Bulletin No 205 Mars-juin 1978

U.R.S.I.

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URSI INFORMATION BULLETIN:
DATES OF PUBLICATION IN 1978

The publication of this issue of the Bulletin has been delayed so as to permit the inclusion of as much information as possible about the scientific programme for the URSI General Assembly in Helsinki. Since the publication date will be late in May, the contents represent those which would have appeared in both the March and the June issues.

The Resolutions adopted at the URSI Assembly in August 1978 will be included in the September issue of the Bulletin, whose publication date will probably be deferred until October.

To sum up, the publication dates of the URSI Information Bulletin in 1978 will be approximately as follows:

No	Cover indication	Publication date
205	March/June	late May
206	September	October
207	December	December

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THE URSI GOLD MEDALS: 1978

The two URSI Gold Medals are presented, at intervals of three years, on the occasion of the URSI General Assembly. They commemorate respectively two scientists who were closely associated with URSI for many years:

Balthasar van der Pol

and

John Howard Dellinger.

Both Medals are awarded for outstanding contributions in the field of radio science during a six-year period preceding the Assembly.

At its meeting in Paris in March 1978, the URSI Board of Officers considered the merits of the nine candidates whose names had been submitted in 1977. The Board took note also of the comments on the candidates made by the

Gold Medals Advisory Panel appointed by the President last year.

In deciding to which of the candidates the awards should be made, the Board faced the problem of trying to assess the relative merits of, on the one hand, well-known and experienced scientists and, on the other, of younger scientists at an earlier stage of their careers. Since the awards are made for work carried out mainly during a specific six-year period, it was decided that,in the event of two candidates having made equally outstanding contributions during this period, preference should be given to the younger candidate.

The laureates for 1978 are as follows:

Balth. van der Pol Gold Medal

James R. WAIT, for his research work on the propagation of electromagnetic waves in the Earth's crust, and on the problems of communications in mine tunnels.

Dr. Wait is in the Office of the Director of the Environmental Research Laboratories of the National Oceanic and Atmospheric Administration in Boulder, Colorado. He is at present Secretary of the United States National Committee for URSI.

John Howard Dellinger Gold Medal

Donald A. GURNETT, for his investigations relating to electromagnetic and electrostatic wave propagation in the Earth's plasma environment, including the discovery of the kilometre-wave radiation emitted by the Earth.

Dr. Gurnett is Professor of Physics at the University of Iowa, where he received his Ph.D. in 1965.

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URSI GENERAL ASSEMBLY 1978

PROVISIONAL SCIENTIFIC PROGRAMME

In accordance with custom in URSI, each of the nine Chairmen of Commissions is responsible for the organisation of the scientific sessions relating to the topics covered by his Commission. However, the Chairman often delegates responsibility for certain sessions to specialists in the field. Also where a topic is of interest to another Commission, the two Chairmen may agree to organise a joint session.

Most of the papers presented at the normal sessions of the Commissions will be given by invited speakers who will not necessarily deal only with their personal research work. In addition to these sessions, there will also be several Open Symposia based on the responses to Calls for Papers circulated in 1977.

Some of the Commissions have found it necessary to arrange simultaneous sessions in order to cover all the topics of their programme. In consequence, on some days, there will be 14 simultaneous sessions covering the normal Commission sessions and those of the Open Symposia.

At the request of the Board of Officers in 1975, Prof. F.L. Stumpers was asked to take on the responsibility for the coordination of the whole programme. As far as possible, and in consultation with the Chairmen, he has tried to ensure that the sessions in progress at any given time will interest different groups of people. However, there is no ideal solution to this problem and it seems inevitable that some cases will arise where participants will be obliged to choose which of several simultaneous sessions they would like to attend.

The provisional timetable for the scientific sessions, as prepared by Prof. Stumpers in March 1978, is reproduced in the following pages and also in the Second Announcement about the Assembly which will be posted from Helsinki by the Finnish Organising Committee.

C O M M I S S I O N S

Date	A	B	C	D
Monday July 31 pm	BS	BS	BS	BS
Tuesday August 1 am	OS1/1	B1 BF	C1 C2	OS1/1
Tuesday August 1 pm	OS2/1	BH OS3/1	C3 C4	D1
Wednesday August 2 am	OS1/2 OS2/2	B2 OS3/2	C5	D2
Wednesday August 2 pm	OS1/3 A1	B3 B4	OS3/3	D3
Thursday August 3 am	OS3/4 OS2/3	BC1 OS2/3	BC1 C6	D4
Thursday August 3 pm	OS2/4 OS1/4	BC2 OS2/4	BC2 CE1	OS3/5
Friday August 4 am	AE1 OS1/5	B5 BJ	C7	D5
Friday August 4 pm	OS1/6 A2	B6	C8 OW1/1	D6
Saturday August 5	free	free	free	free
Sunday August 6	free	free	free	free
Monday August 7 am	OS2/5 BS	B7 BC3	OW1/2 BC3	D7
Monday August 7 pm	AD1 OS2/6	B8	OW1/3	AD1
Tuesday August 8 am	A3 OS2/7	BS	BS	D8 BS

