways as well; and Maria Stuchly who had a major role in assuring the success of the General Assembly.

We are also blessed with an outstanding Secretariat, and it is they - Paul Lagasse, Peter Van Daele and Inge Heleu - who keep things running smoothly. On behalf of all of us, thank you for your hard work and dedication.

It is now my pleasure to introduce our new President, Professor Matsumoto.

CLOSING REMARKS BY THE INCOMING PRESIDENT

Prof. H. Matsumoto

First of all, I wish to express my sincere thanks for the confidence you have shown by electing me as President; I consider it a great honour to me and to my country. I will do my best to uphold the high tradition set by my predecessors in that office and, on this occasion, I would like to mention the name of one of them, Professor Issac Koga, President from 1963 to 1966, whose example has been a source of inspiration to many young radio scientists in Japan. The task ahead seems to be rather difficult, but I know I shall be assisted in this great responsibility by an able Board of Officers, including our immediate past President, Professor Senior, who is far too modest about his contributions to URSI.

Personally, I think that the incoming President should not go into a lengthy address at the onset of his mandate; he should rather do so after he has had the opportunity to act and prove himself. However, a few words seem to be appropriate.

As you know the importance of the communications element related to Radio has tremendously increased over the last decade or so in the work of URSI. However, such a development should not detract from the purely/scientific component of our Union. Its major strength is that it brings together pure scientists and engineers in a way that no other international body can do. URSI must continue to promote basic research, while at the same time bearing in mind that the research scientist can also help in the attainment of objectives of practical value. In this regard we look forward to strengthening our long-

standing and friendly relationship with the International Telecommunication Union. Thereby we hope to be able to make useful contacts, not only with the engineers and others who are responsible for operational systems of communication, but also with the developing countries.

During this Assembly, I was impressed by the vitality of all our Commissions in accordance with our general policy, there is more interaction among them through our business and technical sessions, and we shall put even greater emphasis on sessions which would bring together a very broad cross-section of all radio scientists. But it is also desirable that URSI, with its truly international expertise, should maintain and further develop our contacts and collaboration with other scientific and engineering organisations, both international and national. Indeed, owing to the particular character of the fields they cover, all of our Commissions, in one way or another, are playing an important role on the international scientific scenes. In such as Remote Sensing, Geophysics, Space Sciences, Astronomy and even Medical sciences on top of all aspects of key and basic technological elements in Radio Engineering.

We have worked hard while we have been here, as you can see from the resolutions and recommendations that we have adopted. Our main objective must be to maintain the same measure of enthusiasm and the same spirit of international co-operation that we have experienced since the foundation of our Union.

Finally, I am happy to fully support the well-merited thanks, which Prof. Senior has expressed to Keith Balmain in the Local Organising Committee. I know from personal experience how much work, and even headache, is involved in the organisation of such a major conference. I am confident that we shall long remember the Assembly. I officially declare that the 26th GA is closed.

May I wish you a pleasant journey back to your countries, and also express the wish to have the pleasure of meeting you again in Maastricht in three years time, in the next millennium.

CONCLUDING REMARKS BY THE CHAIR OF THE CANADIAN ORGANISING COMMITTEE

Prof. K.G. Balmain

Professor Keith G. Balmain expresses how pleased he is to have been able to host an URSI General Assembly in Toronto.

The estimated attendance at this General Assembly is 1220 full registrants, 142 students and 118 Young Scientists, this totals 1480 attendants. And 130 accompanying persons registered for the social programme.

Professor Balmain wishes everybody a safe journey home.

REPORTS OF MEETINGS

BOARD OF OFFICERS

Summary Report

The Board of Officers met on two occasions, respectively on 14 and 21 August 1999. During the first meeting of the Board most of the discussions were devoted to items which were subsequently considered by the URSI Council and to the details of the Opening and Closing Ceremonies.

1. URSI Statutes

Council will vote formally on the proposed new version of the Statutes.

2. Resolutions

Three internal URSI resolutions and 4 external resolutions will be proposed to Council for approval.

3. Standing Committees

Following the recommendation of the Chairs of some standing committees, Council will be asked to consider the elimination of these standing committees.

4. Scientific Committee on Telecommunications

Following the recommendation of the Inter-Commission Working Group on Spectrum Congestion, Council will be asked to consider the reactivation the Scientific Committee on Telecommunications.

5. URSI contribution to ICSU

The current adhering category for URSI to ICSU is 8. In 1999 the membership fee from URSI to ICSU was higher than the grant received from ICSU. It was recommended that the new Board should look into this evolution.

6. Young Scientists Programme

The costs involved with the Young Scientists programme is larger than sometimes recognised. It is noted that large administrative efforts and costs are involved. The total cost of the Young Scientists Programme including the costs incurred by the local organising committee is currently estimated at about US\$ 125,000. It is recognised by the Board that maintaining a Young Scientists Programme of this size in future will be difficult.

The incoming Board met on 21 August. Items on the agenda were :

1. Distribution of responsibilities within the Board

- (a) Treasurer : Prof. K. Schlegel
- (b) Long Range Planning : Prof. H. Matsumoto
- (c) Publications : Prof. A.W. Wernik
- (d) Wireless Communications and interactions with developing countries : Dr. J. Shapira
- (e) Young Scientists : Prof. P.H. Wittke
- (f) URSI Awards : Prof. T.B.A. Senior

2. Advisory Panel for Future General Assemblies

This new advisory panel will have 3 very distinctive tasks, namely:

- (a) interact with both the Secretary General and the organising committee in the Netherlands for the organisation of the 2002 General Assembly;
- (b) look into the financial aspects of future General Assemblies and the level of financial risks URSI could take;
- (c) interact with proposers for future venues.

The following people have agreed to serve: Dr. W.R. Stone, Mr. M.P.M. Hall and Dr. F. Lefevre.

3. Scientific Programme 2002 General Assembly

The Coordinator of the Scientific Programme of the 2002 General Assembly will be Mr. Martin P.M. Hall. The Assistant Coordinator will be Prof. Gert Brussaard.

4. Awards Panel

Prof. T.B.A. Senior will chair the Awards Panel. The laureates of the 1999 senior awards, Prof. A. Ishimura, Prof. R.F. Woodman and Prof. S. Shamai, will be asked to serve on this Panel.

5. Next meeting

The next Board meeting will be held in Gent, Belgium, on 10-13 May 2000.

COUNCIL

Summary Report

The Resolutions and Recommendations adopted by the URSI Council are reproduced at the end of this volume.

Council met on Sunday 15 August (8.30 to 12.30 a.m.), Tuesday 17 August (4 to 7 p.m.), Thursday 17 August (5.30 to 8 p.m.) and Saturday 21 (8.30 to 11.30 a.m.).

1. Membership of the Council

President : Prof. T.B.A. Senior
Secretary General: Prof. P. Lagasse

Argentina : Prof. S.M. Radicella
Australia : Prof. D.J. Skellern
Austria : Dr. R. Leitinger
Belgium : Prof. P. Delogne
Brazil : Prof. P. Kaufmann
Canada : Dr. G. Delisle
China CIE : Prof. Zong Sha
China SRS : Prof. Chao-Han Liu
Joint Czech and Slovak Committee : Prof. L. Sumichrast
Denmark : Dr. G.B. Larsen
Egypt : Prof. I.A. Salem
Finland : Prof. Hallikainen
France : Dr. F. Lefevvre
Germany : Dr. K. Dorenwendt
Greece : Prof. J. Sahalos
Hungary : Prof. L. Zombory
India : Prof. V.U. Reddy
Ireland : Prof. N. Evans
Israel : Prof. E. Heyman
Italy : Prof. G. Tofani
Japan : Dr. Y. Furuhamo
the Netherlands : Prof. F. Sluijter
New Zealand : Dr. N. Thomson
Nigeria : Prof. G.O. Ajayi
Norway : Prof. D.T. Gjessing
Peru : Prof. R.F. Woodman
Poland : Prof. S. Hahn

Portugal : Mr. J.F. Patricio
Russia : Prof. N.A. Armand
South Africa : Prof. K.M. Reineck
South Korea : Prof. Jung-Woon Ra
Spain : Prof. J.L. Sebastian Franco
Sweden : Prof. S. Ström
Switzerland : Prof. M. Ianoz
Ukraine : Prof. A. Pogorily
United Kingdom : Prof. A.D. Olver
USA : Prof. S.K. Avery

Commission A : Dr. M. Kanda, Chair
Prof. E. Bava, Vice-Chair
Commission B : Prof. C.M. Butler, Chair
(the Vice-Chair is the official delegate of Sweden)
Commission C : Prof. J.G. Lucas, Chair
Prof. E. Bonek, Vice-Chair
Commission D : Prof. R. Sorrentino, Chair
Prof. A. Seeds, Vice-Chair
Commission E : Prof. M. Hayakawa, Chair
Dr. R.L. Gardner, Vice-Chair
Commission F : Mr. M.P.M. Hall, Chair
(the Vice-Chair is the official delegate of Japan)
Commission G : Prof. B.W. Reinisch, Chair
Dr. P. Wilkinson, Vice-Chair
Commission H : Dr. V. Fiala, Chair
H.G. James, Vice-Chair
Commission J : Prof. R.S. Booth, Chair
Prof. J.N. Hewitt, Vice-Chair
Commission K : Prof. J.C. Lin, Chair
Prof. S. Ueno, Vice-Chair

Honorary Presidents W.E. Gordon and J. Van Bladel, the officers of the Board, the Coordinator of the Scientific Programme and the Assistant Secretary General attended in an advisory capacity. An Observer from Malaysia, Chairs of Standing Committees and representatives from ITU, IUCAF, ESA and various URSI officials also attended the meetings, partially or totally.

2. Formation of Temporary Committees

(a) Drafting Committee

Prof. A.D. Olver and Dr. F. Lefevre kindly agreed to serve.

3. Vote on the new Statutes.

The President recalled the process which has led to the new proposed version of the Statutes. A draft of the new Statutes was approved by the Board and by the Commission Chairs and distributed to all Member Committees requesting proposals for modifications and amendments. A few minor changes were implemented. Two significant amendments were received from the New Zealand Member Committee but, after a mail ballot, both were voted down. The version presented to Council was approved unanimously.

4. Organisation of the XXVIth General Assembly

Prof. K.G. Balmain presented an extensive overview of the arrangements for the XXVIth General Assembly in Toronto and Dr. J. Hamelin, Coordinator of the Scientific Programme, outlined some details of the scientific programme. In total 1748 papers were accepted (971 oral presentations, 777 poster presentations). The papers were distributed amongst the Commissions as follows:

	<u>Oral C.</u>	<u>Posters</u>	<u>Total</u>
Total commission A	104	1	105
Total commission B	111	244	355
Total commission C	63	5	68
Total commission D	73	12	85
Total commission E	96	56	152
Total commission F	116	102	218
Total commission G	106	131	237
Total commission H	111	104	215
Total commission J	114	65	179
Total commission K	77	57	134
<i>Total communications:</i>	<i>971</i>	<i>777</i>	<i>1748</i>

The President thanked Dr. J. Hamelin and Prof. M.A. Stuchly for the excellent work in setting up the scientific programme of the General Assembly.

5. Election of Board of Officers, and of Chairs and Vice-Chairs of Commissions

The results of the elections were as follows :

(a) Board of Officers :

President: Prof. Hiroshi Matsumoto (Japan)
Vice-Presidents: Prof. Kristian Schlegel (Germany)(Treasurer)
Dr. Joseph Shapira (Israel)
Prof. Andrzej W. Wernik (Poland)
Prof. Paul H. Wittke (Canada)
Secretary General: Prof. Paul Lagasse (Belgium)
Prof. T.B.A. Senior remains a member of the Board as Past President.

(b) Chairs and Vice-Chairs of Commissions :

	<u>Chair</u>	<u>Vice-Chair</u>
Commission A:	E. Bava (Italy)	Quirino Balzano (U.S.A.)
Commission B:	S.E.G Ström (Sweden)	Makoto Ando (Japan)
Commission C:	E. Bonek (Austria)	Masami Akaike (Japan)
Commission D:	A.J. Seeds (U.K.)	Peter Russer (Germany)
Commission E:	R.L. Gardner (U.S.A.)	Pierre J. Degauque (France)
Commission F:	Y. Furuhashi (Japan)	Martti T. Hallikainen (Finland)
Commission G:	P. Wilkinson (Australia)	Christian Hanuise (France)
Commission H:	H.G. James (Canada)	Umran Inan (USA)
Commission J:	J.N. Hewitt (U.S.A.)	Makoto Inoue (Japan)
Commission K:	S. Ueno (Japan)	Bernard Veyret (France)

6. Membership

The Council unanimously accepted the application to full membership in category one of Malaysia (see Resolution U.2). It confirmed the associate status of the committees in Belarus, Chile, Kazakstan, Uzbekistan and Yugoslavia (see Resolution U.2).

The Council welcomed the decision of the Member Committee in Finland to move from Category 1 to Category 2.

The Council discussed the problem of the Member Committees with arrears extending to more than two years - Nigeria and Ukraine - and decided to maintain both committees in their current category.

7. Finances

The Standing Committee on Finance recommended Council to approve the accounts as presented by the Treasurer. Council formally accepted the Treasurer's report.

The triennial report on the finances of the Union, including the audited accounts for 1996, 1997 and 1998, was accepted by the Council on recommendation of the Standing Finance Committee.

8. Inter-Commission Working Group on Spectral Congestion

Following the recommendation of the Inter-Commission Working Group on Spectrum Congestion, Council approved the reactivation of the Scientific Committee on Telecommunications.

9. XXVIIth General Assembly

There were four invitations before the Council, from the Member Committees in China (CIE), Egypt, India and the Netherlands. As a result of the vote, the XXVIIth General Assembly will be held in Maastricht, the Netherlands, in the middle of August 2002 (see Resolution U.29). The Coordinator of the Scientific Programme will be Mr. Martin P.M. Hall. (Shortly after the Toronto General Assembly the Dutch Member Committee appointed

Prof. Gert Brussaard as Associate Coordinator). The duration of the Maastricht General Assembly will be equal to the Toronto General Assembly.

10. Publications

Dr. W.R. Stone, Chair of the Publications Committee presented the report which had been distributed prior to the General Assembly. The Council discussed and agreed upon the following :

- (a) In the future IEEE Press will be considered as printer instead of Oxford University Press with regard to the "Review of Radio Science".
- (b) It was recommended to have the "Review of Radio Science" available on CD-ROM for all participants at future General Assemblies and as book available for libraries. Dr. W. Ross Stone accepted to serve as Editor of the "Review of Radio Science" for the next triennium.
- (c) The disk with references, now distributed together with the "Review of Radio Science", will be discontinued.
- (d) The content of "Modern Radio Science", i.e. the general lectures and tutorials of the General Assembly, will be published in 6 issues of the "Radio Science Bulletin", starting one year before the General Assembly. Savings are estimated to be about US\$ 20,000. The Associate Coordinator for the Scientific Program of the General Assembly (who used to be the Editor of Modern Radio Science) automatically becomes an Associate Editor of "the Radio Science Bulletin". The general lectures and tutorials will be included on the same CD-ROM as the "Review of Radio Science".
- (e) A CD-ROM containing 3 to 4 page summaries of the papers will replace the current "Book of Abstracts". By publishing this CD-ROM as a special issue of the "Radio Science Bulletin", these proceedings can be made archival. A paper version may be considered for use by libraries. Electronic submission of abstracts for the General Assembly will be strongly encouraged. The abstracts will be made available on the WWW prior to the General Assembly. Savings are estimated to be about US\$ 15,000 to 20,000.
- (g) URSI will continue to publish the "Radio Science Bulletin" ; it will contain papers presented at Commsphere and other URSI-sponsored conferences.

CO-ORDINATING COMMITTEE

Summary Report

The Resolutions and Recommendations adopted by the URSI Commissions are reproduced at the end of this volume.

The Co-ordinating Committee met on two occasions, on Saturday 14 August (from 2 to 6.30 p.m.), before the official opening of the General Assembly, and on Saturday 21 August (from 3 to 6.30 p.m.). Professor K.G. Balmain, representing the Canadian Organising Committee, attended the first of these meetings.

First Co-ordinating Committee meeting

Terms of reference of URSI Commissions

The "Terms of Reference" of each Commission were distributed prior to the meeting. The Commissions were asked to review and, if appropriate, to update their terms of reference according to developments in recent years.

Election of Commission Vice-Chairs

In order to attract a higher number of candidates for the position of Commission Vice-Chair, the President proposed that each Commission would establish an ad hoc nominating committee. This committee should come up with a list of candidates, in parallel to the nominations deriving from the Member Committees. Out of these candidates, a limited number would be selected in a first round. This proposal was discussed at the business meetings of the Commissions, but eventually turned down.

Every Commission must nominate 2 or 3 people for election. Each Commission is free to use its own procedure to obtain nominations, as long as the Official Members (national representatives) can give input and are involved. At the General Assembly each Commission organises its own election process and presents to Council the names of the elected Vice-Chair and the first runner-up. Council may wish to change the ranking for reasons of better geographical spreading of the candidates.

Responsibilities of Commission Chairs and Vice-Chairs

A text describing the responsibilities of the Commission Chairs and Vice-Chairs was distributed prior to the meeting and could be discussed at the Business Meetings.

Publications

Each Commission was asked to nominate an editor for the *Review of Radio Science* and an associate editor for the *Radio Science Bulletin* in order to increase the number of scientific contributions.

Future General Assemblies

Each Commission was asked to give feedback on the format of the current General Assembly. The overall majority of the Commissions were in favour of this new format.

Overview of the Scientific Programme

Dr. J. Hamelin presented an overview of the Scientific Programme of the Toronto General Assembly. The report was distributed at the meeting.

During the meeting, it was agreed to stick to the original timetable using 20 minutes time slots, even when papers would not be presented. The blank time slots could be filled with extra discussions.

The Local Organising Committee was asked to provide “notice-boards” outside the session rooms and if possible also overhead transparencies with the programme of each session. A questionnaire was distributed to all convenors at the beginning of each session.

Scientific Reports on the General Assembly

The deadline for submission of the reports about the business transacted at the General Assembly by the Commissions was set on 1 November 1999. An example was provided, the incoming Commission Chairs should prepare this report.

Young Scientist Programme at the Toronto General Assembly

Since the Prague General Assembly at least 100 Young Scientists were supported at each General Assembly. In the past considerable financial support were obtained for this programme from external sources, but in Toronto only a very small fraction of the total cost was carried by external sources. As the total cost of the programme equals the support to all Commissions during a triennium, the new Board is requested to look into this.

Second Co-ordinating Committee meeting

All Commissions reported on the outcome of the discussions at their Business Meetings and on their scientific sessions.

Attendance at the Scientific Sessions:

The results of the questionnaire, distributed to all session chairs, was not yet complete, but preliminary results showed that about 10% of all oral papers and about 15% of all posters did not show up. Authors of the no-show papers were mainly from the former Soviet Union and from China. A suggestion made by Dr. W.R. Stone to request that at least one author should be registered before including a paper in the proceedings, was found too difficult to implement. A brief article in *the Radio Science Bulletin* emphasising the importance to attend the meeting, might be useful.

Use of fixed time-slots for paper presentations:

Probable no-shows could be put toward the end of the scientific sessions, in order not to

leave too many blank spots in the programme. Gaps created during the sessions by no-shows should be filled up by the convenors by organising extra discussions or by asking some authors to present their posters.

Scientific sessions on Saturday morning:

As differences in opinion existed among the Commissions, it was left up to the Commissions to use the time-slots available on Saturday morning for scientific sessions.

Book of Abstracts

Following a recommendation by the Standing Committee on Publications, the current *Book of Abstracts* will be replaced by a CD-ROM containing 2-4 page summaries, except for Commission H where a 1-page summary will be used. A printed version will be made available to libraries. Part of the 2-4 page summary will be a 100-word abstract, which will be made available, in printed version, at the General Assembly.

The longer summaries will allow a better selection process. Electronic submission will be encouraged and the submitted papers will be made electronically available (via FTP) for reviewing. To maintain a certain standard of quality and because it is not possible to edit the submitted summaries, papers written in very bad English (or French) will be rejected.

Timetable

A timetable for the definition of the scientific programme of the 2002 General Assembly will be proposed for discussion within 1 year. The following dates are therefore tentative:

- 10/2000: The Co-ordinator of the Scientific Programme invites the Commission Chairs to define the programme and the sessions.
- 01/2001: The Commission Chairs invite the convenors and these are provided with titles and length of the different sessions.
- 03/2001: The convenors confirm their acceptance to the Commission Chairs
- 03/2001: The Commission Chairs provide the Co-ordinator of the Scientific Programme with the titles of the sessions and the co-ordinates of all convenors.
- 04/2001: The convenors provide the Commission Chairs with a draft of the "Call for Papers"
- 04/2001: Meeting of the Co-ordinating Committee for discussion on the "Final Call for Papers" and on the tutorials.

This timetable is open for comments from all Commission Chairs and should be adapted to local arrangements if electronic submission is required.

When defining the final programme, the Commission Chairs should try to avoid joint sessions clashing with specific sessions from the same Commissions. The Scientific Committee on Telecommunications will collaborate in the definition of the final programme by suggesting themes and possibly joint sessions in the area of telecommunications.

Commission H proposes to introduce all encompassing Union Sessions. A General Lecture

on a topic as “solar space power station” could be of interest. It was generally felt that all General Lectures and the Tutorials could be held in the same room.

Guidelines for Commission Chairs and Vice-Chairs

- All Chairs and Vice-Chairs should consult the URSI Homepage (<http://www.intec.rug.ac.be/ursi>) and report any changes that might be required, e.g. with respect to addresses.
- The triennial budget for each Commission was set at 9,000 Euro. It is advisable that the Commission should focus on a few events only and not spread the budget over a large number of events. It is important to note that the URSI Secretariat requests receipts for all support given by the Commissions. The money can only be used for support of Young Scientists and/or to cover travel expenses of key speakers. Certain flexibility is given to use the support to waive registration fees. Exceptions to these rules must be discussed with the Secretary General before the beginning of the meeting.
- When organising an URSI conference, participants should be encouraged to become URSI Correspondents. At this moment participants to URSI conferences other than the General Assembly do not automatically become URSI Correspondents.

Scientific Committee on Telecommunications

Prof. GLucas was nominated to serve on the Scientific Committee on Telecommunications. The Commissions were invited to send their nominations to the URSI Secretariat or to Prof. P. Delogne by the end of October 1999. Prof. P. Delogne asked to nominate persons who would be interested to serve on this Committee.

TREASURER'S REPORT ON URSI FINANCES

The general position of the finances of URSI is at present satisfactory but is critically dependent in the long-term on a sufficient contribution from General Assemblies.

In part the satisfactory position overall arises from the expansion of our asset base due to the strength of the financial markets over the last triennium. It would be imprudent for my successor to assume that the market value of our assets will run ahead of inflation indefinitely.

The balance between expenditure and income is critically dependent on the income from General Assemblies more than the Member contribution (which is generally paid for by National Academies of Member committees). There is evidence that the Member Due income may well decline in the future which emphasises the importance of the General Assembly contribution.

The final out-turn following the 1996 GA in Lille was satisfactory but I would strongly recommend to Council that they examine the budget offered for future General Assemblies to ensure that there will be a sufficient return to URSI otherwise on the longer term URSI will be unable to support the range of activities which are current e.g. support to Commissions at the present level, support for Commsphere, support for the YS programme, etc.

As an example of the unforeseen, for the 1999 GA, URSI is required to make a much larger contribution to the Young Scientist Programme than appeared in the budget because other expected sources of support failed in the end but only after URSI had entered a commitment to the Young Scientists.

Before I conclude, I should like to thank the Secretary General, the Assistant Secretary General and Inge Heleu for their substantial help to me during the six years of my Treasurership of URSI and to ask them to convey to the Ghent University our appreciation of the support to URSI which is received from the Department of Information Technology. We also owe a substantial debt to Ross Stone for the enormous effort he provides in order to bring us the Review of Radio Science and to Piotr Sobieski and Paul Delogne for their contribution to the Radio Science Bulletin. Of course there are others whose contributions, which are given freely to URSI, make it possible to provide a significant service to delegates to a General Assembly, without an additional increase in the Registration Fee.

Finally, as our Secretary General has day-to-day responsibility for the financial affairs of our Union I hereby ask him to present the accounts for the period 1996-1998.

**INTERNATIONAL UNION OF RADIO SCIENCE (URSI)
BALANCE SHEET : 31 DECEMBER 1996**

ASSETS	US\$	
<i>Dollars</i>		
Merrill Lynch WCMA	4,921.02	
Générale de Banque	53,794.62	
Smith Barney Shearson	663.18	
		59,378.82
<i>Belgian francs</i>		
Banque Degroof	8,086.03	
Générale de Banque	41,155.25	
		49,241.28
<i>Investments</i>		
Demeter Sicav shares	22,794.75	
Rorento Units	111,084.59	
Aqua Sicav	64,103.22	
Merrill-Lynch Short Term	24,046.99	
Smith Barney Utilities Fund	81,764.00	
Reinvestment S.B. Utilities	20,851.90	
Smith Barney Grade Bond	49,300.00	
Reinvestment S.B. Grade Bond	14,395.20	
355 Rorento units on behalf of van der Pol Fund	12,950.41	
		401,291.06
<i>Other</i>		
Petty cash		520.72
Total Assets		<u>510,431.88</u>
<i>Less creditors</i>		
IUCAF	16,599.15	
ISES	6,349.59	
FAGS	2,000.00	
Radio Science Press	124.26	
Audit fees	1,875.00	
		-26,948.00
Balthasar van der Pol Medal Fund (1)		-12,950.40
NET TOTAL OF URSI ASSETS		<u>470,533.48</u>

The net URSI Assets are represented by :	US\$	
<i>Closure of Secretariat :</i>		
Provision for Closure of Secretariat	40,000.00	
<i>Scientific Activities Fund :</i>		
Scientific Activities in 1997	80,000.00	
Publications in 1997	60,000.00	
Young Scientists in 1997	10,000.00	
Administration Fund in 1997	80,000.00	
I.C.S.U. Dues in 1997	10,000.00	
		240,000.00
<i>XXIV General Assembly Fund :</i>		
During 1997 :	0.00	
Total allocated URSI Assets		280,000.00
Unallocated Reserve Fund		190,533.48
		<hr/> 470,533.48

**Statement of Income and Expenditure
for the year ended 31 December 1996**

I. INCOME	US\$	
Grant from ICSU Fund and Special Contributions	300.00	
Allocation from UNESCO Subvention to ICSU	20,500.00	
UNESCO Contracts	0.00	
Contributions from National Members	185,781.19	
Contributions from Other Members	0.00	
Special Contributions	7,519.06	
Contracts	0.00	
Sales of Publications, Royalties	0.00	
Sales of scientific materials	0.00	
Bank Interest	3,567.33	
Gain on Exchange	0.00	
Other Income	19,858.62	
		237,526.20

II. EXPENDITURE		
<i>a1) Scientific Activities</i>		221,343.56
General Assembly 1996	211,737.59	
Scientific meetings: Symposia/Colloquia	7,103.78	
Working Groups/Training Courses	0.00	
Representation at scientific meetings	2,502.19	
Data Gather/Processing	0.00	
Research Projects	0.00	
Grants to Individuals/Organizations	0.00	
Other	0.00	
Less covered by UNESCO Contracts	0.00	
 <i>a2) Routine Meetings</i>		 26,063.53
Bureau/Executive committee	26,063.53	
Other	0	
 <i>a3) Publications</i>		 40,315.26
 <i>5 b) Other Activities</i>		 11,762.00
Contribution to ICSU	7,762.00	
Contribution to other ICSU bodies	4,000.00	
Activities covered by UNESCO Contracts	0.00	
 <i>c) Administrative Expenses</i>		 82,666.35
Salaries, Related Charges	57,679.41	
General Office Expenses	12,382.36	
Office Equipment	3,473.03	
Audit Fees	1,758.28	
Bank Charges	2,866.88	
Loss on Exchange	4,506.39	
		<hr/> 382,150.70
 Excess of Income over Expenditure		 -144,624.50
Accumulated Balance at 1 January 1996		615,157.98
		<hr/> 470,533.48
Accumulated Balance at 31 December 1996		

Rates of exchange :

1 January 1996	\$1 = 29.5 BEF
31 December 1996:	\$1 = 30.0 BEF

Observation :

The account indicated with (1) is represented by :

355 Rorento Shares : market value on 31 December 1996	19,280.72
(Acquisition value : US\$ 12,950.41)	

Market value of investments on December 31, 1996 (\$1 = 32.00 BF) :

- DEMETER SICAV :	45,486.38	
- RORENTO UNITS (2) :	396,335.40	
- AQUA-SICAV :	79,935.22	
- M-L SHORT TERM :	20,462.00	
- SMITH BARNEY UTIL. :	101,467.98	
- SMITH BARNEY GRADE :	62,795.62	
		706,482.59

(2) including the 355 Rorento of v. d. Pol Fund

APPENDIX

Detail of Income and Expenditure

I. INCOME	US\$	
<i>Special Contributions for General Assembly Lille</i>		
UK Royal Society (Support YS Programme)	1,451.56	
Japanese URSI Committee (Support YS Programme)	4,000.00	
European Space Agency (Preparatrimon Technical Sessions)	2,067.50	
		7,519.06
<i>Other Income</i>		
Return "Loan to ISSSE'95"	5,000.00	
Interest on Smith Barney Utilities Fund	6,258.60	
Interest on Smith Barney Grade Bond	3,417.14	
Sale of ML Short Term	5,135.00	
Sale of URSI ties	47.88	
		19,858.62

II. EXPENDITURE

General Assembly 1996

Organization	18,779.84	
Scientific activities - officials	70,021.71	
Scientific activities - others	27,263.73	
Young Scientists	41,328.97	
MRS/RRS	54,343.34	
		211,737.59
<i>Symposia/Colloquia/Working Groups :</i>		
URSI 75th Anniversary (remaining expenses)	1,018.84	
NATO ASI-meeting "New Directions	1,500.00	
CLIMPARA'96	1,984.94	
COSPAR Scientific Assembly	700.00	
High Sensitivity Radio Astronomy	900.00	
IAU-164: Galactic and Extra-Galactic	1,000.00	
		7,103.78
<i>Contribution to other ICSU bodies</i>		
FAGS	2,000.00	
IUCAF	2,000.00	
		4,000.00
<i>Publications :</i>		
Printing of <i>The Radio Science Bulletin</i>	18,421.13	
Mailing of <i>The Radio Science Bulletin</i>	13,204.28	
Electronic publications & WWW	8,129.69	
Printing of New Correspondents Cards	560.16	
		40,315.26

**INTERNATIONAL UNION OF RADIO SCIENCE (URSI)
BALANCE SHEET : 31 DECEMBER 1997**

ASSETS	BEF	US\$
<i>Dollars</i>		
Merrill Lynch WCMA	5,717.25	
Générale de Banque	15,024.96	
Smith Barney Shearson	643.93	
		21,386.14
<i>Belgian francs</i>		
Banque Degroof	6,375.93	
Générale de Banque	143,973.47	
		150,349.40
<i>Investments</i>		
Demeter Sicav shares	22,794.75	
Rorento Units	111,084.59	
Aqua Sicav	64,103.22	
Merrill-Lynch Short Term (1320 units)	12,115.28	
Smith Barney Utilities Fund	81,764.00	
Reinvestment S.B. Utilities	29,380.79	
Smith Barney Grade Bond	49,300.00	
Reinvestment S.B. Grade Bond	<u>19,250.23</u>	
	389,792.86	
355 Rorento units on behalf of van der Pol Fund	12,950.41	
		402,743.27
<i>Other</i>		
Petty cash		1,162.68
Total Assets		<u>575,641.49</u>
<i>Less creditors</i>		
IUCAF	4,487.71	
ISES	6,087.09	
		-10,574.80
Balthasar van der Pol Medal Fund (1)		-12,950.41
NET TOTAL OF URSI ASSETS		<u>552,116.29</u>

The net URSI Assets are represented by :		US\$
<i>Closure of Secretariat :</i>		
Provision for Closure of Secretariat		45,000.00
<i>Scientific Activities Fund :</i>		
Scientific Activities in 1998	80,000.00	
Publications in 1998	60,000.00	
Young Scientists in 1998	10,000.00	
Administration Fund in 1998	80,000.00	
I.C.S.U. Dues in 1998	10,000.00	
		240,000.00
<i>XXIV General Assembly Fund :</i>		
During 1998 :		40,000.00
Total allocated URSI Assets		325,000.00
Unallocated Reserve Fund		227,116.29
		552,116.29

**Statement of Income and Expenditure
for the year ended 31 December 1997**

I. INCOME		US\$
Grant from ICSU Fund and Special Contributions	9,000.00	
Allocation from UNESCO Subvention to ICSU	10,000.00	
UNESCO Contracts	0.00	
Contributions from National Members	146,153.88	
Contributions from Other Members	0.00	
Special Contributions	1,170.35	
Contracts	0.00	
Sales of Publications, Royalties	13.55	
Sales of scientific materials	0.00	
Bank Interest	1,212.22	
Gain on Exchange	0.00	
Other Income	94,973.21	
Total Income:		262,523.21

II. EXPENDITURE		
a1) Scientific Activities		50,437.35
General Assembly 1996	6,832.46	
Scientific meetings: Symposia/Colloquia	36,022.85	
Working Groups/Training Courses	0.00	
Representation at scientific meetings	1,582.04	
Data Gather/Processing	0.00	
Research Projects	0.00	
Grants to Individuals/Organizations	6,000.00	
Other	0.00	
Less covered by UNESCO Contracts	0.00	
a2) Routine Meetings		13,145.76
Bureau/Executive committee	13,145.76	
Other	0	
a3) Publications		31,893.71
b) Other Activities		14,102.00
Contribution to ICSU	8,102.00	
Contribution to other ICSU bodies	6,000.00	
Activities covered by UNESCO Contracts	0.00	
c) Administrative Expenses		71,361.58
Salaries, Related Charges	47,459.38	
General Office Expenses	4,126.67	
Office Equipment	1,915.20	
Audit Fees	1,803.52	
Bank Charges	2,288.25	
Loss on Exchange	13,768.56	
Total Expenditure :		180,940.40
Excess of Income over Expenditure		81,582.81
Accumulated Balance at 1 January 1997		<u>470,533.48</u>
Accumulated Balance at 31 December 1997		552,116.29
Rates of exchange :		
1 January 1997: \$1 = 32.00 BEF		
31 December 1997: \$1 = 36.90 BEF		

Observation :

The account indicated with (1) is represented by :

355 Rorento Shares : market value on 31 December 1997 = \$21,305.80
(Acquisition value : US\$ 12,950.41)

Market value of investments on December 31, 1997 (\$1 = 36.90 BF) :

- DEMETER SICAV :	43,379.35	
- RORENTO UNITS (2) :	390,106.12	
- AQUA-SICAV :	71,236.29	
- M-L SHORT TERM :	10,145.00	
- SMITH BARNEY UTIL. :	121,090.22	
- SMITH BARNEY GRADE :	72,450.78	
		708,407.76

(2) including the 355 Rorento of v. d. Pol Fund

APPENDIX

Detail of Income and Expenditure

I. INCOME

US\$

Special Contributions

Commonwealth Science Council	1,170.35	
Support YS Programme URSI GALille		1,170.35

Other Income

Revenue Lille General Assembly	71,430.54	
Interest on Smith Barney Utilities Fund	8,528.89	
Interest on Smith Barney Grade Bond	4,855.03	
Sale of ML Short Term	10,062.00	
Reimbursement bank charges	96.75	
		94,973.21

II. EXPENDITURE

General Assembly 1996

Organization	68.56	
Scientific activities - officials	1,846.80	
Scientific activities - others	500.22	
Printing Proceedings	2,905.88	
Correspondents Cards (Printing + Mailing)	1,511.00	
		6,832.46

<i>Symposia/Colloquia/Working Groups :</i>		
Commission A	6,480.00	
Commission B	0.00	
Commission C	4,000.00	
Commission D	0.00	
Commission E	4,000.00	
Commission F	7,586.18	
Commission G	3,756.67	
Commission H	4,200.00	
Commission J	0.00	
Commission K	6,000.00	
Other	0.00	
		36,022.85
 <i>Grants to Individuals/Organizations</i>		
ICTP-ITU-URSI	6,000.00	
		6,000.00
 <i>Contribution to other ICSU bodies</i>		
FAGS (96 + 97)	4,000.00	
IUCAF (97)	2,000.00	
		6,000.00
 <i>Publications :</i>		
Printing "The Radio Science Bulletin"	15,540.27	
Mailing "The Radio Science Bulletin"	14,702.30	
Transfert of income ('96) on publications on behalf of Radio Science Press	107.75	
Electronic publications & WWW	1,520.49	
Printing New Correspondents Cards	22.90	
		31,893.71

BALANCE SHEET : 31 DECEMBER 1998

ASSETS	US\$	US\$	EURO	EURO
<i>Dollars</i>				
Merrill Lynch WCMA	2,919.46		2,501.88	
Generale Bank	26,126.05		22,389.19	
Smith Barney Shearson	183.44		157.20	
		29,228.95		25,048.27
<i>Belgian francs</i>				
Banque Degroof	5,792.39		4,963.89	
Generale Bank	193,706.62		166,000.36	
		199,499.02		170,964.26
<i>Canadian dollars</i>				
Generale Bank	3,262.99		2,796.28	
		3,262.99		2,796.28
<i>French Francs</i>				
Generale Bank	385.31		330,20	
		385.31		330,20
<i>Investments</i>				
Demeter Sicav shares	22,794.75		19,534.37	
Rorento Units	111,084.59		95,195.93	
Aqua Sicav 64,103.22		54,934.40		
Merrill-Lynch Short Term	12,115.28		10,382.41	
Massachusetts Investor Fund	207,247.52		177,604.48	
Reinvestment Massachusetts				
Investor Fund '98	19,716.60		16,896.49	
355 Rorento units on behalf of van der Pol Fund	12,950.41		11,098.08	
		450,012.36		385,646.16
<i>Other</i>				
Petty cash	1,517.41		1,300.38	
Total Assets		683,906.04		586,085.53
<i>Less creditors</i>				
IUCAF	13,665.31		11,710.73	
ISES		5,835.09		5,000.48
		-19,500.40		-16,711.22
Balthasar van der Pol Medal Fund (1)		-12,950.41		-11,098.08
NET TOTAL OF URSI ASSETS		651,455.23		558,276.23

The net URSI Assets are represented by :

Closure of Secretariat :

Provision for Closure of Secretariat	50,000.00	42,848.40
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Scientific Activities Fund :

Scientific Activities in 1999	90,000.00	77,127.11
Publications in 1999	60,000.00	51,418.07
Young Scientists in 1999	50,000.00	42,848.40
Administration Fund in 1999	80,000.00	68,557.43
I.C.S.U. Dues in 1999	15,000.00	12,854.52

	295,000.00	252,805.53
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XXIV General Assembly Fund :

During 1999 :	100,000.00	85,696.79
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Total allocated URSI Assets	445,000.00	381,350.72
Unallocated Reserve Fund	206,455.23	176,925.51
	651,455.23	558,276.23

Statement of Income and Expenditure for the year ended 31 December 1998

I. INCOME	US\$	US\$	EURO	EURO
Grant from ICSU/UNESCO Fund	15,000.00		12,854.52	
UNESCO Contracts	0.00		0.00	
Contributions National Members	186,593.74		159,904.85	
Contributions Other Members	0.00		0.00	
Special Contributions	0.00		0.00	
Contracts	0.00		0.00	
Sales of Publications, Royalties	201.98		173.09	
Sales of scientific materials	0.00		0.00	
Bank Interest	29,379.03		25,176.89	
Gain on Exchange	11,115.73		9,525.82	
Other Income	24,987.77		21,413.72	
Total Income:		267,278.25		229,048.88
II. EXPENDITURE				
<i>a1) Scientific Activities</i>		35,055.27		30,041.24
General Assembly 1996	49.29		42.24	
Scientific meetings	34,681.39		29,720.84	
Working Groups/Training Courses	0.00		0.00	

	US\$	US\$	EURO	EURO
Representation at scientific meetings	324.59		278.16	
Data Gather/Processing	0.00		0.00	
Research Projects	0.00		0.00	
Grants to Individuals/Organizations	0.00		0.00	
Other	0.00		0.00	
Less covered by UNESCO Contracts	0.00		0.00	
<i>a2) Routine Meetings</i>		38,262.63		32,789.85
Bureau/Executive committee	38,262.63		32,789.85	
Other	0.00		0.00	
<i>a3) Publications</i>		22,179.20		19,006.86
<i>b) Other Activities</i>		10,426.00		8,934.75
Contribution to ICSU	8,426.00		7,220.81	
Contribution to other ICSU bodies	2,000.00		1,713.94	
Activities covered by UNESCO Contracts	0.00		0.00	
<i>c) Administrative Expenses</i>		62,016.21		53,145.90
Salaries, Related Charges	46,369.05		39,736.79	
General Office Expenses	6,092.07		5,220.71	
Office Equipment	4,335.20		3,715.13	
Audit Fees 2,191.24		1,877.82		
Bank Charges	3,028.65		2,595.46	
Loss on Exchange	0.00		0.00	
Total Expenditure :		167,939.31		143,918.60
Excess of Income over Expenditure		99,338.94		85,130.28
Accumulated Balance at 1 January 1998		552,116.29		473,145.95
Accumulated Balance at 31 December 1998		651,455.23		558,276.23

Rates of exchange :

1 January 1998 \$1 = BEF 36.90 = 0.914727 EUR = CAD 1.42 = FRF 5.99

31 December 1998: \$1 = BEF 34.57 = 0.856968 EUR = CAD 1.54 = FRF 5.62

Observation :

The account indicated with (1) is represented by :

355 Rorento Shares : market value on 31 December 1998 = \$24,644.12 = EUR 21,119.22

(Acquisition value : US\$ 12,950.41)

Market value investments December 31, 1998 (\$1 = 34.57 BEF) :

	US\$	US\$	EURO	EURO
Demeter Sicav :	51,047.38		43,745.97	
Rorento Units (2) :	451,230.32		386,689.90	
Aqua-sicav :	78,451.03		67,230.01	
M-1 Short Term :	10,190.00		8,732.50	
Massachusetts Investor Fund :	244,116.60		209,200.09	
		835,035.32		715,598.48

(2) including the 355 Rorento of v. d. Pol Fund

APPENDIX : Detail of Income and Expenditure

I. INCOME	US\$	US\$	EURO	EURO
Other Income				
Sale of Smith Barney Utilities Fund	13,983.94		11,983.79	
Sale of Smith Barney Grade Bond	6,590.27		5,647.65	
Reimbursement Travel expenses	515.16		441.48	
Reimbursement URSI Support of Cancelled Meetings	3,898.40		3,340.80	
		24,987.77		21,413.72
II. EXPENDITURE				
General Assembly 1996				
Correspondents Cards (Printing + Mailing)	49.29		42.24	
		49.29		42.24
Symposia/Colloquia/Working Groups :				
Commission A	2,053.80		1,760.04	
Commission B	9,550.00		8,184.04	
Commission C	4,234.89		3,629.16	
Commission D	4,234.89		3,629.16	
Commission E	2,169.51		1,859.20	
Commission F	3,019.96		2,588.01	
Commission G	1,600.00		1,371.15	
Commission H	0.00		0.00	
Commission J	0.00		0.00	
Commission K	3,310.96		2,837.39	
Other	4,507.38		3,862.68	
		34,681.39		29,720.84
Contribution to other ICSU bodies				
IUCAF (98)	2,000.00		1,713.94	
		2,000.00		1,713.94
Publications :				
Printing The Radio Science Bulletin	9,281.57		7,954.01	
Mailing The Radio Science Bulletin	12,897.63		11,052.86	
		22,179.20		19,006.86

XXVIth General Assembly, Toronto, Canada, 13 - 21 August 1999

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REPORTS OF AD HOC AND STANDING COMMITTEES

STANDING FINANCE COMMITTEE

Accounts for the years 1996 – 1998

The Standing Finance Committee has examined the accounts for the last three years as submitted by the Secretary General. The accounts were audited by Rahier-Van Poyer, Brussels.