C O M M I S S I O N S

E	F	G	H	J
BS	BS	BS	BS	BS
see G. H.	BF1	OS4/1 OS4/2	OS4/1	J1
E1	free	OS4/3	BH	J2
OS5/1	BS	OS4/4	OS5/1	J3
E2 OS5/2	F1	OS4/5 OS4/6	OS5/2	J4
E3 OS5/3	F2	OS4/7 OS4/8	OS5/3	J5
CE1	F3	OS4/9	OS5/4	J6 OW2
AE1	OS3/6	OS4/10	OS5/5	BJ
OW1/1	free	OS4/11	OW1/1	J7 OW1/1
free	free	free	free	free
free	free	free	free	free
OW1/2	F4	BS	OW1/2	J8 OW1/2
OW1/3	F5	OS4/12	OW1/3	J9 OW1/3
E4 BS	F6 BS	OS4/13	BS	J10 BS

A. Open Symposia

OS1 Time and Frequency

(a) Review papers on time, frequency and length metrology. Topics: microwave, infrared and optical standards; laser wavelength measurements; frequency synthesis; characterization of stability.

(b) Review papers on applications of time and frequency. Topics: generation of time, and applications to navigation, communication and relativity.

(c) Contributed papers on precise time and frequency dissemination and coordination.

OS2 Biological Effects of Electromagnetic Waves

Theoretical and experimental dosimetry and field measurements, instrumentation, mechanism of interaction with biological systems, hyperthermia, biomedical applications, behavioural and CNS effects, philosophy of standards, and international cooperative studies.

OS3 Optical Communications

OS3/1 Field theory of optical waveguides.
OS3/2 Techniques and phenomena involving modes, rays and beams.
OS3/3 System aspects of optical communications (fibre and atmospheric).
OS3/4 Measurements in optical communications.
OS3/5 Components and devices for optical communications.
OS3/6 Optical propagation in the Earth's atmosphere.

OS4 Radio Waves and the Ionosphere

OS4/1 The propagation of VLF whistler-mode signals (including the location of their exit points using direction-finding techniques).
OS4/2 The need for improved knowledge for radio communication and navigation purposes (including propagation from VLF to VHF).
OS4/3 High-power radar studies of the region below 100 km .
OS4/4 Sea-scatter using HF sky waves .
OS4/5 Ionospheric structure and dynamics .
OS4/6 Long-range HF ionospheric ducting.

OS4/7 Recent developments in the theory and methods of ionospheric sounding and direction-finding techniques not covered elsewhere.
OS4/8 Ionospheric propagation at high latitudes (including HF propagation and the influence of solar proton events on VLF propagation).
OS4/9 Non-linear effects excited by radio waves .
OS4/10 Studies of ionospheric irregularities (including theoretical investigations and in situ and remote sensing techniques) .
OS4/11 Ionospheric effects on Earth-space propagation (including ATS-6 observations).
OS4/12 Ionospheric modelling and mapping and their applications.
OS4/13 Future directions for ionospheric research (including EISCAT).

OS5 Wave Instabilities in Plasmas

OS5/1 Natural noise in space (organised jointly by Commissions E and H).
OS5/2)Instabilities, anomalous resistance, plasma
OS5/3)resonance.
OS5/4 = OS4/9 (organised jointly by Commissions G and H).
OS5/5 = OS4/10 (organised jointly by Commissions G and H).

OW1 Wave Analysis

Three sessions, the first one giving theoretical background, and one (possibly the third) devoted to radioastronomical applications.

OW2 Workshop on Large Digital Correlators

Final organization on 31 July 1978.

B. Scientific Sessions organised by one Commission

Commission A - Electromagnetic Metrology

A1 Circuit measurements.
A2 Laser measurements (power, energy, safety).
A3 Electromagnetic field measurements.

Commission B - Fields and Waves

B1 Recent developments in electromagnetic theory. Analytical techniques .
B2 Recent developments in electromagnetic theory. Numerical techniques I.
B3 Recent developments in electromagnetic theory. Numerical techniques II.
B4 Non-linear electromagnetics.
B5 Electromagnetic waves and the gravitational field.
B6 General discussion. Techniques for combining high-frequency asymptotic and numerical methods.
B7 Antennas for satellite communications.
B8 Electromagnetics in the USSR.

Commission C - Signals and Systems

C1 Advances in network analysis. Circuit theory and microelectronics.
C2 Satellite communications.
C3 New approaches in broadcasting.
C4 Adaptive systems in communications.
C5 Advances in information theory.
C6 Digital and data communications.
C7 Computer communications.
C8 Speech processing.

Commission D - Physical Electronics

D1 Submicron fabrication technology.
D2 Charge coupled devices.
D3 Plasma devices.
D4 Microwave acoustics, bubble memories.
D5 Mm-wave devices.
D6 Sub-mm and infrared wave devices.
D7 High-power devices.
D8 Acoustic imaging.

Commission E - Interference Environment

E1 Global location of atmospherics, and lightning instrumentation.
E2 Man-made interference I.
E3 Man-made interference II.
E4 New topics.

Commission F - Wave Phenomena in Non-ionized Media

F1 Radio wave propagation characteristics of transmission channels with special reference to phenomena

that affect the broadband and/or high-precision capabilities of telecommunication systems.

F2)Electromagnetic wave propagation and remote sensing
F3)of:

a. the non-ionized parts of the Earth's atmosphere,
b. the surface of the Earth,
c. planetary surfaces.

F4 Precipitation effects on propagation at frequencies above 10 GHz.
F5 Scientific Reports: IUCRM; La Baule Conference.
F6 New Topics.

Commission G - Ionospheric Radio and Propagation

See A. (Open Symposia).

Commission H - Waves in Plasmas

See A. (Open Symposia).

Commission J - Radio Astronomy

J1) New developments in observatories and
J2) laboratories.
J3 Very long baseline interferometry.
J4 Search for extraterrestrial intellingence.
J5 Millimetre-wave electronics.
J6 Physics of non-thermal radio sources.
J7 Recent developments in radio astronomy antennas. Short contributions.
J8 Solar and planetary radio and radar astronomy.
J9 Spectral line research.
J10 Additional scientific contributions.

C. Scientific Sessions organised by two Commissions

AD1 Cryogenic measurements.
AE1 Signal and noise measurements.
BC1 Applications of electromagnetics to transportation problems.
BC2 Antennas as signal processors.
BC3 Leaky feeder and open cable communications.
BF Electromagnetic theory in geophysical exploration.
BJ Recent developments in radioastronomical antennas.
CE Effect of non-gaussian noise on system performance.
BH Antennas in plasmas.

D. Administrative Sessions

Friday July 28	am	Board of Officers
	pm	URSI Council
Saturday July 29	am	URSI Council
	pm	URSI Council
Sunday July 30	am	Chairmen and Vice-Chairmen of Commissions
Monday July 31	am	Opening Meeting
	pm	Business Sessions of Commissions(BS)
Tuesday Aug 1	evening	URSI Council
Monday Aug 7	pm	URSI Council
Tuesday Aug 8	am	URSI Council
	pm	Closing Meeting.

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MEETING OF URSI BOARD OF OFFICERS (résumé)

On 14 and 15 March, the Board of Officers met at the Centre National d'Etudes des Télécommunications, Issy-les-Moulineaux at the invitation of the French National Committee of URSI. All the members and Mme Stevanovitch (Administrative Secretary) were present. Prof. P. Hontoy attended on the invitation of the President.

1. 60th Anniversary of URSI

Consideration is being given to the celebration, in 1979, of the 60th anniversary of the creation of URSI in Brussels in July 1919. Prof. Hontoy (President of the Belgian National Committee of URSI) will later make proposals for a programme of events dealing with the evolution of radio science and telecommunications since 1919, and with probable future developments.

It was noted that URSI was represented by M. M. Thué in the Programme Committee for Telecom 79 in Geneva at which the 50th anniversary of CCIR will be celebrated and during which a special URSI session may be organised.

2. Finances

The accounts for the year 1977 (see page 14) were approved.

A provisional budget for the period 1979-81 was examined. On the recommendation of the Board, it will be submitted to the members of the Lima Finance Committee for their informal comments. A revised budget will be submitted by the Board to the URSI Council in Helsinki.

The Board recommended the creation of a Standing Finance Committee which could, in future, be consulted by the Treasurer between Assemblies.

3. URSI Awards

The Balth. van der Pol and J.H. Dellinger Medals were awarded respectively to Dr. James R. Wait of the National Oceanic and Atmospheric Administration, Boulder,Colorado and Prof. Donald A. Gurnett of the University of Iowa (see p. 1).

A short-list of candidates for the Appleton Prize was agreed and is to be submitted to the Council of the Royal Society in London, which will select the Prizewinner.

4. Objectives of URSI General Assemblies

The URSI Committee in France has asked for the inclusion, in the Agenda for the URSI Council meetings, of an item dealing with the objectives of the scientific programme associated with the General Assembly of URSI. The Board noted that articles on this subject had appeared in URSI Bulletins Nos 202 and 204 (by the Secretary General of URSI and the President of the French URSI Committee respectively). The Secretary General was asked to prepare a document for the Council containing a summary of these articles,and of Lima Recommendation C.1,and also a statement by Prof. Stumpers on his experience in coordinating the scientific programme for the Helsinki Assembly.

The Secretary General will also ask the Chairmen of Commissions for their views on what topics should be covered by URSI Symposia before the next Assembly in 1981.

5. URSI Assembly, Helsinki

It was decided to arrange for the presentation of the URSI Awards at an evening session on Wednesday, 2 August, at which the three laureates will be invited to give

brief reports on their recent research work.