The Committee felt that the financial matters were professionally handled during these years and noted that URSI has a very healthy financial basis.

The following items are specifically important:

- The administrative expenses decreased by about 25 % from 1996 to 1998. According to the Secretary General this was mainly achieved, because the extra man power which had been hired for organising the GA 1996 was not necessary after 1996. The reduction is nevertheless acknowledged, since the trend is opposite to many other organisations where administrative expenses increase.
- The total assets (bank accounts and investments) have increased by about 34 % from 1996 to 1998. This is very remarkable despite of the fact that the currency conversion is variable which affects the balance every year. Most of this increase is due to high stock market returns during the past few years.
- The total assets at the end of 1998 amounted to about the total expenses for the 3 years 1996-1998. The quotient of reserves/(annual running costs) of 1.5 recommended by ICSU is therefore considerably exceeded (see also next section). In fact this quotient would be even higher if the market value of the investments is taken as basis. In the audits the value was assumed to be the buying price. With the market value on 31. Dec. 1998 the quotient would be about 3.8.

Financial plan for the next 6 years

We received the planned budget for the years 1998 – 2003 from the Secretary General. The figures are in EUROS which is logical considering the forthcoming unification of European currencies. A triennium in these plans is somewhat different than usually defined within URSI: it is centred on the years with a GA (1999, 2002) which makes sense, since the expenses peak in these years.

Regarding these budget estimates:

- It was assumed in the budget plan that the main income, namely the dues from member countries (about 70% in 1998) will not increase during the following years. This is probably realistic, since an increase cannot be expected.
- About 6% of the income in 1998 was from ICSU grants. Grants from URSI to ICSU organisations was about the same amount. The situation will worsen in the future since grants by ICSU will be eliminated.
- A major part of the expected income is based on revenues from future General Assemblies. In the triennium 1998-2000 it was assumed that the Toronto GA would contribute about 8% of the total income. In 2001-2003, taking the provided estimates for Hamburg as location of the 2002-GA (not yet decided), an income of 24% was assumed. We believe that 24% is difficult to attain.
- The income from bank interests and dividends (1.7% of the total income in 1998) was assumed to remain constant for the following six years. This is a very conservative assumption.
- With respect to the past triennium 1995-1997 the expected total income for 1998-2000 is about 20% lower, and the expected total expenditure is expected to be about 16% lower. Thus the reserves would be reduced in the coming years.
- Despite of the higher revenue from the 2002-GA as mentioned above, the projected expenditure in the triennium 2001-2003 exceeds the expected income. At the end of 2003 the assets (on the base of the 1998 audit) will therefore be reduced by about 17%. The quotient of reserves/(annual running costs), based on the expected average yearly expenditure in 2001-2003, will therefore fall to about 2 at the end of 2003. This is still higher than recommended by ISCU (and even higher if the market value of the assets is taken into account, see above).
- The budget recommends that the Young Scientists Awards enabling young colleagues to attend the GA will be raised from about 11% of the total expenditure in 1996 to about 15% in 1999 and 2002. We concur with this recommendation.

Conclusion and recommendations

The budget plan for 1999-2003 seems to be solid and realistic. It is based on the long experience mainly of the Secretary General. With respect to income it is very conservative and cautious. The expenditures include a moderate increase, resulting in losses in the coming 6 years. These expected losses can be well compensated by the high reserves, so that URSI finances will remain healthy.

We recommend that the unit contributions should remain unchanged.

Although the amount for the Young Scientists Awards has been increased in the budget plan for the coming years, a further increase is recommended. An increase to 20% in 2002 would reduce the reserves only marginally and decrease the quotient of reserves/(annual running costs) to about 1.9 at the end of 2003. This is still completely sufficient. URSI is not supposed to earn money, but to promote radio sciences. One of the best way

to accomplish this is to support the next generation of scientists. Increasing the funds for Young Scientists Awards would be a step in this direction.

Prof. Dr. K. Schlegel (Chair)
Dr. L. Nagy
Prof. Dr. S.M. Radicella
Prof. Dr. F.W. Sluijter
Dr. W.W.L. Taylor

LONG RANGE PLANNING COMMITTEE

The meetings of the Long Range Planning Committee concentrated especially on the subject of whether or not URSI needed a conference similar to the Corsendonk Conference. As a result of these meetings the Board decided to hold the Strategy Meeting, in Toronto, just prior to the Co-ordinating and Board meetings in 1998.

Most of the Commission Chairs (and/or Vice Chairs) were present, together with the Board members and some additional participants from the Long Range Planning Committee. A very intensive discussion was held and its detailed Minutes are available on the URSI Homepage at url <http://www.intec.rug.ac.be/ursi/fulstrat.htm>. The following is a summary of the intensive discussion associated with each agenda item, which we hope may be useful as a digest. This summary was published in the March 99 issue of the Radio Science Bulletin.

Introduction

Prof. Sagi Chair of the Electrical Engineering Department of the University of Toronto welcomed the attendees of the URSI Strategy Meeting. URSI President Tom Senior briefly reviewed the purpose of URSI. He outlined significant changes in URSI's organisation and operations, as well as examples of URSI's outreach, over the past decade. Hiroshi Matsumoto, Chair of the Long Range Planning Committee, then reviewed how the Strategy Meeting came to be and its purpose.

Relations with ICSU and other Unions

The relationship between URSI and ICSU was summarised. Recent changes in ICSU's organisation make it probable that the financial support of ICSU for URSI will be reduced, and it will remain difficult for URSI to have a major role in ICSU. ICSU-grant money will be given to focused programs, rather than to the scientific unions. It thus may be available to URSI, but URSI will have to bid and compete for it.

- The major way URSI currently interacts with other scientific unions is through inter-union scientific bodies such as COSPAR, SCOSTEP, IUCAF and FAGS, involving many individual Commission members.

- It was noted that while financial support from many nations for scientific unions is declining, support for ICSU has remained strong. This is in part due to the fact that the national organisations supplying the money are members of ICSU, but not of the scientific unions.

Relations with ITU

- URSI has long-standing ties with the ITU, although lately, these have been less successful. The ITU has changed, and is now primarily responsive to commercial interests and industrial members, most of which have no interest in URSI.
- URSI needs to collaborate with the ITU through such forums as COMMSPPHERE and the Working Group chaired by Paul Delogne, and through individuals who are active in both the ITU and URSI.
- Our objective should not be the ITU, but the problem that the ITU is trying to solve: how to develop communication in a more effective way. Our role should be to protect science.
- In addition to continuation of symposia and discussion forums with the ITU, we should encourage the holding of joint sessions with the ITU, and involving ITU people within URSI.

Relations with Standardisation Bodies

- URSI is currently not directly involved in creating standards. However, there are opportunities where international leadership is needed, and URSI could have a significant impact. Standards for human exposure to EM fields is an example of an area needing such leadership.
- Although modest funding would be needed to support such an effort within URSI, it should be possible to solicit such funding from member countries and industry. ICSU might also support such an effort.
- Although URSI cannot set standards, it can create them, with sound scientific basis, for adoption by national and trans-national bodies. This could be of particular value for countries that do not have the resources to develop such standards on their own.

Relations with Professional Societies

- URSI deals with ICSU and the UN, and countries are its Members. Professional societies typically deal with a particular field, and individuals are their members. URSI's technical fields are typically much broader than those of professional societies.
- However, URSI and professional societies have common aspects: the individuals involved; conferences; publications; and the ultimate "customers," the users of their science.
- In looking at the technical-interest overlap between URSI and the IEEE, all Commissions except for J have overlap with multiple IEEE Societies. Commissions A through H have overlap with at least four Societies; some overlap with as many as

10 IEEE Societies. The IEEE Aerospace and Electronic Systems, Antennas and Propagation (AP-S), Communications, Geoscience and Remote Sensing, and Microwave Theory and Techniques Societies each have overlap with four or more URSI Commissions. AP-S has overlap with all URSI Commissions but Commission C.

- Mechanisms for co-operation between URSI and professional societies include joint conferences (the long-standing and highly successful joint IEEE AP-S/USNC/URSI meetings are a possible model), and joint publications. In addition to advantages for scientific exchange, joint conferences can be a source of very significant revenue for URSI (e.g., \$50-\$80K per meeting to the USNC/URSI from the joint meetings).

Relations with Industry and General Public

- One method of outreach in this area is through conferences: COMMSPHERE is an example.
- The LRP needs to address some questions: Should industry be an URSI customer? If so, how does URSI serve industry, and what does URSI get from industry in return?
- Several examples of successful industrial support of scientific organisations—without the organisations becoming controlled or dominated by industry—were cited.
- URSI's outreach to the general public should be through industry and individuals. Several examples of successful outreach by similar organisations were given, including educational programs and public scientific lectures. The need for more effective representation in the press was identified.

Finance and Membership

- For 1995-97, URSI had a deficit from operations of about 10%, or \$70K, covered by selling assets. The University of Gent's donation of many resources to the Secretariat helped minimise the deficit.
- URSI's revenue could be substantially increased by raising registration fees at meetings: they are much lower than similar meetings, and usually paid by attendee's organisations.
- To increase revenue and reduce loss, URSI should insure that future General Assemblies are organised to provide a certain return to URSI. This would probably require shifting at least some responsibility for the GA from the host country to URSI, and that implies additional needed functions within URSI. The AP-S/USNC/URSI model was cited as one way to do this.

Awards

- URSI currently has four awards : the Balthasar van der Pol Gold Medal, the John Howard Dellinger Gold Medal, the Appleton Prize and the Issac Koga Gold Medal. There are also the Young Scientist Awards. The scope of the Appleton Prize will probably need to be broadened.

- The possibility of establishing the position of URSI Fellow was discussed, with many opinions expressed. The idea was favoured by a slight majority.

The General Assembly

- It was felt that General Assemblies should have at least one, and perhaps more, themes.
- There are both pros and cons to attempting to focus the number of topics and to reducing the number of sessions at the General Assembly.

URSI Publications

- The Review of Radio Science (RRS) and the Disk (together, "RRS") continue to be technical successes, and valued by the URSI community. However, the hoped-for breadth of distribution outside of URSI has yet to be realised.
- Oxford University Press has reorganised its science and engineering publishing functions. Although it will publish RRS and Modern Radio Science (MRS) in 1999 as planned, the future is somewhat uncertain. As an alternative if needed, the IEEE Press is willing to publish these.
- In order to achieve wider distribution, the IEEE Press has agreed to purchase and sell a minimum of 200 copies of the 1999 versions of RRS and MRS.
- There was strong agreement that starting with the 1999-2002 triennium, MRS should be discontinued, and the lectures making up MRS should be published in The Radio Science Bulletin. Also, the Disk should become a CD-ROM.

General discussion

- There was strong agreement that the Strategy Meeting was extremely valuable, and should be held on a regular basis, perhaps once between General Assemblies and once in connection with the General Assembly.
- The need for a balance between Commission and national membership in URSI was discussed. Since URSI is a delegation of national academies, if there is no national activity, then it should be our goal to revitalise national activities in URSI.
- Although there are many implications that need to be considered, the possibility of holding one-week-long General Assemblies every two years met with significant support.

H. Matsumoto & W. R. Stone

STANDING PUBLICATIONS COMMITTEE

The URSI Standing Committee on Publications met several times at the last General Assembly. It will not meet again as a full committee until the Toronto General Assembly. However, a number of the members of the Committee have kept in close contact during this triennium. I have also met about five times since the last General Assembly regarding Committee matters with the Vice President whose focus is publications, Peter Clarricoats, and we have also kept in close touch via e-mail.

The URSI publications are doing well, although until very recently there has been some concern regarding the *Radio Science Bulletin (RSB)*, which I will discuss below.

The *Review of Radio Science (RRS)* will have either 36 or 37 chapters, with contributions from all Commissions, and it will be available in time for the Toronto General Assembly. It will include the associated *Disk*. The *Disk* will have contributions from at least five Commissions, and it is believed that there will be contributions from all of the same six Commissions that contributed to the *Disk* for the previous triennium. A report on the *RRS* and the *Disk* is attached. As I reported at the Coordinating Committee and LRP Strategy meeting in Toronto last year, I was able to work out a joint marketing agreement between Oxford University Press (OUP) and the IEEE Press. The IEEE Press will be purchasing and marketing at least 200 copies each of the *RRS* and *Modern Radio Science*. I will also be working with OUP to try to capitalize on the potential marketing resources represented by the attendees at the Toronto General Assembly for these two books.

Modern Radio Science (MRS), being edited by Maria Stuchly, is doing very well. All of the manuscripts have been received, and, as of March 15, 1999, all but one of them had been edited. She was planning on having the camera-ready manuscript in to Oxford University Press in early April. The book will be about 350 pages. Maria Stuchly has prepared and submitted a separate report on *MRS*. In it she asks if her secretary could be included as an Associate Editor. Under the circumstances, I believe that this is appropriate.

The "URSI logo" publications, *Wireless Networks* and *Radio Science*, have also been doing well. The Committee will review these at the Toronto General Assembly, but I feel confident that the recommendation will be to continue having the URSI logo associated with these publications. *Wireless Networks* has become a very well respected and oft-cited publication in its field. *Radio Science* has flourished under the Editorship of Robert Hunsucker. As part of its on-going quality-control process, the American Geophysical Union (AGU), which publishes *Radio Science*, held a review of the journal at the USNC/URSI meeting in Boulder, Colorado, USA, January 4-7. I attended a portion of that review. The comments made were generally quite good, and several constructive suggestions were offered. It was also quite clear that the AGU strongly supports the journal, and is pleased with the degree of acceptance and respect it continues to enjoy. Robert Hunsucker had indicated that he wanted to step down as Editor this year. However, the committee searching for a new Editor apparently did not come up with a satisfactory candidate who could accept the position, and Bob Hunsucker was willing to continue for

another year. This search for an Editor is on-going: if there are any suggestions, please forward them to Bob Hunsucker (e-mail: rdhrpc1@aol.com). I am also exploring the possibility of a joint marketing agreement for *Radio Science* that, if it can be worked out, might substantially increase its circulation among radio scientists and engineers.

In addition to another publications-related initiative coming out of COMMSPHERE'99 (see below), Paul Delogne, Piotr Sobieski, and Joe Shapira have put forth a proposal to consider possibly granting URSI logo status to the publication, *Global Communications*. This is an independent quarterly publication that is published by a ITU-D member. Approximately 20,000 copies are distributed free of charge among all ITU member organizations and their high-level staff. This is all very preliminary at this point, and very much in the research stage. It will obviously be a topic of discussion in the Committee's meetings at the Toronto GA, and in the e-mail correspondence that will be undertaken to prepare for these meetings.

The *Radio Science Bulletin (RSB)* is doing all right. However, as discussed at the Strategy Meeting held in Toronto last year, it has become more and more difficult to get good feature articles for the *RSB*. There were several good suggestions made at the Strategy Meeting. One of those was to have the lectures that are now being published as the *MRS* instead be published in the *RSB*. The Committee will discuss that in its meetings in Toronto, and will make a commendation to the Board and Council. Another initiative to address the problem has also been taken. Paul Delogne and *RSB* Editor Piotr Sobieski have undertaken to get 13 of the best papers presented at the COMMSPHERE'99 conference published as feature articles in the *RSB*. If this is successful, it will help the *RSB* very substantially. It is also appropriate to acknowledge the outstanding efforts of Inge Heleu in producing the *RSB*.

If there are other issues which the Board would like the Committee to consider, please let me know. I want the Board to know how much I continue to enjoy working with the Publications Committee, and editing the *RRS*. Thank you.

W. Ross Stone, Ph.D.
Chair, Standing Committee on Publications

STANDING COMMITTEE ON YOUNG SCIENTISTS

The invitation of young scientists (YS) at URSI General Assemblies is an initiative of the Board of Officers. Since the beginning, one officer of the Board was responsible for the YS Committee. This was not the case after the Lille G.A. This gives an opportunity to re-examine the activities of the YS Committee. The objective of the present report is : first, to show how the missions devoted to the Committee have been fulfilled in the last triennium, and second, to make some recommendations for the future.

1. FINANCING OF THE AWARDS

The financing aspect was taken in charge by the Board, the Local Organisation Committee and the URSI secretariat. The involvement of the YS Committee on that matter is not clear. The report from E. Jull is given below. Support for the accommodation and living expenses are included in the budget by the hosts. As of March 1, 1999 the amount for the Toronto GA is C\$108,000, for accommodation in a university residence and meals for 120 young scientists for 8 days.

Support for travel costs of YS from developing countries. Letters have been written to several organisations which provided funds in 1996. We have received confirmation from a few including Japan URSI (US\$4000.), ESA (US\$2100) and USNC/URSI (US\$3000). An application was made for a grant of CAD60,000 (US\$40,000) from the Canadian International Development Agency (CIDA) but this request was turned down.

2. SELECTION OF THE YOUNG SCIENTISTS

Publicity

Copies of the application forms were available at some URSI related conferences in the year prior to the General Assembly. This was not made in a systematic way this time. It is not so important now since application forms are in the mailings of the preliminary programs, the RSB, the URSI website and the AP-S magazine. But it could be helpful to re-examine the way the publicity is done.

The calendar

The procedure was the following one. The YS were asked to apply before 15 November 1998 through the URSI Member Committee in the country (or territory) in which they are normally working. Only if there was not such a Committee, the YS were allowed to apply directly to the secretariat. After collecting and ranking the applications, the URSI member Committees were requested to send all applications to the URSI secretariat by 15 January 1999. The word "ranking" was underlined on the application form. The Young Scientist Panel was asked to finish the selection process by 15 Mars 1999. In parallel, as for all other scientists, the abstracts from the YS were supposed to reach the URSI GA 99 Management office by 15 January 1999.

Now, applications were transmitted by Commission Official members as well as by Member Committees, some Member Committees did not rank the applications they received, applications were received more than one month after the deadline, YS sent their *abstracts* to the URSI secretariat but not to the URSI GA 99 Management office.

As a matter of fact, except for the applications from one Member Committee, the situation was nearly satisfactory. Most of the problems were solved by the URSI Secretariat. The few non-ranked applications (18) were ranked by E.V. Jull and F. Lefeuvre. For the Member Committees having both ranked applications transmitted by the National Committee and non-ranked applications transmitted by Commission Official Members, the priority was given to the applications ranked by the Member Committees. From Ed Jull's point of view, the process improves at each General Assembly, as it should. The point about ranking is a very important one. Priorities are not the same for all Member

Committees. Examining the rankings given by several National Committees, one may identify three different strategies :

- put the priority to the work already done, i.e. to YS having many published papers, invited papers, etc..
- favour YS who just finished their thesis and who need to meet scientists from other countries (which means that the senior scientists and YS with invited papers are financed by their National Committee and/or their labs),
- invest on one YS in one given domain (which explains applications for the same scientists from one G.A. to the other).

These decisions must obviously remain country decisions. But it may be surprising to see a YS, having already received two awards, running for a third one, without having more publications in his CV. Moreover, at a given stage, inter-rankings between countries are unavoidable. For those reasons it is suggested that the National Committees indicate the criteria they used when they send their rankings. As far as the applications transmitted by Official Commission members are concerned, a decision must be taken by the URSI Council. It is difficult to accept that a country be represented by Official Commission members as well as by Committee members. One point is probably to make sure that YS as well as Commission and Committee members know who is who.

YS with accepted papers

The authors being supposed to be notified of acceptance/rejection of their papers by 30 March, it was impossible to finish the selection by 15 March. In order to accelerate the process, the URSI secretariat asked the Commission chairmen to send the list of YS with accepted papers. For so doing a list of the YS applications was communicated to each chairman. But :

- the procedure being new, some Commission chairmen took very long to react (the last list was obtained on 12 April),
- no clear criterion being given, chairmen considered the first author only whereas others accepted a second author.

Finally, the list of YS with accepted paper was finalised after the full process of acceptance/rejection of the papers, i.e. on 13 April. It is difficult for the YS to find cheap tickets when they are informed on their selection by mid of April only. This has a consequence on the URSI budget as well as on Member Committees budgets. For the future it would be highly desirable to accelerate the full process of acceptance/rejection papers or to inform the Commission Chairs well in advance about their tasks. A way to facilitate the work is to ask the authors to indicate on their abstracts if they apply for a YS award.

Selection

The selection was initiated by E.V. Jull with the help of F. Lefeuvre. It was finalised by F. Lefeuvre and J. Van Bladel at the URSI secretariat. A main list (~ 90%) was established country by country using the following criteria :

- selection of the upper 3/4 of the ranked list for YS with invited papers,,
- selection of the upper half in the ranked list for YS with oral papers,
- selection of the upper 1/3 in the list for YS with poster papers,.

YS from developed country were eliminated when they already received one YS award. YS from other countries were allowed for a second award. The complementary list (~10%) was established in adjusting the ratio of the selected YS to the total demands, both by Commission and by countries. This explains why an YS whose the rank is n+p may have been finally selected whereas an YS at the rank n is not. The criteria used for the main list by the YS Panel have for effects :

- to favour Commission A, who has oral papers only (but this was partially corrected with the complementary list),
- to modify rankings from National Committees.

On the other hand they avoid conveners having too many “holes” in their oral session. Now, it is clear that the National Committees must know about these criteria before they rank the applications in order to get results coherent with their strategy. But it is also helpful for the selection Committee to have some flexibility.

3. SUGGESTIONS FOR THE FUTURE

The Standing Committee on Young Scientists set up in Lille was composed of 7 scientists. Although the objective was clear no written mandate and/or task definition was given. As a result three members only participated in the activities of the Committee, without always knowing what was expected from each other. It was the aim of the present report to point out the problems the Committee members encountered and to make suggestions for the future. These suggestions are addressed to the Board of Officers and to the URSI Council.

Suggestion 1 Give a written mandate to the Committee including the expected distribution of tasks (for the financial aspects as well as for the selection of the Young Scientists).

Suggestion 2 Re-examine the possibility of having copies of application forms available at all URSI related conference in the year prior to a G.A.

Suggestion 3 Be more precise on the Application form on the procedure which will be used (e.g. indicate that applications transmitted by Official Committee members will not be accepted),

Suggestion 4 Send guidelines on National Committees on what they have to do for the selection of young scientists (ranking, indications on the criteria used for the ranking, ..)

Suggestion 5 Define a procedure allowing the Young Scientist panel to get as soon as possible the list of Young Scientists with accepted papers.

Suggestion 6 Make official the criteria used by the Young Scientist panel to make the final selection (this is obviously related with suggestion 3).

The Young Scientist Committee thanks Inge Heleu for the great job she did and for the numerous problems she solved by herself.

F. Lefevre
Chairman of the YS Committee

AD HOC COMMITTEE FOR THE REVISION OF THE URSI STATUTES

Tom Senior, President of URSI, established an Ad Hoc Committee to revise the URSI Statutes. The stated purposes of this Committee were to do the following:

1. Re-order the articles to make the presentation clearer;
2. Eliminate any superfluous material which should not be in the Statutes;
3. Add minor statements which are omitted, but which were clearly the intent of the original framers;
4. Make the final document gender neutral;
5. Clean up the wording, punctuation, usage, and spelling, in an effort to clarify but not change the meaning; and (possibly)
6. Change the objects [objectives] to better reflect the aims of URSI.

The Committee consists of Ross Stone (Chair), Paul Delogne, Maria Stuchly, and Ed Jull. Major input was also received from Tom Senior, Yela Stevanovitch, and Paul Lagasse. All of the members of this committee have been very active participants, and the products reflect this. Special recognition must go to Paul Delogne, who undertook the translation of the revised Statutes into French. We began this work at the General Assembly in Lille. The work has continued until now. Most of the work was carried on via e-mail correspondence, augmented by meetings of the Committee in Toronto and Montreal during this period.

All of the items in the above-stated purposes of the Committee were completed, in detail (with one exception: see the comments regarding gender neutrality in the French language, below). The revision of the Objectives was also given careful consideration, and resulted in the revision shown in the revised Statutes after significant discussion and input. During this process, a total of nine overall iterations were produced, discussed in detail, and a result that was unanimously acceptable to the members of the Committee was reached, in all cases. The revised Statutes were reviewed by the Board, the Board's recommendations were addressed and appropriate changes incorporated after discussion, and the Board was in agreement with the resulting revised Statutes at the end of February, 1998. The revised Statutes were sent out to the Coordinating Committee prior to the meeting in Toronto in April, 1998, and the Commission Chairs voted to approve the revised Statutes at that time. There were a few minor items raised subsequently, and these were again extensively discussed by the Committee, and the resulting minor revisions communicated to the Board for approval, which was received.

The revised Statutes were distributed to all Member Committees in early 1999, asking for suggestions of any desired changes. Some minor changes were suggested, and these were taken into account by the Ad Hoc Committee. Two major changes were suggested by the New Zealand Committee. These were considered by the Ad Hoc Committee and the Board, and it was the recommendation of both that these changes not

be made. Because of the more substantial nature of the changes suggested by New Zealand, a ballot on these two changes was sent to all Member Committees, with the vote to be returned by June 1. Both suggested changes were rejected. Thus, the version being distributed now reflects all of the changes that have been approved by the Member Committees. These revised Statutes are thus now being sent to all Member Committees in preparation for final approval at the Toronto General Assembly.

It must be acknowledged that, to some extent, the Committee proceeded in the wrong order: we revised the English version and then translated it to French. Since the French version is the authoritative version (see Article 82), the process arguably should have been done in the opposite order. However, most discussion of the Statutes over recent triennia has been carried out in English. What really matters is that both versions say what they should, and that they agree. Attention should also be paid to the “Notes Regard Gender Neutrality in French.” These are from Paul Delogne, and explain why—regretably—the French version of the Statutes is not gender neutral.

The revised Statutes, in both English and French, are attached. It is apparent that there were many changes from the original Statutes, at least in the English version. Most involved corrections of usage, spelling, punctuation, and changes to make the text gender neutral. However, a number of changes were made to accomplish the other tasks of the Committee, particularly in the interests of clarity and making the various articles consistent.

The Committee has taken great care and given substantial consideration to every change made. It is hoped and believed that the revised Statutes will meet with wide acceptance, and be readily adopted. If there are any questions as to why a change was made, please contact the Chair, or any member of the Committee. On behalf of the Committee, I thank Tom Senior, the Board, and the Council for the privilege of doing this work.

W. Ross Stone

Chair, Ad Hoc Committee for the Revision of the URSI Statutes

Notes Regarding Gender Neutrality in French (from comments provided by Paul Delogne)

The revised English version has been made gender neutral. The “Chairman” becomes a “Chair.” There is no equivalent simple neutral formulation in French: the way to proceed would be to write systematically “le (la) président(e).” However, then the formulation becomes a bit more complex, because in French, the gender of verbs and adjectives must be in concord with the relevant substantive. For instance, “the Chair is authorised” should then be translated as “le (la) président(e) est autorisé(e),” whereas the plural form would be “les président(e)s sont autorisé(e)s.” At the end, the text would become hardly readable. My personal feeling is that it is better not to make the text gender neutral in French. I tried to get the opinion of the French URSI Committee about this, but I got no answer to my request. Therefore, I personally decided not to make the French version gender neutral. [The Committee agreed with Paul’s choice.]

Still regarding this gender question, as far as I know, the Académie Française has not (yet) changed the rules about the use of genders, and still admits that the male formulation is used to indicate a function, independently of the gender of the person. Somewhat strange formulations are admitted, such as “Madame le président.” On the contrary, the Belgian Academy of French Language has defined female terms for everything, but this is not really accepted by people. Anyway, I think the Académie Française should be considered as the reference for international French.

Council approved the revised version of the Statutes, as it is printed below (in French and English).

UNION RADIO-SCIENTIFIQUE INTERNATIONALE

STATUTS

BUTS

Article 1. Les sciences de la radioélectricité comprennent la connaissance et l'étude de toutes questions liées aux champs et ondes électromagnétiques. L'Union Radio-Scientifique Internationale (International Union of Radio Science), une organisation non-gouvernementale et sans but lucratif sous les auspices du Conseil International pour la Science, a pour but de stimuler et de coordonner, à l'échelle internationale, les études, recherches, applications, échanges scientifiques et transferts d'information dans les domaines des sciences de la radioélectricité et, plus particulièrement :

- a) d'encourager et de promouvoir, à l'échelle internationale, les activités dans le domaine des sciences de la radioélectricité et de ses applications, au profit de l'humanité ;
- b) d'encourager l'adoption de méthodes de mesure communes, ainsi que la comparaison et l'étalonnage des instruments de mesure utilisés dans les travaux scientifiques ;
- c) de stimuler et de coordonner les études portant sur :
 - les aspects scientifiques des télécommunications utilisant les ondes électromagnétiques guidées et non guidées ;
 - la production, l'émission, le rayonnement, la propagation, la réception et la détection de ces champs et ondes, ainsi que le traitement des signaux dont ils sont porteurs ;
- d) de représenter les sciences de la radioélectricité auprès du public et des organisations publiques et privées.

MEMBRES

Article 2. Les Membres de l'Union sont les Comités dont les demandes d'admission ont été acceptées au cours d'une Assemblée générale ordinaire.

Article 3. Un Comité Membre est créé dans un territoire donné, par l'Académie des Sciences ou le Conseil de la Recherche compétent, ou bien par une institution ou association d'institutions analogues.

Article 4. L'Union peut admettre comme Membre tout Comité qui, dans un territoire donné, développe une activité dans le domaine de la radioélectricité scientifique.

Article 5. Dans leurs territoires respectifs, les Comités Membres ont les mêmes buts que l'Union ; entière liberté leur est laissée quant à leur organisation interne.

Article 6. Chaque Comité Membre désigne un Représentant au Conseil (voir Article 21) et un Membre officiel au sein de chacune des Commissions (voir Article 30). Un même Membre officiel peut représenter un Comité au sein de deux ou plusieurs Commissions.

Article 7. Lors de leur adhésion à l'Union, les Comités Membres choisissent la Catégorie dans laquelle ils se proposent d'être classés. Le nombre des unités de contribution annuelle dues à l'Union ainsi que le nombre de voix qui leur est attribué au sein du Conseil sont déterminés par la Catégorie choisie et sont spécifiés ci-dessous :

Catégorie	1	2	3	4	5	5A	6
Nombre de voix	2	4	6	8	10	11	12
Nombre d'unités de contribution	1	2	4	8	16	24	32

Le montant de l'unité de contribution est fixé par le Conseil.

Article 8. Les Comités Membres peuvent passer à une Catégorie supérieure au début de l'année financière. Ils peuvent passer à une Catégorie inférieure soit au cours d'une Assemblée générale ordinaire, soit dans la période de trois mois qui suit la fin de l'Assemblée. Tout transfert d'une catégorie à une autre entre en vigueur au début de l'année financière suivante.

Article 9. A moins d'une décision contraire du Conseil, tout Comité Membre qui n'aura pas versé sa contribution annuelle à deux reprises est considéré comme cessant de faire partie de l'Union. Ce Comité pourra néanmoins demander à être admis dans la catégorie des Membres associés.

Article 10. Les Comités Membres peuvent quitter l'Union en signifiant leur intention par écrit au Secrétaire général. En cas de démission, ils sont tenus de payer leur contribution annuelle pour l'année en cours.

Article 11. Les Comités Membres qui quittent l'Union, ou qui sont considérés comme ayant cessé d'en faire partie en vertu de l'Article 9, perdent leurs droits de vote et tous droits à l'actif de l'Union.

Article 12. En cas de dissolution de l'Union, le Conseil dispose des avoirs de l'Union ; ceux-ci ne seront pas répartis entre les Membres.

MEMBRES ASSOCIES

Article 13. La catégorie des Membres associés est réservée, à titre d'option,

- a) aux Comités qui sont créés en vertu des Articles 3, 4, et 5, mais qui ne réunissent pas encore toutes les conditions pour solliciter leur adhésion en tant que Membres, et
- b) aux Comités Membres de l'Union qui, pour des raisons d'ordre financier, souhaitent passer temporairement à la catégorie de Membres associés.

Le statut de chacun des Membres associés sera réexaminé lors de chaque Assemblée générale.

Article 14. Les Membres associés de l'Union sont les Comités dont les demandes d'admission dans cette catégorie ont été acceptées au cours d'une Assemblée générale ordinaire.

Article 15. Les Comités Membres associés ne sont pas tenus de verser une contribution annuelle à l'Union. Ils n'ont pas droit de vote au Conseil et dans les Commissions, et n'ont aucun droit à l'actif de l'Union.

Article 16. Chaque Comité Membre associé désigne un Observateur au Conseil et un observateur au sein de chacune des Commissions. Un même Observateur peut représenter son Comité au sein du Conseil et de plusieurs Commissions.

ADMINISTRATION ET ORGANISATION

Le Bureau

Article 17. La direction des affaires de l'Union et l'organisation de ses activités sont confiées au Bureau qui agit en conformité avec les résolutions et les lignes de conduite générale formulées par le Conseil.

Article 18. Le Bureau est composé du Président, du Président sortant, de quatre Vice-Présidents et du Secrétaire général. Le Président peut inviter les Présidents d'honneur à assister aux séances du Bureau à titre consultatif.

Article 19. Le Bureau se réunit au cours et dans l'intervalle des Assemblées générales, à l'initiative du Président ou de deux de ses membres.

Article 20. Dans l'intervalle des Assemblées générales, le Bureau, agissant au nom de l'Union, est autorisé à prendre des décisions sur les affaires urgentes à condition que ces décisions ne soient pas en contradiction avec les résolutions et les lignes de conduite générale formulées par le Conseil. Les décisions ainsi prises sont reconsidérées lors de l'Assemblée générale ordinaire suivante.

Le Conseil

Article 21. Le Conseil est composé du Président de l'Union, des Représentants des Comités Membres et des Commissions scientifiques (Article 26). Chaque Comité Membre ayant rempli ses obligations statutaires désigne un Représentant au Conseil de l'Union. Les Commissions scientifiques sont représentées par leur Président ou par son suppléant. Un

représentant d'un Comité Membre ne peut aussi représenter une Commission scientifique. Un membre du Bureau ne peut être Représentant d'un Comité Membre.

Article 22. Le Conseil se réunit pendant les Assemblées générales de l'Union pour examiner les points figurant à l'ordre du jour cité aux Articles 63-65 ou 72. Les résolutions du Conseil expriment le point de vue de l'Union.

Article 23. Dans le cas où le Représentant d'un Comité Membre serait empêché d'assister à une séance du Conseil, le Comité qu'il représente peut désigner un suppléant pour cette séance. Cette désignation doit être signifiée au Président ou au Secrétaire général avant le début de la séance.

Article 24. Dans le cas où un Comité Membre ne pourrait envoyer aucun délégué à l'Assemblée générale, il peut adresser son vote par écrit au Président sur toutes questions figurant à l'ordre du jour, qui est diffusé conformément à l'Article 65. Pour être valable, ce vote doit être reçu avant le dépouillement du scrutin.

Article 25. Le Président invite les membres du Bureau à assister aux séances du Conseil à titre consultatif. Il peut aussi inviter au même titre les Présidents d'honneur, les Vice-Présidents des Commissions scientifiques, les Présidents des Comités scientifiques et toutes autres personnes concernées.

Les Commissions Scientifiques

Article 26. La réalisation des buts de l'Union dans les différents domaines de la radioélectricité scientifique incombe aux Commissions scientifiques (aussi appelées en abrégé Commissions), qui sont établies par le Conseil. Les Comités scientifiques sont établis par le Conseil pour étudier les questions présentant un intérêt commun à plusieurs Commissions.

Article 27. Les Commissions ont pour fonctions :

- (a) d'assurer le suivi des progrès réalisés dans la mise en œuvre des buts définis à l'Article 1 ;
- (b) d'assurer la présentation et la discussion d'exposés relatant ces progrès au cours des Assemblées générales ordinaires ;
- (c) de préparer les programmes de travail, résolutions et recommandations à soumettre au Conseil en conformité avec l'Article 29 ;
- (d) de former des Groupes de travail pour l'étude de sujets scientifiques déterminés ;
- (e) d'organiser, dans l'intervalle des Assemblées générales, les colloques scientifiques ainsi que les réunions des Groupes de travail qui ont reçu l'approbation du Bureau ;
- (f) de participer aux activités du Conseil.

Article 28. Les Commissions se réunissent pendant les Assemblées générales ordinaires. Dans des circonstances particulières et avec l'approbation du Bureau, les Présidents des Commissions peuvent convoquer des réunions de leur Commission en tout autre moment.

Article 29.

- a) Pour toutes questions se rapportant à l'administration de l'Union ou ayant des implications financières, les Commissions présentent leurs vues et opinions au Conseil sous forme de recommandations.

- b) Pour toutes questions ressortissant à leurs mandats respectifs et ne tombant pas sous a) ci-dessus, les Commissions peuvent adopter des résolutions. Celles-ci sont présentées au Conseil pour information.

Article 30. Chaque Commission est composée d'un Président, d'un Vice-Président et des Membres officiels désignés par les Comités Membres, à raison d'un Membre officiel par Comité Membre.

Article 31. Dans le cas où un Membre officiel serait empêché d'assister à une séance de sa Commission, il peut soit désigner un suppléant parmi les membres de sa délégation, soit adresser son vote par écrit au Président de la Commission, sur toute question à l'ordre du jour. Dans la deuxième éventualité, ce vote, pour être valable, doit être reçu avant le dépouillement du scrutin.

Article 32. La mise en œuvre des programmes recommandés par les Commissions ou les Comités scientifiques incombe aux Comités Membres qui acceptent d'y prendre part.

Article 33. Chaque Groupe de travail formé en vertu de l'Article 27 d) est dissout à la fin de l'Assemblée générale ordinaire qui suit celle de sa création. Un Groupe de travail dont la tâche n'est pas terminée au moment de l'Assemblée générale peut être reconstitué par la Commission-mère.

Article 34. Les Présidents et les membres des Groupes de travail sont désignés par le Président de la Commission-mère après consultation des Membres officiels, si besoin par correspondance.

Article 35. Chaque Groupe de travail prépare un rapport d'activité comprenant ses conclusions et recommandations ; la date de présentation de ce rapport est fixée par le Président de la Commission-mère.

Le Comité de Coordination

Article 36. Le Comité de Coordination est composé des Présidents des Commissions et des Comités scientifiques, et des membres du Bureau. Dans le cas où le Président d'une Commission serait empêché s'assister à une réunion du Comité de Coordination, il peut se faire représenter par le Vice-Président de sa Commission.

Article 37. Le Comité de Coordination a pour tâche :

- a) de coordonner les activités scientifiques des Commissions, particulièrement dans les domaines où l'action conjointe de deux ou plusieurs Commissions paraît souhaitable ;
- b) de préparer le programme scientifique des Assemblées générales.

Article 38. Le Comité de Coordination se réunit au moins un an avant chaque Assemblée générale ordinaire pour en établir le programme scientifique. Le Président convoque des réunions du Comité de Coordination pendant l'Assemblée générale.

Divers

Article 39. Le Président de l'Union préside les séances du Bureau, du Conseil et du Comité de Coordination. En cas d'absence ou d'empêchement, il est remplacé par le Président sortant.

Article 40. Le Bureau désigne l'un des Vice-Présidents comme Trésorier de l'Union. Le Trésorier gère les fonds de l'Union en conformité avec les directives du Conseil. Il est tenu de déléguer au Secrétaire général les pouvoirs nécessaires à la conduite des affaires financières courantes.

Article 41.

- a) Le Secrétaire général assure la gestion des affaires de l'Union et l'organisation de ses activités en conformité avec les directives du Bureau. Il est chargé, en particulier, de la mise en œuvre des résolutions adoptées au cours des Assemblées générales, du maintien des relations avec les Comités Membres, les Comités Membres associés, les Commissions et autres organes de l'Union, ainsi que des publications de l'Union.
- b) Le Bureau a pouvoir de désigner, sur proposition du Secrétaire général, un Secrétaire général adjoint qui restera en fonction de la date de sa nomination jusqu'à la fin de l'Assemblée générale ordinaire suivante. Le Secrétaire général peut déléguer certaines des tâches qui lui incombent au Secrétaire général adjoint.

Article 42. Tous les actes qui engagent l'Union et ont été approuvés par le Bureau sont signés par deux membres du Bureau dont l'un doit être soit le Président soit le Secrétaire général.

Article 43. Le Bureau peut donner pouvoir à l'un de ses membres pour ester en justice.

Elections

Article 44. L'admission officielle de nouveaux Comités Membres par le Conseil ne peut s'effectuer qu'au cours d'une Assemblée générale ordinaire. L'admission provisoire de ces Comités, sans droit de vote, peut être autorisée par le Bureau à partir de la date de paiement de la première contribution annuelle à l'Union.

Article 45. L'admission officielle de nouveaux Comités Membres associés par le Conseil ne peut s'effectuer qu'au cours d'une Assemblée générale ordinaire. L'admission provisoire de Membres associés peut être autorisée par le Bureau.

Article 46. Les membres du Bureau sont élus par le Conseil au cours de l'Assemblée générale ordinaire. Leur mandat entre en vigueur à l'issue de l'Assemblée qui a prononcé leur élection et prend fin à l'issue de l'Assemblée générale ordinaire suivante.

Article 47. Les candidats aux fonctions de membre du Bureau sont présentés par les Comités Membres. Les candidats ne sont éligibles que moyennant les conditions suivantes :

- a) soit leur candidature est présentée par au moins deux Comités, soit elle est présentée par un seul Comité et appuyée ultérieurement par au moins un autre Comité ;
- b) de plus, ils doivent confirmer au Secrétaire général qu'ils acceptent de prendre part aux élections.

Article 48. La liste définitive des candidats éligibles est établie selon la procédure suivante :

- a) Au plus tard six mois avant l'ouverture de l'Assemblée générale ordinaire, le Secrétaire général invite tous les Comités Membres à présenter leurs candidats, à raison d'un candidat à chacun des postes suivants: Président, quatre Vice-Présidents, Secrétaire général.

- b) Sur la base de ces propositions, qui doivent lui parvenir au plus tard cinq mois avant l'Assemblée, le Secrétaire général diffuse aux Comités Membres deux listes provisoires indiquant les noms des candidats et les Comités proposant :

Liste A: candidats présentés par au moins deux Comités,

Liste B: candidats présentés par un seul Comité.

- c) En plus de ses propositions figurant sur la liste A, tout Comité peut appuyer les candidatures figurant dans la liste B, à raison d'une candidature pour chacun des postes cités en a). Notification en est donnée au Secrétaire général au plus tard trois mois avant l'Assemblée.
- d) La liste définitive des candidats éligibles est diffusée aux Comités Membres au plus tard deux mois avant l'Assemblée.

Article 49. Dans le cas où le Secrétaire général ne serait pas réélu, le Bureau veille à prendre toutes les dispositions utiles pour que les responsabilités soient transférées au nouveau Secrétaire général au plus tard six mois après la fin de l'Assemblée générale.

Article 50. Le Président n'est pas rééligible. Les Vice-Présidents peuvent être réélus une fois.

Article 51. Après consultation des membres du Bureau et des Comités Membres, le Président peut pourvoir aux vacances intervenant au sein du Bureau. Tout membre ainsi nommé assume ses fonctions jusqu'à la fin de l'Assemblée générale ordinaire suivante ; il peut être élu pour le terme suivant, même dans le cas où le membre du Bureau qu'il a été appelé à remplacer n'est pas rééligible.

Article 52. Le Conseil peut conférer le titre de Président d'honneur à un ancien membre du Bureau ou à un ancien Président de Commission qui ont apporté une contribution particulière à la réalisation des buts de l'Union ; le nombre des Présidents d'honneur n'excédera pas cinq.

Article 53. Les Présidents et les Vice-Présidents des Commissions sont élus par le Conseil sur recommandation des Commissions respectives. Les Présidents entrent en fonction à la fin de l'Assemblée qui a prononcé leur élection et leur mandat expire à la fin de l'Assemblée générale ordinaire suivante. Sauf circonstances exceptionnelles, les Vice-Présidents succèdent automatiquement aux Présidents.

Article 54. Les Présidents de Commission qui sont en même temps Membres officiels au sein de leur propre Commission sont tenus de désigner un autre membre de leur délégation comme Membre officiel pour la durée de l'Assemblée générale.

Article 55. Chaque Commission peut élire un secrétaire de langue française et un secrétaire de langue anglaise parmi les délégués présents à l'Assemblée générale.

Article 56. Les Présidents des Comités scientifiques sont élus par le Conseil sur recommandation du Bureau.

Article 57. Les représentants de l'Union auprès d'autres organisations internationales sont élus par le Conseil sur recommandation du Bureau.

L'ASSEMBLEE GENERALE ORDINAIRE

Article 58. L'Union se réunit normalement tous les trois ans en Assemblée générale ordinaire. Au cours de l'Assemblée ont lieu :

- a) des séances du Conseil, du Comité de Coordination et du Bureau,
- b) des séances administratives des Commissions,
- c) des séances plénières réunissant tous les délégués désignés par les Comités Membres et les Comités Membres associés, et les observateurs autorisés par le Bureau,
- d) des séances scientifiques des Commissions et des colloques,
- e) des séances des groupes de travail établis par les Commissions.

Article 59. A l'assemblée générale ordinaire assistent :

- a) les membres du Bureau,
- b) les Présidents et Vice-présidents des Commissions,
- c) les Présidents des Comités scientifiques,
- d) les délégations des Comités Membres comprenant chacune le Représentant au Conseil, les Membres officiels des Commissions, et des délégués ordinaires,
- e) les délégations des Comités Membres associés comprenant chacune l'Observateur au Conseil, les Observateurs au sein des Commissions, et des délégués ordinaires,
- f) les Présidents d'honneur et anciens Présidents de l'Union,
- g) les représentants invités en vertu de l'Article 61.

Article 60. Les séances scientifiques des Commissions et les colloques sont ouverts à tous les scientifiques (y compris les étudiants) inscrits comme participants de l'Assemblée générale. Le nombre total des participants pourrait être limité par le Comité Membre qui organise l'Assemblée générale en fonction des possibilités locales.

Article 61. Le Président de l'Union peut inviter les représentants désignés par des organisations internationales à assister à l'Assemblée générale en qualité d'observateurs.

Article 62. La date et le lieu de l'Assemblée générale sont communiqués par le Secrétaire général aux Comités Membres et aux Comités Membres associés au moins six mois avant l'ouverture de l'Assemblée.

Article 63. L'ordre du jour des séances du Conseil est établi sur la base des propositions présentées par les Comités Membres, le Bureau, le Comité de Coordination, les Commissions et les Comités scientifiques de l'Union.

Article 64. Les questions à inclure à l'ordre du jour du Conseil doivent parvenir au Secrétaire général au moins quatre mois avant l'ouverture de l'Assemblée générale. Toute question présentée ultérieurement n'est prise en considération qu'avec l'assentiment préalable d'au moins la moitié des voix émises par les membres présents à la séance.

Article 65. L'ordre du jour des séances du Conseil est préparé par le Secrétaire général et communiqué aux Comités Membres et aux Comités Membres associés au moins trois mois avant l'ouverture de l'Assemblée.

Article 66. Pour chaque Assemblée générale ordinaire, le Secrétaire général prépare :

- a) à l'intention du Conseil, un rapport circonstancié sur les affaires de l'Union, y compris un état des recettes et des dépenses depuis la dernière Assemblée générale ordinaire,

- ainsi qu'un projet de prévisions budgétaires pour le triennat suivant,
- b) à l'intention de tous les délégués, un rapport général sur les activités de l'Union depuis la dernière Assemblée générale ordinaire.

Article 67. Le Conseil a pleins pouvoirs pour décider de toutes les activités découlant pour l'Union des buts définis à l'Article 1. Il a pour attributions particulières :

- a) d'examiner les mesures prises par le Bureau depuis l'Assemblée générale ordinaire précédente relativement aux affaires de l'Union ;
- b) d'élire :
 - [i] les membres du Bureau,
 - [ii] les Présidents et Vice-Présidents des Commissions,
 - [iii] les Présidents des Comités scientifiques,
 - [iv] les représentants de l'Union auprès d'autres organisations internationales ;
- c) de créer et d'abolir les Commissions et les Comités scientifiques et d'en déterminer les titres et mandats ;
- d) d'examiner et, si jugé opportun, d'approuver les programmes de travail, résolutions et recommandations présentés par les Commissions et les Comités scientifiques de l'Union ;
- e) sur proposition du Bureau, d'examiner les demandes d'admission à l'Union et, si jugé opportun, d'accepter ces demandes ;
- f) sur proposition du Bureau, d'examiner les demandes d'admission à l'Union dans la catégorie des Membres associés et, si jugé opportun, d'accepter ces demandes ;
- g) de fixer l'année et le lieu de l'Assemblée générale ordinaire dans la limite des deux Assemblées générales suivantes ;
- h) de désigner un Comité des finances permanent chargé :
 - [i] de préparer un rapport sur les comptes de l'Union depuis la dernière Assemblée générale ordinaire et sur les prévisions budgétaires pour la période allant jusqu'à l'Assemblée générale ordinaire suivante,
 - [ii] de présenter ses recommandations concernant les finances de l'Union,
 - [iii] d'aider le Trésorier, à sa demande, à faire le point sur les affaires financières de l'Union pendant la période allant jusqu'à l'Assemblée générale ordinaire suivante.
- i) sur proposition du Comité des finances, d'approuver les comptes et les prévisions budgétaires et de considérer les recommandations formulées par ce Comité;
- j) de déterminer le montant de l'unité de contribution définie à l'Article 7 ;
- k) d'établir des règles pour la conduite des travaux de l'Assemblée générale ;
- l) sur proposition du Bureau, d'approuver les amendements aux Statuts ;
- m) de prendre des décisions sur toutes autres questions touchant les activités de l'Union.

Article 68. Les résolutions adoptées par le Conseil et les Commissions au cours de l'Assemblée générale sont présentées pour information à la séance plénière de clôture de l'Assemblée à laquelle assistent tous les délégués et observateurs.

Article 69. A défaut de prescriptions pertinentes dans les Statuts, ou bien dans des circonstances exceptionnelles, le Conseil est autorisé à prendre des décisions sur toutes

les questions relatives aux activités de l'Union. Ces décisions ne peuvent contenir de prescriptions qui seraient en contradiction avec les termes des Statuts.

L'ASSEMBLEE GENERALE EXTRAORDINAIRE

Article 70. Dans des circonstances particulières et avec approbation de la majorité des voix des Comités Membres, le Président peut convoquer une Assemblée générale extraordinaire. Il est tenu de le faire lorsqu'il en est requis par un tiers au moins des voix de tous les Comités Membres.

Article 71. Le Conseil, tel que défini à l'Article 21, siège au cours de l'Assemblée générale extraordinaire. Le Président peut inviter les membres du Bureau, les Présidents d'honneur et des tiers intéressés à assister aux séances à titre consultatif.

Article 72. L'ordre du jour, la date et le lieu de l'Assemblée générale extraordinaire sont communiqués aux Comités Membres et aux Comités Membres associés par le Secrétaire général au moins trois mois avant l'ouverture de l'Assemblée.

Procédure de vote

Article 73.

- a) Au sein du Conseil, seuls les Représentants des Comités Membres et des Commissions scientifiques ont droit de vote.
- b) Le nombre des voix attribuées à chacun des Comités Membres est déterminé par la Catégorie de ce Comité, suivant le barème figurant à l'Article 7.
- c) Chaque Commission dispose de deux voix. Les Commissions Scientifiques peuvent voter sur toutes questions, à l'exception de l'élection du Bureau, de l'admission et de l'exclusion des Comités Membres, du montant de l'unité de contribution et de toute question relative aux finances de l'Union. Le nombre total de voix attribuées aux Commissions ne peut être supérieur ou égal au nombre total de voix attribuées aux Comités Membres.
- d) Toutes les résolutions du Conseil sont adoptées à la majorité simple des voix, exception faite de celles portant modification des Statuts, pour lesquelles la majorité des deux tiers est requise.
- e) Au sein des Commissions, chaque Membre officiel présent, ou son suppléant votant en vertu de l'Article 31 a une voix.
- f) Au sein du Bureau, du Comité de Coordination et des Comités, chaque membre présent a une voix. Un membre du Bureau qui est rémunéré pour ses services à l'Union n'a pas droit de vote.
- g) Au sein du Bureau, du Conseil, du Comité de Coordination, des Commissions et des Comités, les décisions sont prises en tenant compte du nombre des votes positifs et des votes négatifs émis par les membres présents et prenant part au scrutin. En cas d'égalité des voix, la décision appartient au Président. Les votes adressés par écrit en

vertu des Articles 24 et 31 ne sont admis que dans les séances du Conseil et des Commissions.

Quorum

Article 74. Dans les séances du Bureau et du Conseil, le quorum est atteint par la moitié du nombre des membres. Dans les séances du Comité de Coordination, il est constitué par la moitié du nombre des membres du Bureau et les représentants de la moitié du nombre des Commissions.

Article 75. Dans le cas où le quorum ne serait pas atteint par le nombre des membres présents au Conseil, le Président peut convoquer une séance extraordinaire; celle-ci n'aura pas lieu avant expiration d'un délai de 24 heures. Dans ces conditions, si le nombre des membres présents n'est pas inférieur à douze, le quorum sera atteint nonobstant l'Article 74.

Finances

Article 76. Les recettes de l'Union proviennent

- a) des contributions annuelles payées par les Comités Membres en vertu de l'Article 7,
- b) des recettes nettes des Assemblées générales ordinaires, ainsi que des symposia organisés par les Commissions et dont l'Union approuve les comptes,
- c) de donations et de subsides des Comités Membres,
- d) de subventions, donations, concessions et octrois, legs acceptés par le Bureau au nom de l'Union, conformément à l'Article 20.

Article 77. Les fonds provenant de donations et de subsides sont utilisés selon les désirs exprimés par les donateurs. Tous les autres fonds sont consacrés à couvrir les dépenses faites par l'Union en vue de la réalisation de ses buts.

Article 78. Les dépenses ordinaires de l'Union peuvent comprendre :

- a) les dépenses relatives aux Assemblées générales,
- b) les allocations attribuées aux Commissions pour l'exercice de leurs responsabilités scientifiques,
- c) les frais de voyage des membres du Bureau, des Présidents et Vice-Présidents des Commissions et des membres du Secrétariat se déplaçant pour les besoins de l'Union,
- d) les frais de rédaction et d'impression des publications de l'Union,
- e) les frais d'administration,
- f) toutes autres dépenses autorisées par le Conseil.

Article 79. L'année financière de l'Union commence le 1er janvier et prend fin le 31 décembre.

Diver

Article 80. Les langues officielles de l'Union sont le français et l'anglais. Tous les documents administratifs sont publiés dans les deux langues.

Article 81. En cas de contestation, le texte français des Statuts fait foi.

INTERNATIONAL UNION OF RADIO SCIENCE

STATUTES

OBJECTIVES

Article 1. Radio science encompasses the knowledge and study of all aspects of electromagnetic fields and waves. The International Union of Radio Science (Union Radio-Scientifique Internationale), a non-governmental and non-profit organisation under the International Council for Science, is responsible for stimulating and co-ordinating, on an international basis, studies, research, applications, scientific exchange, and communication in the fields of radio science. Included within the objectives are the following:

- a) to encourage and promote international activity in radio science and its applications, for the benefit of humanity;
- 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 co-ordinate studies of:
 - the scientific aspects of telecommunications using electromagnetic waves, guided and unguided;
 - the generation, emission, radiation, propagation, reception, and detection of fields and waves, and the processing of the signals embedded in them.
- d) to represent radio science to the general public, and to public and private organisations.

MEMBERS

Article 2. The Members of the Union are the Committees whose applications for membership have been adopted at an Ordinary General Assembly.

Article 3. A Member Committee is established in a territory by its Academy of Sciences or Research Council, or by a similar institution or association of institutions.

Article 4. The Union can admit to membership a Committee that, in any territory, develops an activity in radio science.

Article 5. Member Committees, within their respective territories, have the same objectives as the Union. They have complete freedom in matters relating to their internal organisation.

Article 6. Each Member Committee appoints a Representative to the Council (See Article 21) and one Official Member to each Commission (See Article 30). The same Official Member can represent a Committee on more than one Commission.

Article 7. Each Member Committee is free to choose the Category in which it will adhere to the Union. The number of units of contribution payable annually to the Union by a

Member Committee and the number of votes allocated to it in meetings of the Council are determined by the Category chosen, and are as follows:

Category	1	2	3	4	5	5A	6
Number of votes	2	4	6	8	10	11	12
Number of units of contribution	1	2	4	8	16	24	32

The value of the unit of contribution is fixed by the Council.

Article 8. A Member Committee can transfer to a higher Category at the beginning of any financial year. A transfer to a lower Category can be made during an Ordinary General Assembly or during the three-month period after the end of an Assembly. The transfer takes effect from the beginning of the next financial year.

Article 9. Unless the Council decides otherwise, a Member Committee which has not paid its annual contribution for two years is considered to have resigned from the Union. The Committee may, however, apply for Associate Membership.

Article 10. A Member Committee can resign from the Union by giving notice in writing to the Secretary General. In the event of resignation, the Member Committee is liable to pay its annual contribution for the current year.

Article 11. A Member Committee that resigns from the Union, or that is considered as having resigned in accordance with Article 9, loses all rights to the assets of the Union and all voting rights.

Article 12. In the event of the dissolution of the Union, the Council decides on the disposal of the assets of the Union. The assets shall not be distributed among the Members.

ASSOCIATE MEMBERSHIP

Article 13. Associate Membership is reserved, as an option, for a) Committees which are established in accordance with Articles 3, 4 and 5, but are not yet ready for full membership; and b) Committees which, being already Members of the Union, wish to transfer temporarily to Associate Membership for financial reasons. Every Associate Membership will be reviewed at each General Assembly.

Article 14. Associate Member Committees are admitted to the Union at an Ordinary General Assembly.

Article 15. Associate Member Committees are not required to pay an annual contribution to the Union. They have no voting rights in the Council and in the Commissions, and have no rights to the assets of the Union.

Article 16. Each Associate Member Committee appoints one observer to the Council, and one observer to each Commission. The same observer can represent his or her Committee on the Council and on more than one Commission.

ADMINISTRATION AND ORGANIZATION

Board of Officers

Article 17. The direction of the affairs of the Union and the organisation of its work are the responsibilities of the Board of Officers, which acts in accordance with the resolutions and general guidance of the Council.

Article 18. The Board of Officers comprises the President, the Immediate Past President, four Vice-Presidents and the Secretary General. The President can invite Honorary Presidents to attend meetings of the Board in an advisory capacity.

Article 19. The Board of Officers meets during and between General Assemblies at the request of the President, or at the request of two of the Board's members.

Article 20. During the interval between General Assemblies, the Board of Officers, acting in the name of the Union, can make decisions relating to urgent matters provided that these decisions do not conflict with the resolutions and general guidance of the Council. Decisions made in this way are subject to review at the next Ordinary General Assembly.

Council

Article 21. The Council comprises the President of the Union and Representatives of Member Committees and Scientific Commissions (Article 26). Each Member Committee that has complied with its statutory obligations appoints one Representative to the Council of the Union. The Scientific Commissions are represented by the Commission Chairs or their designates. A representative of a Member Committee cannot also represent a Scientific Commission. A member of the URSI Board of Officers cannot be appointed as Representative to the Council.

Article 22. The Council meets during General Assemblies of the Union to consider the agenda as referred to in Articles 63-65 or 72. Resolutions of the Council are adopted in the name of the Union.

Article 23. If the Representative of a Member Committee is unable to be present at a meeting of the Council, the Member Committee can appoint a substitute for that meeting. Notice of such a substitution must be given to the President or the Secretary General before the beginning of the meeting.

Article 24. If a Member Committee is unable to send any delegate to a General Assembly, the Committee can submit its vote in writing to the President on any item that appears in the agenda circulated in accordance with Article 65. Such a vote is valid only if it is received before the counting of the votes.

Article 25. The President invites the members of the Board of Officers to attend meetings of the Council in an advisory capacity. He or she may also invite, in the same capacity, Honorary Presidents, Vice-Chairs of Scientific Commissions, Chairs of Scientific Committees, and other interested parties.

Scientific Commissions

Article 26. The achievement of the objectives of the Union within particular parts of the fields of radio science is the responsibility of the Scientific Commissions (also referred to simply as the Commissions), which are established by the Council. Scientific Committees of the Union are established by the Council to deal with matters which are of interest to several Commissions.

Article 27. The functions of a Commission are as follows:

- (a) to review progress made in the achievement of the objectives referred to in Article 1;
- (b) to arrange for the presentation and discussion of surveys of progress during Ordinary General Assemblies;
- (c) to prepare programmes of work, resolutions, and recommendations for submission to the Council, in accordance with Article 29;
- (d) to form Working Groups for the study of particular scientific subjects;
- (e) to organise, between General Assemblies, scientific symposia and meetings of Working Groups that have been approved by the Board of Officers;
- (f) to participate in Council activities.

Article 28. The Commissions meet during Ordinary General Assemblies. In special circumstances and with the approval of the Board of Officers, the Chair of a Commission can convene a Commission meeting at any time.

Article 29.

- (a) The opinion of a Commission on any matter relating to the administration of the Union, or having financial implications, is submitted to the Council in the form of a recommendation.
- (b) A Commission can adopt resolutions on matters within its terms of reference other than those specified in (a). Such resolutions are submitted to the Council for information.

Article 30. Each Commission comprises a Chair, a Vice-Chair, and the Official Members; one Official Member is appointed by each of the Member Committees.

Article 31. If an Official Member of a Commission is unable to be present at a meeting of the Commission, the Official Member may nominate a member of his or her delegation to represent him or her, or the Official Member may submit his or her vote on any item in writing to the Chair of the Commission. In the latter case, the Official Member's vote will be valid only if it is received before the counting of the votes.

Article 32. The execution of programmes recommended by the Commissions or the scientific Committees is the responsibility of the Member Committees that agree to participate in them.

Article 33. Each Working Group, formed in accordance with Article 27 (d), is dissolved at the end of the General Assembly following that of its creation. A Working Group that has not completed its task by the date of the General Assembly can be reconstituted by the parent Commission.

Article 34. The Chair and the members of a Working Group are chosen by the Chair of the parent Commission, after consultation with the Official Members, by correspondence if necessary.

Article 35. Each Working Group prepares a report on its work including conclusions and recommendations. The date for the submission of this report is fixed by the Chair of the parent Commission.

Co-ordinating Committee

Article 36. The Co-ordinating Committee comprises the Chairs of the Commissions and of the Scientific Committees, and the members of the Board of Officers. If a Chair is unable to be present at a meeting of the Co-ordinating Committee, he or she can authorise the Vice-Chair of the Commission to represent the Chair.

Article 37. The Co-ordinating Committee is responsible for:

- (a) the co-ordination of the scientific activities of the Commissions, especially where joint action by two or more Commissions is desirable;
- (b) the planning of the scientific programme of General Assemblies.

Article 38. The Co-ordinating Committee meets at least one year before each Ordinary General Assembly to define the scientific programme for the Assembly. The President convenes meetings of the Co-ordinating Committee during a General Assembly.

Miscellaneous

Article 39. The President of the Union presides at meetings of the Board of Officers, the Council, and the Co-ordinating Committee. If the President is absent or unable to preside the immediate Past President presides.

Article 40. The Board of Officers nominates one of the Vice-Presidents as Treasurer of the Union. The Treasurer manages the finances of the Union in accordance with the directives issued by the Council. The Treasurer must delegate to the Secretary General the powers necessary to deal with day-to-day financial matters.

Article 41.

- (a) The Secretary General is responsible for the management of the affairs of the Union, and for the organisation of its work under the direction of the Board of Officers. In particular, the Secretary General is responsible for the implementation of Resolutions adopted during General Assemblies, for maintaining contact with the Member Committees, the Associate Member Committees, the Commissions and other organs of the Union, and for the publications of the Union.
- (b) The Board is empowered to appoint, upon nomination by the Secretary General, an Assistant Secretary General, who will serve from the date of his or her appointment until the end of the next Ordinary General Assembly. The Secretary General may delegate some of his or her duties to the Assistant Secretary General.

Article 42. All documents that are formally binding on the Union and that have been approved by the Board of Officers shall be signed by two members of the Board, one of whom must be the President or the Secretary General.

Article 43. The Board of Officers can nominate one of its members to act for the Union in legal proceedings.

Elections

Article 44. The formal admission of new Member Committees by the Council takes place only at an Ordinary General Assembly. Provisional membership, without voting rights, can be authorised by the Board of Officers from the date of payment of the first annual contribution to the Union.

Article 45. The formal admission of new Associate Member Committees by the Council takes place at an Ordinary General Assembly. Provisional admission to Associate Membership can be authorised by the Board.

Article 46. The Members of the Board of Officers are elected by the Council during an Ordinary General Assembly. Each member holds office from the end of the Assembly at which he or she is elected until the end of the next Ordinary General Assembly.

Article 47. Candidates for membership of the Board of Officers are nominated by Member Committees. A candidate is not eligible for election unless:

- (a) either the candidate has been nominated by two or more Committees, or the candidate has been nominated by one Committee and has later been supported by at least one other Committee; and
- (b) the candidate has confirmed to the Secretary General that he or she is willing to stand for election.

Article 48. The final list of eligible candidates is prepared in accordance with the following procedure:

- (a) Not later than six months before the beginning of an Ordinary General Assembly, the Secretary General invites every Member Committee to nominate one candidate for each of the following offices: President, four Vice-Presidents, and Secretary General.
- (b) On the basis of the nominations he or she received not later than five months before the Assembly, the Secretary General sends to the Member Committees two provisional lists showing the names of the candidates and the Committees which nominated them:

List A, consisting of candidates nominated by two or more Committees;

List B, consisting of candidates nominated by one Committee only.

- (c) In addition to a contribution to List A, any Committee can support the nomination of one of the candidates in List B for each of the offices mentioned in (a) by notifying the Secretary General not later than three months before the Assembly.
- (d) The final list of eligible candidates is sent to Member Committees not later than two months before the Assembly.

Article 49. If the Secretary General is not re-elected, the Board of Officers is responsible for making all the necessary arrangements for the transfer of responsibilities from the outgoing to the incoming Secretary General within a period not exceeding six months after the end of the General Assembly.

Article 50. The President can not be elected for a second term, but the Vice-Presidents can be re-elected for at most one second term.

Article 51. A vacancy that occurs in the Board of Officers can be filled by the President after consultation with the Board of Officers and the Member Committees. An Officer appointed in this way holds office until the end of the next Ordinary General Assembly. Election of this officer to the Board can occur even if the Officer replaced was not eligible for re-election.

Article 52. The Council can confer the title of Honorary President on not more than five people who have been former members of the Board of Officers or former Chairs of Commissions, and who have made notable contributions to the achievement of the objectives of the Union.

Article 53. The Chairs and Vice-Chairs of Commissions are elected by the Council on the recommendation of the respective Commissions. Each Chair assumes his or her responsibilities at the end of the Assembly at which he or she is elected, and serves until the end of the next Ordinary General Assembly. Except in unusual circumstances, the Vice-Chair of a Commission succeeds automatically as Chair.

Article 54. A Chair of a Commission who is also an Official Member for the same Commission must nominate another member of his or her Delegation to act as Official Member during a General Assembly.

Article 55. Each Commission may elect one French-speaking and one English-speaking Secretary from the delegates present at a General Assembly.

Article 56. The Chairs of the Scientific Committees are elected by the Council on the recommendation of the Board of Officers.

Article 57. The representatives of the Union to other international bodies are elected by the Council on the recommendation of the Board of Officers.

ORDINARY GENERAL ASSEMBLY

Article 58. The Union holds an Ordinary General Assembly, normally at intervals of three years. At each Ordinary Assembly there are:

- (a) Meetings of the Council, the Co-ordinating Committee, and the Board of Officers;
- (b) Business meetings of the Commissions;
- (c) Plenary meetings attended by all Delegates appointed by Member Committees and Associate Member Committees, and Observers appointed by the Board;
- (d) Scientific meetings of the Commissions, and Symposia;
- (e) Meetings of Working Groups established by the Commissions.

Article 59. The Ordinary General Assembly is attended by:

- (a) Members of the Board of Officers;
- (b) Chairs and Vice-Chairs of Commissions;
- (c) Chairs of Scientific Committees;
- (d) Delegations of Member Committees, each of which comprises the Council Representative, Official Members of Commissions, and ordinary delegates;
- (e) Delegations of Associate Member Committees, each of which comprises the Observer to the Council, Observers to the Commissions, and delegates;
- (f) Honorary and Past Presidents of the Union; and
- (g) Representatives invited in accordance with Article 61.

Article 60. Scientific meetings of Commissions, and Symposia, are open to all scientists (including students) who have registered as participants of the General Assembly. The total number of registrants may be restricted by the host Committee so that the meeting can be accommodated within the facilities available.

Article 61. The President of the Union can invite representatives nominated by international organisations to attend the General Assembly as observers.

Article 62. The date and place of the General Assembly are communicated by the Secretary General to Member Committees and Associate Member Committees not less than six months before the beginning of the Assembly.

Article 63. The agenda for the meetings of the Council are based on the proposals submitted by the Member Committees, the Board of Officers, the Co-ordinating Committee, the Scientific Commissions and Committees of the Union.

Article 64. Items for inclusion in the agenda for the meetings of the Council must be received by the Secretary General not later than four months before the beginning of the General Assembly. Items received after this date can be added to the agenda only upon approval by at least half of the votes of those present at the meeting.

Article 65. The Secretary General prepares the agenda for the meetings of the Council, and communicates them to the Member Committees and Associate Member Committees not less than three months before the beginning of the Assembly.

Article 66. For each Ordinary General Assembly, the Secretary General prepares:

- (a) for the Council, a detailed report on the affairs of the Union, including the accounts of income and expenditures since the previous Ordinary General Assembly, and the budgetary estimates for the three years following the Assembly;
- (b) for all Delegates, a general report on the activities of the Union since the previous Ordinary General Assembly.

Article 67. The Council has full power to make decisions regarding any activity of the Union relating to the objectives defined in Article 1.

In particular, it has the following powers and obligations:

- (a) to review the direction of the affairs of the Union by the Board of Officers since the previous Ordinary General Assembly;

- (b) to elect:
 - (i) the members of the Board of Officers;
 - (ii) the Chairs and Vice-Chairs of Commissions;
 - (iii) the Chairs of Scientific Committees;
 - (iv) the representatives of the Union to other international bodies;
- (c) to create or abolish Commissions and Scientific Committees, and to decide the titles and the terms of reference of these bodies;
- (d) to consider and, if thought fit, to approve programmes of work, resolutions, and recommendations submitted by the Commissions and Scientific Committees of the Union;
- (e) on the proposal of the Board of Officers, to examine and, if thought fit, to accept applications for membership of the Union;
- (f) on the proposal of the Board of Officers, to examine and, if thought fit, to accept applications for Associate Membership of the Union;
- (g) to decide the year and place of up to the limit of the next two Ordinary General Assemblies;
- (h) to appoint a Standing Finance Committee, charged with:
 - (i) the preparation of a report on the accounts for the period since the last Ordinary General Assembly, and the budget for the period until the next Ordinary General Assembly;
 - (ii) the submission of recommendations concerning the finances of the Union;
 - (iii) the provision of assistance, when so requested by the Treasurer, to review the financial affairs of the Union during the period until the next Ordinary General Assembly;
- (i) to approve the accounts and the budget, on the proposal of the Finance Committee, and to consider recommendations made by this Committee;
- (j) to decide the unit of contribution defined in Article 7;
- (k) to make rules for the conduct of the work of the General Assembly;
- (l) on the proposal of the Board of Officers, to approve proposed amendments to the Statutes;
- (m) to take action on any other matter affecting the activities of the Union.

Article 68. Resolutions adopted by the Council and the Commissions during a General Assembly are submitted to the closing plenary meeting of all delegates and observers, for information only.

Article 69. In the absence of any relevant provisions in the Statutes, or in extraordinary circumstances, the Council is authorised to make decisions on all matters relating to the activities of the Union. These decisions must not contain provisions contrary to the terms of the Statutes.

EXTRAORDINARY GENERAL ASSEMBLY

Article 70. In special circumstances and with the approval of the majority of the votes of the Member Committees, the President can convene an Extraordinary General Assembly. He or she must do so on receipt of a request supported by at least one-third of the votes of all Member Committees.

Article 71. At an Extraordinary General Assembly, there are meetings of the Council as defined in Article 21, to which the President can invite members of the Board of Officers, Honorary Presidents, and other interested parties in an advisory capacity.

Article 72. The agenda, the date, and the place of an Extraordinary General Assembly are communicated to the Member Committees and Associate Member Committees by the Secretary General not less than three months before the beginning of the Assembly.

VOTING PROCEDURE

Article 73.

- (a) In meetings of the Council, only the Representatives of Member Committees and Scientific Commissions can vote.
- (b) The number of votes allocated to each Member Committee Representative is determined by the Category of his or her Committee, in accordance with the schedule given in Article 7.
- (c) Each Commission has two votes. The Scientific Commissions participate in all votes except the election of the Board, the status of Members, the value of the unit of contribution and other matters affecting the dues. In no circumstance shall the total of the votes of the Scientific Commissions be equal to or greater than the total of the votes of the Member Committees.
- (d) Resolutions of the Council are adopted by a simple majority of votes, with the exception of those relating to modifications of the Statutes, for which a two-thirds majority is required.
- (e) In meetings of Commissions, each Official Member present, or representative thereof in accordance with Article 31, has one vote.
- (f) In meetings of the Board of Officers, the Co-ordinating Committee and Committees, each member present has one vote. Any member of the Board of Officers receiving remuneration for services to the Union has no vote.
- (g) In meetings of the Board of Officers, the Council, the Co-ordinating Committee, Commissions, and Committees, decisions are based on the affirmative and negative votes of those present and taking part in the vote. In the case of equal numbers of affirmative and negative votes, the Chair of the meeting decides. Votes submitted in writing in accordance with Arts. 24 and 31 are admissible only in meetings of the Council and of the Commissions.

QUORUM

Article 74. In meetings of the Board of Officers and of the Council, half the membership constitutes a quorum. In meetings of the Co-ordinating Committee, half the members of the Board and the representatives of half the number of the Commissions constitute a quorum.

Article 75. If the members present at a meeting of the Council do not constitute a quorum, the President can convene an extraordinary meeting timed to begin not less than 24 hours later. Under these circumstances, twelve members shall constitute a quorum, Article 74 notwithstanding.

FINANCES

Article 76. The income of the Union is derived from:

- (a) annual contributions received from Member Committees in accordance with Article 7;
- (b) revenue from an Ordinary General Assembly, and from symposia of the Commissions in which the Union has a financial interest.
- (c) donations and grants made by Member Committees;
- (d) subventions, donations, grants, levies, and legacies accepted by the Board of Officers on behalf of the Union, in accordance with Article 20.

Article 77. Funds derived from donations and grants are used in accordance with the wishes expressed by the donors. All other funds are used to meet the expenses of the Union incurred in accordance with its objectives.

Article 78. The ordinary expenses of the Union may include:

- (a) expenses of an Ordinary General Assembly
- (b) allocations to the Commissions in support of their scientific objectives.
- (c) expenses relating to travel of the Officers of the Board, Chairs and Vice-Chairs of Commissions, and members of the Secretariat, when on business of the Union;
- (d) the cost of editing and printing the publications of the Union;
- (e) administrative expenses;
- (f) other expenses authorised by the Council.

Article 79. The financial year of the Union begins on 1 January and ends on 31 December.

MISCELLANEOUS

Article 80. The official languages of the Union are French and English. All administrative documents are issued in both languages.

Article 81. In any question relating to the interpretation of these statutes, the French text is regarded as authoritative.

REPORTS ON ACTIVITIES OF INTER-UNION ORGANISATIONS

INTER-UNION COMMISSION ON THE ALLOCATION OF FREQUENCIES TO RADIO ASTRONOMY AND SPACE SCIENCE, IUCAF (1996 - 1998)

— Clean Spectral Windows for Radio Science —

The rapidly changing telecommunications infra-structure around the world represents a mixed blessing for both the developed and the developing nations. The rapidly increasing demand for spectrum is already leading to spectrum congestion. The science services use the electromagnetic spectrum mostly in a passive mode for studies of the Earth's environment and the weather, of the Earth's global resources and its management, of the Earth's ionosphere and of celestial objects within our Galaxy and objects millions of light years away. These ground-based and space-based passive science services are the first to suffer from a congested electromagnetic environment and spectrum pollution.

The 1996 ICSU General Assembly in Washington recognized that the "preservation of clean spectral windows for the science services" is of extreme importance (Resolution 1). IUCAF has already been working for many years towards this goal on behalf of the international Earth remote sensing, space research, and radio astronomy communities. IUCAF leads the radio science efforts and participates actively in the regulatory processes at the level of national and regional administrations and as a Sector Member of the International Telecommunication Union (ITU). Both on the international and the national level, IUCAF members are currently preparing proposals for the passive services issues on the Agenda of the bi-annual ITU-R WRC-00. In all these environments, the passive user community is far outnumbered and out-financed by the commercial representatives.

Not all developed and even fewer developing countries have strong traditions of observational radio science. However, the rapid progress of the telecommunications industry and other economic realities have been pressuring all national governments into making long-term spectrum management decisions, that will unfavorably affect the prospects of radio science in the future. IUCAF and URSI have been working together to present radio science issues to spectrum managers in all and especially in developing countries. Bi-annual Commsphere conferences (Dakar '98 and Toulouse '99) already bring together commercial and non-commercial spectrum users and regulators from many countries in an effort to provide a forum for discussion of spectrum related issues. IUCAF members also support other efforts to raise the awareness of regulators and government officials on issues of spectrum congestion and the needs for the radio science spectrum

users. Seeking general limitations on unwanted emissions from transmitters, establishing protection criteria for frequency bands allocated for radio astronomy and remote sensing, coordination procedures relating to emissions from satellite downlinks, reorganization of the radio spectrum from 71-275 GHz, and preventing to repeat the errors from the past are among the many interest areas of IUCAF members and corresponding members. IUCAF members are active participating in ITU-R Study Group 7 on Science Services and SG 4 and 8 on Satellite Services, ITU-R Task Group 1-5 on Unwanted Emissions, the Space Frequency Coordination Group, as well as many national and regional working groups. The spectrum conservation work of IUCAF has partly been supported by its sponsoring unions, IAU, the International Astronomical Union, URSI, the International Union for Radio Scientists, and COSPAR, the Scientific Committee for Space Research. IUCAF also operates under the umbrella of ICSU, the International Council for Science.

Willem A. Baan (The Netherlands, Chair 1996-1999)
and Klaus Ruf (Germany, Chair since 1999)

Report for 1996

1. Introduction

IUCAF, the Inter-Union Commission on Frequency Allocations for Radio Astronomy and Space Science, was formed in 1960 by URSI, IAU and COSPAR. Its brief is to study and co-ordinate the requirements for radio frequency allocations for radio astronomy, space science, and remote sensing in order to make these requirements known to the national and international bodies for frequency allocations. IUCAF operates as a standing committee under the auspices of ICSU, the International Council of Scientific Unions and is strongly supported by IAU, URSI and COSPAR. ICSU works under the umbrella of the United Nations organisation UNESCO.