It was decided also that the election of the new Board of Officers should take place at a Council Meeting on the evening of Tuesday, 1 August. The early election will leave sufficient time for the members of the new Board to consult each other about the future organisation of their work.

A Session commemorating the work of Prof. Samuel Silver (President of URSI from 1966-1969 and Honorary President) is to be arranged by Prof. Stumpers in consultation with the Chairman of the Commission in which Prof. Silver was particularly active.

5. Relations with ITU

The Board noted that the URSI-CCIR-CCITT Liaison Committee had met in 1977 (see URSI Bulletin No 204) and agreed on the need to maintain and strengthen the relations with CCIR, and also to explore possible procedures for assisting CCITT in future.

6. Relations with ICSU

Lima Resolution C.9 invited the Board to examine the position of the Unions within ICSU, and to report its conclusions to the URSI Council in Helsinki.

The Board noted that the Secretary General had prepared a preliminary factual report which had been published in URSI Bulletin No 200. It was agreed that the essential elements of this report should be submitted to the URSI Council. The Board does not, at present, wish to make any specific proposals regarding the relations between the Unions and ICSU.

7. Future of SCOSTEP

It was noted a) that ICSU had asked for the opinion of the Unions on the proposal to terminate SCOSTEP at the end of 1980, after the termination of the main IMS programme; b) that there was support for the concept of a future Middle Atmosphere Programme (MAP) which would last at least until the mid-1980's; c) that if MAP were formally approved, ICSU would have to decide how to coordinate it.

Two possible courses had been suggested for the coordination of MAP:

1. the creation of a new ICSU Special Committee for MAP;

2. the prolongation of the life of SCOSTEP whose terms of reference would then be revised so as to cover the termination of IMS and the coordination of the MAP.

It was considered that, although there would be advantages in creating a new Committee which could concentrate its attention on MAP, it would probably be easier to ensure the continuation of the present national financial support for SCOSTEP than to provide finance for a new Committee. On the whole, therefore, the second alternative seemed preferable. It was appreciated, however, that the final decision on MAP must rest with the ICSU General Assembly, and especially with the Academies of Science and similar bodies which would be responsible for the provision of the necessary funds, either for SCOSTEP or for a new ICSU Committee, until at least the mid-1980's.

8. Active Experiments in Space

It was noted that URSI was cooperating with the COSPAR Panel on Potentially Environmentally Detrimental Activities in Space. It was agreed that URSI should pay particular attention to experiments likely to affect the propagation of radio waves, and the performance of communication systems.

9. Contacts with UNESCO

It was agreed that the President should meet the new Director of the Division of Communications in UNESCO with a view to developing closer collaboration with UNESCO in the field of research in communications.

10. Application for Membership

It was noted that an application for membership of URSI had been received from the Royal Irish Academy in Dublin and it was agreed that this should be submitted to the URSI Council in accordance with Art. 62 (e) of the Statutes.

11. Conclusion

At the invitation of the French URSI Committee, the members of the Board were entertained to dinner on 14 March. In addition to Prof. M.-Y. Bernard (President of the French Committee), also present were M. M. Thué (Past President) and M. D. Lombard (Secretary General).

At the conclusion of the Board Meeting, the members expressed their thanks for the generous hospitality they had enjoyed during their stay in Issy-les-Moulineaux.

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URSI FINANCES

In accordance with the recommendation of the URSI Finance Committee in Lima in 1975, the audited accounts of income and expenditure for the year 1977 are published in this issue of the Bulletin (see URSI Inf. Bull. Nos 198 and 202 for the accounts for 1975 and 1976 respectively).

The excess of income over expenditure during 1977 is due mainly to:

a) a supplementary grant of $3,000 from ICSU/UNESCO;
b) miscellaneous income of $4,000;
c) the second and final allocation of $10,000 towards the cost of the 1978 Assembly, which had not been spent by the end of 1977.

After making allowances for these items and other secondary items, income and expenditure during 1977 did not differ significantly from the provisions of the Lima budget.

During 1977 the value of the dollar fell by 5.4% relative to the Belgian franc, and the total fall since the Lima budget was prepared in mid-1975 amounted to 7.9%.

The accounts for the years 1975-1977 inclusive will be submitted for approval to the URSI Council during its meetings in Helsinki in July-August 1978.

Brussels, 29 March 1978

C.M. Minnis
Secretary General.

INTERNATIONAL UNION OF RADIO SCIENCE (URSI)

BALANCE SHEET 31st DECEMBER, 1977.

ASSETS	U.S.$	U.S.$	U.S.$
Bank Balances:			
On Deposit Account			
In Belgian Francs	31,428		
In American Dollars	32,415	63,843	
On Current Account			
In Belgian Francs	3,314		
In American Dollars	3,803	7,117	70,960
Belgian Government Securities			70,909
Petty Cash and Stamps			202
Sundry Debtors			751
			142,822
Less: Creditors:			
IUCAF		10,149	
IUCRM		657	
IUWDS		2,326	
Sundry		20,027	(33,159)
			109,663
Special Funds			
Balth. van der Pol Gold Medal Fund		4,859	
Pension Fund - Secretary General		15,882	(20,741)
NET TOTAL OF URSI FUNDS			$ 88,922

Represented By:

As at 1st January, 1977. U.S.$ @ $1 = B.F. 35	U.S.$ @ $1 = B.F. 35		As at 1st January, 1978. U.S.$ @ $1 = B.F. 35	U.S.$ @ $1 = B.F. 35
		Reserve Fund:		
46,429		Closure of Secretariat		49,643
		Funds for Scientific Activities		
	9,197	XIX General Assembly	18,800	
	12,857	Meetings and Symposia in 1978	16,857	
22,054	-	Special Purposes Fund	3,535	39,192
309		Unallocated		87
$ 68,792		Total URSI Balances		$ 88,922

Note:

In certain cases where Receipts or Payments represent amounts originally quoted in U.S. Dollars, these Receipts or Payments have been shewn in the amounts so quoted. In other cases the figures shewn on the above Balance Sheet and attached Income and Expenditure Account, represent the amounts actually received or paid in Belgian Francs or the equivalent thereof at the Official United Nations rate of exchange ruling at the date of the Receipt or Payment concerned and all such amounts have, for the purposes of these Accounts, been converted into U.S. Dollars at the Official United Nations rate of exchange ruling at 31st December, 1977.

REPORT OF THE AUDITORS TO THE MEMBERS OF THE INTERNATIONAL UNION OF RADIO SCIENCE (URSI)

In our opinion the above Balance Sheet and attached Income and Expenditure Account give a true and fair view of the state of the affairs of the International Union of Radio Science at 31st December, 1977, and of the excess of Income over Expenditure for the year ended on that date.

22-24, Buckingham Palace Road,
LONDON, SW1W 0QP.

GIMSON & CO.
Chartered Accountants.

23rd March, 1978.

INTERNATIONAL UNION OF RADIO SCIENCE (URSI)

INCOME AND EXPENDITURE ACCOUNT

FOR THE YEAR ENDED 31st DECEMBER, 1977.

	U.S.$	U.S.$	U.S.$
INCOME			
Subscriptions from Member Committees			77,309
Interest - Gross - In Belgian Francs	7,704		
Less: Tax	1,705		
	5,999		
Interest - in U.S. Dollars	956	6,955	
Less: Interest attributable to:			
Pension Fund - Secretary General	961		
Balth. van der Pol Gold Medal Fund	330	1,291	5,664
Sale of Publications:			
URSI Bulletin		414	
Miscellaneous		74	488
Allocation from UNESCO Subvention to ICSU			11,000
Surplus on Symposium			3,535
			97,996
EXPENDITURE (for further details see schedule attached)			
Meetings		6,251	
Publications		4,984	
Scientific Activities			
Symposia, etc.	9,662		
Grants	1,550	11,212	
TOTAL EXPENDITURE ON SCIENTIFIC ACTIVITIES		22,447	
Administration:			
Salaries and Pensions (including Social Security)	45,666		
Office and General Expenses	7,820		
TOTAL EXPENDITURE ON ADMINISTRATION		53,486	
I.C.S.U. - Dues for 1977		1,933	
TOTAL EXPENDITURE FOR THE YEAR			(77,866)
EXCESS OF INCOME OVER EXPENDITURE FOR THE YEAR			20,130
BALANCE IN HAND AT 1st JANUARY, 1977.			
B.F. 2,407,738 @ 35	68,792		
B.F. 2,407,738 @ 37	65,074		
Profit on Devaluation	3,718		
Balance as per Accounts at 31st December, 1976.		65,074	
Add: Profit on Devaluation - as above		3,718	
Revised Balance in Hand at 1st January, 1977.			68,792
BALANCE IN HAND AT 31st DECEMBER, 1977.			$ 88,922

INTERNATIONAL UNION OF RADIO SCIENCE (URSI)

INCOME AND EXPENDITURE ACCOUNT

FOR THE YEAR ENDED 31st DECEMBER, 1977, (CONTINUED)