2. Membership

At the end of 1996 the composition of IUCAF was:

URSI	W.A. Baan, U.S.A. R.J. Cohen, United Kingdom A. van Eyken, Norway W. Keydel, Germany P. Poiares Baptista, The Netherlands K. Ruf, Germany J.B. Whiteoak, Australia
IAU	R. Sinha, U.S.A. A.R. Thompson, U.S.A. M. Ishiguro, Japan B.A. Doubinsky, Russia

COSPAR D. Breton, France
 A. Gasiewski, U.S.A.

Ex Officio Advisers:

Director ITU Radio Bureau : Robert Jones, Canada

Chairman ITU Radio Board : M. Miura, Japan

During the URSI General Assembly in Lille, France, 1996 the following changes were made to the IUCAF membership sponsored by URSI: Klaus Ruf (Comm. J - Radio Astronomy) replaces Hans Kahlmann after six years of active service in IUCAF. Thank you, Hans. Three new members were added: Tony van Eyken (Comm. G - Ionospheric Radio and Propagation), and Wolfgang Keydel and Pedro Poiares Baptista (Comm. F - Wave Propagation and Remote Sensing).

IUCAF continues to maintain its network of Correspondents in 35 countries to interact with national authorities responsible for radio frequency management.

3. International scientific meetings

During the period of January 1995 to January 1996, IUCAF Members or Correspondents took part in the following meetings:

The fourth and fifth meetings of the ITU-R Task Group 1-3 on Spurious Emissions in Paris (April) and Santa Rosa, CA (October) [IUCAF 422 and 430] Two meetings of ITU-R Working Party 7D in Nancy, France in March and Geneva in October [IUCAF 422 and 428]. The Annual Meeting of CORF, the Committee on Radio Frequencies of the USA National Research Council, in Washington, DC in February. Two meetings of CRAF, the Committee on Radio Astronomy Frequencies of the European Science Foundation, in Manchester, United Kingdom in April and Bologna, Italy in November. The URSI XXVth General Assembly in Lille, France in August [IUCAF 424]. The ICSU XXVth General Assembly in Washington, USA in September [IUCAF 427]. The 16th Annual Meeting of the Space Frequency Co-ordination Group SFCG-16 in Moscow, Russia, in September [IUCAF 431] The ITU-R World Telecommunication Policy Forum, Geneva, in October [IUCAF 429].

4. A description of relevant issues

a) URSI General Assembly

The URSI General Assembly has turned into a long working session for IUCAF. Two general meetings were attended by seventy or more radio astronomers and people from the remote sensing community from many countries. A special session of the General Assembly was totally dedicated to spectrum issues and well attended.

A major issue discussed during the IUCAF meeting related to the co-ordination proceedings in progress with Motorola's IRIDIUM. Because of an inadequate design of the satellite, IRIDIUM intends to transmit spurious emission into a radio astronomy band, which is 20 dB above the "harmful interference threshold". IUCAF issued a position statement at the end of the meeting on these Mobile Satellite Service issues [IUCAF Doc.

425]. In order to show good faith, IUCAF has expressed willingness to co-ordinate with IRIDIUM on behalf of the radio astronomy community. At the writing of this report no real progress has been made in reaching any co-ordination agreement.

Another issue discussed extensively was the use of the mm wave frequency range (frequencies above 60 GHz), that is becoming of interest for commercial use. Up till the present time, the radio astronomers have been mostly alone in using these bands. Concern was expressed about the 95 GHz Cloud Radar proposed by fellow scientists from the remote sensing community. An amicable solution has since been found on this issue (see section d.1 below). One other direct result of the URSI GA is the establishment of the "IUCAF mm Wave Working Group" on the use of frequencies above 70 GHz (see item f below).

The URSI General Assembly adopted a number of resolutions relating to radio astronomy and spectral protection and the need for "clean spectrum" for the use by radio scientists. A similar Resolution was later also adopted by ICSU during its General Assembly (see discussion below).

b) ICSU General Assembly

ICSU is the International Council of Scientific Unions and incorporates international unions as well as academies of sciences. IUCAF is a standing committee operating within the "ICSU family" under the auspices of IAU, URSI, and COSPAR. At the invitation of ICSU, the IUCAF chairman participated in the ICSU General Assembly. The chairman was invited to participate in all discussions and spoke about the needs for clean spectrum for scientific research within the Working Group on Earth and Space Sciences. This group, which mostly consisted of members of the Earth science community, expressed strong support and understanding for the fight against electromagnetic pollution to protect radio sciences.

In the Working Group, URSI and IUCAF presented the text for a new ICSU resolution on "The Need for Radio Frequency Spectrum for Radio Science". This resolution was later adopted as ICSU Resolution 1 of the XXVth GA. The final statement of this resolution "Urgently requests the Executive Board to persuade governments and the International Telecommunication Union, through the appropriate bodies, to maintain adequate protection of those spectral windows that are vital to research of the above types." ICSU has since taken action with regard to this resolution and informed all its member unions. URSI and IUCAF are currently working together to further this message.

c) ITU-R Radiocommunication Sector

c.1 ITU-R Task Group 1-3 on Unwanted Emissions

Task Group 1-3 on "spurious emissions" has held a total of five meetings at half year spacings. Of the passive users, only the radio astronomers showed serious interest in the proceedings of TG 1-3 and several IUCAF members were very active. Several IUCAF papers were contributed to the proceedings describing the presence of spurious emissions in passive bands and the serious concerns about downlinks of the space services.

However, the final outcome of TG 1-3 has not been favourable for the passive services. Commercial spectrum users and equipment manufacturers in the USA, Canada, and Japan forced TG 1-3 to adopt the existing standards of the USA and Canada. Proposed standards are rather lenient and do not reflect state-of-the-art engineering practices. The CEPT countries have already put in place their own standards, which are typically 20-30 dB more stringent than the USA standards. Furthermore, a sudden change of position of the USA allowed that the recommended standards for the Space Services become “design goals” until re-considered at WRC-99. In addition, the Space Services were further exempted from the already lenient standards. An updated recommendation ITU-R SM.329 will be considered at WRC-97. *In this manner the ITU will adopt spurious emission standards that date from the 1970’s, adopt them in 1997 to be enforced starting in the year 2005.*

IUCAF recognises the support that the CEPT countries have given the passive services during the proceedings of TG 1-3. IUCAF also trusts that the “Category B” standards already in force in the CEPT countries will become the de-facto standards, because it is unlikely that manufacturers operating in global markets will adhere to two different standards.

c.2 ITU-R Working Party 7D and 7C

Working Party 7D meets twice a year and deals with ongoing radio astronomy spectrum studies within the ITU-R. WP7D does liaison work with other Study Groups like those of the Space Services in SG 4 and 8. WP7D provides a forum to put forward new ideas and standards on protection for the radio astronomy service. Similarly WP7C works on behalf of the remote sensing community.

d) Spectrum Co-ordination Efforts

d.1 95 GHz Cloud Radar

The radio astronomy community have expressed reservations about the space borne 95 GHz Cloud Radar proposed by fellow scientists from the remote sensing community. Radio astronomers are intensively using the 92 - 100 GHz part of the spectrum although it is not a radio astronomy spectrum. Discussions at the URSI meeting and subsequent meetings in Geneva have produced a compromise solution, that will go forward to WRC-97 in October 1997. Only a small (100 MHz) band will be re-allocated at 94 - 94.1 GHz for active remote sensing. Since only a few satellites will operate in this band, it has been proposed that the down-looking satellite radar will be turned off when it passes overhead of an operating radio astronomy telescope. “If the sky is cloudy, the astronomers will not observe. If the sky is very clear, the cloud radar may have nothing to look at.”

d.2 Mobile Satellite Services

The negotiations between IUCAF and the GLONASS administration (Russia) resulted in a plan to “clean up” the 1612 MHz RAS band from GLONASS emissions. Currently IUCAF is again actively working on protecting this band from Mobile Satellite operations like Motorola’s IRIDIUM. An inadequate design of the satellites causes them to transmit

into the RAS band during high traffic loading, which is unacceptable to a number of radio observatories. Besides direct discussion at various observatories, IUCAF members are also participating in the discussion forums of CEPT SE28, and ITU-R TG 1-3 on this issue. *IUCAF took the initiative to organise an more technical IUCAF-IRIDIUM meeting in Phoenix, AZ, to prepare the basis for co-ordination. This meeting was cancelled by IRIDIUM at the last moment. Since that time IUCAF has done great efforts to keep a united front among the astronomers, in particular because the aim of the satellite people appears to be “divide and conquer”. At present there is a stand-off between the two parties. Discussions with other MSS operators are ongoing.*

e) Remote Sensing Issues

The Remote Sensing community has seen a very active year in 1996. A great effort has been done to finalise requests for Earth Exploration Service allocations at various parts of the spectrum. Because the EES has been behind in its needs for spectrum, the allocation of spectrum for the EES has been placed on the agenda for WRC97. In preparation, the international community has produced a “do-or-die” list of frequencies for active and passive remote sensing. In particular, Daniel Breton (IUCAF, France) and Guy Rochard (France) have played a critical role in establishing this list and in generating discussion on the relative validity of the various bands. Many of the items of this wish list have appeared in “Proposals for the Work of the Conference” from various national administrations. The allocations above 70 GHz have been postponed to the agenda of WRC99, which will allow further alignment with the radio astronomy needs.

During the URSI GA three new members were elected to IUCAF. These members represent various disciplines from the Earth Exploration Services. Because of these members, IUCAF will be able to better serve the remote sensing community and its interests.

f) Radio Astronomy at Frequencies above 70 GHz

The frequency range above the oxygen absorption band at 60 GHz have been allocated to various services but until recently only few (military) applications have used these high frequencies. On the other hand, the radio astronomers have used essentially all the spectrum in the various atmospheric windows up to frequencies of 1000 GHz in order to observe numerous lines from many molecules. This picture is changing rapidly as new technology is becoming available (see section d.1 above on 95 GHz Cloud Radar).

In order to prepare for the future, IUCAF has formed a “mmWave Working Group”. This group has the task to characterise the radio astronomy use of the mmwave spectrum over the last 20 years and to try to prioritise various observing bands. The objective is to be able to prepare balanced proposals by the time of WRC99 on RAS spectrum allocations above 70 GHz. The item of “Radio Astronomy allocations above 70 GHz” has been placed on the official agenda for WRC99. Indeed WRC99 is likely to be the last conference where corrections may be made to existing allocations in order to accommodate radio

astronomy. In addition, ITU-R Working Party 7D will be studying the sharing of critical bands between radio astronomy and other services. This effort is done in co-ordination with similar efforts of the remote sensing community, in order to prepare co-ordinated proposals.

5. Publications and reports

- IUCAF 421 - Annual Report 1995 of IUCAF (Baan)
- IUCAF 422 - ITU-R Working Party 7D Meeting, Nancay Observatory, 25-29 March, ITU-R Task Group 1-3 at CNET, Paris, 1-4 April, 1996 (Cohen, Thompson, Baan)
- IUCAF 423 - "Keeping the Windows to the Radio Universe Open, the side effects of increased telecommunication", ICSU Science International Newsletter No. 62, August 1996 (Baan)
- IUCAF 424 - Report of the XXVth General Assembly of URSI, Lille, France, 28 August - 5 September (Baan)
- IUCAF 425 - IUCAF Position on MSS Sharing, 8 September
- IUCAF 426 - IUCAF Position on the 95 GHz Cloud Radar, September
- IUCAF 427 - Report of the XXVth General Assembly of ICSU, Washington, 24-27 September (Baan)
- IUCAF 428 - Report on ITU-R Working Party 7D, Geneva, 8-16 October (Thompson)
- IUCAF 429 - ITU World Telecommunication Policy Forum on GMPCS - Global Mobile Personal Communications by Satellite, Geneva, 21-23 October (Baan)
- IUCAF 430 - Report on the fifth Meeting of Task Group 1-3 on Spurious Emissions, Santa Rosa, CA, 23-28 October (Thompson)
- IUCAF 431 - Report on IUCAF Participation at SFCG-16, Moscow, 24 September - 3 October (Doubinsky)
- IUCAF 433 - Annual Report 1996 of IUCAF (Baan)

All reports are available on the IUCAF Home Page at <http://www.naic.edu/iucaf/>
All reports have been distributed to the complete IUCAF electronic mailing list.

6. Organisational matters

Finances

Generous support from URSI, IAU, and COSPAR has enabled IUCAF to make travel grants to its Members and Correspondents to ensure adequate participation at important conferences. During 1996 IUCAF was able therefore to participate actively in meetings of the Radiocommunication Sector at the meetings of TG 1-3, the URSI General Assembly, and SFCG-16 of the Space Frequency Co-ordination Group.

It is increasingly important that IUCAF representatives attend key spectrum meetings. Already the IUCAF members are often outnumbered by representatives advocating commercial use of the spectrum. In addition, the remote sensing community has a number of professional spectrum managers. The radio astronomy community has only one in the USA. The radio astronomers working on spectrum issues are all volunteers. Since the co-ordination problems are becoming more global, IUCAF has an important

role to play in preserving the cleanliness of the bands allocated for passive and active scientific use. Such global efforts require an increased travel budget and the continued support of URSI, IAU, and COSPAR is essential. In addition, IUCAF Members and Correspondents have obtained substantial financial support for travel from their home institutions.

Secretariat

IUCAF has no formal Secretariat. The business is conducted from Arecibo Observatory, Puerto Rico, USA and is generously supported by the NAIC, the National Astronomy and Ionosphere Centre, which provides secretarial support and access to all means of electronic communication. NAIC is operated by Cornell University under a co-operative agreement with the National Science Foundation of the United States of America.

7. General publications

A number of publications appeared during 1996 that relate to spectrum issues for the passive services. The chairman wrote an article for the August 1996 issue of *ICSU Science International*, Newsletter No 62 [IUCAF 423]. Similarly, Derek McNally of the ICSU Working Group on "Adverse Environmental Impacts on Astronomy" wrote an article on the "Star of Tolerance" in the same issue. Hans Kahlmann submitted a report on "The Passive Use of the Frequency Spectrum" to the NATO Committee on the Challenges of Modern Society (NATO, CCMS 213, Aug 1996).

In addition, various articles and Letters to the Editor in *Nature*, *Sky and Telescope*, *Physics Today*, and some national newspapers mentioned the IRIDIUM issue and the general plight of the passive services to keep their passive spectrum clean. Various spectrum related reports and submissions have been made by IUCAF Members and associates of a more technical nature to ITU-R forums, the European Science Foundation, the USA Federal Communication Commission, and the CEPT.

A more complete list of publicly available articles is maintained at the IUCAF WWW site.

8. Conclusion

The telecommunication industry is growing extremely rapidly. For example, satellite systems for broadband data transfer to link remote computer systems have become a possibility. At present, a total of 71 of such systems have been announced at the ITU, of which 13 are from the USA alone. These systems will require uplinks and downlinks, and inter-satellite links for the more than 1000 new satellites. The spectrum is a limited and public resource that needs to be conserved and used effectively and carefully. Will the passive services be able to survive in such a competitive environment ?

The name of the ITU in itself suggests that its emphasis lies with "telecommunication". Passive spectrum use for scientific purposes is often an afterthought. Although IUCAF worked very hard within Task Group 1-3, the Group's final recommendations are discouraging. Manufacturers of radio equipment prevailed to allow

inferior equipment to be marketed without penalty. It was said during these meetings that: “We are not going to modify the rules for all of the industry in order to protect a small number of radio astronomy observatories”.

Spectrum is becoming increasingly valuable. Certain countries have already “auctioned” parts of the spectrum in order to compensate for the cost of spectrum management and for filling the coffers of state. As a result, the paying spectrum users will consider it “a right” to transmit and not “a privilege”. Furthermore, because of financial considerations, the ITU is considering a more active role for the commercial entities in spectrum management. This raises concerns that passive spectrum use as advocated by international scientific organisations will become a secondary aspect of spectrum allocation in the future.

An increasing number of spectrum issues faces the passive and active scientific spectrum users and IUCAF has its work cut out for many years to come. IUCAF continues to provide information to the community via email exploders and using presentations at various scientific meetings. Within the telecommunication race, IUCAF has a critical role that is becoming more global each day.

W.A. Baan, Chairman

Report for 1997

1. Introduction

IUCAF, the Inter-Union Commission on Frequency Allocations for Radio Astronomy and Space Science, was formed in 1960 by URSI, IAU and COSPAR. Its brief is to study the requirements of radio frequency allocations for radio astronomy, space science, and remote sensing in order to make these requirements known to the national and international bodies that allocate frequencies. IUCAF operates as a standing committee under the auspices of ICSU, the International Council of Scientific Unions and is strongly supported by IAU, URSI and COSPAR. ICSU works under the umbrella of the United Nations organisation UNESCO.

2. Membership

At the end of 1997 the composition of IUCAF was:

URSI	W.A. Baan, U.S.A. (currently The Netherlands)
	R.J. Cohen, United Kingdom
	A. van Eyken, Norway
	W. Keydel, Germany
	P. Poiars Baptista , The Netherlands
	K. Ruf, Germany
	J.B. Whiteoak, Australia
IAU	S. Ananthkrishnan, India
	A.R. Thompson, U.S.A.

K. Kawaguchi, Japan
B.A. Doubinsky, Russia
COSPAR D. Breton, France
A. Gasiewski, U.S.A.

Ex Officio Advisers:

Director ITU Radio Bureau Robert Jones, Canada

Chairman ITU Radio Board M. Miura, Japan

During the 1997 IAU General Assembly in Kyoto, Japan, replacement changes were made to the IAU representation on IUCAF: Dr. Kentaro Kawaguchi from Nobeyama Observatory in Japan, Prof. Dr. S. Ananthkrishnan from the Tata Institute and the Giant Meter Radio Telescope (GMRT) in Pune, India. Thanks to R. Sinha (India) and M. Ishiguro (Japan) for their service to the spectrum management community.

IUCAF continues to maintain its network of Correspondents in 35 countries in order to interact with national authorities responsible for radio frequency management.

3. International scientific meetings

During the period of January to December 1997, IUCAF Members and Correspondents took part in the following meetings:

February	The Annual Meeting of CORF, the Committee on Radio Frequencies of the USA National Research Council, in Washington, DC.
March	Meeting of CRAF, the Committee on Radio Astronomy Frequencies of the European Science Foundation, in St. Petersburg, Russia.
May	The WRC-97 Conference Preparatory Meeting in Geneva [IUCAF 434].
June	Meeting of ITU-R Working Party 7D in Geneva [IUCAF 435].
July	The first meeting of ITU-R Task Group 1-5 on Unwanted Emissions in Geneva [IUCAF 436].
August	The IAU XXVth General Assembly in Kyoto, Japan [IUCAF 438].
September	The 17th Annual Meeting of the Space Frequency Co-ordination Group SFCG-17 in Houston, USA [IUCAF 437].
October	Second meeting of CRAF in Zurich, Switzerland.
October	The ITU-R Radiocommunication Assembly 1997, Geneva [see IUCAF 439, 441].
October/November	The ITU-R World Radiocommunication Conference 1997 [IUCAF 440, 441 and 441A].

4. Description of relevant issues

4.1 IAU General Assembly

Just as the URSI GA in August 1996, so also the General Assembly of the International Astronomy Union (IAU) has turned into one long working session for IUCAF. Two general

meetings were well attended. Several well attended special sessions of the GA were totally dedicated to spectrum issues. In addition, a special meeting on spectrum management for Observatory Directors was organised to brief the directors on the trends in spectrum management and to unify the RAS efforts in this area. An extensive report on the various meetings has been reproduced on the IUCAF Website (Doc 438).

A major issue discussed during the IUCAF meetings and the Directors' meeting related to the co-ordination proceedings in progress with Motorola's IRIDIUM (see Doc 438). IUCAF has been leading in the this co-ordination efforts, and IUCAF has repeatedly expressed willingness to co-ordinate with IRIDIUM on behalf of the radio astronomy community. At the writing of this report no real progress has been made in reaching any satisfactory co-ordination agreement. During the IAU GA the "Kyoto Declaration" was drafted under the leadership of Prof. Roy Booth (Sweden), which was signed by 36 observatory directors. The Declaration draws attention to the increasing problems experienced by radio astronomers and proposes to resolve this problem through vigilance, education of other spectrum users and in-house research. Strong support has been expressed by the directors for the activities of IUCAF, CRAF and CORF.

Another issue discussed extensively at the GA was the use of the mm wave frequencies above 60 GHz, which are becoming of interest for commercial use. Up till the present time, the passive users have been mostly alone in using these bands. Concern was expressed about the 95 GHz Cloud Radar proposed by fellow scientists from the remote sensing community. An amicable solution has since been found on this issue (see section 4.4.1 below). The "IUCAF mm Wave Working Group" on the use of frequencies above 70 GHz is working intensely on this issue (see item 4.6 below).

4.2 Joint URSI-IUCAF Efforts - Commsphere Conferences

During the ICSU XXVth General Assembly in Washington D.C. in 1996, URSI and IUCAF presented the text for Resolution 1 on "The Need for Radio Frequency Spectrum for Radio Science". The final statement of this resolution "Urgently requests the Executive Board to persuade governments and the International Telecommunication Union, through the appropriate bodies, to maintain adequate protection of those spectral windows that are vital to research of the above types". URSI, under the leadership of Vice-President J. Shapira and with support from IUCAF, is taking further action on this issue on behalf of ICSU. A letter is being prepared to be sent to all National Academies of Science explaining the needs of the passive scientific spectrum users and suggesting specific actions to be taken at the national level.

IUCAF continues to support the organisational efforts for the Commsphere Conferences, and particularly Commsphere Africa (July 1998, Dakar), and Commsphere 99 (January 1999, Toulouse). These conferences are aimed at facilitating "an open discussion on spectrum use and spectrum applications". Participants of the conferences have professional backgrounds and interests that vary from governmental spectrum management, commercial operations, industrial design environments, and passive/scientific spectrum use, to the building and providing communication infra-structure of developing

countries. IUCAF members actively participate in these conferences as they provide the correct forum for open discussions on spectrum matters.

4.3 ITU-R Radiocommunication Sector

4.3.1 ITU-R Task Group 1-5 on Unwanted Emissions

The standards proposed in the final version of Recommendation ITU-R SM.329 by the Task Group 1-3 on “Spurious Emissions” were rather lenient and did not reflect state-of-the-art engineering practices. This Recommendation ITU-R SM.329 has been reviewed at WRC-97 and incorporated into Appendix S3 of the Radio Regulations, such that these new “spurious emission standards” will apply to all systems installed after January 2003 and to all transmitters after January 2013. The community will need to wait six years before these new (and greatly inadequate) “Category A” limits (from the USA and Canada regulations) will be first enforced. Already the CEPT countries have put in place their own standards, which are typically 20-30 dB more stringent than the TG 1-3 standards. Furthermore, the recommended (lenient) standards for the Space Services, are only “design goals” until re-considered and possibly redefined at WRC-99.

At WRC-97 the Recommendation 66 was also modified to allow the new Task Group 1-5 to do its work on “Unwanted Emissions”, which includes unsolved issues on spurious emissions as well as out-of-band emissions. IUCAF members are playing a leading role in the ongoing work of Task Group 1-5 on behalf of the passive user community. Several IUCAF papers have been contributed to these proceedings describing issues of spurious and out-of-band emissions in passive bands and the particularly serious threats of downlinks of the space services.

4.3.2 ITU-R Working Party 7D and 7C

Working Party 7D meets twice a year and deals with ongoing radio astronomy spectrum studies within the ITU-R. The radio astronomers working in WP7D maintain the liaison with other Study Groups such as those of the Space Services in SG 4 and 8. WP7D provides a forum to put forth new ideas and standards on protection for the radio astronomy service. Current issues within WP7D are a) the “10 percent issue”, relating to the amount of time that can be lost to man-made interference, b) the use of Monte Carlo methods for the determination of co-ordination distances between mobile spectrum users and radio astronomy observatories, and c) the mmwave radio spectrum above 71 GHz. Similarly WP7C works on behalf of the remote sensing community.

4.3.3 The Radiocommunication Assembly and World Radiocommunication Conferences

The bi-annual ITU World Radiocommunication Conference (“WRC-97”) was held in Geneva from October 27 to November 21, 1997. Spectrum allocation issues for the Radio Astronomy (“RAS”) were not on the Agenda for this Conference, only issues of peripheral interest. However, the allocation of spectrum for the Earth Exploration Satellite (“EES”) service was an important part of the Agenda, because the EES had not been allocated any spectrum since 1979. The EES was partially successful in its efforts regarding relevant issues, while the RAS was more so. Participation from both the radio astronomy and

Earth exploration communities was strong during the Conference and there was effective co-ordination between both groups. The remote sensing people were all part of national delegations, while half of the RAS representatives were part of the IUCAF delegation. With a total of 15 delegates at WRC-97, the RAS had a mid-size delegation. The ITU Radiocommunication Assembly (“RA”) dealing with the work of the ITU Study Groups was held in the week preceding WRC-97.

IUCAF submitted one input document to the RA (IUCAF 439) related to the use of Monte Carlo methods in the determination of co-ordination zones around radio observatories. The input Document for WRC-97 (IUCAF 440) was a position document describing the IUCAF positions on all WRC-97 Agenda Items relating to the RAS. This document was well received and was used within IUCAF and among administrations to help determine the course of action in these issues.

The following global trends characterised the WRC-97 conference:

1. The Conference showed a continued pressure from operators and certain administrations to consolidate more spectrum allocations for satellite applications.
2. Serious co-ordination efforts still need to be made to allow implementation of many planned (mostly non-GSO) satellite systems and to allow a peaceful coexistence of new systems and existing systems. It appears that sharing in certain bands between different satellite systems and various terrestrial applications will be very difficult if not impossible.
3. The demand for high frequency spectrum has risen dramatically with the possibility of terrestrial and satellite-based high-density data systems. Specific new assignments have been made for such applications up to frequencies of 66 GHz. In particular, “high density fixed” applications have been given provisional band space for providing such services as “Internet to the home and the car”. An aerostat balloon system is being designed to serve about 200 cities world-wide in this manner from heights of 20 km or more. Although many of these systems might still be far into the future, passive spectrum users are warned that the (currently interference-free) mmwave spectral regions may soon have active applications.
4. Other services, such as those of terrestrial fixed and aeronautical radio navigation, are seriously worried about “harmful interference”, a fact they strongly expressed at the Conference. It is becoming clear that the RAS and EES are not anymore the sole sufferers from unwanted emissions and so there may be some new allies of the passive spectrum users.

4.4 Current Spectrum Management Issues

4.4.1 95 GHz Cloud Radar

In the past radio astronomy community has expressed reservations about the space borne Cloud Radar at 95 GHz proposed by fellow scientists from the remote sensing community.

WRC-97 adopted a narrow (100 MHz) allocation in the 94 - 94.1 GHz band for active remote sensing. A new footnote RR 5.562 restricts this band for cloud radars only. These radars will be turned off over mmwave RAS observatories.

4.4.2 Mobile Satellite Services

The negotiations between IUCAF and the GLONASS administration (Russia) resulted in a plan to “clean up” the 1612 MHz RAS band from GLONASS emissions by the year 2006. Progress is being made and the band is already considerably cleaner than before. Currently IUCAF is again intensely working on preventing interference in this band from Mobile Satellite Service operations from systems such as Motorola’s IRIDIUM with 66 satellites. An inadequate design of the satellites causes them to produce out-of-band emissions in the RAS band during higher traffic loading, which will destroy observations at a number of radio observatories. No progress has yet been made in the stand-off situation with Iridium but the discussions with MSS operators are ongoing. IUCAF members are also part of the discussions in CEPT SE28, and ITU-R TG 1-5 on general satellite issues.

In various discussions and publications, IUCAF has expressed its strong concerns about the interference potential from downlinks of the space services. These are the single most imminent threat for the terrestrial passive spectrum users. The emission standards for satellite transmission systems are not very restrictive, because economic factors play a dominant role in their design. In particular, as the operating frequencies get higher, it is becoming more difficult to build effective filters. IUCAF Documents 442 and the IUCAF contribution to Joint Discussion 5 on Interference at the IAU (Doc 444) clearly state the problems and some of the solutions.

4.5 Remote Sensing Issues

The EES community was not completely successful in all its objectives for WRC-97. About 18 allocations for the Earth Exploration Satellite service have been made in bands from 400 MHz to 94 GHz. Some of these allocations were upgrades from secondary to Primary and some are new world-wide Primary allocations. Many have restrictive “non-interference to existing services” footnotes. Before WRC-97 extensive studies had been done to realign the allocations in the 50.2 - 71 GHz bands to accommodate the needs of the EES (passive) and SR (passive) and other active services (like Inter-Satellite Service) in the high-opacity oxygen absorption bands. The proposals for the allocation plan have been adopted by WRC-97. The allocations for EESS (passive) above 71 GHz have been deferred to WRC-99 (see next section).

4.6 Passive Spectrum Use at Frequencies above 71 GHz

A new resolution from WRC-97 calls for studies of EESS (passive) and RAS frequency bands above 71 GHz (WRC-99 Agenda 1.16). The two communities are working together intensely in order to align their requirements for spectrum use at higher frequencies at WRC-97. The frequency range above 30 GHz has drawn strong interest for commercial applications. On the other hand, the passive spectrum users and particularly the radio

astronomers have essentially had all the spectrum in the various atmospheric windows up to frequencies of 1000 GHz available for observations of the thousands of lines from many molecules. This picture will change rapidly as new techniques become available.

The IUCAF “mmWave Working Group” is playing an important role in the preparations for WRC-99 and for the preparation of a co-ordinated request for passive spectrum allocations at high frequencies. This group has characterised the radio astronomy use of the mmwave spectrum over the last 20 years and has attempted to prioritise various observing bands. Indeed WRC-99 is likely to be the last conference where corrections may be made to existing allocations in order to accommodate passive services. IUCAF and the mmWG is submitting studies to ITU-R Working Party 7D regarding the sharing conditions of critical bands between radio astronomy and other terrestrial services. In particular, the remote locations of radio observatories allow sharing of mmwave spectrum with Mobile and Fixed services by creating quiet zones or co-ordination zones.

5. Publications and reports

All reports are available on the IUCAF Home Page at <http://www.nfra.nl/iucaf/> Most reports have been distributed to the complete IUCAF electronic mailing list. Any person requiring additional information on spectrum management relating to the passive use spectrum may contact the IUCAF Secretariat.

- IUCAF 432 - URSI Commsphere 97, Lausanne, February 1997
- IUCAF 433 - Annual Report 1996 of IUCAF
- IUCAF 434 - Conference Preparatory Meeting CPM97 for WRC-97, Geneva, May 1997
- Various inputs to ITU-R Working Party 7D
- IUCAF 436 - ITU-R Task Group 1-5, Geneva, July 1997
- IUCAF 437 - Space Frequency Co-ordination Group SFCG-17, Houston, 1997
- IUCAF 438 - IAU General Assembly 1997, Kyoto, August 1997
- IUCAF 439 - Input Radiocommunication Assembly (RA97/PLEN/54-E), Oct 97
- IUCAF 440 - Input ITU-R WRC-97, (WRC-97 144-E) Geneva Oct/Nov 1997
- IUCAF 441 - WRC-97 RAS and EES Results, Geneva, Oct/Nov 1997
- IUCAF 441A - WRC-97 Results, Condensed Version, Geneva, Oct/Nov 1997
- IUCAF 442 - IUCAF Position on Radio Interference, November 1997

6. Organizational matters

Finances: Generous support from URSI, IAU, and COSPAR has enabled IUCAF to make travel grants to its Members and Correspondents to ensure adequate participation at important conferences. During 1997 IUCAF was able therefore to participate actively in meetings of the Radiocommunication Sector, at the meetings of ITU-R Task Group 1-5, the ITU-R World Radiocommunication Conference 1997 all in Geneva, the IAU General Assembly in Kyoto, Japan, and SFCG-17 of the Space Frequency Co-ordination Group in Houston, USA.

It is increasingly important that IUCAF representatives attend key spectrum meetings. Already the IUCAF members are often outnumbered by representatives advocating commercial use of the spectrum. The radio astronomers working on spectrum issues are mostly volunteers. Within the radio astronomy community there is one such spectrum manager at the National Science Foundations in the USA and recently a second person started work at Dwingeloo, The Netherlands, as Spectrum Manager for the European Science Foundation. On the other hand, the remote sensing community has a number of professional spectrum managers. Since the co-ordination problems are becoming more global, IUCAF has an important role to play in preserving the cleanliness of the bands allocated for passive and active scientific use. Such global efforts require an increased travel budget and the continued support of URSI, IAU, and COSPAR is essential. In addition, IUCAF Members and Correspondents have obtained substantial financial support for travel from their home institutions.

Secretariat: IUCAF has no formal Secretariat. During 1997 the business of the IUCAF Secretariat was conducted from Arecibo Observatory, Puerto Rico, USA and was generously supported by the NAIC, the National Astronomy and Ionosphere Centre, which provided partial travel support, secretarial support and access to all means of electronic communication. NAIC is operated by Cornell University under a co-operative agreement with the National Science Foundation of the United States of America. Beginning 1998, the IUCAF Secretariat has changed co-ordinates to the Westerbork Observatory, Netherlands Foundation for Radio Astronomy (NFRA-ASTRON) in Dwingeloo, The Netherlands.

7. General publications

A number of publications appeared during 1997 that relate to spectrum issues for the passive services. A rather complete list of publicly available articles is maintained at the IUCAF WWW site (www.nfra.nl/iucaf/).

In addition, various articles and Letters to the Editor in *Nature*, *Sky and Telescope*, *Physics Today*, and some national newspapers mentioned the IRIDIUM issue, the WRC-97 results, and the general plight of the passive services to keep their passive spectrum clean. Various papers of a more technical nature have been submitted by IUCAF Members and associates to ITU-R committees and conferences, the European Science Foundation, the USA Federal Communication Commission, and the European CEPT.

The contributions to Joint Discussion 5 from the IAU GA will be published as a book and edited by Prof. S. Isobe (Japan). This review will provide a broad discussion of "astronomical pollution issues" and will be useful as a general information document.

8. Conclusion

At this time of rapid growth in the telecommunication industry, the position of the passive spectrum users is also strengthened. There is increasing recognition that the protection levels for passive spectrum use are a necessity for survival. The passive spectrum user community has not changed its "need for protection message" for many years, although

many experiments are done at power flux density levels of one or several orders of magnitude below the protection levels published in the ITU literature. A growing number of administrations has become cognisant of the needs of the passive services and is committed to provide for and protect them.

The protection levels for harmful interference are often difficult to meet by active spectrum users. Some companies and operators take pride in co-operating with the passive users. Others hope the problem will go away and try to steam-roll applications through the system that are less efficient in their use of the spectrum. Of course, spectrum efficiency has different meanings for different spectrum users, depending on the financial consequences.

Certain members and friends of IUCAF are participating in efforts to bring the radio spectrum pollution issue to the highest governmental offices. The OECD Mega-Science Forum on Radio Astronomy has addressed these issues and intends to bring them to the attention of government officials and leaders of the telecommunication industry. IUCAF wholeheartedly supports this effort and hopes that this will lead to increased recognition of the global issues facing the scientific community.

The issues for the passive user community are clear. For the radio astronomers, the satellite downlinks comprise the most imminent threat that necessitates constant supervision. In this regard, the work of Task Group 1-5 is indispensable for setting standards for unwanted emissions in the future. TG 1-5 is indeed looking at practical rules for protecting the passive user operations. The allocations in the spectrum above 71 GHz will be high on the list of priorities for the communities because of the deadlines put by the WRC-99 conference. Within the telecommunication race, the role of IUCAF is becoming more globally inclusive each day.

W.A. Baan, Chairman
Dwingeloo, The Netherlands
March 31, 1998

Report for 1998

1. Introduction

The Scientific Committee on Frequency Allocations for Radio Astronomy and Space Science, IUCAF, has been formed in 1960 by URSI, IAU and COSPAR. Its brief is to study the requirements of radio frequency allocations for radio astronomy, space science, and remote sensing in order to make these requirements known to the national and international bodies that allocate frequencies. IUCAF operates as a standing committee under the auspices of ICSU, the International Council for Science and is strongly supported by IAU, URSI and COSPAR. ICSU works under the umbrella of the United Nations organisation UNESCO.

As a result of the changes in the statutes of ICSU made during a Special General Assembly in 1998, IUCAF has changed its name in 1998 from Inter-Union Commission to Scientific Committee, while retaining its original acronym. The name of ICSU itself has also changed from International Council for Scientific Unions to International Council for Science.

2. Membership

At the end of 1998 the composition of membership for IUCAF was:

URSI	W.A. Baan, The Netherlands R.J. Cohen, United Kingdom A. van Eyken, Norway W. Keydel, Germany P. Poiares Baptista, The Netherlands K. Ruf, Germany J.B. Whiteoak, Australia
IAU	S. Ananthkrishnan, India A.R. Thompson, USA M. Ohishi, Japan B.A. Doubinsky, Russia
COSPAR	D. Breton, France A. Gasiewski, USA

Ex Officio Advisers:

Director ITU Radio Bureau	Robert Jones, Canada
Chairman ITU Radio Board	M. Miura, Japan

At the request of Dr. Kentarou Kawaguchi from Nobeyama Radio Observatory, Dr. Masatoshi Ohishi from the National Observatory in Tokyo, Japan, has taken over the responsibilities of IUCAF membership. Dr Ohishi is very active in millimetre-wave molecular line astronomy and has been Co-Chair of the MM Working Group that has been instrumental in preparing the scientific basis for the radio astronomy proposals on the bands above 71 GHz for the WRC-2000. We thank Ken for his contributions to IUCAF in the last years and we wish him well with his work.

IUCAF continues to maintain its network of Correspondents in 35 countries in order to interact with national authorities responsible for radio frequency management.

At the end of 1998, the membership of IUCAF has decided to appoint Dr. Klaus Ruf from the Max Planck Institute for Radioastronomy in Bonn, Germany, as chairman after Dr. Willem Baan had expressed the desire to step down. During 1998 Dr. Baan has taken up the new function as Director of Westerbork Observatory in The Netherlands. Dr. Ruf had already served as secretary for IUCAF during most of 1998 and has extensively participated in national and international activities relating to spectrum management on behalf of the science services. The transition of Chairmanship will take place in the next

meeting of IUCAF in Grenoble in January 1999. The secretariat and the Homepage location of IUCAF will move to the MPIfR in early 1999.

3. International meetings

During the period of January to December 1998, IUCAF Members and Correspondents took part in the following meetings:

January	ITU-R Task Group 1-5 on Unwanted Emissions in Geneva
February	IUCAF Pre-Meeting at IRAM in Grenoble, France
February	ITU-R Working Party 7D in Geneva, Switzerland
April	Meeting of CRAF, the Committee on Radio Astronomy Frequencies of the ESF in Bonn, Germany
July	ITU-R Task Group 1-5 on Unwanted Emissions in Munich, Germany
July	Commsphere Africa in Dakar, Senegal
September	CEPT Consultation on European Spectrum Policy in Brussels, Belgium
September	IUCAF Pre-Meeting at IRAM in Grenoble, France
September/October	ITU-R Working Party 7D in Geneva, Switzerland
October	Meeting of CRAF, the Committee on Radio Astronomy Frequencies of the ESF in Strasbourg, France

3.1 IUCAF Meetings

During the year 1998 IUCAF has met two times as a committee with invited guests at Institute Radio Astronomie Millimetric (IRAM) in Grenoble, France. These pre-WP7D meetings were held with the purpose of discussing and focussing on important issues without the interference of other (non-science) interest groups. IUCAF is thankful for the hospitality given by IRAM and its Director, Dr. Michael Grewing.

During international meetings attended by radio scientists in the last few years, caucus meetings under flag of IUCAF have served well to bring together the radio scientists to determine common positions regarding issues in these meetings.

4. Contact with the Unions

IUCAF has kept regular contact with the secretariats of the supporting unions and with the ICSU secretariat. The Unions plays a strong supporting role for IUCAF and the membership is greatly encouraged by their support.

4.1 Relations with IAU

In collaboration with members of IAU Commission 50, IUCAF members assisted in the preparations of IAU Colloquium 196 in Vienna, Austria in July 1999. This conference on "Preserving the Astronomical Skies" will address all issues of pollution related to astronomy including light pollution and the issue of space debris. The topical meeting will be held the week preceding the UNISPACE III conference organised by UNESCO on the "Peaceful Use of Space". Regular contact has been maintained between the General Secretary and the Chairman.

4.2 Relations with URSI – The Commsphere Conferences

Commsphere Africa was held 20-22 July in Dakar, Senegal. At this meeting the IUCAF Chairman presented a general overview of the various scientific uses of the radio spectrum and some of the applications relevant for the continent of Africa. The need for protection of the science bands was clearly relayed. In addition, the talks by Joe Shapira (URSI VP, Israel) and R. Struzak (ITU, Geneva) also re-emphasised the needs for the scientific services.

The meeting was attended by 50 representatives from African telecoms, African government regulators (and some from France), educators, and some satellite operators operating in Africa. The purpose of this meeting was to address the development of telecom infrastructure in Africa, multi-national co-ordination in regional and ITU related spectrum management issues. In particular, the need for collaboration was addressed extensively and great progress was made in local networking efforts. It has become clear that this Commsphere meeting contributed significantly in this African effort and it is hoped that the African nations can produce a strong common position in the upcoming WRC-2000.

IUCAF members actively participated in the organisation of the next Commsphere meeting to be held from 25 to 28 January, 1999, in Toulouse, France. This URSI meeting will again provide a discussion forum between passive (scientific) spectrum users, government regulators, telecom operators, and manufacturers. It is important that passive spectrum users actively participate in these forums and also contribute papers.

5. *Affairs of the international telecommunication union*

5.1 The ITU-R World Radiocommunication Conference 2000

The World Radiocommunication Conference planned for October November of 1999 has been postponed to the period of 8 May – 2 June 2000 and will be in Istanbul, Turkey. The Agenda Items that relate to Passive Scientific use of the spectrum can be found at the IUCAF Web site. An IUCAF-CRAF-CORF position paper is being produced addressing all these relevant issues. The Agenda of WRC-2000 also sets a large fraction of the agendas for Working Parties 7C, 7D, and Task Group 1/5 as much of the preparatory work for the Conference is done in the ITU-R Study Groups.

- 2.2 The WRC-2000 Agenda Items Related to Radio Science
- 2.2 Finalise the remaining issues on spurious emission in Appendix S3 for space services,
- 1.4 Consider issues relating to allocations and regulatory aspects related to Res. COM5-16 (40.5 - 42.5 GHz FSS (space-Earth)) and others,
- 1.5 Consider regulatory provisions and possible additional frequency allocations for services using High Altitude Platforms taking into account the results of COM5-7,
- 1.6.1 Review the spectrum requirements for the operation of terrestrial IMT-2000 with the view to identify future expansion bands and adjustments to the Table of Allocations,
- 1.9 Take into account the results of ITU-R studies in evaluating the feasibility of an allocation in the space-to-Earth direction to the MSS in a portion of the 1559 - 1567

- MHz frequency range, in response to Resolutions 213 and COM5-31,
- 1.10 To consider the results of ITU-R studies in accordance with Resolution COM5-24 (Use of the bands 1525 - 1559 MHz and 1626.5 - 1660.5 MHz by the MSS),
 - 1.11 Consider constraints on existing allocations and to consider additional allocations on a world-wide basis for the non-GSO/MSS below 1 GHz, taking into account Res. 214 (Rev WRC-97) and COM5-25 (406 MHz),
 - 1.13 On the basis of the results of the studies in accordance with Resolution COM5-18 on the “Use of NGSO (non-geo-stationary-orbit) systems in the FSS in certain frequency bands”,
 - 1.14 Review the results of the studies on the feasibility of implementing NGSO MSS feeder links in the 15.43 - 15.63 GHz range in accordance with Res. COM5-8,
 - 1.15.1 To consider new allocations to the radio-navigation-satellite service required to support developments in the range from 1 to 6 GHz,
 - 1.16 To consider allocation of frequency bands above 71 GHz to the EES (passive) and RAS, taking into account Res. COM5-1,
 - 1.17 To consider possible world-wide allocations for the EES (passive) and SR (passive) services in the band 18.6 - 1.8 GHz taking into account the results of the ITU-R studies.

5.2 *IUCAF Activities Related to the Agenda Item 1.16 of WRC-2000*

The IUCAF MMWave Working Group under chairmen Drs. Phil Jewell (NRAO, USA) and Masatoshi Ohishi (NAO, Japan) has finished its epic evaluation of the needs of radio astronomy at frequencies above 71 GHz and presented this report to WP 7D during its October Meeting (ITU-R WP7D/xxx). This effort was aimed at providing the scientific basis for the request for astronomy allocations of frequency bands as addressed in this crucial WRC-2000 Agenda Item 1.16. This conference will provide the last opportunity for the radio science community to make significant changes in the frequency allocation table above 71 GHz. Such changes are needed in order to reflect the changes in scientific insights that were gained since the current table was adopted at WARC-79. The guiding principles for re-allocation of the RAS bands have been the following: 1) the RAS can share some spectrum with terrestrial services by means of protection zones around the few mmwave observatories, 2) satellite downlinks and aeronautical operations need to be located adjacent to each other at the edges of atmospheric spectral windows, 3) any potentially damaging active operations need to be located in places where they do least damage to passive spectrum use, and 4) all services need to have continued access to the spectrum.

Based on the spectrum requirements in this MMWG document and similar requirements from the remote sensing community a proposal has been produced for the allocation table above 71 GHz. Within Europe, the CEPT Project Team 33 (Chairman Chris van Diepenbeek, The Netherlands) has been very essential in addressing this issue, which resulted in a proposal plan for re-organisation of the bands from 71 GHz to about

300 GHz. This plan has been submitted to WP7D and WP7C for discussion in the Fall meetings and to the SFCG, the Space Frequency Co-ordination Group, in their September meeting in Kyoto. In addition, co-ordination between WP7C (EES) and WP7D (RAS) participants from the USA, Japan, Australia, and Europe has resulted in further modifications of the proposal. This issue will be addressed further in the upcoming SG7 meetings and in various personal contacts in order to finalise these proposals in time for the Conference Preparatory Meeting in the Fall of 1999. The current proposals would give the remote sensing community access to bands that are of crucial importance for the studies of the Earth atmosphere and the surface. Similar the RAS will obtain dramatically increases in spectrum shared with terrestrial telecommunication services.

5.3. ITU-R Task Group 1-5 on Unwanted Emissions

The "Spurious Emission" standards contained in Recommendation ITU-R SM.329 have been incorporated into Appendix S3 of the Radio Regulations at WRC-97. The international community will have to wait six years before these "Category A" limits (mostly from the USA and Canada regulations) will be first enforced. It should be noted that these new standards will do very little to help the radio science community in protection from interference. On the other hand, the CEPT countries have put in place standards, which are typically 20-30 dB more stringent than the ITU-R standards.

At WRC-97 the Recommendation 66 was also modified to allow the new Task Group 1-5 to do its work on "Unwanted Emissions", which includes the unsolved issues on spurious emissions as well as the out-of-band emissions. IUCAF members have been playing a leading role in the ongoing work of Task Group 1-5, providing many input papers and the chairmen of large and critical drafting groups. IUCAF has considered TG 1-5 and its work very important for radio science and both TG 1-5 meetings in 1999 had some six radio astronomy participants from various countries. The important issues for the first two meetings of TG1-5 have been 1) setting the Space Service Limits that have only been "design limits" since WRC-97 and the preparation of CPM text, 2) revising Recommendation ITU-R SM.329 in order to also include limits for out-of-band emission, 3) revising the SM.328 on out-of-band emissions and better define the boundary conditions between spurious and OOB, and 4) defining protection procedures for the safety and passive services.

Although Recommendation 66 was initially meant to promote the study of new standards for unwanted emissions in order to protect the passive services, this part of the objective has been pushed back further and further into the background. It became clear already in the proceedings of TG 1-3, that the tighter standards would be burdensome for the Space Services and would cost much money to implement. Since then the Space Service operators, particularly from the USA and Canada, have led the effort to resist any tighter emission standards in Task Group 1-5. The CEPT countries in collaboration with the European space operators and equipment manufacturers have been very willing to establish standards for terrestrial and space operations that are meaningful. The effort of the USA has been to establish very lenient "safety net" standards as general standards and

consider other state-of-the-art standards (as from CEPT) as special cases. This USA position has severely limited the viability of the TG 1-5 effort and is degrading the eventual outcome.

As a result of this Space Services effort the protection of the passive services and of the safety services have been relegated to a special case as well. In particular, the radio astronomy protection levels are very difficult to meet for the space operations. A Canadian proposal in tune with the wishes of the space services community has suggested that radio astronomy bands be considered on a “band-by-band” basis. Rather than having general limits that would benefit all spectrum users by reducing unwanted emissions as intended by Rec. 66, this proposal will only protect the radio science bands to a level that is practical for the interfering service. Such protection may not even meet the required criteria of the radio science bands.

Despite the goodwill of the IUCAF and RAS participants, the protection of the radio science bands will remain in jeopardy because of the burden it presents particularly for the space operators. In the meantime, the terminology of the discussions has changed as well. In general, spectrum sharing has been used to describe the situation where two equal spectrum occupants share the spectrum. Now the word sharing is also used to describe the situation, where a primary user needs to share the spectrum with a neighbour that is polluting its spectrum because of unwanted emissions. This would imply that bad engineering has turned into a right to invade a neighbour’s spectrum.

5.4. ITU-R Working Parties 7D and 7C

Working Party 7D meets twice a year and deals with ongoing radio astronomy spectrum studies within the ITU-R. The radio astronomers working in WP7D maintain the liaison with other Study Groups such as those of the Space Services in SG 4 and 8. WP7D provides a forum to put forth ideas and standards on protection for the radio astronomy service, while WP7C addresses the issues of the remote sensing community. Some twelve to fourteen radio scientists participated in both WP7D meetings of which six were IUCAF members.

A major effort for Study Group 7 has been the preparation of the guidance text on all relevant issue to be included in the Report for the Conference Preparatory Meeting for WRC-2000. CPM text has been produced on the following major issues:

- a) the use by the Fixed Satellite Service of the 42.5-43.5 GHz band, which is adjacent to an important RAS band (Item 1.4 & Resolution 128),
- b) the use of the 48 GHz band by High Altitude Platforms above major metro areas for high density (broad band) applications (Item 1.5 & Resolution 122),
- c) the use of the 1626.5-1660.5 MHz band usage by the Mobile Satellite Service (Item 1.10 & Res. 218). This concerns a revision of text and application of Recommendation ITU-R M.1316 “Principles and methodology for frequency sharing in the 1610.6-1613.8 and 1660-1660.5 MHz bands between the MSS (Earth-to-Space) and the RA service”,

- d) the re-allocation of bands below 1 GHz Item 1.11 (Res. 214 and 219),
- e) the creation of a global allocation for the Earth Exploration Satellite Service in the 18 GHz band as contained in Item 1.17,
- f) the mmwave radio spectrum for the EES and the RAS above 71 GHz (Item 1.16 & Res. 723), and
- g) Item 1.2 relating to Recommendation 66 and Unwanted Emissions as part of the work of Task Group 1-5 (see section 4.5.1 above).

Other important issues within WP7D during 1999 have been:

- a) the “10 percent issue”, relating to the amount of time that can be lost to man-made interference,
- b) the use of Monte Carlo methods for the determination of co-ordination distances between mobile spectrum users and radio astronomy observatories, and
- c) the use of the bands 1390-1400 MHz and 1427-1432 MHz by the Mobile Satellite Service and the interference to the RAS in the 1400-1427 MHz band, which may become a WRC item in the future.

5.5. Specific Spectrum Issues

5.5.1 The Particular Case of the RAS 15.4-15.6 GHz Band

Resolution 123 of WRC97 asks for studies of the feasibility of feeder links for NGSO satellites in the Mobile Satellite Service (Space to Earth) in the frequency band 15.43 - 15.63 GHz taking account of the protection requirements of radio astronomy in the band 15.35 - 15.4 GHz, and of the interference potential of these feeder links to radio astronomy in the 15GHz band.

A satellite down link band, FSS (space-to-Earth) 15.4 - 15.7 GHz has been inserted into the table of frequency allocations by the WRC95. In order to protect the passive RAS band 15.35 - 15.4 GHz the footnote S5.511A has been inserted which limits the power flux density of the satellite transmissions and requests the interference threshold levels of Recommendation ITU-R RA.769 to be obeyed in the neighbouring band. Later studies within the ITU-R have concluded that an Fixed Satellite Service allocation would not be useful under these constraints. Therefore WRC97 introduced guard bands, but relaxed the pfd-limits. Additionally the uplink direction FSS (Earth-to-space) was introduced into the band 15.43 - 15.63 GHz and Resolution 123 was adopted.

In July 1998 a joint expert group of working parties 4A and 7C met at Toulouse, France, to discuss Res.123. Only one input document, from IUCAF, had been submitted. Additionally the UK presented a preliminary calculation during the discussion. The conclusions of both written and verbal inputs was that it would be very difficult for the FSS to include enough filtering to suppress the out-of-band emissions sufficiently to protect radio astronomy. In addition, it would be also very difficult for radio astronomy stations to include enough filtering to prevent overload by the satellite transmissions in the nearby band, when a satellite comes close to the main beam of a radio telescope. The meeting therefore followed, unanimously, the view of the IUCAF paper that the problem be best

avoided by removing the FSS (space-to-Earth) allocation from the Radio Regulations. This conclusion has been brought to the attention of ITU-R Working Parties 4A and 7D, which met in Fall 1998, and of which the latter is tasked by the CPM to co-ordinate the studies and to provide text for the CPM report.

5.5.2. Mobile Satellite Services

IRIDIUM has kept radio astronomy frequency protectors busy since 1992. Shortly before IRIDIUM's delayed initiation of commercial operation on November 1, 1998, a stable situation had developed that the IRIDIUM system had been issued licenses in most countries, subject to the requirement to protect radio astronomy in the nearby frequency band.

IRIDIUM offers to provide world-wide telephone (and fax and data transmission) service via a fleet of 66 low-Earth-orbit satellites. Unfortunately, these satellites use frequencies in the band 1621.35 - 1626.5 MHz to connect to the mobile Earth stations with both uplinks and downlinks. However, the current generation of satellites has been designed such that unwanted emissions spill over into the nearby Hydroxyl OH frequency band 1610.6 - 1613.8 MHz, which will reach unacceptable levels at already moderate traffic loads on the system.

A major effort has been ongoing in Europe order to come to a mutually agreeable solution for the radio astronomy community. Given the geographical fragmentation in Europe, it was felt that co-ordinating satellite downlink transmissions can only be done in a Europe-wide manner. For this purpose the Milestone Review Committee (MRC) was set up by the European Radio Committee ERC to evaluate the progress of the applying systems against commercial, technical, and compatibility criteria. Earlier work in Project Team 28 of the ERC spectrum engineering working group had not lead to generally accepted conclusions. The co-ordination process culminated in MRC Recommendation No. 04 giving surprisingly clear guidelines to the European administrations. MRC Recommendation No. 04 asks for a co-ordination agreement between IRIDIUM and Committee on Radio Astronomy Frequencies (sponsored by the European Science Foundation) has been very difficult to reach and at the end of 1998 it only covers the short-term and the long-term perspective. This agreement stipulates that until March 1, 1999 and after January 1, 2006, the IRIDIUM satellites will have to limit their out-of-band emissions into the radio astronomy band to below the threshold levels of ITU-R Recommendation RA.769-1. Discussions about time sharing parameters for the interim period from March 1, 1999 until December 31, 2005 are underway between IRIDIUM and CRAF. IUCAF has played a supporting role in all these negotiations

Other mobile satellite systems making use of this same MSS frequency allocation have avoided the complication of satellite downlink transmissions adjacent to the RAS band by putting the uplink at another frequency. GLOBALSTAR, which is planning to launch its service shortly, will use frequencies in the 2483.5 - 2500 MHz band for its satellite downlink. In this case the radio astronomy operations and the mobile uplink

operations need to be co-ordinated geographically. Discussions about co-ordination zones around radio telescopes have started in some countries but have not yet been directed to IUCAF or CRAF. It is expected that the necessary co-ordination radius for uplink systems co-sharing with the RAS will be much larger than the exclusion zones for IRIDIUM mobile Earth stations.

5.5.3 The Earth Exploration Satellite Band at 18.6-18.8 GHz

The 18.6-18.8 GHz band is used by Earth Exploration satellites to measure with scanning microwave radiometers a number of geophysical parameters: precipitation over ocean and land, ice concentration, type and temperature, liquid water content, snow extent, land surface temperature, etc. These parameters are derived by combining and interpolating the measurements done at 18.6-18.8 GHz with those done at other key frequencies (around 6.8 GHz, 10.6 GHz, 23.8 GHz, 36.5 GHz and 89 GHz) from the same instruments. The use of this type of sensor is extremely important to meteorology and climatology activities. These microwave instruments present the important characteristic of not being affected by cloud cover, as is the case for the instruments working in the infrared range.

The current ITU allocations in the band 18.6-18.8 are primary allocations to Fixed Satellite Service (FSS) and Fixed Service (terrestrial; FS) systems world-wide and, in region 2 (The Americas) only, a primary allocation to EESS (passive). Two footnotes invite all administrations to take into account the need for passive EESS measurements in the band by limiting radiated and output power (for FS) and power flux density (for FSS).

At the moment only a limited amount of FS systems are active, leading to limited and acceptable interference to the EESS, but the situation will degrade rapidly in the near future when more FS systems will become active and new high power Ka-band geostationary FSS systems will start to operate. While one may count on power and pfd limits imposed by FCC for the US, nothing similar has happened in Europe, with total disregard of the ITU footnotes. An attempt to extend the US limits to the other ITU regions failed at WRC-97 because of the strong European and Japanese opposition. The item will now be reported to WRC 2000. Compromise values have now been proposed, but, despite ad-hoc meeting by ITU in July this year, the solution seems to be still very far.

6. Publications and reports

IUCAF has contributed a number of documents to the proceedings of Task Group 1-5 and Study Group 7. These documents have all appeared on the ITU-R Home Page and have not all been distributed by email. As a result there was less need to post these documents on the IUCAF Home Page. Information about IUCAF documents and meeting reports is generally available on the IUCAF Home Page and has been distributed by email to the general IUCAF electronic mailing list.

7. Organizational matters

The need to be present at critical spectral meetings remains very strong for the radio science community, because not all parties look out for the well-being of scientific use of the spectrum when decisions are made. The radio scientists are often outnumbered by other participants with strongly opposing views. With only two professional spectrum managers, the radio astronomy community is particularly vulnerable and a global division of tasks among IUCAF members and correspondents has been instituted. Since co-ordination problems are becoming more global, IUCAF has an important role to play in unifying the efforts to protect the bands allocated for passive and active scientific use. Such global efforts require an increased travel budget and the continued support of ICSU, URSI, IAU, and COSPAR is essential.

Generous support from URSI, IAU, and COSPAR has enabled IUCAF to provide travel support to its Members and Correspondents to ensure adequate participation at important conferences. During 1998 IUCAF has been able to participate actively in meetings of the ITU Radiocommunication Sector, the meetings of ITU-R Task Group 1-5, and SFCG-18 of the Space Frequency Co-ordination Group. IUCAF Members and Correspondents have obtained considerable financial support for travel from their home institutions. ICSU has also awarded IUCAF with a grant for support of travel. The purpose of this grant was to stimulate the participation of scientists from developing countries in international spectrum meetings and for addressing issues related to preserving bands used by radio scientists in those countries.

During 1998 the business of the IUCAF Secretariat has been conducted from the Arecibo Observatory at Arecibo, Puerto Rico (USA), which is part of the National Astronomy and Ionosphere Centre (NAIC) and is based at Cornell University in Ithaca, New York (USA), and from the Westerbork Observatory, which is part of the Netherlands Foundation for Research in Astronomy (NFRA), based in Dwingeloo (The Netherlands). IUCAF thanks NAIC and NFRA for providing secretarial support and access to all means of electronic communication for partial travel support for the Chairman.

Starting February 1999, the IUCAF secretariat will be hosted by the Max Planck Institut für Radioastronomie in Bonn, Germany.

8. Conclusion

The pressure for commercial spectrum applications has remained steady and intense during recent years. In order to obtain access to large bandwidths the commercial applications are now calling for spectrum up to the edge of the atmospheric window at 60 GHz. These applications mostly relate to high density (and wide band) applications such as Internet from the sky or from stratospheric (aerostat) platforms located above major cities, and as terrestrial wide-area distribution systems. This drive for spectrum results in part from the desire to be first in the targeted market. In addition, the technology for operating at these high frequencies is now becoming commercially available, in part as a result of the pioneering work of the radio astronomers and Earth exploration scientists. In this regard

it is of extreme importance that the band allocations above 71 GHz are being considered at WRC-2000. This will indeed be the last chance for the radio science community to change things in that part of the spectrum. It is good to see that IUCAF has been able to take up a central role in the preparations for this Agenda Item at WRC-2000.

In recent years it has also become clear that the commercial markets will not be able to support so many system. For instance, close to one hundred satellite systems have been announced at the ITU to provide broad band (Internet-like) services. In the space application sector, there is also the concept of "paper satellites". These systems have been announced at the ITU to operate in certain spectrum bands but they exist only on paper to reserve a place for the future and have no adequate funding. In particular for the geo-stationary orbits, there are many more satellites than orbital slots. Although this situation appears grim for the radio scientists, it is likely that most of these applications and that many ventures will fail. It could very well be that systems, that raise concerns for the radio astronomers at this time, may not become commercial successes at all.

The protection levels for harmful interference continue to be difficult to meet by active spectrum users. Task Group 1-5 has continued its efforts to set sensible thresholds for unwanted but has not been able to convince certain administrations that this would be in the benefit of all spectrum users. Special interest groups, such as the USA space community, have lobbied strongly against any global standards that are any tighter than the current standards. Rather than alleviating some of the interference problems of the passive services and of the safety services through general standards, TG 1-5 has been forced to choose for non-state-of-the-art standards and for making the needs of the vulnerable services into a special case. A growing number of administrations has recognised the needs of the science services and is committed to help their cause. On the other hand, many consider the radio scientist and their needs a great nuisance. IUCAF remains committed to the work of Task Group 1-5 and is thankful for the support that is received from many sympathetic administrations.

Members and correspondents of IUCAF have continued to support and initiate efforts to bring the radio spectrum pollution issue to the highest governmental offices. Recently the OECD Mega-Science Forum on Radio Astronomy has also addressed these issues and appears successful to bring them to the attention of government officials of OECD countries and leaders of the telecommunication industry. IUCAF continues to supports this effort and hopes that this will lead to increased recognition of the global issues facing the scientific community.

IUCAF members and correspondents clearly have their plate full of spectrum issues relevant to radio science. Many existing spectrum issues have remained and the interference problems continue to expand to higher frequencies. IUCAF will continue to emphasise the message of protecting the radio science for future generations. In particular, the need for expounding on the relevance of such efforts in developing countries and for expanding personal contacts there remain urgent for the coming years. Also the satellite down-link issues will continue to draw attention.

IUCAF is thankful for the moral and financial support that has been given for these continuing efforts by ICSU, IAU, URSI, and COSPAR during the recent years. IUCAF also recognises the clear support that has been given by radio astronomy observatories and universities to individual members in order to participate in the work of IUCAF.

On a personal note, the former chairman would like to praise the members and correspondents of IUCAF for their help and support. It has been very rewarding and an honour to work with this group.

W.A. Baan, Chairman
Dwingeloo, The Netherlands
May 24, 1999

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BUSINESS TRANSACTED BY COMMISSIONS

COMMISSION A – ELECTROMAGNETIC METROLOGY

Chair: Dr. M. Kanda (USA)
Vice-Chair Prof. E. Bava (Italy)

REPORT ON THE OPEN COMMISSION MEETINGS (BUSINESS MEETINGS)

The Commission held three Open Commission Meetings, respectively on 16, 18 and 20 August 1999. At the beginning of each meeting there has been the introduction of the Chair, followed by the Vice-Chair and by all the other participants, both Officers and just audience. Then the Chair proposed the agenda, requested suggestions for new items or modifications, before the approval. The minutes of the three Meetings have been taken by the Vice-Chair, who, as usual, is responsible to report on the activity of Commission A at the XXVI General Assembly (GA).

First Open Commission Meeting (16 August 1999)

1. According to a recent request of the URSI Board the elections of the new Vice-Chair have to be carried out in the first Business Meeting. The Chair proposes as a candidate Dr. Quirino Balzano, Corporate Vice-President and Director, Florida Corporate Electromagnetics Research Laboratory, Motorola, USA. During the organisation of the XXVI GA, Dr. Balzano has operated as a Convenor of session A1 (New RF-to-Submillimeter wave standards and measurements) and is also the speaker of the Commission A Tutorial “Electromagnetic Metrology Issues in Wireless Communications”. His research has been concerned mainly with electromagnetic field measurements and with the interactions of the field strength with the human body. Dr. Kanda points out also the complementarity in research between the Vice-Chair and Dr. Balzano, which is in agreement with the tradition of Commission A. Because there is no other proposal for candidates, the election starts with eleven Officers present; meanwhile Dr. Kanda shows a viewgraph with the indications of the Commissions Chairs and Vice-Chairs as established in the Lille GA and with the proposals of the new Vice-Chairs.

2. There are at the moment no proposals for variations in the Commission A list of the terms of reference. It is agreed that new terms or variations, if any, will be discussed in the next meeting before being submitted to Council for approval.
3. The preliminary data available on the program of the XXVI GA are summarised in general, and in particular as far as Commission A is concerned. Compared with the total of 1764 communications (oral+posters) the 105 presentations in Commission A appear a reasonable number. Although metrologists are not so many as the scientists of other URSI Commissions in the world, however it is stressed that the participation of people active in the measurement area to the URSI-GA must be increased. This shall be an important goal charged to the incoming Chair and Vice-Chair, to the Officers and to all the scientists working in this area. Summarising the Commission A program in this GA there are 1 Tutorial, 9 Commission A sessions, 4 joint sessions and 5 sessions where Commission A is involved (18 oral sessions in the overall) and 1 poster. Dealing with the Young Scientist Program, there were in the overall 224 applications and 121 were accepted; as regards Commission A the applications were 11, 9 accepted.
4. The triennial report of Commission A is available on INTERNET at the site (also reported on the Bulletin) <http://www.intec.rug.ac.be/ursi>. In particular Dr Kanda summarised in this occasion how the money for sponsorships has been used. The total amount of 360 000 BEF was distributed as B sponsorship to ISEM 97 (96 000 BEF), EMC Wroclaw Conference 98 (87 000 BEF), CPEM 98 (35 000 BEF), EMC 98-Rome (71 000 BEF), EMC 99-Zurich (71 000 BEF), whereas A sponsorship (no financial support) was given to Telecom 97, EFTF 98, PIERS 98. Explanations have been given by Dr. Kanda about his choice. According to the URSI indications, one and the most important guidelines is that a financial support can be given to the young scientist program, if exists, in the sponsored meeting. Although CPEM is to be considered a wealthy conference, there was in that occasion a well defined young scientist program. As far the other sponsored meetings, these were in agreement with indications expressed in the Lille GA. For the next triennium there are at the moment two requests: EUROEM 2000 (A) and International School of Physics (B). There is the agreement among the Officers present that the incoming Chair will report on the use of the money for sponsorships in the next GA.
5. The Chair informs that in the next business meeting the Commission A must choose its own Editor for the Review of Radio Science, the Editor of the Disk of References and the Assistant Editor for the Radio Science Bulletin. The attendees are invited to submit proposals for these charges.
6. Prof. Leschiutta gives to the audience a copy of a recommendation concerned with the proposal to discontinue the practice of the Leap Second in UTC. The discussion and decision on this topic are postponed to the next meeting.

At the end of this first business meeting the election results of the new Vice-Chair are communicated. On 11 votes there were 9 in favour of Dr. Balzano (USA) and 2 against.

Second Open Commission Meeting (18 August 1999)

1. The Chairman introduces Dr. Quirino Balzano, the new elected Vice-Chairman, who could not attend the previous business meeting. Dr. Balzano took the “Laurea” degree in Electronic Engineering in 1975 at the University of Rome “La Sapienza”, Italy. His main research interests have been in microwave radars, specifically in antennas and propagation, and in interactions of the electromagnetic energy on the human body, dealing in particular with dosimetry, field measurements and sensor development.
2. Prof. Leschiutta introduces his proposal of recommendation as distributed in the preceding meeting. It is concerned with the Leap Second practice in UTC to keep the difference between UTC and UT1 at a level lower than .7 s. The adoption of UTC was made by ITU after a consultation with BIH, URSI Comm A, UAI, UGGI, IMO, IAMA, ICAO and other bodies. The widespread use of satellite navigation systems has questioned this practice and the problem has been discussed at CCTF in Paris in April 99 and an inquiry has been promoted among the already consulted bodies and other bodies interested in the use of UTC. At the discussion participate Prof. Leschiutta (Chairman of CCTF and IEN President), Dr. Banerjee (NPL, India) and Dr. Petit (BIPM, Paris). The proposed recommendation is approved after some amendments as an expression of opinions. The amended version shall be delivered to the URSI Board.
3. Dr. Kanda informs the audience about some important modifications in the Review of Radio Science (R.R.S.) discussed by the Standing Committee on Publications. The book is highly appreciated in general and its publication will continue. However, to cope with the problems that URSI participants usually have with its weigh and volume, in the next GA the book will be provided to the attendees as a CD-ROM. The hardbound book will be available and sold to individuals and institutions after order. To fulfil the requirements of the Standing Committee, the Chairman proposes Prof. S. Celozzi, University of Rome “La Sapienza”, as Commission A Editor for the R.R.S.. Prof. Celozzi (Tel +3906 44585 520, fax +3906 488 3235, e-mail: celozzi@elettrica.ing.uniroma1.it, Italy) acted as the Commission A Editor for the Disk of References in the last triennium. The proposal is approved and Dr. Kanda requests scientists and officers, who can provide useful suggestions for the R.R.S., to contact Prof. Celozzi,
4. The Standing Committee on Publications has proposed to discontinue the Disk of References because it requires too much effort if compared to the use, since many ways to have access to references are now available. For this last GA only a few Commissions (6) prepared the Disk. The Editor for Commission A was Prof. Celozzi, he collected 238 references. There is a general agreement on this point.
5. No proposal has been presented for modifications of the list of Terms of References. Dr. Kanda suggests that, if proposals arise, they can be submitted with the proper motivations to the incoming Chairman. He can make known the proposals and organise a ballot by mail.

6. Dr. Kanda proposes Dr. Banerjee (NPL, India) as the new Associate Editor for the Radio Science Bulletin. The attendees agree on that and Dr. Banerjee accepts.
7. Concerning the organisation of the XXVI GA the opinion is in general accepted that the concentration of the scientific sessions and of the business meetings in one week period shows advantages and disadvantages. On the one hand there is the gain in time and as a consequence in lodging expenses as well, on the other it turned out a too crowded list of scientific sessions and of business meetings. To allow an easier movement between sessions of different commissions it is suggested that not only time is to be squeezed, but space as well. From this point of view a Convention Centre is a better solution than a University. It has been remarked the problem of no-shows as well, in some way linked to the level of presentations: no-show is typical of contributed papers or posters, not of invited. It has been agreed that it is responsibility of the convenors to accept or reject a contribution, considering that there are people who can not attend a meeting if their work is not accepted. The poster sessions, which are not to be considered as collections of low-level works, but on the contrary the proper site where to discuss problems too specialised and unsuitable for an oral presentation, could help to cope with the requests that papers be accepted to allow participation without imposing a heavy oral preparation. However there is no way to avoid no-shows linked to financial difficulties. It is stressed, moreover, the use of equal time slots in presentations to allow easier movements from one session to another.

Third Open Commission Meeting (20 August 1999)

1. The expression of opinion discussed in the previous meeting is presented in the final form as passed to the URSI Board with the amendments requested .
2. Dr. Kanda informs the attendees on the results of the Council elections of the new Board (President, Vice-Presidents). Moreover the Council has decided that the XXVII GA shall be held in Maastricht (The Netherlands) in 2002, 17-24 August.
3. Dr. Kanda introduces the incoming Chairman, Prof. Elio Bava, Italy. Prof. Bava warmly thanks Dr. Kanda, also on behalf of the Commission A members, for his work in the organisation of the GA, keeping the main responsibility in accomplishing this task. The number of Commission A sessions and joint sessions has exceeded that of the previous GA, in spite of the squeezed time.
4. The incoming Chairman introduces the last part of the Business Meeting. The first item is the list of the requests of URSI Sponsorship for the next triennium already received and those supposed to arrive in next future according to the previous experience and the information available. As soon as the amount of money is established by the URSI Secretariat decisions shall be taken and, as agreed in the first Business Meeting, he will report at the next GA on the distribution adopted. The list shall be sent to the URSI Board as a preliminary list, as it has been requested.
5. Representatives of Commission A in other bodies give their report. Prof. Stumper, Dr.

Kanda and Dr. McSteele gave detailed reports on the triennial report available in INTERNET. Prof. Leschiutta, who had to leave suddenly, informed the incoming Chairman that he did not attend either IMEKO conferences or the Assembly (Tampere, Finland) and is not interested to be the representative in IMEKO any longer. Dr. Lundén gives his report on IEC and ISO. In the last triennium there has been a lot of publications by IEC and ISO, however the activity relevant with URSI Commission A is limited. IEC publications are available in the web site catalogue <http://www.iec.ch/catlg-e.htm>. On CD-ROM a multilingual dictionary is available, as well as the EMC International Standards. Of interest for URSI should be the IEC61983 "Measurement and Evaluation of High-Frequency Electromagnetic Fields with regard to Human Exposure". The representatives in the next triennium are then proposed. It should be remembered that the Chair is the representative in CPEM and in CIPM and the related committees. However, as occurred in the past, the incoming Chairman would like that scientists, who are very active in these bodies, be charged as representatives as follows: Prof. Leschiutta (CCTF, of which he is the Chair), Dr. Helmcke (CCL), Dr. Erard (CCE), Prof. Stumper (RF-WG of CCE) and Dr. Kanda (CPEM). Moreover Dr. Lundén accepts to continue as the representative in IEC and ISO.

6. As far as the program for the next GA, the incoming Chair shows the following proposal, which takes into account the well established sessions and joint sessions of Commission A, including suggestions received in the preceding days.

A1- New RF-to-Submm Wave Standards and Measurements

A2- Material Measurements

A3- Time and Frequency Standards

A4- Optical Frequency Standards (Laser Stabilisation)

A5- Time Keeping and Time Transfer

A6- Optical and Fiber Measurements

A7- Quantum Metrology

A9- Measurements on Tissues

AB1- Antenna and Electromagnetic Field Measurements

AB2- Time-Domain Measurements and Analysis

AC - Clock Synchronisation in Telecommunications

AE - EMC Measurements

EA - Electromagnetic Compatibility and EM Pollution

FAB- Techniques and Applications (for Sub-Surface) Remote Sensing

KA - Exposure Assessment for Cellular and Personal Telecommunications

Tutorials (to be chosen among)

New Techniques in Atomic Frequency Standards

New Techniques in Two-Ways Time Comparison

Advances in Quantum Electronics Devices

According to the elected Vice-Chairman there is a lot of work and funds at the moment in the area indicated in A9, therefore it is likely that many new results be available for

the next GA. It was also suggested to make some inquiry on few traditional sessions where very few contributions were presented, with large no-shows as well, in areas where CPEMs receive many papers of value. It was suggested to include in A1 also dc and low-frequency standards. At the proper time this inclusion will be evaluated considering also the possibility of a new session. A few of the joint sessions received a confirmation of interest from the relevant incoming Chairmen, a deeper analysis will be carried out as soon as possible.

7. The Board suggestion on a different way to prepare the election of the Vice-Chairman is discussed. The proposal concerns the establishment of a small committee, composed by Past-Chairmen, Vice-Chairman and/or scientists involved for a long time in the works of a commission, aimed at soliciting, generating and then selecting two/three candidates for the election, in order to offer both choice and not excessive number of candidates. After a debate the present Officers and Members decide to keep the traditional way to elect the Vice-Chairman.
8. On behalf of Prof. Leschiutta, Prof. Bava announces that in 2000 (25 July- 4 August) at the International School of Physics (Varenna, Italy) a Course will be held on "Recent advances in metrology and fundamental constants", organised by IEN. The Directors are Prof. S. Leschiutta (IEN) and Dr. T.J. Quinn (BIPM), the secretary is Dr. P. Tavella (IEN) (tel. +39 011 3919235, fax +39 011 3919259, E-mail tavella@tf.ien.it). This Course is the third of a series (1976, Varenna, Italy and 1989, Lerici, Italy) organised by the same school; teachers are chosen among leading scientists to assure a high-level course useful for Ph.D. students or post-docs who want to be acquainted with the latest methodologies and results in the field. 50 hours of lessons are foreseen and applications from young scientists for support are possible.
9. Just to remind Officers and members the structure of Commission A for the next triennium, the incoming Chair recalls that
Chair: Prof. E. Bava (Italy)
Vice-Chair: Dr. Q. Balzano (USA)
RRS Editor: Prof. S. Celozzi (Italy)
Bulletin Associate Editor: Dr. Banerjee (India)
10. The last issue of the meeting is how to increase URSI attendance of scientists active in Commission A. The discussion resumes the claims already exposed for heavy no-shows which upset some sessions. Attention should be paid by convenors in accepting contributions when there are suspects on the willing to attend the GA, however efforts should be done by the Chair, Vice-Chair, Officers and members to generate interest in participating to the GA. The proposal from the Standing Committee on Publications to substitute the book of abstracts (heavy and of little use to select papers and to document author's scientific work) with Proceedings of summaries up to 3-4 pages each, distributed both as CD-ROM and as a book in a form yet to be defined, should help in yielding more enthusiasm in attending URSI GA.

COMMISSION B - FIELDS AND WAVES

Chair: Prof. C.M. Butler (USA)

Vice-Chair: Prof. S. Ström (Sweden)

The intensity of the scientific activity in the area represented by Commission B, i.e. "Fields and Waves", remains on a very high level and this is particularly true concerning areas which border on and overlap with other Commissions. As a consequence, in spite of the reduced time available, Commission B had a scientific program that was in essence as comprehensive as during previous General Assemblies.

Thus, Commission B organised by itself 10 half-day scientific sessions (B1-B10) consisting of oral contributions and in addition there was a poster session organised around the same theme as each of the oral sessions. Two convenors had been appointed for each of the 10 session topic areas and the convenors were also responsible for the related poster sessions. Commission B also organised two comprehensive poster sessions which had no oral counterparts and which were subdivided into 5 and 4 subsessions respectively with two convenors for each of these subsessions. In total, approximately 250 poster presentations were scheduled at poster sessions organised by Commission B.

The breadth of the Commission B interests are further illustrated by the fact that Commission B was involved in organising 9 sessions jointly with other Commissions, viz. A, C, D, E, F, J, and K (sessions AB 1, AB 2, BD 1, BD 2, DB, EB, FAB, JBC, and KB).

Commission B also contributed in an essential way to Modern Radio Science and Review of Radio Science, 1996-1999. The Commission B contributions to the latter was edited by Prof. Y. Rahmat-Samii, UCLA. As decided at the previous General Assembly in Lille, Commission B contributed to the contents of the CD-ROM with "Collected References" from 1996-1999, distributed together with "Review of Radio Science, 1996-1999". The Editor for the Commission B part of this disk was Prof. M. Ando, Tokyo Institute of Technology. In this task he was assisted by 8 topic area editors.

The Commission B Tutorial Lecture, "Electromagnetic System Design Using Genetic Algorithms", authored by E. Michielssen, Y. Rahmat-Samii and D.S. Weile and presented by E. Michielssen was followed by a session (B2) on the same topic and both enjoyed a very high attendance. Other sessions with a high attendance were B3 "Scattering and Diffraction", B4 "Electromagnetic Theory", and B5 "Time-domain Electromagnetics". In general, the attendance at all Commission B sessions was good.

In total there were some 350 (oral and poster) papers presented at Commission B sessions, out of a total of 1750. Therefore, Commission B has, as before, a strong interest in getting a share of the time and space available for the scientific program that is commensurate with the scientific contributions of the Commission B community.

The following views and sentiments concerning the arrangements during the Toronto General Assembly were often heard among the Commission B community:

1. The fact that the times for the individual talks were not listed in the final program was very much regretted. As a consequence it was difficult or impossible to plan how to switch between sessions

2. The “one week plus weekends” format for the General Assembly should be kept, but the Council meetings, various committee meetings, and Commission business meetings should be held as much as possible during the weekends at the beginning and the end of the General Assembly

3. Additional efforts should be made to avoid collisions between sessions dealing with closely related topics.

Do not schedule all the poster sessions belonging to one Commission for the same time, as was done for Commission B. The posters should be allowed to stay up some time beyond the time of the poster session.

During the General Assembly, Commission B held one business meeting. The Chair, Prof. Chalmers Butler, gave an exposé over the preparations for the General Assembly and thanked all involved: convenors, editors and others, who had contributed so generously with their time and professional experience. The contributions of all those who were involved in the organisation of the 1998 EM Theory Symposium in Thessaloniki were also recognised and thanked. In addition the Chair gave some statistics concerning the General Assembly, with focus on the Commission B participation.

An important point on the agenda was the completion of the vote concerning incoming vice-chair. The result was that Prof. M. Ando was elected, with Prof. K. Langenberg as alternate (the URSI Council subsequently appointed Prof. Ando as Commission B vice-chair for the triennium 1999-2002).

Taking into consideration that a fairly large number of proposals concerning the venue for the 2004 EM Theory Symposium can be expected, the Chair proposed that, in order to avoid having a succession of votes (which is time-consuming when conducted by mail), a committee should be set up with the task of selecting the 2 (or at most 3) most attractive proposals. The national representatives would then be asked to vote, in one ballot, on these proposals. An invitation to Commission B national representatives to submit a proposal will be sent out during the fall of 1999. The vote can then take place well in advance of the 2001 EM Theory Symposium in Victoria, thus giving the organisers of the 2004 Symposium more than three years for their preparations.

Prof. Jens Bornemann, Chair of the Local Organising Committee for the 2001 EM Theory Symposium in Victoria gave a brief presentation of the present status of the preparations for that event.