SUPPLEMENTARY SCHEDULE SHOWING FURTHER

DETAILS OF CERTAIN ITEMS OF EXPENDITURE

	U.S.$	U.S.$	U.S.$
Meetings			
URSI Board of Officers		3,896	
URSI-CCIR-CCITT Committee		1,706	
Miscellaneous Travel		649	6,251
Publications			
URSI Bulletins Nos. 201-204		4,734	
INAG Bulletins		250	4,984
Scientific Activities			
Symposia, etc.			
Propagation: La Baule	2,351		
Eurocon: Venice	2,643		
EMC: Montreux	1,229		
Bioeffects: Airlie	1,057		
Measurements: Lannion	507		
Information Theory: Ithaca	507		
Optical Communication: Tokyo	246		
Calls for papers: Helsinki 1978	1,122	9,662	
Grants			
IUCAF	1,250		
IUCRM	300	1,550	11,212
TOTAL EXPENDITURE ON SCIENTIFIC ACTIVITIES			$ 22,447
Administration			
Salaries and Pensions			
Salaries and Social Security		42,960	
Supplementary Pension Provision			
Y. Stevanovitch	1,669		
C.M. Minnis	1,037	2,706	45,666
Office and General Expenses			
Office Rent, Heat, Repairs, etc.		2,460	
Stationery and Office Supplies		590	
Insurance		690	
Telephone		680	
Postage		765	
Bank Charges		285	
Entertainment		42	
Audit and Accountancy		1,571	
Miscellaneous		40	
Loss on Exchange (Net)		697	7,820
TOTAL EXPENDITURE ON ADMINISTRATION			$ 53,486

INTERDISCIPLINARY STUDIES: NOT A NEW CONCEPT, BUT AN OLD ONE

Historical Aspects

Those of us who studied science as late as the 1930's did not regard the boundary between chemistry and physics as a sharply defined line. The laboratory devoted to physical chemistry provided an easily crossed bridge between the two subjects, since the experimental methods used in it were combinations of those used in the main chemistry and physics laboratories. In a similar way, mathematics and pure physics were conveniently linked together by mathematical physics. Even astronomy and the physics of the Earth were not regarded as isolated specialised subjects, but rather as particular facets of pure physics. At that time it was much easier for scientists to see the whole of their subject in perspective and to appreciate its essential unity. In consequence, the interactions between those who worked in different branches of science were not regarded as very unusual or remarkable.

It is unfortunate that the rapid growth of scientific knowledge during the past 30 years has led to a situation where there are fewer and fewer scientists who can take a broad view of scientific research. The counterpart of this is the increasing specialisation and the growing numbers of research workers who have little experience outside the confines of narrow fields, in which they tend to work in isolation from each other. It is increasingly common to find that, when two specialists from somewhat different fields cooperate successfully in an investigation, their achievements are often attributed particularly to what is described as the "interdisciplinary" character of their work which seems to be mistakenly regarded as a modern concept.

In fact, the transfer of ideas and of experimental methods from one branch of science to another, with beneficial results, follows a centuries-old tradition. Although the foundations of astronomy were laid as a result of the remarkable observations made over many centuries without the aid of precision instruments, it was the application of the science of optics to the development of the telescope and the spectroscope that opened the way to the growth of modern astronomy. Several centuries later, it was the results of research in radiocommunication

science that made it possible for astronomers to look through a second window in the Earth's atmosphere and to make important new discoveries that could never have been made by looking only through the traditional optical window.

Interdisciplinary Studies in URSI

After World War II, radio scientists were quick to exploit the availability of surplus radar equipment for scientific research. As a result, some of them became the first radioastronomers, and URSI provided the obvious background for international discussions of the latest results in this new field, until the creation of the Commission for Radio Astronomy in the Astronomical Union.

Half a century ago, research work on the scientific basis of radiocommunications led to a similar result. From the 1920's onwards, the need to understand the way in which high-frequency radio waves were propagated over great distances obliged radio scientists to investigate the physical characteristics of the ionosphere, in parallel with their studies of how the ionized layers affected radio waves. In consequence, radio scientists became the first upper-atmospheric physicists. In fact, until the beginning of the era of the artificial Earth satellite, only the radio scientist had the observing instruments which made such studies possible, and indeed only he could interpret the data acquired by these instruments. During this period, ionospheric research was not regarded as a branch of geophysics; the relevant sections of the Geophysics Union (IUGG) were concerned with meteorology and with terrestrial magnetism and electricity, but only in the lowest levels of the atmosphere.

In a closely related field, whistling atmospherics first attracted the attention of URSI in 1938, since atmospherics in general represented a serious hindrance to radiocommunications. It was not until the time of the URSI General Assembly in 1952 that "whistlers" were shown to be capable of providing valuable information about the geomagnetic field and the residual ionisation at hitherto inaccessible heights. Any discussions on the structure of the magnetosphere necessarily involved questions concerned with the propagation of electromagnetic waves and other wave phenomena in ionized media. Since the radio scientist had already been familiar with such subjects for many years, it was only natural that URSI should have been

the recognised international forum for discussions on both the ionosphere and the magnetosphere.

It is interesting to recall that, in 1938, the IUGG Association for Terrestrial Magnetism and Electricity (IATME) took the initiative and expressed an interest in cooperating with URSI through the Commission on Wave Propagation which dealt also with the ionosphere. However, it was only after World War II that IATME widened its terms of reference and adopted its present title: Geomagnetism and Aeronomy (IAGA).