During the meeting of the Coordinating Committee on 14 August, it was suggested that the Commissions should become more active in making sure that a sufficient number of qualified candidates were persuaded to stand for election. Thus it was suggested that the Commissions form a small committee consisting of the vice-chair plus a few experienced scientists which is then charged with the task of vitalising the elections. This pros and cons of this proposal were discussed and it was noted that, even if it is not formalised, Commission B usually operates in a way that is similar to what is now proposed.

Conclusion

The scientific program of a Commission is the responsibility of its Chair, who invites the convenors and editors and coaches them through the arduous process of creating a program that properly reviews and highlights the scientific status of the field. Therefore, on behalf of the Commission B community, I want to express our gratitude and appreciation to Prof. Chalmers Butler, past Chair of Commission B, for his dedicated and successful work in creating the excellent Commission B program at this General Assembly. The same gratitude and appreciation goes to all the convenors and editors for their very professional work.

COMMISSION C – SIGNALS AND SYSTEMS

Chair: Prof. J.G. Lucas (Australia)

Vice-Chair: Prof. E. Bonek (Austria)

REPORT ON THE OPEN COMMISSION MEETINGS (BUSINESS MEETINGS)

The Commission held open business meetings on 16, 18, and 20/8/99. The following persons were present at least at one meeting, but mostly at several: Robin Braun, Australia; Godfrey Lucas, Australia (Chair); Ernst Bonek, Austria (Vice Chair); Paul Delogne, Belgium; Paul Wittke, Canada; Maurice Bellanger, France; P. Reibiger, Germany; V. U. Reddy, India; Shlomo Shamai, Israel; Guido Tartara, Italy; Masami Akaike, Japan; Valeri Ya. Kontorovitch, Mexico; M. Yesufu, Nigeria; Börje Forsell, Norway; Marian Piekarski, Poland; Alexander B. Shmelev, Russia; V. A. Potapov, Russia; Mike Darnell, United Kingdom; Igor A. Gepko, Ukraine; Irina V. Lysitskaya, Ukraine; David Thomson, USA;

At the opening of the first meeting attendees introduced themselves. The Chair welcomed everyone to the meeting and noted that there were 13 young scientists selected in Commission C.

1. Chair report and setting the scene

The Chair explained his personal view of what URSI is all about:

- . Internationalism
- . Total support of Radio Science
- . Excellence in research and communication.

The all important General Assembly is an opportunity to learn and also meet convivially. We need to have a program which will continue to attract the very best people in the world at what we do.

The Chair noted that during the last three years while he had the responsibility of getting ready for the Toronto General Assembly he found it difficult to get reactions from many of the national Commission C representatives. Of course there were notable exceptions.

The whole URSI organization is working hard to make its links with the ITU work really well. This will provide opportunities for URSI people to tap in to the huge and important work which is handled by ITU's study groups and to provide scientific input to ITU-R.

2. Election of the next Vice - Chair.

Commission C had a single candidate : Masami AKAIKE, Japan

Nevertheless, it was deemed fit to make a formal election by the national representatives present. No votes had been cast prior to the GA.

The result was 15 Yes, 1 No, so the candidate was elected.

3. Review of the Terms of Reference

The existing Terms of Reference were considered to be very broad. While it was felt that we can't drop anything, a focus on radio communication systems was considered necessary. A GA cannot compete with the numerous specialized conferences in the area of signals and systems, so the Terms of Reference should make clear to scientists in these areas that their work for radio science and mobile communications is welcome. As Commission C provides enabling technologies for many other commissions' work, collaboration with other commissions is also essential.

The new version of the Terms of Reference, later approved by Council, now read:

The Commission promotes Research and Development in:

- (a) Telecommunication Systems;
- (b) Spectrum and Medium Utilization;
- (c) Signal Processing;
- (d) Information Theory, Coding, Modulation and Detection;
- (e) Circuit Theory and Design in the areas of radio science and radio communications.

The design of effective telecommunication systems must include scientific, engineering and economic considerations. This Commission emphasizes research into the scientific aspects, and provides enabling technologies to other areas of radio science.

4. Role of National Representatives of Commission C

In order to find a way to activate national representatives to contribute to the work of the Commission with ideas, with their desires what do they want to see done, what will attract *them* to come to the GA and contribute, the Chair presented a "job description" for the National Representatives:

- Wherever possible respond in reasonable time to requests for information/advice from the Chair of the Commission.
- Undertake to communicate with Commission C researchers in their own country and make them aware of URSI - particularly the subject matter of the next GA - and also encourage them to attend the General Assembly.

- Advertise the availability/existence of Young Scientist Awards
- Attend the GA themselves and aim to contribute a paper.
- Make a short report at the GA about developments and activities in Commission C matters within their country.
- Offer help to make the GA work.

This was met with approval.

5. The program for the next General Assembly

Particularly for researcher active in the areas of Commission C, the non-referenceable one-page abstracts in the Book of Abstracts were a deterrent in the past. For URSI GA Proceedings to become archival from now on will requires summaries to be at least four (4) pages in length. This will certainly greatly assist in assessing and improving the quality, make submissions much more attractive to potential contributors, but will require significantly more reviewing effort. The idea was welcomed.

As concerns topics for the next GA, Ernst Bonek compiled a provisional list of possible topics, which was enlarged and refined during the business meetings. It was agreed to circulate this list nationally and to other commissions, and to iteratively reduce it to the topics of widest interest. Each proposer of a new topic should say with three sentences what the topic is to include and to suggest a list of invited speakers, both highly recognized and willing to speak.

As of August 21, 1999, this list reads:

- Broadband radio access
- Coding, Modulation and Detection
- Software radios
- Channel estimation techniques
- Adaptation to changing radio channel
- Statistical analysis/synthesis of radio systems and signals
- Signal estimation
- Blind signal detection
- Antenna array signal processing
- UMTS/IMT 2000 trials
- Spectrally efficient signal design
- Interference problems in radiocommunications
- Wireless LANs
- Mobile telephones and public health

Possible topics together with other commissions include WDM for fiber optics, Application of secondary standards in telecommunications, Synchronization between satellites and ground, Clock synchronization for High-Speed Digital, Channel sounding in mobile radio (Commission A), Interference mitigation for passive radio science, High data rates in real-time systems, Software radio technologies and their application to radio astronomy, Photonics in radio astronomy, Wideband array technologies and systems (Com. J).

6. Editor for RRS

As in previous trienna, it was decided to charge the incoming Vice-Chair, Masami Akaike, with this task. He accepted.

7. Associate Editor for the Radio Science Bulletin

It was decided to charge Robin Braun from Australia with this task, who accepted.

8. Other business

Paul Delogne described developments in Council to redefine the Scientific Committee for Telecommunications (SCT) and ongoing efforts with "Commsphere".

Robin Braun, stressing the international idea in URSI observed the difficulty non-native speakers have with English. He suggested mentoring by senior persons, eg practice sessions before the next GA.

SCIENTIFIC REPORT

The enormous progress in applied and fundamental research in digital signal processing, stochastic and non-linear methods, in multicarrier transmission, in combined source and channel coding and modulation, in smart antenna technologies, radio over optical fiber, low-power radio circuit design have found their way into many contributions presented and discussed at the Toronto General Assembly.

Spectrum utilization and the avoidance of intersystem interference played an important role in the GA, and an inter-commission workshop was devoted specifically to spectrum congestion.

The topics of "Signals and Systems" and the underlying methods cut across the work of several commissions. The importance of Commission C-related-topics for URSI in general showed in the great number of joint sessions with other Commissions, i.e.

- JBC "Adaptive Antenna Technologies for Decametric Radio Telescopes"
- JCEG "Interference Protection Measures"
- GC "Digital Techniques in Ionospheric Radio Propagation, Control and Communication"
- JDC "Future Millimetric Receivers"
- DC1 "Microwave-Optical Interaction"
- DC2 "Advanced Techniques for Wavelength Division Multiplex Systems"

In mobile radio, *signals* are transmitted via electromagnetic waves, terrestrial and satellite mobile radio *systems* are the most complex telecommunications systems ever devised, not the least because of the difficulties radio multipath propagation presents. So, many aspects of *mobile communications* have become a major theme at this GA. This fact bore out in a number of sessions within commissions,

- Commission A: A-Tutorial "EM Metrology Issues in Wireless Communications"
- Commission B: B8 "Electromagnetics in Wireless Communications"

- . Commission C: C6 “Software Radio for Future Communications – Including Developments in High Frequency Integrated-Circuit Technologies for Portable/ Personal Communications”
- . Commission F: WS-F1 “Interfacing Propagation with Transmission and System Studies for Mobile/Personal Communications” and F1 “Mobile Terrestrial and Satellite Propagation Modeling”
- . Commission K: K3 “Hazard Assessment for Wireless Communications” as well as the joint sessions
 - . CF “Mobile and Personal Communications”
 - . KA “Exposure Assessment for Cellular and Personal Telecommunications”
 - . KC “Health Effects of Mobile Telephones”.

The General Lecture of Prof. Bach Andersen on “Scientific Trends in Personal Communications ” was a sweeping success.

Presently cellular subscribers outnumber internet subscribers 300 vs. 200 million worldwide. Cellular radio will overtake fixed-line subscribers by 2010, also worldwide. This already has happened in some European countries, an outflow of the overwhelming success of GSM.

For the future, Prof. Bach Andersen expects different technologies, not a single system, to fill different application pockets. Among them “Blue Tooth ”, a very short range cable cutting technology in many devices (dish washer, washing machine, ...), wireless broadband access for stationary customers, and aircraft carrying piggyback transponders for wide area broadband coverage. The multiple access method for 3^d generation mobile communications systems will be Code Division Multiple Access. Prof. Bach Andersen pointed out that there exists a trade-off between spectral and power efficiency, spectrum being more valuable. However, power consumption drains handset batteries and power is related to range. One way of getting around the range problem are adaptive antennas. In a scattering environment, adaptive antennas make possible multiple independent channels, so “the bad channel is the good channel”. Signal processing, “blind” (i. e. without reference data) also, will solve many problems in multi-user detection and in estimating/predicting the channel (a wavelength ahead is already possible now). Software radio will adapt to local system and channel situations, but is presently limited by power-hungry analog-digital conversion. An interesting new development is a purely stochastic approach to urban propagation. Biological effects - not hazards - are still a potential problem, setting a power limit near the head.

COMMISSION D - ELECTRONICS AND PHOTONICS

Chair: Professor Roberto Sorrentino (Italy)
Vice-Chair: Professor Alwyn Seeds (United Kingdom)

REPORT ON THE OPEN COMMISSION MEETINGS (BUSINESS MEETINGS)

The Commission held Open Commission Meetings on 16th and 20th August 1999. They were attended by a total of 12 delegates and members.

1. Appointment of Minute Secretary

The US Official Representative agreed to undertake this task.

2. Adoption of Agenda

The Agenda was agreed as proposed by the Chair.

3. Chair's report

4. Attendance list, Update of Official Commission D Member List

5. Schedule of Business Meetings

These were agreed, as above.

6. Election of Chair and Vice-Chair

Professor Alwyn Seeds was proposed to Council as Commission Chair.

Two candidates for Vice-Chair had been duly nominated. Professor Peter Russer was submitted to Council as first choice, based on the result of the Commission D postal ballot with the inclusion of votes from official representatives present, who had not previously voted or who wished to change their vote.

7. Proposal for an Ad Hoc Nomination Committee for Commission Vice-Chairs

The present system was considered to operate satisfactorily and the new proposal was not considered necessary for Commission D.

8. Review of Radio Science

Professor Seeds, editor of the Commission D contribution to the Review of Radio Science, reported that the three reviews he had commissioned had all been received in satisfactory form and that he considered them excellent contributions ranging across the Commission D field of interest.

Both candidates for Vice-Chair confirmed that they would be prepared to act as Commission editor for the Review of Radio Science if elected.

9. Appointment of Commission D Associate Editor for Radio Science Bulletin

Professor Emile Schweicher kindly agreed to assume this responsibility.

10. Evaluation of Young Scientist Programme

The programme was considered useful and capable of enhancement by Conveners encouraging young scientists to contribute papers, see 16 below.

11. Terms of Reference

No changes to the Terms of Reference were considered to be required.

12. Relations with ICO (International Commission on Optics)

Agreed that Commission D would welcome the proposal of a joint session for the next General Assembly from ICO.

13. ISSSE 2001

Received an excellent announcement and first call for papers from the Japanese organising committee. Agreed that this meeting would be the focus for Commission D activity prior to the next General Assembly. Mode B support approved. Steering Committee to include Drs. Akaike, Lucas, Bonek, Professors Itoh, Sorrentino, Seeds and Russer.

14. Proposed nominations for URSI Committees

No requests had been received.

15. General Assembly Sessions

It was agreed that the Commission D tutorial had been very successful with attendance exceeding 75. Joint sessions were also successful. Commission D Sessions were reasonably attended - 75 max, 30-40 typical, as few as 8 for badly scheduled sessions. Close attention to session time-slots will be needed for next General Assembly. Poster Sessions overcrowded and not well laid out. For future General Assemblies, Commission C and Commission D rooms should be in close geographical proximity. Much better space for posters should be provided as there was considerable overcrowding. More time for the poster sessions needed to be allocated. No sessions on the final Saturday of the Assembly should be scheduled.

It was agreed to maintain a strict refereeing standard for both poster and oral papers.

16. Stimulating paper submissions to Commission D sessions

It was agreed that Official Representatives should take a leading role in soliciting the submission of papers to Commission D sessions. A first outline of proposed sessions would be developed later in the agenda and Official Representatives needed to identify key workers in the proposed topics within their countries and solicit appropriate contributions.

17. Terrorism

(of which members are: R. Gardner (incoming Chair Comm. E), C. Baum (USA), W. Radasky (USA), M Wik (Sweden), H. Wipf and M. Ianoz (Switzerland))

18. Sponsorship of International Conferences

Radio Africa '99 - no sponsorship

ISRAMT '99 - Mode A

AP-RASC '01 - Mode B, Eu.\$ 1,000, Professor Seeds to join International Advisory Board.

19. Scientific Programme for 2002

Topics proposed for the next General Assembly included:

Belgian Committee (Professor Schweicher)

Band gap modification for III/V semiconductors, including quantum well intermixing.
Infra-red sensors, including staring arrays.

Professor Russer

Silicon microwave circuits.

Micromachined antenna structures including MEMS.

Multi-chip hybrid integration.

Microwave semiconductor device modelling.

Professor Sorrentino

Re-configurable antennas/receivers.

Professor Itoh

Join Session Commissions C & D: Hardware aspects of wireless communications.

Professor Pyee

Open contributed session

Joint session AD: Superconducting components.

Drs. Favennec & de Fornel

Nanotechnological processes for advanced optic and electronic systems.

Dr. Edwards

Joint Session C, D, F: Optical intersatellite links.

Agreed that proposers of these sessions be invited to prepare a short abstract outlining the session content by April 30 2,000. All conveners would be encouraged to solicit papers from young scientists.

20. Vote of Thanks

The Vice—Chair, Professor Seeds, proposed a vote of thanks to the outgoing Chair, Professor Sorrentino. This was carried with acclamation.

COMMISSION E - ELECTROMAGNETIC NOISE AND INTERFERENCE

Chair: Prof. M. Hayakawa (Japan)

Vice-Chair: Dr. R.L. Gardner (USA)

Commission E continued encouraging scientific work in a variety of subjects during the triennium. That work was reflected in nine half-day scientific sessions during the General Assembly. There has been a recent emphasis on the possibility of the use of electromagnetic energy by criminals or terrorists to damage the electronics in the civilian infrastructure. Commission E believes this is a potential danger to the public and that member nations should conduct research into the means of detecting and quantifying the threat and to mitigate the potential damage. To that end Commission E added a new working group on intentional electromagnetic interference during the General Assembly and sponsored a resolution for Council consideration that supported research in electromagnetic terrorism and related intentional electromagnetic interference subjects.

1. Election of Vice-Chair

Dr. Pierre Degauque was elected as Vice-Chair. Professor Degauque will also serve as the Commission E Editor for Review of Radio Science as is Commission E's custom. The new Commission E Editor for Radio Science Bulletin will be Dr. Ahmed Zeddani

2. Terms of Reference

Minor changes were made to the Terms of Reference

3. Working groups

Commission E conducts most of its activities through its working groups.

The new working groups that were voted for the new triennium are:

- E.1. Spectrum Utilization/Management and Wireless Telecommunications
Co-Chairs: G. Hurt (USA), R. Struzak (Poland)
- E.2. Intentional Electromagnetic Interference
Co-Chairs: M. Wik (Sweden) and W. Radasky (USA)
- E.3. High Power Electromagnetics
Co-Chairs: C. E. Baum and R. L. Gardner (USA)
- E.4. Terrestrial and Planetary Lightning Generation of Electromagnetic Noise
Co-Chairs: Z. Kawasaki (Japan) and V. Cooray (Sweden)
- E.5. Interaction with, and Protection of, Complex Systems
Co-Chairs: J. Nitsch (Germany), P. Degauque (France), M. Ianoz (Switzerland) and J. P. Parmentier (France)
- E.6. Effects of Transients on Equipment
Co-Chairs: J. ter Haseborg (Germany) and B. Demoulin (France)
- E.7. Extra-Terrestrial and Terrestrial Meteorologic-Electric Environment
Chair: H. Kikuchi (Japan)

- E.8. Geoelectromagnetic Disturbances and Their Effects on Technological Systems
Co-Chairs: M. Hayakawa (Japan) and R. Pirjola (Finland)
- E.9. Interference and Noise at Frequencies Above 30 MHz
Chair: J. Gavan (Israel)

4. Support for the various academic meetings

The following meetings will be supported in the coming triennium with primary monetary support to the main EMC meetings that comprise support the work of Commission E.

- EuroEM, Edinburgh, May 00
- EMC Wroclaw, June 00 (Open Meeting, Comm E)
- Congres International et Exposition sur la Compatibilite Electromagnetique, Clermont Ferrand, March 00
- EMC Zurich, Feb 01 (Open Meeting Comm E)
- Asia-Pacific Radio Science Conference, Tokyo, Aug 01
- AmerEM, Annapolis, May 02
- Congres International et Exposition sur la Compatibilite Electromagnetique, Limoges, 02
- EMC Wroclaw, June 02
- URSI General Assembly Maastricht, Netherlands, Aug 02

In particular the membership voted to support Open Meetings of Commission E at the EMC Wroclaw Symposium in 2000 and at the EMC Zurich Symposium in 2001.

5. Resolution

The resolution on intentional electromagnetic interference that was introduced by Prof. Ianoz of Switzerland and supported by Commission E was URSI Resolution on Electromagnetic Terrorism and Adverse Effects of High Power Electromagnetic Environments, presented by the Swiss Member Committee and an ad hoc group on EM Terrorism (of which members are: R. Gardner (incoming Chair Comm. E), C. Baum (USA), W. Radasky (USA), M Wik (Sweden), H. Wipf and M. Ianoz (Switzerland)

6. Recommendations

1. Perform additional research pertaining to EM Terrorism in order to establish appropriate levels for the threats, and to understand the large variation of susceptibility levels and system weaknesses.
2. Investigate techniques for appropriate protection against EM Terrorism and to provide methods This should be used to protect the public from the damage that can be done to the infrastructure by EM Terrorists.
3. Develop high-quality testing and assessment methods to evaluate system performance in the special electromagnetic environments.
4. Provide reasonable data regarding the formulation of standards of protection and support the standardization work which is in progress.

It is hoped that the information presented in this document and its scientific basis will emphasize the need to recognize the seriousness of EM Terrorism.

7. Other business

The sense of Commission E was the format of one week plus weekend should be kept.

COMMISSION F - WAVE PROPAGATION AND REMOTE SENSING

Chair: Mr. M. P. M. Hall (UK)
Vice-Chair: Dr. Yoji Furuhamo (Japan)

REPORT ON THE OPEN COMMISSION BUSINESS MEETINGS

The Commission held three Open Business Meetings, respectively on 16, 18, and 20 August 1999. Copies of the agenda were made available and of the Commission F report to Council for 1996-99 (to be published in the September Radio Science Bulletin). The following items were discussed at the meetings:

1. Election of Vice-Chair

Member Committee Representatives had had the opportunity to vote for Vice-Chair by mail, but were again given the opportunity to vote (or to change their vote) at the GA. Credentials of those voting were checked. The following names were proposed to Council, in order of preference:

1. M. T. Hallikainen (Finland)
2. G. O. Ajayi (Nigeria)

The Commission confirmed its wish that Dr. Furuhamo would become Chair at the conclusion of the General Assembly. Council subsequently confirmed the appointment of Dr Furuhamo and Prof. Hallikainen.

2. 1999 General Assembly Program

Commission F organized 10 scientific oral sessions of invited papers and one large poster session. Session names and convenors were as follows;

- F1: Mobile terrestrial and satellite propagation modelling, F. Perez-Fontan (Spain) and Y. Karasawa (Japan)
- F2: Climatic parameters in radiowave propagation, J. P. V. Poiars Baptista (The Netherlands) and T. Tjelto (Norway)
- F3: Millimetric, sub-millimetric and optical wave propagation prediction, K. H. Craig (UK) and S. Ito (Japan)
- F4: Remote and in-situ sensing of clouds and their effects on radiowave propagation, P. A. Watson and A. J. Illingworth (UK)

- F5: Atmospheric dynamics in the lower atmosphere: measurement, modelling and effects, D. T. Gjessing (Norway)
- F6: Spaceborne remote sensing of precipitation-TRMM, C. Kummerow (USA) and K. Okamoto (Japan)
- F7: Remote sensing of Earth surfaces, M. T. Hallikainen (Finland) and B. Arbesser-Rastburg (The Netherlands)
- F8: Interferometric techniques in remote sensing, J. Fr. Hjelmstad (Norway) and J. van Zyl (USA)
- F9: Polarimetric techniques in remote sensing, W-M, Boerner (USA) and S. R. Cloude (UK)
- F10: Synergetic use of remote sensing instruments, H. Oetl (Germany) and A. J. Bedard (USA)
- FP: Wave propagation and remote sensing, Y. Furuhashi (Japan)

Having all invited papers distinguishes Commission F sessions at General Assemblies (GAs) from those at the Triennial Open Symposia held the year before Gas.

Joint sessions were:

- FAB: Techniques and applications for sub-surface remote sensing, D. Noon (Australia) and G. S. Smith (USA)
- CF: Mobile and personal communications, E. Bonek (Austria) and H. Bertoni (USA)
- EF: Interference in communication, E. J. Gavan (Israel) and B. Arbesser-Rastburg (The Netherlands)
- GF: Ionosphere and troposphere parameters retrieved from GPS/GLONASS measurements, P. Hoeg (Denmark) and J. P. V. Poyares Baptista (The Netherlands)
- JF: Tropospheric path delay correction, D. Woody (USA) and J. P. V. Poyares Baptista (The Netherlands)

Commission F tutorial lecture was:

Remote characterization of geophysical phenomena using EM waves, D. T. Gjessing (Norway)

Before the regular scientific sessions of the GA, Commission F had organized three Workshops:

- WSF1: Interfacing propagation with transmission and antenna system studies for mobile/personal communications, F. Perez-Fontan (Spain) and Y. Karasawa (Japan)
- WSF2: Synergy of active and passive remote sensing instruments, B. Arbesser-Rastburg (The Netherlands) and M. T. Hallikainen (Finland)
- WSF3: WISP-Wideband (ULF to UV) Interferometric sensing and imaging polarimetry-theory and applications, W-M. Boerner (USA) and S. R. Cloude (UK)

The regular sessions had a well balanced technical content and also were geographically well balanced. However there was concern that the quality level was not so high for some papers and that the whole meeting had been too busy.

3. *Matters relating to Council and the Coordinating Committee*

3.1 Commission Assistant Editors for the Radio Science Bulletin

Mr. Hall informed that Dr. W. R. Stone (USA) sought from each commission an Associate Editor to solicit two papers per year (e.g. radiowave propagation and remote sensing for Commission F), and to arrange full refereeing. Certain papers at conferences might be a starting point. Dr. K. Andersen (USA) volunteered to do this. People were urged to get their libraries to subscribe.

3.2 Duration of future General Assembly

In this Toronto GA, 7 days duration was introduced. All Commissions had been invited to give their opinion and Commission F confirmed its preference by a show of hands as to whether the format of the next GA should be 7 days as this time or 10 days as the previous one. Answers of Commission F representatives were slightly in favor of the present duration of 7 days.

3.3 Formation of Nomination Committee for a Vice Chair

Mr. Hall said there had been a strong recommendation for commissions to have Ad Hoc Nominating Committees to solicit and generate nominations, and to then select a slate of three candidates who would agree to serve if elected. However, all Commission F representatives, including several ex-Commission F chairs, expressed the wish to keep the present selection procedure in Commission F and not to change as proposed. This was later accepted in Council.

3.4 Terms of Reference

It was agreed to keep them as they were.

3.5 Relations between URSI and ITU-R

Mr. Hall said there had been a lot of discussion on this in Council and that Commission F was noted for its good interaction with ITU-R Study Group 3 and its Working Parties. However, there was now some activity in trying to promote contacts between other Commissions and Study Groups. It was important to recognize the major work of IUCAF in relation to protecting radio frequency interests of those in remote sensing and radioastronomy, as had been reported in the Radio Science Bulletin. (See also Section 7.4.)

3.6 Other proposals

Mr. Baptista (The Netherlands) said that there was need for a statement about the frequency bands for Earth exploration. Prof. Boerner (USA) spoke on the importance of reserving several frequency bands below 10GHz for SAR. Commission F made two recommendations: F.1 "Support for EES (Earth Exploration Services) spectrum management" and F.2 "Allocation and sharing of frequencies within the MF/HF/VHF/UHF bands".

4. *Inter-assembly meetings*

4.1 Commission F meetings in last triennium

Commission F was sponsor or co-sponsor of 21 meetings between the 1996 and 1999

URSI GAs. Below are shown meetings, locations, dates and Modes (where Mode A has the name of URSI and logo, but no URSI money; Mode B has a grant (typically 2000 US\$) from Commission F, but only for participation of individual scientists, mainly from developing countries or the New Independent States; Mode C is a major conference with direct involvement of URSI headquarters in management and budget with significant support (typically 5000 US\$), and share in any profits).

The main Commission F meeting between URSI General Assemblies is the Commission F Open Symposium, held this time in Aveiro, Portugal on September 22-25, 1998 (Mode B).

Commission F, as usual, co-sponsored with the IEEE Geoscience and Remote Sensing Society three International Geoscience Remote Sensing Symposia (IGARSSs), all as Mode A; these, the largest remote sensing meetings, continue to draw nearly 1000 papers. IGARSS'97 was held in Singapore on August 3-8, 1997, IGARSS'98 was held in Seattle, Washington, USA on July 6-10, 1998, IGARSS'99 was held in Hamburg, Germany on June 28-July 2, 1999.

CLIMPARA'98, the third in the series, was held in Ottawa, Canada in April 27-29, 1998 (Mode B). Again it was followed immediately by ITU-R Working Party meetings and was a focus of relations with ITU-R Study Group 3.

In addition, the International Symposium on Radiowave Propagation (ISRP) was held in Qiangdao, China on August 12-16, 1997 (Mode B), the Eighth International Workshop on Technical and Scientific Aspects of MST Radar (MST8) was held in Bangalore, India on December 15-20, 1997 (Mode B), the Physics and Engineering of MM and SubMM EM Waves meeting was held in Kharkov, Ukraine on September 15-17, 1998 (Mode B), and the Workshop on Radio Methods for Studying Turbulence was held in Urbana, Illinois, USA on August 9-12, 1999 (Mode B). A meeting on Microwave Signatures in Remote Sensing was initially planned to be held in Moscow, Russia on March 11-13, 1998, but this Symposium was cancelled at short notice and the grant returned in full.

Other Mode A meetings co-sponsored with other groups, including other URSI commissions, were the International Symposium on Antennas and Propagation (ISAP'96), held in Chiba, Japan, on September 24-27, 1996, the International Conference on Antennas and Propagation (ICAP'97), held in Edinburgh, UK, on April 14-17, 1996, Radio Africa'97, held in Nairobi, Kenya, on August 4-8, 1997, the Urban Radiowave Propagation Symposium (URPS'97), held in Tomsk, Russia, on September 2-4, 1997, the 1998 International Wireless and Telecommunications Symposium/Exhibition (IWTS'97), held in Kuala Lumpur, Malaysia, on May 11-15, 1998, the European Conference on Synthetic Aperture Radar (EUSAR'98), held in Friedrichshafen, Germany, on May 25-27, 1998, the International Workshop "Day on Diffraction'98", held in St. Petersburg, Russia, on June 2-4, 1998, the COSPAR Scientific Assembly, held in Nagoya, Japan, on July 12-19, 1998, PIERS'98, held in Nantes, France, on July 13-17, 1998, the 10th Microcoll, held in Budapest, Hungary,

on March 21-25, 1999, and the International Workshop “Day on Diffraction’99”, held in St. Petersburg, Russia, on June 1-44, 1999.

4.2 Proposed Commission F meetings for next triennium

Most of the following meetings were mentioned during Commission F business meetings, but a few have been added since.

Mode A (moral support)

AP2000 – Davos, Switzerland, April 9-14, 2000

EUSAR 2000– Munich, Germany, May 23-25, 2000

GPR 2000 – Gold Coast, Queensland, Australia, May 23-26, 2000

IGARSS 2000 – Honolulu, Hawaii, USA, July 24-28, 2000

ISAP 2000 – Fukuoka, Japan, August 22-25, 2000

Antennas and Propagation for Wireless Communications – Waltham, MA, USA, November 6-8, 2000

ICAP 2001– Manchester, UK, April 2001

IGARSS 2001 – Sydney, Australia, July 9-13, 2001

Mode B (financial support)

Radio Africa’99 – Gaborone, Botswana, October 25-29,1999

MST9-COST79 Workshop – Toulouse, France, March 13-17, 2000

33rd COSPAR Scientific Assembly – Warsaw, Poland, July 23-26, 2000

Commission F Triennial Open Symposium– 2001

AP-RASC’01 (2001Asia-Pacific Radio Science Conference) –Tokyo, Japan, August 1-4, 2001

CLIMPARA’01– 2001

There were several opinions about the venue for Commission F Triennium Meeting and Climpara’01. We would like to continue these discussions by e-mail.

4.3 Responsibilities of URSI Representatives at meetings sponsored by Commission F

Mr. Hall emphasized the importance of the role of Commission F representative in organizing meetings, namely:

For all Mode: ensure URSI involvement clearly, logo etc., especially in Call for Papers, etc.: participate in organizing committee, especially for technical program; provide call-for-papers and report on the meeting for URSI’s Radio Science Bulletin; and keep Commission F Chair fully informed of developments.

For Mode B: organize invitation and funding of URSI-supported scientists; possibly speak in opening session, banquet, etc; report to URSI Bulletin and Secretariat, copied to Commission F Chair.

For Mode C and for major Mode B events being organized exclusively by URSI: arrange for registration fees to be reduced by 30 US\$ for all URSI correspondents, the 30 US\$ paid by non-URSI correspondents to be remitted to URSI headquarters with a list of those who paid it. Those paying then become URSI correspondents and receive the Radio Science Bulletin, etc.

5. 2002 General Assembly

5.1 Proposals for sessions and organizers

Many proposals for sessions have been put forward by Dr. J. P. V. Poiares Baptista (The Netherlands), Prof. W-M. Boerner (USA), Dr. T. Tjelta (Norway), Dr. R. L. Olsen (Canada), Dr. J. Lemorton (France), Dr. D. Noon (Australia), Dr. D. T. Gjessing (Norway), Dr. B. Arbesser-Rastburg (The Netherlands), Prof. M. T. Hallikainen (Finland), and Dr. J. Fr. Hjelmstad (Norway). These proposals will need rationalization and grouping together.

In the business meetings, it was felt that, in view of the Triennial Open Symposia (covering all Commission F topics areas), it was appropriate to maintain the Commission F tradition of having compact invited-paper sessions on specific subjects and allow a broader allocation of contributed papers as posters. There should be 8 oral sessions, each with two less papers per session followed by discussion, having 4 sessions for propagation and 4 sessions for remote sensing. It was agreed that it had been well worth using the opportunity to hold Workshops in 1999, but that they were too separated from the sessions held in the following week. Any such workshops in future would be part of the main program.

5.2 Proposals for joint sessions with other commissions

Up to now, several people expressed their interest in joint sessions with Commissions of B, C and D. However, it was felt that time would allow only one session on this.

5.3 Proposals for tutorial topics, general lectures and their speakers

None were proposed in the business meetings, but Mr. Hall requested proposals be sent to Dr. Furuham. The tutorials were felt to be of general interest and good for young scientists.

6. Intercommission Working Groups

Mr. Hall mentioned that these automatically end at a General Assembly unless renewed by Resolution to Council. It was felt that results from Working Groups should be made known through the Radio Science Bulletin, as well as in reports to Council.

It was agreed to continue **WG GF.1** (Middle atmosphere) with Prof. J. Röttger (Germany) as coordinator and Prof. C-H Liu (China, SRS) as the Commission F representative.

It was also agreed to continue WG GFA1, but with the designation and title slightly changed to "**WG FG.1: Atmospheric and Ionospheric Remote Sensing using Global Positioning Systems (GPS/GLONASS)**" with Mr. J. P. V. Poires Baptista (The Netherlands) as coordinator and Dr. P. Hoeg (Denmark) as Commission G representative.

7. Representatives to other organizations

7.1 SCOR (Scientific Committee on Oceanic Research)

Commission F interests are looked after by Prof. M. T. Hallikainen.

7.2 IUCAF (Inter-Union Committee on Frequency Allocations for Radioastronomy and Space Research)

Commission F to be represented by Mr. J. P. V. P. Baptista and Dr. G. Rochard (France).

7.3 COSPAR (Committee on Space Research)

Mr. J. P. V. Poires Baptista to be the formal member, with the representation at a meeting depending on where that meeting is to be held.

7.4 SCT (Scientific Committee for Telecommunications)

Mr. Hall mentioned the progress of chairs meeting about relations between URSI and ITU. The outcome was that the Scientific Committee for Communications (SCT) was to be reactivated. However there was no time to enter into details. In general, the currently retiring Commission Chairs were being proposed to serve on the STC in its early stages and it was agreed that Mr. Hall represent Commission F on this basis.

8. *Publications and publicity*

8.1 Review of Radio Science

It was agreed to continue the policy of having review chapters corresponding to most General Assembly session topics and for the session convenors to write the chapters; it was also agreed that the new Vice Chair be the editor for Commission F.

Council had decided that future publication of the RRS be on CD-ROM for distribution to the attendees at the General Assembly, with hardbound books produced for sale to libraries, institutions, and those who specifically want a paper book.

8.2 Disk

Mr. Hall expressed appreciation for the work undertaken by Dr. R. L. Olsen (Canada) and by the national representatives in preparing material for the disk of references for Commission F. Dr. Olsen mentioned the big task of preparing the disk and felt it was not realistic to retain the present method anymore. Considering that the perceived value from the disk is not commensurate with the very substantial amount of time required on the part of the Commission Disk Editor and others involved in preparing it, Council subsequently concluded that preparation and publication of the Disk should not be undertaken for the next triennium.

8.3 Modern Radio Science

The equivalence of MRS (Modern Radio Science) will in future be published in RSB (Radio Science Bulletin)

8.4 General Assembly book of abstracts

There had been much paperwork for Commission Chairs and Session Convenors that should be avoided in future. The Standing Committee on Publications had recommended that the current book of one-page abstracts be replaced by three-to-four page summaries, made available by electronic media and distributed at the GA on CD-ROM

8.5 Publicity

Mr. Hall commented on the difficulty of contacting some Member Committee Representatives and the fact that certain Member Committees did not even have Representatives for Commission F (as was also the case for other Commissions). He also commented on the need to make known the activities of Commission F within the various countries, some of whom had national meetings and some of whom did not.

9. *Any other business*

It was noted that Mr. Hall had been appointed as Coordinator for the Scientific Program for the next General Assembly. He would welcome comments sent to him directly. Dr Furuhama introduced a proposal for publication in "Radio Science" (RS). He had been invited to serve as a guest editor for setting up a special section for publication in RS on the most important areas of research in the area of URSI Commission F as we enter the 21st Century. He proposed that several authors of Commission F chapters for "Review of Radio Science" in Toronto GA and some appropriate members, perhaps session convenors, should revise the contents by adding new information which appeared in this GA and prepare manuscripts for RS. He would prepare an introductory note for the special section.

COMMISSION G - IONOSPHERIC RADIO AND PROPAGATION

Chair: Prof. B.W. Reinisch (USA)
Vice-Chair: Dr. P.J. Wilkinson (Australia)

REPORT ON THE OPEN COMMISSION MEETINGS (BUSINESS MEETINGS)

First Open Commission Meeting (Monday 16 August 1999)

1. In Memorium

The Business Meeting commenced with a brief moment remembering past friends of Commission G.

Lucien Bossy

Prof. Lucien Bossy died two weeks after the Lille URSI General Assembly at the age of 78. He was a mathematician and physicist who has dedicated his outstanding talents to the understanding of the earth's environment, especially the ionosphere. For long years he represented the ionospheric research community at URSI and other international organizations and has been an inspiration and friend to many of us. Josef Lemaire has reported on his life in The Radio Science Bulletin (Dec 96).

Edward J. Weber

Dr. Ed Weber died on 1 December 1998 at the age of 50 years. He was an ionospheric research scientist at the AF Research Laboratories at Hanscom AFB in Massachusetts, USA. At the time of his death he was the Chief of the Ionospheric Interactions Branch. From his early years as a graduate student in Antarctica to his very last day he was dedicated to the exploration and understanding of the earth's ionosphere using optical and radio techniques. With his observations from the ground and aboard the KC135 research plane he discovered and described the development and dynamics of the polar cap patches, and he gave one of the early descriptions of the ionospheric depletions associated with plumes,

spread F and scintillations. In his last years he developed satellite programs for the study of ionospheric dynamics and structure.

Harvey Cummack

Dr. Harvey Cummack, who died December 1 1996, was born March 3rd, 1929 in Auckland, New Zealand. He was educated at the University of Canterbury as a mathematician and subsequently devoted his scientific life to the terrestrial ionosphere, first in the New Zealand Geophysical Observatory and then, on retirement in 1987, at the Physics and Astronomy Department of the University of Canterbury. His early work covered modelling the ionosphere at middle and low latitudes; his later work aimed at understanding the returns observed on ionograms. Harvey traveled little outside New Zealand, but for those who met him he will always be remembered as a person willing to discuss new ideas and impart the benefit of his experience to co-workers, and to people entering atmospheric and ionospheric physics. In his retirement, he was very proud of his work with several younger scientists as they set out on their careers.

2. Commission G Triennial Report

The Chair, B. Reinisch, noted that the past triennium had been a busy and productive time for Commission G. The complete URSI Commission Report was published prior to the General Assembly in Toronto and can be found on the Commission G Web site, currently at <http://ulcar.uml.edu/ursi/>.

3. Terms of Reference

In discussions, P. Cannon, J. Matthews and Sa. Basu suggested the Commission G terms of reference should be broadened to encompass topics that are currently either dealt with in the commission or could be. The new terms of reference expand Commission G interests beyond communications and emphasise both ground-based and space-based operations. These changes were adopted by the meeting and proposed to the URSI Council where they were subsequently accepted. The general terms of reference remain the same with the minor changes shown below, underlined.

Commission G: IONOSPHERIC RADIO AND PROPAGATION

The Commission deals with the study of the ionosphere in order to provide the broad understanding necessary to support space and ground-based radio systems. Specifically, the study includes the following areas:

- (a) Global morphology and modelling of the ionosphere;*
- (b) Ionospheric space-time variations;*
- (c) Development of tools and networks needed to measure ionospheric properties and trends;*
- (d) Theory and practice of radio propagation via the ionosphere;*
- (e) Application of ionospheric information to radio systems.*

To achieve these objectives, the Commission co-operates with other URSI Commissions, corresponding bodies of the ICSU family (IUGG, IAU, COSPAR, SCOSTEP, etc.) and

other organisations (ITU, IEEE, etc.).

4. Election of Commission G Vice- Chair for 1999-2002

Following a decision by the URSI Board, a maximum of three candidates may nominate for the Vice-Chair position per General Assembly. This Assembly the three candidates were: P. Bencze, C. Hanuise and S. Pulinets. Votes were distributed to 40 Commission G national delegates and, including votes cast during the Assembly, 27 countries voted with C. Hanuise being the successful candidate and S. Pulinets second. Subsequently, the URSI Council endorsed C. Hanuise as the Vice Chair of Commission G for 1999-2002.

5. Joint working groups

All Working Group Triennium reports are included in the Commission Triennium Report that is available on the Commission G website. Groups that did not supply a triennium report are indicated below. These reports are the responsibility of the lead Commission representative. In some cases these reports did not state that the working groups were to continue or not, this being settled during Working Group Business meetings held as part of the URSI General Assembly. Below the current Commission G working Groups, and Joint Working groups, are summarised together with brief reports and recommendations for future activity.

- *G.1. Ionosonde Network Advisory Group (INAG)*
Chair: R. Conkright (USA); Vice-Chairs: P. Wilkinson (Australia) and J-C. Jodogne (Belgium).
The principal objectives for the next three years is to extend the INAG Webpage (<http://www.ips.gov.au/INAG>) and promote ionosonde data exchange using the World Data Center A Space Physics Interactive Data Resource (SPIDR). Recommend continuing with same officers.
- *G.2. Studies of the Ionosphere Using Beacon Satellites*
Chair: R. Leitinger (Austria) Vice-Chairs: J.A. Klobuchar (USA) and P.V.S. Rama Rao (India). Tomography and occultation are new techniques encompassed by the Working Group now. Recommend continuing with same officers.
- *G.3 Incoherent Scatter*
Chair : A.P. van Eyken (Norway); Vice-Chair: W. Swartz (USA).
The main objective is to schedule the Incoherent Scatter World Day program. Recommend continuing with same officers.
- *G.4 Ionospheric Informatics*
Chair : S.M. Radicella (Argentina); Vice-Chair: R. Hanbaba (France). Work on developing mean electron density profiles will be extended further to encompass the globe. Recommend continuing with same officers.
- *GF.1. Middle Atmosphere*
Co-Chair for Comm. G : J. Röttger (Germany); Co-Chair for Comm. F: C.H. Liu (China, SRS). The group will continue to conduct workshops. Recommend continuing with same officers.

- *GFA.1. Ionosphere and Atmosphere Remote Sensing using Global Positioning Systems (GPS/GLONASS)*
Co-Chair for Commission G: P. Høeg (Denmark); Co-Chair for Commission F: F. Solheim (USA); Co-Chair for Commission A: P. Banerjee (India). No report was supplied. Further action was deferred until the second Business Meeting.
- *GH.1. Active Experiments in Plasmas*
Co-Chair for Commission G: Sa. Basu (USA); Co-Chair for Commission H: T. Leyser (Sweden). Recommend continuing with same officers.
- *GH.2. Computer Experiments, Simulation and Analysis of Wave Plasma Processes*
Co-Chair for Commission G: H. Thiemann (Germany); Co-Chair for Commission H: H. Matsumoto (Japan) No report was supplied. Recommend continuing with same officers.
- *CGH.1. Wave and Turbulence Analysis*
Co-Chair for Commission G: A.W. Wernik (Poland); Co-Chair for Commission H: F. Lefeuvre (France). No Commission C person was identified to participate in this group. A very successful workshop was held Aug 9-12, 1999, at University of Illinois at Urbana-Champaign, hosted by Prof. K. C. Yeh and Commissions E, F, G, H and J assisted with finance, in addition to SCOSTEP, and NSF helped fund students to attend.
- *EGH.1. EM Effects Associated with Seismic Activity*
Co-Chair for Commission E : T. Yoshino (Japan); Co-Chair for Commission G: O.A. Pokhotelov (Russia); Co-Chair for Commission H: M. Parrot (France) No report was supplied. Further action was deferred until the second Business Meeting.

6. Inter-Union Working Groups

There are two inter-Union Working Groups sponsored by Commission G.

- *URSI/IAGA VLF/ELF Remote Sensing of the Ionospheric and Magnetosphere (VERSIM)* Co-Chair for IAGA Commission 2 and 3: A.J. Smith (UK); Co-Chair for URSI Commission G and H: M. Parrot (France). Recommend continuing with same officers.
- *URSI-COSPAR on International Reference Ionosphere (IRI)* Chair: D. Bilitza (USA); Vice Chair for COSPAR: K.I. Oyama (Japan); Vice Chair for URSI: B.W. Reinisch (USA). Recommend continuing with same officers. A Commission G resolution was also proposed by this group.

7. Report on Contributions to Reviews of Radio Science

The Chair, B. Reinisch, on behalf of the Commission, thanked the Commission G Editor, C. Hanuise, for his excellent work preparing the Commission contributions to Reviews of Radio Science. Hanuise commented that the task had been straightforward thanks to the reminders from Ross Stone, and the good work and rapid responses received from the referees.

8. Proposal for Sessions in 2002

Several proposals for sessions were discussed. Some attempt was made to emphasise sessions that would include issues known to be important to the International Telecommunications Union (ITU). Subsequent discussions raised topics that could not be readily accommodated in the first set of sessions proposed. Using this information a set of potential sessions was prepared and discussed in the second Business Meeting.

9. Commission G Resolutions Committee

At the previous Assembly Commission G received a flood of resolutions diluting the tenuous value of Commission resolutions. Consequently, to act as a filter for the Commission a Committee to handle resolutions was formed. The committee comprised the past Chair, current Chair, current Vice-Chair and Vice-Chair elect. This Committee would have greater responsibilities than the Resolution Committees from previous Assemblies. B. Reinisch stressed that resolutions must be directed to somebody so it is apparent what action ought to occur.

10. Session Review Forms

A review form was proposed by URSI to be filled out by Convenors, continuing the session assessments made at previous Assemblies. In addition, Commission G decided to introduce a further level of assessment by distributing assessment forms to a few members of the audience for each session Commission G headed. This information would be held by the Commission Chair and used to assist Convenors prepare sessions.

11. Joint Business Meeting with Commission H

No joint meeting was held with Commission H as the main tasks for the meeting were identified and dealt with by the Commission Chairs. While this was suitable at the time, Commission H has now requested that a Joint Meeting be scheduled for future Assemblies. This will be done.

Second Open Commission Meeting (Friday, 20 August 1999)

The meeting opened with a brief summary of the results of the Council Elections that took place on the previous evening. The meeting congratulated K. Schlegel and A. Wernik on being elected as Vice-Presidents of URSI.

1. Publications

Commission G editor for Reviews of Radio Science: J. Sahr (USA) has been appointed. Proposed Commission G topics for Reviews of Radio Science

- a) Ionospheric effects on HF propagation – P. Cannon
- b) Space weather effects on the ionosphere.
- c) To be decided

Commission G associate editor for Radio Science Bulletin: D. Hysell (USA) has been appointed.

Commission G tutorial lecture for 2002: Proposed: Radio Occultation Observations.

2. Commission G Website

During the triennium 1996-1999, URSI Commission G has been active through its Working Groups, sponsored symposia and workshops. Early in the triennium a Commission G web site was established (<http://ulcar.uml.edu/ursi/>) to ease communication between the Chair and the Commission. The triennium report is available at this site.

During the next triennium this Website will be moved to the URSI Web site and updated there. Future Commission Newsletters and Reports will be found on the Commission Website.

3. Resolutions

There were four resolutions, below, proposed by Commission G and endorsed by the meeting.

The meeting endorsed the first resolution, noting that it ought to be a URSI resolution, rather than a Commission resolution but the new rules for URSI resolutions prevent this. URSI Resolutions must now be proposed well in advance of the Assembly so that the National Delegates have time to consider them prior to the Assembly.

The second resolution discussion noted there are many models of the ionosphere, but the meeting accepted it was important to acknowledge one model as a baseline.

The third resolution acknowledged recent work on the International Reference Ionosphere (IRI) has shown there are significant defects in our synoptic knowledge of the topside ionosphere that cannot be redressed globally without a topside ionosonde program. Some felt the resolution should be framed in stronger words.

The fourth resolution acknowledged that a good start has been made to protect Jicamarca Observatory, but this resolution will reinforce the efforts already made and confirm the International value of the work carried out there.

All resolutions were passed by the meeting and later accepted by the URSI Council.

3.1 Resolution 1: The IGY plus 50 years: New Perspectives for the Next Millenium

Recognizing that the years 2007-2008 will be exactly 50 years after the highly successful International Geophysical Year, and

Whereas the science agencies of the various adherent nations are engaged in, or have planned, aggressive science programs, and

Whereas these science programs are directed toward understanding the solid bodies, the oceans, the atmospheres, and the plasma environments of the Earth, the planets, the minor bodies, and the sun itself along with their physical and biological interaction, and

Whereas the science programs hold great promise for the education of the younger citizens of the whole world and the enthusiastic engagement of people everywhere, and

Whereas the further comprehensive understanding of the sun, the Earth system, and indeed all the planetary systems, will give us a practical ability to protect human technological systems, and

Whereas radio science contributed and will continue to contribute crucially in all aspects of the above-mentioned science programs, URSI Commission G resolves

To support the SCOSTEP initiative to declare the period 2007 to 2008 “The IGY plus 50 years: New Perspective for the next Millenium” and urges all URSI Commissions to join the opportunity to share in the exploration, the excitement, and the adventure as humankind pushes forward in the next Millenium to a consolidated view of our entire solar system, just as humans did in the Earth’s case in the decades following the IGY.

3.2 Resolution 2: The IRI as a standard for the ionosphere

Recognizing the need for an international standard for the specification of the ionospheric environment, and

Recognizing that the Presidents of URSI and COSPAR have written to international organizations in support of the International Reference Ionosphere as an ionospheric standard, URSI Commission G resolves

That the International Reference Ionosphere (IRI), as developed by the URSI / COSPAR Inter-Union IRI Working Group, be internationally recognized as the standard for the ionosphere.

3.3 Resolution 3: Encouragement for topside sounder programs

Considering the large uncertainties in the specification of the F layer peak densities and heights over large parts of the globe, specifically the oceans and the southern hemisphere, and

Considering the large uncertainties in the specification of the topside ionospheric and plasmaspheric densities, and

Considering the need for the real-time specification of the ionosphere for operational use, URSI Commission G resolves

That National Space Agencies be encouraged to launch a series of topside sounders that can specify the topside ionosphere in real time up to an altitude of about 1000 km.

3.4 Resolution 4: Protection for Jicamarca Observatory

Whereas the Jicamarca observatory is a unique facility for international atmosphere and ionosphere research at the magnetic equator, and

Whereas the location was selected for its isolation from radio interference and its clear environment, and

Whereas encroaching urban and demographic growth threaten these special characteristics of the site, and

Whereas we have been informed by the Peruvian delegation of legal initiatives that have been taken to protect the unique environment of the Jicamarca Observatory,

Therefore Commission G applauds the initial steps taken by the Peruvian Government, and URSI Commission G resolves

To urge the Peruvian Authorities to take the additional necessary steps to complete the protection of this valuable facility.

4. Scientific Committee on Telecommunication, SCT

Over the last triennium there has been much effort in URSI to increase ITU/URSI interactions. This effort commenced in Prague (1990) with the creation of the Scientific Committee on Telecommunications (SCT), lead by L. Barclay. While the SCT did some good work, there was also a good deal of impatience and criticism of its output. Consequently, the SCT was dissolved in Lille and replaced by an ad hoc group chaired by J. Shapira. Commsphere was formed, but the link to the URSI Commissions was not evident. Nor did the Commission Chairs support an expansion of Commsphere into the General Assembly, proposed at this Assembly. The Commissions are therefore encouraged to increase their connections with ITU. In particular, while Commissions B, C and F have close relationships, Commission G used to be very active through the initiative of L. Barclay and P. Bradley. The meeting noted this information.

The past Commission G Chair, B. Reinisch, has proposed P. Bradley becomes the Commission G member on the reconstituted SCT.

5. Working Groups 1999-2002

The meeting approved the following Working Groups and Joint Working Groups for the next triennium.

- *G.1. Ionosonde Network Advisory Group (INAG)*
Chair: R. Konkright (USA); Vice-Chairs: P. Wilkinson (Australia) and J-C. Jodogne (Belgium).
- *G.2. Studies of the Ionosphere Using Beacon Satellites*
Chair: R. Leitinger (Austria); Vice-Chairs: J.A. Klobuchar (USA) and P.V.S. Rama Rao (India).
- *G.3 Incoherent Scatter* Chair: A.P. van Eyken (Norway);
Vice-Chair: W. Swartz (USA).
- *G.4 Ionospheric Informatics*
Chair: S.M. Radicella (Argentina); Vice-Chair: R. Hanbaba (France).
- *GF Middle Atmosphere* (this is the former AFG.1)
Co-Chair for Comm. G: J. Röttger (Germany); Co-Chair for Comm. F: C.H. Liu (China, SRS).
- *GH.1. Active Experiments in Plasmas*
Co-Chair for Commission G: Sa. Basu (USA); Co-Chair for Commission H: T. Leyser (Sweden).
- *GH.2. Computer Experiments, Simulation and Analysis of Wave Plasma Processes*
Co-Chair for Commission G: H. Thiemann (Germany); Co-Chair for Commission H: H. Matsumoto (Japan).
- *GH.3. Wave and Turbulence Analysis*

Co-Chair for Commission G: A.W. Wernik (Poland), Co-Chair for Commission H: F. Lefeuvre (France). The group will continue, but as a joint GH Working group. After a successful workshop in Urbana, a similar meeting is planned within the next 2 – 3 years. A school on methods of data analysis in turbulence has also been considered.

- *EGH Lithosphere-Atmosphere-Ionosphere coupling.*

Co-Chair for Commission E: Hayakawa (Japan); Co-Chair for Commission G: S. Pulinets (Russia); Co-Chair for Commission H: M. Parrot (France) This group replaces the Working Group EGH.1 “EM Effects Associated with Seismic Activity”.

- *FG. Atmospheric and Ionospheric Remote Sensing using Global Positioning Systems (GPS/GLONASS)*

Co-Chair for Commission F: P. Baptista (Netherlands); Co-Chair for Commission G: P. Høeg (Denmark). This working group is a continuation of Working Group GFA.1 with a minor change of name and Commission F is now the lead commission as this better reflects the interests of the group.

6. Inter-Union Working Groups, 1999-2002

The meeting approved the following two inter-Union Working Groups for the next triennium.

- *URSI/IAGA VLF/ELF Remote Sensing of the Ionospheric and Magnetosphere (VERSIM)*

Co-Chair for IAGA Commission 2 and 3: A. J. Smith (UK); Co-Chair for URSI Commission G and H: M. Parrot (France). Recommend continuing with same officers.

- *URSI-COSPAR on International Reference Ionosphere (IRI)*

Chair: D. Bilitza (USA); Vice Chair for COSPAR: K. I. Oyama (Japan); Vice Chair for URSI: B. W. Reinisch (USA). Recommend continuing with same officers. A Commission G resolution was also proposed by this group.

7. Commission G Sessions Proposed for the URSI General Assembly, 2002

Several sessions were suggested for the 2002 General Assembly. The sessions and convenors will be confirmed in the lead up to commencing preparations for the next Assembly. The final format for the next Assembly is not yet defined, but the Scientific Organizer, M. Hall, has suggested there should be fewer sessions than was the case this Assembly. Suggestions and problems with the present Assembly format identified by the meeting will be brought to the attention of the URSI Council in the final Commission report.

The sessions suggested are shown below.

- *G1 Ionospheric effects on HF propagation (P. Cannon - UK, P. Lassudrie - France).*
A specific problem of interest to ITU is a requirement for a model of delay spread caused by ionospheric features on HF wideband (say 100 kHz) transmissions. This is one of the propagation topics that should be dealt with in this session.
- *G2 Transionospheric signal degradation (R. Leitinger - Austria, to be decided).* ITU is still seeking a suitable model, or models, for amplitude and phase scintillation, their

frequency dependence and cumulative statistics, and characteristics and low and high latitudes. Topics likely to be of interest in this session will include: scintillation, Satellite-to-satellite propagation

- G3 *Operational ionospheric models including data ingestion* (D. Bilitza - USA, K. Igarashi - Japan). In a variety of situations, ionospheric models are used to assist in system planning and, more recently, real time operation. This session will draw on the more novel uses of ionospheric models, among other aspects of ionospheric modeling.
- G4 *New approaches to radio sensing of the ionosphere* (C. Hanuise - France, J. Röttger - Germany). A wide variety of new applications including lower ionosphere results and meteor radio science will feature in this session.
- G5 *Open session and latest results* (B. Reinisch - USA, to be decided). During the last two Assemblies this session, intended to catch late breaking new scientific results, has become a selection of papers from a diverse range of radio science topics. An effort will be made to distribute some of these papers into other sessions for the next Assembly, hopefully returning the emphasis to the latest results. An alternate suggestion is to increase the time allowed for the session, but this is unlikely to be possible. A later submission date may be explored, but then some evidence may be required to show the paper could not have been submitted earlier.
- GH1 *High power radio wave ionospheric interaction: coupling of plasma processes.* (G: Sa. Basu - USA; H. T. Leyser - Sweden).
- GH2 *Topside ionosphere and plasmasphere* (G – J. Foster - USA, H – I. Kimura - Japan). This session is expected to encourage papers exploring this part of the ionosphere recently identified as poorly modelled.
- GHE *Space Weather effects on systems* (G – P. Wilkinson - Australia; H – A. Hilgers E to be decided.) This session will focus on space weather related system effects, especially failures and fault mitigation. It anticipates that before the next Assembly there will be at least one major solar storm and results from this storm are likely to form the core of this session. It will also seek input from the analysis stage of the SRAMP Space Weather Month, September 1999.
- EGH1 *Lightning effects in the ionosphere and the radiation belts* (H – S. Cummer - USA, C. Rodgers - UK, G - to be decided, E - to be decided)
- EGH2 *Lithosphere-Atmosphere-Ionosphere coupling* (E – M. Hayakawa - Japan, G – S. Pulinets - Russia, H – M. Parrot - France)
- FG1 *Atmospheric and ionospheric parameter retrieval using GNSS* (F - P. Baptista - Netherlands, G - P. Hoeg - Denmark)
- HG1 *Space and ground observations of stimulated and natural space-plasma waves* (H – M. Hashimoto - Japan, R. Anderson - USA, G - to be decided)
- HG2 *Active experiments in space and laboratory plasmas* (W. Amatucci - USA, R. Hatakeyama - , J. Raitt - USA)
- HGE *Dynamics of dusty plasmas in space and laboratory* (H – G. Ganguli - USA; G – S. Avery - USA; E – R. Merlino - USA)

- HGJC *Analysis methods for plasma waves and turbulence* (H - T. Dudok de Wit - France; G - A. Wernik - Poland; J - B. J. Rickett - USA, C - to be decided). This may be accompanied by a Workshop to be held before the next Assembly.

8. Close of Business

At the conclusion of the meeting the outgoing Chair, B. Reinisch, thanked the Commission for the support they had given him during his tenure. Dr Wilkinson then acknowledged the work put in by Prof. Reinisch and thanked him for his efforts as well as and expressing his pleasure at being the incoming Chair.

9. Sessions held this Assembly

<i>Sessions Commission G held</i>	<i>P/O**</i>	<i>Convenors</i>
G1 Recent Radar Systems and Scientific Highlights In Polar Ionosphere and Atmosphere Research	17 / 11	J. Röttger (Germany) and W. Hocking (Canada)
G2 Ionospheric Storms And Substorms: Radio Observations And Modeling	14 / 8	A. Shirochkov (Russia) and J. Hargreaves (UK)
G3 Low Latitude Ionosphere Effects On Systems And Radio Propagation	9 / 15	Su. Basu (USA) and B. M. Reddy (India)
G4 Open Session And Latest Results	55 / 14	K. Schlegel (Germany)
G5 Internet Session : Ionospheric Data And Models On The WWW	11 / 11	D. Bilitza (USA) and T. Araki (Japan)
General Lecture Engineering Issues in Space Weather		L.J.Lanzerotti, D. J. Thompson and C. G. MacLennan (USA)
G Tutorial Radar Systems For Ionospheric Research		J. Roettger (Germany)
<i>Sessions Commission G lead in co-operation with other Commissions</i>		
GC Digital Techniques In Ionospheric Radio Propagation, Control and Communication. (*)	4 / 11	D. M. Haines (USA) and P. Cannon (UK)
GF Ionosphere And Troposphere Parameters Retrieved From GPS/GLONASS Measurements.	8 / 11	P. Hoeg (Denmark) and J. P. V. Poiaries-Baptista (Netherlands)
GH1 Electromagnetic Coupling Including Seismic Activity Between The Ground And The Upper Ionosphere & Magnetosphere	11 / 16	S. Pulinets (Russia), M. Parrot (France), S. Uyeda & M. Hayakama (Japan)
GH2 Lightning Ionosphere Interaction	5 / 10	U. Inan (USA) and D. Nunn (UK)

Sessions Commission G participated in.

HG1 Theory & Simulation Of Non linear Kinetic Processes In Space Plasmas	7 / 11	Y. Omura, (Japan), M. Ashour-Abdalla, (USA) and S. Ossakow (USA)
HG2 Radio-Frequency Sounders In Space, New And Old	13 / 11	G. James (Canada), R. Benson (USA) and B. Reinisch (USA)
HG3 Wave Propagation : Observation And Data Analysis	13 / 18	F. Lefeuvre (France) and Y. Hashimoto (Japan) and K. Mahajan (India)
HG4 Comparative Studies Of Space & Laboratory Plasmas	- / 10	W. Gekelman (USA) and C. Hanuise (France)
HG5 Ionospheric Modification With High Power Radio Waves: Coupling Of Plasma Processes	22 / 15	T. B. Leyser (Sweden) and S. Basu (USA)
JCEG Interference Protection Measures	3 / 7	R. Fisher (USA)

* *Contribution to the spectrum congestion theme*

** Number of (P) poster and (O) oral papers presented for each session.

COMMISSION H - WAVES IN PLASMAS

Chair: Dr. V. Fiala (Czech Republic)

Vice-Chair: Dr. H.G. James (Canada)

REPORT ON THE OPEN COMMISSION MEETINGS (BUSINESS MEETINGS)

First Open Commission Meeting (16 August 1999)

The Chairman proposed a first meeting agenda which corresponds to the main numbered headings below.

1. Election of the Vice-Chair

In 1999, there were six nominations. Since the URSI Secretariat wants final elections with two or three candidates, there were preliminary and final votes, both by mail-in ballot before the General Assembly (GA). After the addition of one national vote (France) from the floor, the Chairman declared Dr. U.S. Inan (USA) to be the Vice-Chair designate for the new triennium. The vote tallies are available upon request from the outgoing Chairman.

2. Working Group activities and proposals for the next triennium

Five working groups involving Commission H will continue to operate:

- VLF/ELF: remote sensing of the ionosphere and magnetosphere (VERSIM), an URSI/IAGA inter-union WG. A report was submitted by M. Parrot. See also the VERSIM web site at <http://www.nerc-bas.ac.uk/public/uasd/versim.html>
- GH.2: Computer experiments, simulations and analysis of wave plasma processes . This WG was involved in the 5th International School/Symposium of Space Simulations (ISSS-5). It was held during 13-19 March 1997 in Kyoto, Japan and attracted 182 participants. Y. Omura is the H co-chair, and submitted a report. More information can be obtained at <http://www.kurasc.kyoto-u.ac.jp/iss/program.html>
- CGH.1: Wave and turbulence Analysis. 47 participants attended a workshop on radio Methods of Studying Turbulence at Urbana, Illinois, USA during 9-12 August 1999. T. Dudok de Wit was the H representative.
- GH.1: Active Experiments in Space Plasmas . J. Raitt was the H co-chair, and helped to organize a session with this name at the COSPAR 32nd Scientific Assembly in Nagoya in 1998.
- EGH.1: Electromagnetic effects associated with seismic activity . M. Parrot was the H representative.

3. Past and future sponsorship of conferences and meetings

A report is available from the Secretariat listing the meetings and other activities that were supported by H in 1996-1999. Five meetings of various sorts were sponsored under mode B at a total cost of \$US 5100. Four other meetings were endorsed under mode A (no financial support). Another \$US 4025 went to supporting individuals' costs associated with the Toronto GA. For more details, the 1996-1999 H Triennial Report also can be examined.

The meeting was reminded that URSI has established guidelines for meetings that it sponsors. These guidelines include application, approval and preparation cycles before the meeting and reporting afterward. A communication from the Secretary General indicated that the Commission budget sum in the new triennium will be about 9,000 Euro.

4. Review of Radio Science (RRS) and Reference Disk

It was reported that RRS Editor Ross Stone will plan to allocate about the same space for each commission in the next RRS. It will be distributed largely on CD-ROM, with hard copies going to institutional libraries.

The URSI publications committee reportedly will recommend cessation of the Disk to Council. The meeting agreed with this recommendation.

5. Commission H and joint HG sessions, propositions for the next GA

Upon invitation from the Chair, various delegates contributed verbal descriptions of proposed sessions for the next General Assembly. Some speakers urged more joint sessions than in GA99. The final GA business meeting report below gives the list of session titles.

6. Commission resolutions, recommendations and opinions

It was proposed by J.F. Lemaire that Commission H submit a Recommendation for URSI approval, entitled "Survey of the spatial distributions of VLF and ELF waves in the magnetosphere". The Commission supported the action after it was confirmed that it represented similar interests of the VERSIM (A.J. Smith) and NASA/GSFC (S. Boardsen) groups.

7. Next business meeting

A joint G-H business meeting was planned for 18 August, subject to G interest therein.

8. Any other business

R. Horne and R. Anderson took an action to draft, for the Chairman's signature, a letter of tribute to the late Alan Johnstone.

Second Open Commission Meeting (18 August 1999)

H-only and H-leading sessions for the next GA

It was reported that Commission G did not require a joint meeting with H. No G representatives were present. Nevertheless the interests of Commission G in joint sessions were clarified. Since URSI leaders encouraged greater interdisciplinary contact, more joint Commissions were discussed. H decided to plan one Union session.

Third Open Commission Meeting (20 August 1999)

1. Sessions for the next GA

A list of 11 H-only sessions and H-led joint sessions and convenors was approved, as follows:

H-only:

- H1 Kinetic Effects in Boundary Layers (B. Lembege, M. Hoshino, B. Daughton)
- H2 Wave and Coherent Structures in Space Plasmas (Y. Omura, M. Ashour-Abdalla)
- H3 Antennas and RF Probes in Plasmas (E. Mareev, V. Fiala, I. Nagano)
- H4 Plasmaspheric Structure and Phenomena (B. Fraser, G. Ganguli, R. Anderson)
- H5 Open Session on Latest Results (G. James)

H-led joint sessions:

- HG1 Spacecraft and Ground Observations of Stimulated and Natural Space-Plasma Waves (H - K. Hashimoto, R. Anderson; G - tbd)
- HG2 Active Experiments in Space and Laboratory Plasmas (H - W. Amatucci, R. Hatakeyama, J. Raitt; G - tbd)
- HGE1 Lightning Effects in the Ionosphere and the Radiation Belts (H - S. Cummer; G - C.J. Rodger; E - Y. Hobara)

- HGE2 Dynamics of Dusty Plasmas in Space and Laboratory (H - G. Ganguli; G - S. Avery; E - R. Merlino)
 - HGJC Analysis Methods for Plasma Waves and Turbulence (H - T. Dudok de Wit; G - A. Wernik; J - B. Rickett; C - tbd)
- Union Power Transmission from Solar Power Stations, Technological, Environmental and Biological Aspects (H - K. Hashimoto, others - tbd)

In addition other joint sessions led by other Commissions were submitted:

- GH1 High-Power Radio Wave-Ionosphere Interactions: Coupling of Plasma Processes (G - Sa. Basu; H - T. Leyser)
- GH2 Topside Ionosphere and Plasmasphere (G - J. Foster; H - I. Kimura)
- EGH Lithosphere-Atmosphere-Ionosphere Coupling (E - M. Hayakawa; G - S. Pulnits; H - M. Parrot)
- GHE Space Weather Effects on Systems (G - P. Wilkinson; H - A. Hilgers; E - tbd)

2. Commission H meeting support

It was agreed to support the five following meetings:

- 33rd COSPAR Scientific Assembly, 16-23 July 2000, Warsaw, Mode A.
- First STEP-Results, Applications and Modeling Phase (S-RAMP) Conference, 2-6 October 2000, Sapporo, Japan, Mode A.
- School "Analysis techniques for plasma data as obtained by satellites", February 2001 Marseille, Mode B.
- Sixth International School for Space Simulations (ISSS-6), June 2001, Germany, Mode B.
- 2001 Asia-Pacific Radio Science Conference (AP-RASC '01), 1-4 August 2001, Tokyo, Mode B.

It was noted that formal applications for support have been received so far only for the first two of the above five events.

Some delegates reported that the H Workshop at GA99, organized by J. Lemaire and O. Storey, was a very successful event, and said that another workshop should be considered for GA02. A suggestion from the first business meeting for a workshop celebrating the work of an esteemed colleague had to be withdrawn. Given the uncertainty about the length of GA02, a tentative theme for an H workshop was subsumed under the proposed regular session on the plasmasphere.

3. H chapters in the RRS99-02

A number of topics and author names were suggested to incoming Vice Chair Inan:

- Wave-Particle Interactions (Horne et al.)
- Boundaries in Space Identified by Plasma Waves (tbd)
- Auroral Acceleration Processes and AKR (Strangeway, Kintner)
- Dusty Plasmas (Verheest, Merlino, Mendis, Ganguli)

- State of the art sensors, instrumentation and techniques (Beghin)
- Solar System Radio Emissions (Bougeret, Kaiser, Mann, Reiner)
- Lightning Effects in the Ionosphere (Hiroshi Fukunishi)
- Active Experiments (Raitt, Bernhardt)
- Waves in strongly inhomogeneous media (G. Ganguli)

4. Radio Science Bulletin

F. Lefeuvre agreed to serve as H-Commission Associate Editor in 1999-2002.

5. H tutorial lecture for GA02

The names of a number of well known scientists and proposed topics were given to the incoming Chair James, who will enter into contact with prospective speakers.

6. Commission Vice Chair Nominations

The meeting was apprised of a proposal from the Secretariat that each commission set up a nominating committee. The delegates were of the opinion that the present system, wherein the Chairman gathers nominations from national committees, has worked satisfactorily in the past and should be retained in Commission H. Hope was expressed for a higher percentage of national votes in the next triennium.

7. Concerns about the GA technical program

Abstract Length and Oral Sessions:

The meeting was informed that URSI leaders are considering extending abstract length to four pages for the next GA. The meeting voted to inform the URSI Board that H wishes to retain the present one-page abstract.

The abstract form should ask the submitter to indicate whether special audio-visual facilities will be used or needed. It should ask the submitter to say whether only oral or only poster presentation is acceptable.

The discussion of abstract length per se also evoked concern about the quality of communications in the GA sessions. The problems encountered in oral papers at GA99 were usually in the area of presentation, not in content. The call for papers should urge presenters to practice their presentations in front of colleagues prior to the GA and to limit their visual displays to several, clear examples.

Participants asked the URSI GA organizers to print the starting time (hr:min) with each paper title entry in the Program book. Also, session chairs should be equipped with timing devices to help them better enforce presentation time lengths.

Facilities at GA99: Participants found insufficient time to visit all posters of interest to them at GA99. It would be more desirable to have all GA posters in one large hall and to budget more time for poster sessions.

The H-session meeting room was uncomfortably cold, and there was no way to correct this. Participants found the computer access good.

Combined G-H business meeting:

The delegates felt that the combined meeting should be retained at the next GA.

8. *Thanks to outgoing Chair.*

F. Lefeuvre expressed thanks to V. Fiala for his leadership and for the profitable technical sessions that were enjoyed at GA99; this was unanimously approved by the meeting.

COMMISSION J - RADIO ASTRONOMY

Chair: Professor Roy S. Booth (Sweden)

Vice-Chair: Professor Jacqueline N. Hewitt (United States)

REPORT ON THE OPEN COMMISSION MEETINGS (BUSINESS MEETINGS)

First Business Meeting (16 August 1999)

1. Election of Vice-Chair

One candidate was nominated for the position of vice-chair, Professor Makoto Inoue of Nobeyama Radio Observatory in Japan. Seventeen letters from Commission J delegates were transmitted to the Chair before the General Assembly, testifying to the strong support for Professor Inoue's candidacy. Professor Inoue accepted the position of Vice Chair of Commission J.

2. Discussion of Commission J Sessions at General Assemblies

A discussion took place on the organization of sessions at URSI general assemblies. There was general agreement that at these meetings topics with strong connections to the other URSI commissions should be emphasized, that the session devoted to science should be made longer, and that conflicts between Commission J sessions and joint sessions involving Commission J should be avoided.

3. Review of Commission Activities

Professor Booth reviewed the activities and budget expenditures of the previous triennium.

4. Discussion of Coordinating Committee Meeting.

Professor Booth reported on the discussion that took place at the meeting of the Coordinating Committee. The participants' views on the publication of the Assembly abstract book and *Reviews of Radio Science* were solicited. There was a general feeling that more use should be made of electronic technology; for example, General Assembly abstracts should be put on the web. Participants strongly supported URSI's plans to distribute *Reviews of Radio Science* in CD form.

5. Reports of the Working Groups

Dr. Schilizzi reported on the activities of the Global VLBI Working Group. It was felt that this group should continue to operate, coordinating VLBI activities around the world.

It was decided that the Large Telescope Working Group would cease to operate since it had been successful in launching significant activities toward the development of a Square Kilometer Array (SKA) radio telescope. National research programs working toward the SKA are well under way, and an international steering committee coordinating and leading these efforts was being formed.

It was further decided that the Millimeter/Submillimeter Array Working Group would also be dissolved. Work in this area is now moving ahead with the ALMA project.

A discussion was held on new working groups that might be formed. It was felt that there is a need for a working group to participate in the effort to form an international radio quiet reserve for radio astronomy. Its role would be to communicate the scientific need for such a reserve, to develop technical specifications based on this scientific need, and to coordinate technical efforts.

6. Commission J Resolutions

Professor Booth invited proposals for resolutions to be presented at the Assembly. A discussion was held on the process for bringing resolutions to the Assembly; the opinion was strongly voiced that the Secretariat's requirement, that the resolution be written before the Assembly, was impractical. Rather, resolutions must be developed at the Assembly with the full participation of those present.

Second Business Meeting (18 August 1999)

1. Report on IUCAF

Dr. Baan presented a report on the activities of IUCAF. Of the four Commission J members (W. Baan, J. Cohen, K. Ruf, and J. Whiteoak), all except one (K. Ruf) were rotating off. It was agreed that Dr. Baan would remain as an ex officio member; Drs. van Driel, Tzioumis, and Davis were elected as new members.

2. Review of Radio Science

R. Strom reviewed the procedures for writing and submitting papers to the Review of Radio Science in preparation for further discussion at the next business meeting.

3. Commission J Resolutions

Two proposed Commission J resolutions were discussed: one that would create a working group to support efforts to create a radio quiet zone for astronomy, and one that would create a working group to study issues associated with the leap second.

Third Business Meeting (20 August 1999)

1. Tribute to Victims of Plateau de Bure Accident

A. Baudry spoke in memory of those killed in the tragic accident at Plateau de Bure.

2. Commission J Resolutions

Four resolutions were presented to the group and approved by those present.

These were:

- (1) To set up a working group to provide support to the OECD Task Force on safeguarding radio astronomy use of the spectrum
- (2) To set up a working group to study the effect of halting leap second insertions into UTC
- (3) To continue the activities of the Global VLBI Working Group
- (4) To recommend formation of regional working groups to monitor spectrum use and safeguard radio astronomy use of the spectrum

3. General Assembly 2002

Topics for the next general assembly were presented by participants and discussed.

The following topics for sessions were approved:

- (1) Radio and radar studies of the solar system
- (2) Post-COBE cosmic microwave background studies
- (3) Wide field imaging and mosaicing in radio interferometry
- (4) Interference mitigation for radio science
- (5) Antenna metrology and active control
- (6) Wideband array technologies and systems

The participants agreed to propose that the General Lecture be on the subject of measurements of the cosmic microwave background. The participants further agreed that the Commission J tutorial should be on the subject of "Positional Radio Astronomy and the Move Toward Microarcsecond Accuracy from Geodesy to Cosmology."

The participants suggested that the poster sessions be organized in a way that would encourage poster presentation and make them more accessible. Reserving time in the program for a poster review would increase their visibility. It was also felt that there should be more joint session with other commissions, and fewer sessions overall. The participants requested that a larger room be made available to Commission J during the next general assembly, and that arrangements be made so that it would be possible for participants to use their personal computers in presentations.

4. Reviews of Radio Science

The following topics for review papers were approved:

- (1) Gravitational lenses
- (2) Planetary radar astronomy
- (3) The search for extraterrestrial intelligence

COMMISSION K – ELECTROMAGNETICS IN BIOLOGY AND MEDICINE

Chair: Professor James C. Lin (USA)

Vice-Chair: Professor Shoogo Ueno (Japan)

REPORT ON THE OPEN COMMISSION MEETING (BUSINESS MEETING)

Commission K held a single open commission meeting on 16 August 1999.

1. Election of a Vice-Chair

Three candidates were nominated for the position of Vice-Chair for the next triennium: Jitendra Behari (India), Niels Kuster (Switzerland) and Bernard Veyret (France). Of the 54 votes that were cast in the election, Bernard Veyret received the majority vote. Niels Kuster and Jitendra Behari followed respectively.

2. Resolution of Commission K

A resolution of Commission K, which calls for an increase in national support for research on the beneficial applications of electromagnetic fields in diagnostic and therapeutic medicine, was passed unanimously.

3. Resolution of the French National Committee

A resolution of the French National Committee, which proposes to create a network of research centres to distribute and to co-ordinate information distribution in relation to the bioeffects and hazards associated with electric and magnetic fields, was discussed. Also, the relationship with WHO and its large database were discussed. No action was taken in either case.

4. 2001 International Scientific Meeting on Electromagnetic Fields in Medicine

The next meeting of the International Scientific Meeting on Electromagnetic Fields in Medicine will be held in Tokyo, Japan in the spring of 2001.

5. Review of Radio Science and Disk of Reference

Five chapters were contributed to the *Review of Radio Science 1996-1999*, which was edited by Professor Shoogo Ueno, the editor of Commission K. Chapters included the biological effects and RF dosimetry of mobile communications, bioelectric and biomagnetic measurements, and biomedical applications.

About 800 references were collected for the Disk of collected references of Commission K, which was edited by Professor Masao Taki (Japan).

6. Expression of Gratitude

The vice-Chair, Professor Shoogo Ueno, congratulated and expressed his sincerest gratitude to the outgoing chair, Professor James C. Lin, for his tremendous efforts and accomplishments in organising and promoting the Commission in the last triennium.

7. Scientific Programme

7.1 Commission K organised four sessions and four joint sessions with Commissions A, B, C and E.

- K1 Mechanisms and modelling of electromagnetic interaction with biological systems
Conveners: C. Polk (USA) and G. D'Inzeo (Italy)
- K2 Biological effects of electromagnetic fields
Conveners: L. Kheifets (USA) and R. Korenstein (Israel)
- K3 Hazard assessment for wireless communications
Conveners: P. Bernardi (Italy) and B. Veyret (France)
- K4 Biomedical applications of electromagnetic fields and waves
Conveners: C. Gabriel (UK) and S. Ueno (Japan)
- KA Exposure assessment for cellular and personal telecommunications
Conveners: C. Chou (USA) and M. Taki (Japan)
- KB Computation of electromagnetic fields in the human body
Conveners: O. Gandhi (USA) and Y. Rahmat-Samii (USA)
- KC Health effects of mobile telephones
Conveners: R. Adey (USA), N. Kuster (Switzerland) and E. Bonek (Austria)
- KE Electromagnetic interference with medical devices
Conveners: D. Witters (USA) and O. Fujiwara (Japan)

Session	Oral	No-Shows	Poster	No-Shows	Participants
K1	8	1	9	4	65
K2	10	0	9	7	80
K3	10	2	0	0	100
K4	11	0	25	12	160
KA	11	1	4	1	80
KB	11	0	11	2	80
KC	8	0	0	0	160
KE	8	0	0	0	40
TOTAL	77	4	58	26	765

7.2 K-Tutorial: An Assessment of the Bioeffects Induced by Power-Line Frequency Electromagnetic Fields

Professor Russel J. Reiter (USA) reviewed studies related to the biological effects of power-line frequency electromagnetic fields as well as possible mechanisms including radical pair models. 160 people attended with great interest.

RESOLUTIONS AND RECOMMENDATIONS OF THE COUNCIL

U.1. Organisation of URSI General Assemblies

The URSI Council,

Considering

- a) that Member committees are often confronted with practical difficulties (financial, organisational) in the preparation of the venue of URSI General Assemblies in their territories;
- b) that a mutual advantage, for the local organising committee of a General Assembly and for URSI, could be gained from a stronger direct involvement of URSI in the setting up of a General Assembly;
- c) that the recurrent organisation of such large events, once a format has been approved and a structure has become operational, should be facilitated;
- d) that the current financial situation of URSI provides several degrees of freedom;

Resolves

to allow the URSI Board to take control of the organisation, and of the financing, of URSI General Assemblies, to the extent deemed appropriate.

U.2. URSI standing committees

The URSI Council,

Considering

- a) that URSI standing committees have been set up to achieve important tasks for the Union;
- b) that each Standing Committee chairman has to co-ordinate actions with the committee members in full interaction with the URSI Board of Officers;
- c) that in many instances the operation of these standing committees has proven to be difficult and sometimes impossible due to a lack of proper articulation with the URSI instances (Board, Secretariat...);

Resolves

1. to re-examine the need of each Standing Committee and to eliminate those which are not indispensable;

2. to give to the remaining Standing Committees the means to be active, e.g. by inviting the Standing Committee chairmen to the relevant meetings of the Board of Officers or through establishing the appropriate procedure allowing them an optimal operation.