The decision to extend the field of interest of IUGG (IAGA) upwards so as to include all aspects of upper atmospheric physics was a logical one, even though the geophysicist was still obliged to rely on the radio scientist for the acquisition and analysis of most of the observational data. The advent of the instrumented satellite at last made it possible to make in situ measurements of all kinds in the upper atmosphere and in the magnetosphere and, since then, geophysicists have made good use of the new facilities provided for them.

But the upper atmospheric physicist can not work in isolation; he must collaborate with the astronomer, who provides the necessary information on the various solar radiations which permeate interplanetary space and which ultimately control the Earth's environment. He can not ignore the meteorologist, who is familiar with the important dynamical processes in the lowest levels of the atmosphere whose influence may extend up to much greater heights. Finally, without the benefits of the results of many years of basic research in various aspects of communication science, the upper atmospheric physicist would be unable to transfer the observational data from his satellite to the laboratory computer and ultimately to his office desk.

Thirty years ago, the growing demand for new radiocommunication systems and the limited width of the available radio spectrum provided the stimulus for the generation of radio waves at very much higher frequencies. As in the early days of ionospheric research, the radio scientist found himself in an analogous situation; he was obliged to investigate structural features of the atmosphere whose existence had not previously been suspected by the meteorologist. The links between radio scientists on the one hand, and meteorologists and lower-atmospheric physicists on the other have now become very close. This

is due partly to the great importance of microwave frequencies in satellite and other types of communication system, and partly to the adoption of various radio methods as aids to meteorological forecasting and research in atmospheric physics.

Radio studies of the ionosphere and the magnetosphere, radio astronomy and radio meteorology are all by-products of research on radio communications and have acquired an almost traditional character. Radio oceanography is a comparatively recent innovation which seems likely to develop further, thanks to the collaboration of radio scientists, meteorologists and oceanographers in an Inter-Union Commission (IUCRM) in which both URSI and IUGG are represented.

Because of the finite width of the radio spectrum, the never-ending demand for additional frequency allocations, and the consequent enhanced risk of mutual interference, it is becoming more and more important to avoid, wherever possible, the use of open radiating systems of radiocommunication. In consequence, research on the use of waveguides for the transmission of electromagnetic waves has been a subject of interest to URSI for many years. Such waveguides are now widely used and are very reliable components of many communication systems. The experience gained by the radio scientist in the study of waveguides is now being usefully employed in the development , for communication systems, of optical fibres which, in many respects, can be regarded as waveguides intended for use in the optical part of the spectrum.

Another and even more recent subject of investigation in URSI is the study of the biological effects of electromagnetic radiation and their possible importance as a hazard to health for those who are subject to prolonged exposure. The difficulties of studying the propagation of such radiation in living tissues, and of making the necessary in situ measurements of the radiation and of the effects produced by it in an organism, present many problems which will demand the close collaboration of both radio- and bio-scientists having special interests in this new subject.

Conclusion

URSI is concerned primarily with the basic scientific aspects of telecommunications and especially of radiocommunications. Nevertheless the physicists, electrical

engineers and mathematicians associated with URSI during the past half century have shown their breadth of vision and versatility by maintaining the long-standing tradition of initiating interdisciplinary studies. This is illustrated by their pioneering work in the development of new branches of astronomy, geophysics and atmospheric physics the major responsibility for which has since been transferred from URSI to the appropriate Unions: IAU and IUGG. The more recent entry of URSI into fields such as wave propagation in optical fibres, radio oceanography and the biological effects of electromagnetic radiation shows that the radioscientist is still prepared to play an important part in the development of new branches of science not directly related to radiocommunications.

31 March 1978 C.M. Minnis

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FREQUENCY ALLOCATIONS FOR RADIO ASTRONOMY AND SPACE SCIENCE

Everyone concerned with radiocommunications is aware of the problems created by, on the one hand, the limited range of frequencies within the radio spectrum and, on the other, the apparently unlimited growth in the numbers of radio transmitters and their radiated power. As Mr. Kirby has pointed out elsewhere in this issue, the need for the orderly utilization of the radio spectrum, in such a way as to minimise mutual interference, has been appreciated for over half a century.

More recently, special problems have emerged from the requirements for frequency allocations of radio astronomers and space scientists. These are partly due to the very low levels of the signals received, and partly to the fact that the scientist is often not free to choose the frequencies at which he will operate. His working frequencies are determined often, for example, by the natural frequencies of emitting or absorbing atoms and molecules in space, by Doppler shifts in these frequencies, and by absorption of certain frequency bands in the terrestrial atmosphere.

The search for solutions to the problems associated with the acquisition of adequate frequency allocations

for radio astronomy and space science has been the responsibility of the Inter-Union Commission on Frequency Allocations for Radio Astronomy and Space Science (IUCAF) since its creation in 1960. This Commission represents the world scientific community and consists of representatitives of URSI, IAU and COSPAR; it also has contacts with scientists in many countries through its network of national Correspondents. Representatives of CCIR and IFRB attend the meetings of IUCAF and this is a reflection of the excellent relations between these ITU organisations and the scientific bodies represented in IUCAF.