U.3. Network of Correspondents

The URSI Council,

Resolves to maintain the Network of Correspondents with the following provisions :

1. Any scientist attending a General Assembly or an URSI Symposium will become a Correspondent for the three-year period following the Assembly, the cost financed by a special fee included in the registration fee;
2. Any Correspondent must explicitly indicate if he/she authorises the URSI Secretariat to use his/her name and address exclusively in relation with the objectives of the Union, e.g. the publication of a Correspondent directory;
3. Other scientists may seek inclusion in the Network of Correspondents for the same three-year period by applying directly to the URSI Secretariat and paying the special fee;
4. After each General Assembly the URSI Secretariat shall contact the the Correspondents who did not attend this last General Assembly and propose to them that they pay the relevant fee;
5. The Board may decide to waive the special fee for a scientist, indicated in resolves 3, above, who requests this dispensation;
6. Correspondents will be issued a numbered card allowing reduced registration fees at certain URSI-sponsored symposia and conferences, and will receive the Radio Science Bulletin;
7. Correspondents will have no voting rights, but will be encouraged to express their views to the Commissions.

U.4. Support for Bioelectromagnetic research

The URSI Council

Recognising:

- a) that all lives on earth thrive in a natural electromagnetic environment. Over the past few decades, we have learned to understand some of its characteristics and we have applied them in abundant ways to embellish our lives. Indeed, we have come to depend on the electromagnetic environment for life, health, safety, information, comfort, and conveyance.
- b) Bioelectromagnetic research has developed a unique body of new knowledge and it is crossing a threshold from the traditional boundaries of biological and biophysical sensitivities. This new knowledge provides an invaluable bridge between health hazards

of exposures to electromagnetic fields and waves and new diagnostic and therapeutic uses of electromagnetic fields and waves.

- c) As scientific understanding of the interaction of electromagnetic interaction with biological systems increases, the prospect for its use in biology and medicine becomes greater also.

Resolves

that URSI Member Committees encourage appropriate international and national organisations to promote research on the effects of electromagnetic fields and waves in biology, and their uses in diagnostic and therapeutic medicine, for the benefit of human society.

U.5. URSI Resolution on Criminal Activities using Electromagnetic Tools

The URSI Council

Considering

- a) At the URSI General Assembly of 1984 a resolution was adopted on the adverse effects of a High Altitude Electromagnetic Pulse due to a Nuclear Explosion.
- b) The present resolution is intended to draw the attention of the scientific community to the effects of criminal activities using electromagnetic tools. This kind of action can be defined as an intentional malicious generation of electromagnetic energy introducing noise or signals into electric and electronic systems, thus disrupting, confusing or damaging these systems for terrorist or criminal purposes.
- c) Criminal activities using electromagnetic tools is an outgrowth of more familiar disciplines: Electromagnetic Compatibility (EMC) and Electromagnetic Interference (EMI). In this case, however, the terrorist produces the offending currents or radiation intentionally. Accidental radiation can cause severe and inopportune damage to electronics, so those fields or more severe field levels can certainly also be intentionally impressed on vulnerable equipment. The electromagnetic compatibility community must be prepared to deal with new threats as they emerge.

This resolution is intended to make people aware of:

- *the existence of criminal activities using electromagnetic tools and associated phenomena.*
- *the fact that criminal activities using electromagnetic tools can be undertaken covertly and anonymously and that physical boundaries such as fences and walls can be penetrated by electromagnetic fields.*
- *the potential serious nature of the effects of criminal activities using electromagnetic tools on the infrastructure and important functions in society such as transportation, communication, security, and medicine.*

- *that in consequence, the possible disruption on the life, health and economic activities of nations could have a major consequence.*

It should be noted that the International Electrotechnical Commission (IEC) under Subcommittee 77C is developing a program to protect systems against these new EM threats.

Resolves

That URSI should recommend to the scientific community in general and the EMC community in particular to take into account this threat and to undertake the following actions:

1. Perform additional research pertaining to criminal activities using electromagnetic tools in order to establish appropriate levels of vulnerability.
2. Investigate techniques for appropriate protection against criminal activities using electromagnetic tools and to provide methods that can be used to protect the public from the damage that can be done to the infrastructure by terrorists.
3. Develop high-quality testing and assessment methods to evaluate system performance in these special electromagnetic environments.
4. Provide reasonable data regarding the formulation of standards of protection and support the standardisation work which is in progress.

U.6. URSI Resolution on Seismo-Electromagnetics

The URSI Council

Considering

that there have been recently increased interests and a lot of achievements in seismo-electromagnetics. There have been many convincing reports on the presence of electromagnetic noises immediately preceding earthquakes and also on the atmospheric and ionospheric perturbations (plasma disturbances and waves) associated with earthquakes. The overall understanding on the lithosphere-atmosphere-ionosphere coupling will be a new, challenging science field, and also this would be important for the short-term earthquake prediction.

Resolves

that URSI Member Committees encourage studies to be undertaken of the relationship of electromagnetic phenomena and atmospheric and ionospheric perturbations with earthquakes. Support for the research in this interdisciplinary field is encouraged, and collaboration with other societies is highly required.

U.7. Scientific Committee on Telecommunications

The URSI Council

Considering that

- a) Scientific aspects of telecommunications are present in the terms of reference of most Commissions and that this situation calls for some liaison,
- b) URSI research activities in the telecommunications domain would greatly benefit by an increased collaboration with ITU-R and, to some extent, with industry,
- c) The interests of Science Services in the frequency allocation process are represented by IUCAF,
- d) A Scientific Committee on Telecommunications (SCT) had been created at the XXIIIrd GA (Prague, 1990) to deal with relevant matters, but it was deactivated at the XXVth GA (Lille, 1996),

Resolves

1. To reactivate the SCT with Terms of Reference as defined below,
2. To appoint Prof. P. Delogne as the Chairman of the SCT. The SCT will include a representative of each Commission, appointed by the Chairs of the Commissions, and will also include a representative of the ITU Radiocommunications Bureau.

Terms of Reference

1. To initiate, promote and co-ordinate inter-commission activities in the telecommunications area through the formation of inter-commission working groups on specific topics to be identified, and through the organisation of joint symposia such as Commsphere.
2. To identify areas of common interest to URSI and ITU-R and, where appropriate to exchange relevant information between the URSI Commissions and the ITU-R Study Groups, and to promote URSI/ITU-R activities,
3. To keep the URSI community informed on ITU-R matters through the Radio Science Bulletin,
4. To initiate, co-ordinate and liaise URSI contributions with ITU-R.

RESOLUTIONS, RECOMMENDATIONS AND OPINIONS OF THE COMMISSIONS

Commission A - Electromagnetic Metrology

A.1. Opinion on discontinuing the leap second inside UTC

URSI Commission A

considering that

1. in 1971, the ITU-R (formerly CCIR, International Consultative Committee for Radiocommunications) proposed the present form of UTC (Universal Time Coordinated), which is based upon the SI second but remains linked to the variable rotation of the Earth through the introduction of leap seconds in such a manner that UT1-UTC will always less than 0.9 second,
2. this proposal was accepted after discussions with BIH (Bureau Internationale de l'Heure), URSI, IAU, IUGG, and other bodies active in positioning and navigation,
3. this system has worked well for most purposes,
4. at the time of introduction, the future implementation of satellite and other systems which cannot easily incorporate the leap second was not foreseeable,
5. the CCTF (Consultative Committee for Time and Frequency) of CIPM is discussing the suggestion that no additional leap second practice should be inserted into UTC, and it is calling the advice of the scientific Unions and other bodies concerned,

fully supports

the action to consult on this subject with the appropriate Unions, the IERS (International Earth Rotation Service) and other bodies interested in the use of time scales,

and is of the opinion that

no further leap seconds should be inserted, if no major objections will arise from that consultation.

Joint URSI Commissions C and D Resolution

CD.1. ISSSE - International Symposium on Signals, Systems and Electronics

Commissions C and D

considering

that they have had four successful ISSSE conferences in 1989, 92, 95, and 98

resolve

that a Steering Committee for ISSSE be created with the following Terms of Reference:

- to maintain long term continuity of both administrative and technical aspects, to put in place conference guidelines in keeping with URSI requirements, and
- to receive and evaluate proposals and select future conference sites;
- that membership will be up to three representatives from each commission;
- that Commission Chairs will serve as Ex Officio members;
- that the Coordinator for the Steering Committee will be selected for a three year term and will be the point of contact.

Commission F - Wave Propagation and Remote Sensing

F.1. Support for EES spectrum management

URSI Commission F

recognising *that*

1. The use of various key spectral bands for the earth exploration services (EES), as determined by the ITU, is critical to the modern scientific understanding and monitoring of the Earth as a bio-geochemical system;
2. Financial pressure within most countries to exploit the spectrum for communication purposes is continually increasing, resulting in the development of active systems requiring operation in many of the above bands, and in turn rendering these bands unusable for the EES;
3. That financial means for the promotion of the scientific value of the spectrum for earth observation and for the development of new sharing and interference mitigation techniques are scarce;

resolves

that member committees should encourage programs for:

1. the identification of appropriate frequency bands to be allocated for the EES;

2. the definition, promotion and defence of the scientific value of key EES spectral bands and of the economic value of their usage in EES within regulatory and public forums;
3. the development of sharing criteria for dual use of such key EES bands, where possible;
4. the identification of sources of interference in currently allocated EES bands;
5. the development of interference mitigation techniques for the recovery of bands deemed valuable for EES but currently allocated and/or rendered unusable by the presence of active communication services, where possible.

F.2. Allocation and Sharing of frequencies within the MF/HF/VHF/UHF bands

URSI Commission F

Recognising *that*

1. in order to enable environmental stress-change monitoring of terrestrial vegetative covers, it is necessary to implement Polarimetric Interferometric SAR (POL-IN-SAR) observations at multiple frequencies in the MF to UHF bands;
2. POL-IN-SAR deployment requires coherent broadband operation with bandwidths in the order of 20% of the center frequency, i.e. spread-spectrum or noise techniques cannot be used;
3. With a future re-allocation of the frequency bands used for broadcasting and telecommunications within the MF to UHF bands, spectral space is expected to become available;

resolves *that member committees*

1. pursue the allocation of periodically spaced frequencies within the MF to UHF bands for scientific research and applications in remote sensing;
2. encourage studies for the definition of appropriate frequency bands to be used for these purposes, in support of the process of frequency (re-)allocation in the MF to UHF bands.

Commission G - Ionospheric Radio Propagation

G.1. The IGY plus 50 years: New Perspectives for the Next Millennium

Recognising that the years 2007-2008 will be exactly 50 years after the highly successful International Geophysical Year, and

Whereas the science agencies of the various adherent nations are engaged, or have planned, aggressive science programs, and

Whereas these science programs are directed toward understanding the solid bodies, the oceans, the atmospheres, and the plasma environments of the Earth, the planets, the minor bodies, and the sun itself along with their physical and biological interaction, and

Whereas the science programs hold great promise for the education of the younger citizens of the whole world and the enthusiastic engagement of people everywhere, and

Whereas the further comprehensive understanding of the sun, the Earth system, and indeed all the planetary systems, will give us a practical ability to protect human technological systems, and

Whereas radio science contributed and will continue to contribute crucially in all aspects of the above-mentioned science programs,

URSI Commission G resolves

To support the SCOSTEP initiative to declare the period 2003 to 2008 “The IGY plus 50 years: New Perspective for the next Millennium” and urges all URSI Commissions to join the opportunity to share in the exploration, the excitement, and the adventure as humankind pushes forward in the next Millennium to a consolidated view of our entire solar system, just as humans did in the Earth’s case in the decades following the IGY.

G.2. International Reference Ionosphere as a standard for the ionosphere

Recognising

the need for an international standard for the specification of the ionospheric environment,

And recognising that

the Presidents of URSI and COSPAR have written to international organisations in support of the International Reference Ionosphere as an ionospheric standard,

URSI Commission G resolves

That the International Reference Ionosphere (IRI), as developed by the URSI / COSPAR Inter-Union IRI Working Group, be internationally recognised as the standard for the ionosphere.

G.3. Protection for the Jicamarca observatory

Whereas the Jicamarca observatory is a unique facility for international atmosphere and ionosphere research at the magnetic equator, and

whereas the location was selected for its isolation from radio interference and its clear environment, and

whereas encroaching urban and demographic growth threaten these special characteristics of the site, and

whereas we have been informed by the Peruvian delegation of legal initiatives that have been taken to protect the unique environment of the Jicamarca Observatory,

therefore Commission G

applauds the initial steps taken by the Peruvian Government,

and resolves

to strongly urge the Peruvian Authorities to take the additional necessary steps to complete the protection of this valuable facility.

G.4. Encouragement for topside sounder programs

Considering the large uncertainties in the specification of the F layer peak densities and heights over large parts of the globe, specifically the oceans and the southern hemisphere, and

Considering the large uncertainties in the specification of the topside ionospheric and plasmaspheric densities, and

Considering the need for the real-time specification of the ionosphere for operational use,

URSI commission G resolves

That National Space Agencies be encouraged to launch a series of topside sounders that can specify the topside ionosphere in real time up to an altitude of ~1000 km.

Commission H - Waves in Plasmas

H.1. Survey of the spatial distributions of VLF and ELF waves in the Magnetosphere

Considering

1. the lack of comprehensive maps of the distribution of VLF and ELF waves in the magnetosphere,
2. the need of this information to evaluate properly the losses of radiation belt particles due to resonant wave particle interactions,
3. the need of this information to evaluate the electromagnetic noise levels in different frequency ranges in designing antennae for future space missions,

Commission H recommends

4. that a comprehensive spatial survey of the power spectrum (intensity versus wave frequency), of the polarization and of the propagation directions (k-vector) be undertaken in the magnetosphere,
5. that already available data sets from Radio Antennae flown in the Magnetosphere be first identified, catalogued and analyzed in order to build empirical models and maps of the 3-D distribution of these wave parameters in the Radiation Belts and in the whole magnetosphere,
6. that comprehensive maps of the occurrence frequency of special wave emissions (whistlers, chorus, plasmaspheric hiss, etc...) observed in the magnetosphere be produced based on existing and future wave measurements.

Commission J - Radio Astronomy

J.1. The effect of halting leap second insertions into UTC

Considering that

1. In 1971, the ITU-R (formerly the CCIR, the International Consultative Committee for Radiocommunications) proposed the present form of UTC, which is based upon the SI second but remains linked to the variable rotation of the Earth through the introduction of leap seconds in such a manner that UTI-UTC will always be less than 1 second,
2. that this proposal was accepted after discussions with the BIH (Bureau International de L'Heure), URSI, IAU, IUGG, and other bodies active in timing, positioning, and navigation,
3. that this system has worked well for most purposes,
4. but that the future implementation of satellite and other systems which can not easily incorporate the leap second system was not foreseeable at the time,
5. for which reason the CCTF (Consultative Committee for Time and Frequency) of the BIPM, the ITU-WG7A, and other international bodies are discussing the suggestion that no additional leap seconds should be inserted into UTC,
6. with the understanding that any change would be made through the consensus of many international bodies,
7. and that it appears such a change would result in no serious adverse consequences to the work carried out by the commission members,
8. but that the change would result in some practical benefits due to the simplification of procedures

Recommends

1. that a Working Group be established to study the practical consequences of allowing the magnitude of UTI-UTC become unbounded,
2. and that this Working Group prepare a final report by August of 2000, and for the next URSI General Assembly prepare a draft resolution and if necessary an updated report.

J.2. Resolution on Regional Working Group on Spectral Management

Commission J

Considering

the profile use of the spectrum by active sources and the increase in “out of band” emission in the ITU-recognised radio astronomy bands,

recommends

the formation of regional working groups to monitor the interferal signals in the radio astronomy bands and to negotiate nationally and internationally, together with colleagues in the repairs, for their suppression

noting

that the Working Groups in existence are CORF (USA) & CRAF (Europe)

Commission J recommends

the formation of similar working groups in the Asia Pacific region, South America & Africa and charge respective National Delegates to act on our behalf.

J.3. IUCAF Delegates 1999-2002

Considering

that three of the Commission J delegates must retire under the ICSU 6 years rule

Commission J resolves

to appoint

1. Dr. Klaus Ruf (Max Planck Institute für Radioastronomie, Bonn) as the Chair of IUCAF;
2. the following Commission J representatives : Mike Davis (Arecibo Ionosphere Observatory, Puerto Rico); T. Tzoumis (Australia Telescope National Facility, CSIRO, Epping, N.S.W., Australia); W. Van Driel (Nancay Radio Astronomy Observatory, France) and ex-officio : W.A. Baan (NFRA, Dwingeloo, The Netherlands) to maintain continuity.

J.4. Global VLBI Working Group

Commission J

resolves

to maintain the Global VLBI Working Group for another 3 years, under the chairmanship of Richard Schilizzi (Dwingeloo, The Netherlands).

J.5. Millimeter/sub Millimeter Array and the Large Telescope Working Groups

Commission J

recognising

that international collaborations around these projects are now in place

resolves

to disband the following working groups :

1. Millimeter/sub millimeter array working group
2. Large telescope working group

RÉSOLUTIONS ET RECOMMANDATIONS DU CONSEIL

U.1. Organisation des assemblées générales de l'URSI

Le conseil de l'URSI

Considérant

- a) que les membres des comités sont souvent confrontés à des difficultés pratiques (financières, organisationnelles) dans la préparation de la tenue des Assemblées Générales de l'URSI sur leur territoire;
- b) qu'un avantage mutuel tant pour le comité d'organisation de l'Assemblées Générales que pour l'URSI pourrait être tiré d'une implication directe plus forte de l'URSI dans la préparation matérielle de l'Assemblée Générale;
- c) que l'organisation récurrente d'aussi considérables événements, une fois qu'un format a été approuvé et qu'une structure est devenue opérationnelle, devrait être facilitée;
- d) que la situation financière actuelle de l'URSI permet quelques degrés de liberté;

décide

de permettre au bureau de l'URSI d'exercer un contrôle sur l'organisation et le financement des Assemblées Générales de l'URSI au niveau approprié.

U.2. Comités permanents de l'URSI

Le conseil de l'URSI

Considérant

- a) que les Comités permanents de l'URSI ont été mis en place pour accomplir des tâches importantes pour l'Union;
- b) que le Président de chaque Comité permanent doit coordonner les tâches à remplir avec les membres du Comité, en interaction complète avec les membres du Bureau de l'URSI;
- c) que dans de nombreuses circonstances le fonctionnement de ces Comités Permanents s'est montré difficile voire impossible de part le manque d'articulations adéquates avec les instances de l'URSI (Bureau, Secrétariat);

décide

- 1 - de réexaminer la raison d'être de chaque Comité et d'éliminer ceux qui ne sont pas indispensables;
- 2 - de donner aux Comités restant les moyens d'être actif, par exemple en invitant les Présidents de Comités aux réunions de Bureau qui les concernent ou en mettant en oeuvre des procédures appropriées leur permettant un fonctionnement optimal.

U.3. Réseau de Correspondants

Le Conseil de l'URSI,

décide de maintenir le réseau des correspondants avec les réserves suivantes :

- 1 - tout scientifique participant à une Assemblée Générale de l'Union deviendra correspondant pour la période de trois ans suivant l'Assemblée Générale, le coût est financé par une cotisation incluse dans le droit d'inscription;
- 2 - tout correspondant doit indiquer de façon explicite si il/elle autorise le secrétariat de l'URSI à utiliser son nom et adresse en lien exclusif avec les objectifs de l'Union, par exemple publication d'un répertoire des correspondants
- 3 - d'autres scientifiques peuvent adhérer au réseau de correspondants pour la même période de trois ans, en s'adressant directement au secrétariat de l'URSI et en versant la cotisation mentionnée en (1);
- 4 - après chaque Assemblée Générale le secrétariat de l'URSI contactera les correspondants qui n'ont pas assisté à cette dernière Assemblée Générale et leur proposera de payer la cotisation ;
- 5 - le Bureau peut, sur demande de l'intéressé, exonérer un scientifique mentionné en (3) du versement de la cotisation;
- 6 - les Correspondants recevront une carte numérotée leur accordant des réductions sur les droits d'inscription à certains Symposia et Conférences parrainés par l'URSI, et recevront le périodique "Radio Science Bulletin";
- 7 - les Correspondants n'auront pas de droit de vote, mais seront invités à exprimer leur opinion aux Commissions.

U.4. Soutien à la recherche en biologie et électromagnétisme

Le Conseil de l'URSI,

Considérant

- a) que la vie sur Terre croit dans un environnement électromagnétique naturel, que durant ces dernières décades nous avons appris à comprendre certaines de ses caractéristiques et à les utiliser pour améliorer notre vie quotidienne, que nous sommes devenus de fait dépendant de notre environnement électromagnétique pour notre vie de tous les

- jours, notre santé, notre sécurité, notre information et notre confort;
- b) que la recherche en bioélectromagnétisme a créé un nouveau corpus de connaissances aux frontières traditionnelles entre la biologie et la biophysique, que cette nouvelle connaissance fournit une passerelle sans prix entre l'évaluation des risques sanitaires dus à l'exposition aux champs électromagnétiques et aux ondes et les applications aux risques thérapeutiques;
 - c) que la compréhension scientifique des interactions électromagnétiques avec les systèmes biologiques croît, et que les perspectives de leur utilisation en biologie et en médecine croissent également,

Décide

que les membres des comités de l'URSI encouragent les organisations internationales et nationales appropriées à promouvoir la recherche sur les effets des ondes et des champs électromagnétiques en biologie et sur leur utilisation en particulier en diagnostic et en thérapie.

U.5. Résolution de l'URSI au sujets d'activités déloyales utilisant des outils électromagnétiques

Le Conseil de l'URSI

considérant

- a) qu'à l'Assemblée Générale de l'URSI de 1984 une résolution a été adoptée sur les effets néfastes des impulsions électromagnétiques de haute altitude produites par une explosion nucléaire;
- b) que la présente résolution a pour objet d'attirer l'attention de la communauté scientifique sur les activités hors la loi utilisant les outils électromagnétiques, ce type d'activité pouvant être défini comme la génération intentionnelle d'énergie électromagnétique introduisant du bruit ou du signal dans des systèmes électriques ou électroniques afin de les perturber, les mettre en défaut ou les mettre en panne dans un but terroriste ou criminel;
- c) que les activités hors la loi utilisant des outils électromagnétiques sont une excroissance de disciplines plus familières comme la compatibilité électromagnétique (EMC) et les interférences électromagnétiques (EMI) avec dans ce cas une production intentionnelle de courants et de radiation (sachant que les radiations accidentelles peuvent être à l'origine de dommages sévères et inopportuns aux équipements électroniques on imagine quels peuvent être les effet de perturbations intentionnelles plus fortes sur des équipements vulnérables); que la communauté travaillant sur les problèmes de compatibilités électromagnétique doit être prête à faire face à ces nouvelles menaces émergente;.

Cette résolution a pour but d'informer les personnes :

- *de l'existence d'activités hors la loi utilisant des outils électromagnétiques et des phénomènes associés,*
- *du fait que ces activités hors la loi utilisant des outils électromagnétiques peuvent être entreprises de façon anonyme et cachée et que des barrières physiques comme des palissades et des murs peuvent être traversés par des ondes électromagnétiques,*
- *des effets potentiellement très néfastes des activités hors la loi utilisant des outils électromagnétiques sur l'infrastructure de nos sociétés et sur des fonctions aussi importantes que le transport, les communications, la sécurité et la médecine,*
- *de conséquences potentiellement majeures sur la vie quotidienne, la santé et les activités économiques des nations.*

Il faut noter que la Commission "International Electrotechnical Commission (IEC) mise en place par le sous-comité 77C développe un programme dont l'objectif est la protection des systèmes contre ces nouvelles menaces électromagnétiques.

Décide

que l'URSI recommande à la communauté scientifique en général et à la communauté EMC en particulier de prendre en compte cette menace et d'entreprendre les actions suivantes :

- 1 - effectuer des recherches supplémentaires sur les activités hors la loi utilisant des outils électromagnétiques afin d'établir des niveaux appropriés de vulnérabilité;
- 2 - faire une investigation des techniques de protection appropriées contre les activités hors la loi utilisant des outils électromagnétiques et mettre à disposition des méthodes qui peuvent être utilisées pour protéger le public contre des dommages aux infrastructures causées par des terroristes;
- 3 - développer des tests de haute qualité et des méthodes d'estimation pour évaluer la performance de systèmes dans des environnements électromagnétiques particuliers;
- 4 - mettre à disposition les données adéquates permettant de définir des standards de protection et soutenir le travail de standardisation qui est en cours.

U.6. Résolution de l'URSI sur les effets sismo-électromagnétiques

Le conseil de l'URSI

Considérant

qu'il y a eu récemment un intérêt croissant et de nombreux résultats en sismo-électromagnétisme; que de nombreux rapports convaincants ont été publiés sur la présence de bruit électromagnétique précédant immédiatement des tremblements de terre et sur des perturbations atmosphériques et ionosphériques (perturbations plasma et ondes)

associées à des tremblements de terre; que la compréhension globale de couplage lithosphère - atmosphère - ionosphère ouvre un nouveau et prometteur domaine de sciences, qui sera important pour la prédiction de tremblements de terre à court terme;

Décide

que les membres des Comités de l'URSI encouragent les études à entreprendre sur les relations des phénomènes électromagnétiques et des perturbations atmosphériques et ionosphériques avec les tremblements de terre; et qu'un soutien soit apporté à une recherche interdisciplinaire dans ce domaine et à la collaboration avec d'autres sociétés savantes.

U.7. Comité Scientifique sur les Télécommunications

Le Conseil de l'URSI

Considérant

- a) Que les aspects scientifiques des télécommunications sont présents dans les termes de référence de la plupart des commissions et que cette situation appelle à quelques concertations,
- b) que les activités de recherche de l'URSI dans le domaine des télécommunication bénéficieraient grandement d'une collaboration accrue avec l'UIT-R et, de quelque façon, avec l'Industrie;
- c) que les intérêts des services scientifiques dans les procédures d'allocation des fréquences sont défendus par l'IUCAF;
- d) qu'un Comité Scientifique sur les Télécommunications (SCT) a été créé à la XXIII^{ème} AG (Prague, 1990) pour traiter des problèmes inhérents, mais qu'il a été "désactivé" à la XXV^{ème} AG (Lille, 1996);

Décide

- 1 - de "réactiver" le SCT avec les termes de références définis ci-dessous,
- 2 - de nommer le Professeur P. Delogne Président de ce Comité; le Comité devant inclure un représentant de chaque Commission, nommé par les Présidents de Commission, et également un représentant du Bureau "Radiocommunications" de l'UIT.

Termes de référence

- 1 - initier, promouvoir et coordonner des activités inter-commission dans le domaine des télécommunications via la formation de groupes de travail inter-commission sur des sujets spécifiques à identifier, et via l'organisation de symposia communs comme Commsphere;
- 2 - identifier les domaines d'intérêt commun à l'URSI et au groupes d'étude R de l'UIT, lorsque c'est utile échanger les informations appropriées entre les Commissions de

- l'URSI et les groupes d'étude de l'UIT-R , et promouvoir les activités URSI/UIT-R;
- 3 - garder la communauté URSI informée des travaux de l'UIT-R via le "Radio Science Bulletin";
 - 4 - initier, coordonner et associer les contributions de l'URSI à l'UIT-R.

RÉSOLUTIONS, RECOMMANDATIONS ET AVIS DES COMMISSIONS

Commission A – Métrologie électromagnétique

A.1. Avis sur la proposition de cesser d'introduire des secondes intercalaires dans l'échelle de temps UTC.

La Commission A de L'URSI

Considérant :

1. qu'en 1971, l'ITU-R (anciennement CCIR, Comité Consultatif International pour les Radiocommunications) a proposé la réalisation actuelle de UTC (Temps Universel Coordonné) laquelle est basée sur la seconde SI mais reste liée à la rotation variable de la Terre par l'introduction de secondes intercalaires en sorte que $UT_1 - UTC$ soit toujours inférieur à 0.9 seconde,
2. que cette proposition avait été acceptée après concertation avec le BIH (Bureau International de l'Heure), l'URSI, l'UAI, l'UGGI et autres organismes actifs en positionnement et navigation,
3. que cette procédure était acceptable pour la plupart des applications,
4. qu'au moment de son introduction on ne pouvait prévoir les développements futurs de satellites et autres systèmes, sur lesquels la seconde intercalaire ne peut être implémentée facilement,
5. que le CCTF (Comité Consultatif du Temps et des Fréquences) du CIPM examine la suggestion que des secondes intercalaires ne soient plus introduites dans le UTC et sollicite l'avis des Unions scientifiques et autres organismes concernés,

soutient entièrement

la consultation, en cette matière, engagée avec les Unions, l' IERS (Service International de la Rotation de la Terre) et d'autres organismes concernés par l'utilisation d'échelles de temps,

et est d'avis que

si aucune objection majeure n'est soulevée au cours de cette consultation, dans le futur aucune seconde intercalaire ne devrait être introduite.

Résolution conjointe des Commissions C et D

CD.1. ISSSE — Symposium international sur les signaux, les systèmes et l'électronique

Les Commissions C et D

considérant

que quatre conférences ISSSE ont été organisées avec succès en 1989, 92, 95 et 98

décide

1. de créer un Comité de Direction ayant le mandat suivant:
 - a. d'assurer la continuité en ce qui concerne les aspects administratifs et techniques, de mettre en place des directives pour la conférence en accord avec les exigences de l'URSI et
 - b. de recevoir et d'évaluer les propositions et de sélectionner les futurs sites de conférence;
2. qu'il y aura jusqu'à trois membres représentants de chaque commission;
3. que les Présidents de Commission seront membres ex officio;
4. que le coordinateur du Comité de Direction sera choisi pour un mandat de trois ans et sera le contact.

Commission F – Propagation des Ondes et Télédétection

F.1. Soutien à l'utilisation du spectre pour les services d'observation de la Terre

La Commission F de l'URSI

Reconnaissant :

- 1) que l'utilisation de certaines bandes spectrales clés pour les services d'observations de la Terre (SOT), déterminées par l'UIT, est critique pour la compréhension et la gestion de la Terre en tant que système bi-géochimique;
- 2) que la pression financière s'exerçant dans la plupart des pays pour exploiter le spectre pour les télécommunications augmente constamment, se traduisant par le développement de systèmes actifs dans de nombreuses bandes mentionnées ci-dessus, et en conséquence rendant ces bandes inutilisables pour les SOT;
- 3) que les moyens financiers pour la promotion de la valeur scientifique du spectre, pour l'observation de la Terre et pour le développement de nouvelles techniques de partage et de lutte contre les interférences, sont faibles:

Recommande

aux Comités membres d'encourager les programmes de travail sur :

- 1 - l'identification des bandes de fréquence adéquates devant être allouées aux SOT;
- 2 - la définition, la promotion et la défense de la valeur scientifique des bandes de fréquence clés pour les SOT, et la valeur économique de leur utilisation pour les SOT au sein des instances publiques et réglementaires;
- 3 - le développement de critères de partage pour une double utilisation de ces bandes clés pour les SOT, quand cela est possible;
- 4 - l'identification des sources d'interférences pour les bandes actuellement allouées aux SOT;
- 5 - le développement de techniques de lutte contre les interférences pour la récupération des bandes ayant de la valeur pour les SOT mais allouées actuellement et/ou rendues inutilisables par la présence des services de communication actifs, quand cela est possible.

F.2. Allocation et partage de fréquences dans les bandes MF/HF/VHF/UHF

La Commission F de l'URSI

reconnaisant que :

- a) dans le but de permettre la surveillance des changements de la couverture de végétation de la Terre dus aux stress environnementaux, il est nécessaire de réaliser des observations par des techniques polarimétriques et interférométriques, à l'aide de radars à synthèse d'ouverture (POL - IN - SAR), à différentes fréquences dans les bandes MF à UHF;
- b) le déploiement de techniques POL - IN - SAR requiert un fonctionnement en mode cohérent sur une large bande de fréquence, avec une largeur de bande de l'ordre de 20% autour de la fréquence centrale, c'est à dire que des techniques d'étalement de spectre ne peuvent pas être utilisées;
- c) lors d'une prochaine ré-allocation des bandes de fréquence utilisées pour la radiodiffusion et les télécommunications dans les bandes MF à UHF, de l'espace devrait être disponible dans le spectre;

Recommande

que les Comités membres :

- 1 - poursuivent l'allocation de fréquences espacées régulièrement dans les bandes MF à UHF pour la recherche scientifique et les applications en télédétection
- 2 - encourage les études pour définir les bandes de fréquence appropriées pour ces utilisations, comme support au processus de ré-allocation de fréquences dans les bandes MF à UHF.

Commission G - Propagation Ionosphérique

G.1. L'Année Géophysique Internationale plus 50 ans: Nouvelles perspectives pour le prochain millénaire

Reconnaissant que les années 2007-2008 marqueront les cinquante ans du déroulement couronné de succès de l'Année Géophysique Internationale, et

Attendu que les agences scientifiques des diverses nations adhérentes sont engagées dans, ou ont planifié, des programmes scientifiques dynamiques, et

Attendu que ces programmes scientifiques ont pour but la compréhension des corps solides, des océans, des atmosphères, et de des environnements ionisés de la terre, des planètes, des corps mineurs, et du soleil lui-même ainsi que leur interaction physique et biologique, et

Attendu que les programmes scientifiques donnent de grands espoirs pour l'éducation des jeunes citoyens du monde entier et l'engagement enthousiaste d'habitants en tous lieux, et

Attendu que la compréhension plus complète du soleil, du système terre, et bien entendu de tous les systèmes planétaires, nous donnera la capacité pratique de protéger les systèmes technologiques humains, et

Attendu que la science radio a contribué et continuera à contribuer de manière cruciale à tous les aspects des programmes scientifiques mentionnées ci-dessus,

La Commission G de l'URSI décide

De soutenir l'initiative du SCOSTEP de déclarer la période de 2003 à 2008 "L'Année Géophysique Internationale plus 50 ans: Nouvelle Perspective pour le prochain millénaire" et recommande à toutes les Commissions de l'URSI de se joindre à l'occasion de partager l'exploration, l'animation et l'aventure alors que l'humanité avance dans le prochain Millénaire vers une vue globalisée de notre système solaire, comme les humains l'ont fait dans le cas de la terre lors des décennies suivant l'Année Géophysique Internationale.

G.2. L'Ionosphère Internationale de Référence en tant que norme pour l'Ionosphère

Reconnaissant

Le besoin d'une norme internationale pour la spécification de l'environnement ionosphérique,

Et reconnaissant que

les Présidents de l'URSI et du COSPAR ont écrit aux organisations internationales en

soutien de l'Ionosphère Internationale de Référence en tant que norme ionosphérique,

La Commission G de l'URSI décide

Que l'Ionosphère Internationale de Référence (IRI), développée par le groupe de travail inter-unions ad-hoc URSI / COSPAR, soit reconnue internationalement comme norme de l'ionosphère.

G.3. Protection de l'observatoire de Jicamarca

Attendu que l'observatoire de Jicamarca est une installation unique pour la recherche internationale sur l'atmosphère et l'ionosphère à l'équateur magnétique, et

Attendu que l'emplacement avait été sélectionné pour son isolation des interférences radio et son environnement dégagé

Attendu que l'empiètement de la croissance urbaine et démographique menace ces caractéristiques particulières du site, et

Attendu que nous avons été informés par la délégation Péruvienne des initiatives légales prises pour protéger l'environnement unique de l'Observatoire de Jicamarca,

Aussi la Commission G

applaudit les démarches initiales prises par le gouvernement Péruvien,

et décide

de presser fortement les autorités Péruviennes à prendre les mesures additionnelles nécessaires pour compléter la protection de cette installation de valeur.

G.4. Encouragement pour les sondeurs en contre-haut

Considérant les grandes incertitudes dans la spécification de la densité et de l'altitude du pic de la région F dans de nombreuses parties du globe, et plus particulièrement les océans et l'hémisphère sud, et

Considérant les grandes incertitudes dans la spécification des densités de l'ionosphère supérieure et la plasmasphère, et

Considérant le besoin d'une caractérisation en temps réel de l'ionosphère pour une utilisation opérationnelle,

La Commission G de l'URSI décide

D'encourager les Agences Spatiales nationales à lancer une série de sondeurs en contre-haut pouvant caractériser l'ionosphère supérieure en temps réel jusqu'à des altitudes de ~1000 km.

Commission H - Ondes dans les Plasmas

H.1. Distribution spatiale et spectrale des ondes TBF et EBF dans la magnétosphère

La Commission H de l'URSI

Considérant

- a) l'absence de modèles empiriques de la distribution spatiale et spectrale des ondes TBF et EBF dans la magnétosphère,
- b) la nécessité de telles informations pour évaluer correctement les pertes des particules chargées piégées dans les zones de radiation de Van Allen par interaction résonante avec ces ondes,
- c) la nécessité de telles informations pour évaluer le niveau de bruit électromagnétique dans différents domaines de fréquence afin de définir les caractéristiques des antennes radioélectriques pour les futures missions spatiales,

Recommande

1. d'entreprendre un relevé systématique de la puissance spectrale (intensité des ondes en fonction de la fréquence), de la polarisation et des directions de propagation (vecteur k) de ces ondes TBF et EBF dans les différentes régions magnétosphériques;
2. d'identifier en premier lieu les séries de données expérimentales existantes et disponibles, obtenues dans la magnétosphère, à l'aide d'antennes radio ou de magnétomètres, de les cataloguer et de les analyser en vue de construire des modèles empiriques et des cartes synthétiques de la distribution spatiale des paramètres caractéristiques de ces ondes dans les zones de radiation et dans toute la magnétosphère;
3. d'établir sur la base de mesures existantes et futures des cartes synthétiques des fréquences des émissions électromagnétiques observées dans la magnétosphère (sifflements, choeurs, souffles plasmasphériques, etc..).

Commissions J — Radioastronomie

J.1. L'effet de la suppression de secondes de correction dans l'UTC

Considérant

1. qu'en 1971, l'ITU-R (connue avant sous le nom de CCIR, le Comité Consultatif International pour les Radiocommunications) a proposé la forme actuelle de l'UTC, qui est basée sur la seconde SI, mais qui reste liée à la variation de rotation variable de la Terre via l'introduction de secondes de correction afin que l'écart UTI-UTC soit toujours inférieur à 1 seconde,

2. que cette proposition fut acceptée après discussion avec le BIH (Bureau International de l'Heure), l'URSI, l'IAU, l'IUGG et d'autres organismes actifs dans le domaine de la métrologie, du positionnement et de la navigation,
3. que ce système a bien fonctionné pour la plupart des applications,
4. mais que l'implémentation de futurs satellites et autres systèmes qui ne peuvent pas facilement incorporer le système de la seconde de correction, n'était pas prévisible à cette époque,
5. que c'est la raison pour laquelle le CCTF (Comité Consultatif du Temps et des Fréquences) du BIPM, l'ITU-WG7A et d'autres organismes internationaux discutent de la suppression de secondes de correction supplémentaires dans l'UTC,
6. qu'étant entendu que tout changement se ferait avec le consensus de nombreux organismes internationaux,
7. et qu'il apparaît qu'un tel changement n'aurait pas de conséquences négatives importantes pour le travail effectué par les membres de la commission,
8. mais que ce changement aboutirait à certains avantages pratiques grâce à la simplification des procédures.

La Commission J recommande

1. qu'un groupe de travail soit créé pour étudier les conséquences pratiques de l'autorisation d'un écart UTI-UTC illimité,
2. que ce Groupe de travail prépare un rapport final pour août 2000, et prépare pour la prochaine Assemblée Générale de l'URSI un projet de résolution et si nécessaire, un rapport mis à jour.

J.2. Résolution concernant le groupe de travail régional sur la gestion du spectre

La Commission J

Considérant

l'utilisation du spectre par des sources actives et l'augmentation de l'émission «hors bande» dans les bandes de fréquences reconnues par l'ITU pour la radioastronomie.

recommande

la création de groupes de travail régionaux pour surveiller les interférences dans les bandes de fréquence utiles pour la radioastronomie, et de négocier leur suppression au plan national et international avec leurs collègues travaillant dans le même domaine.

notant

que les Groupes de travail existants sont le CORF (États-Unis) et le CRAF (Europe)

la Commission *recommande*

la création de Groupes de travail similaires dans les régions Asie Pacifique, Amérique du Sud et Afrique, et de charger les Délégués Nationaux d'agir en notre nom.

J.3. Délégués IUCAF 1999-2002

Considérant

que trois délégués de la Commission J doivent partir en raison de la règle des 6 ans de l'ICSU

La Commission J décide

de nommer

1. Dr. Klaus Ruf (Max Planck Institut für Radioastronomie, Bonn) Président de l'IUCAF
2. les représentants suivants à la Commission J : Mike Davis (Arecibo Ionosphere Observatory, Puerto Rico); T. Tzoumis (Australia Telescope National Facility, CSIRO, Epping, N.S.W., Australie); W. Van Driel (Observatoire de Radioastronomie de Nancy, France) et ex-officio : W.A. Baan (NFRA, Dwingeloo, Pays-Bas) pour assurer la continuité.

J.4. Groupe de travail global VLBI

La Commission J

décide

de maintenir le Groupe de travail global VLBI pour encore 3 ans, sous la présidence de Richard Schilizzi (Dwingeloo, Pays-Bas).

J.5. Groupes de travail pour un Grand réseau millimétrique/submillimétrique et pour un Grand télescope

La Commission J

constatant

que des collaborations internationales sont maintenant en place autour de ces projets

décide

de dissoudre les groupes de travail suivants:

1. «réseau millimétrique/submillimétrique»
2. «Grand télescope».

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