It would be quite unrealistic to suggest that all the requirements of scientists for frequency allocations can be satisfied in full. IUCAF is well aware of this limitation and, by avoiding making excessive or unreasonable demands, the recommendations and the views of IUCAF are treated seriously by ITU and its technical Committees.

During the past 18 years, IUCAF has presented the views of the research scientist during preparations for the Conferences convened from time to time by ITU, and at the important technical discussions in CCIR which precede such Conferences. At the present time IUCAF is actively engaged in doing preparatory work for the World Administrative Radio Conference in 1979 and for the Special Preparatory Meeting of CCIR in 1978. The 1979 Conference is particularly important because the decisions reached during it will probably be valid during the next 10-20 years.

As a result of consultation with the national Correspondents of IUCAF over several years, documents are being prepared setting out what are considered to be the reasonable requirements of the world community of radio astronomers and space scientists, so far as these can be foreseenat present.

It must be remembered, however, that only the representatives of national Administrations have the right to vote at ITU Conferences. For this reason, scientists in each country must take whatever steps they consider necessary to ensure that their national Administrations will support, as far as this is possible, the requirements of scientists for frequency allocations or for the protection of certain frequency bands.

The national Correspondents of IUCAF have already been notified of the progress made by the Commission.

Further enquiries should be addressed to the nearest Correspondent (see List below) or to the Secretary of IUCAF:

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Dr. May Kaftan-Kassim, Iraq
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Prof. H. Tanaka, Japan
Dr. P. Kaufmann, Brazil
Prof. M. Tiuri, Finland

Prof. A. Tlamicha, Czechoslovakia
Prof. M. Vukicevic-Karabin, Yugoslavia
Dr. R. Woodman, Peru
Dr. G. Wrixon, Ireland
Dr. G.F. Block, European Space Agency
Prof. E.A. Müller, IAU
Dr. C.M. Minnis, URSI
Mr. Z. Niemirowicz, COSPAR.

March 1978 C.M. Minnis

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REMARKS ON FUTURE NEEDS FOR IONOSONDES

(Note From Secretary General. A summary of the Report on Needs for Ionosondes in the 1980's appeared in URSI Bulletin No 204, p.14 and included some comments made by Prof. L. Bossy. The following remarks have been received from Prof. K. Rawer).

Ionosonde stations were originally established mainly for radio wave propagation studies and predictions. In spite of the decreasing importance of hf communications, such services still have some importance, in particular for developing countries. Meanwhile two more aspects of ionospheric sounding have increased in importance: namely, geophysical investigations and, more recently, environmental considerations.

The actual size of the world-wide network was reached about the time of the International Geophysical Year(1957-58). Only since then has reasonable world-wide coverage been available, although there are still some important gaps in the Southern Hemisphere and over the oceans.During the past 20 years, a global description of the planet Earth has been of primary interest. Meanwhile, the impact of space research has stimulated increasing interest in aeronomic problems and, in consequence, there is now a demand for more detailed analysis of data gathered using different techniques. With the existing world network, such studies can only be made in the very few regions where the network is particularly dense. For example, a recent study aimed at the determination of atmospheric exchange coefficients in space and time could only be made with the European network, since the distance between stations is too large in almost all other regions. The

same is true for certain studies of dynamic phenomena; for example, those with which sporadic-E is apparently linked.

Considering the needs of stations in the future, one should avoid taking a short-sighted point of view, and one should take account of three orientations of users of ionospheric data namely:

(i) applications to telecommunications (now including the effect of the ionosphere on vhf and uhf waves which penetrate it);

(ii) the world-wide geophysical description and interpretation of the ionosphere;

(iii) regional studies of aeronomic and dynamical phenomena.

In my opinion, these three considerations should have equal weight. In view of Item (i), it can be stated that the existing description (for example CCIR Report No 340) urgently needs improvement in certain zones. To cope with Item (ii) a world-wide network of reasonable minimum extent is needed and it should not be very much smaller than the present one. As for Item (iii) the few existing denser networks at least should be continued.

March 1978

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ELECTROMAGNETIC COMPATIBILITY

As greater and greater numbers of radio transmitters of all kinds are brought into use, communications scientists are increasingly confronted with several major problems, such as the limited width of the radio spectrum and hence the necessity for the sharing of frequency allocations, and the risk of mutual interference between different Services, and even within the same Service. Other problems have arisen from the unwanted emissions originating in radio transmitters and in household and industrial electric and electronic equipment, and from the potential danger to health associated with prolonged exposure to strong electromagnetic fields.

Each of these and other problems has been a subject for study, sometimes over many years, and solutions have often been found for particular problems. More recently it has been appreciated that it is insufficient to seek solutions to such problems in isolation; it is necessary to consider all the problems relating to a given situation in a coherent way and to find an optimum general solution. The objective is to design and operate the various systems in such a way that they are compatible with each other and this has led to the adoption of the term electromagnetic compatibility (EMC) which is now in general use.

An international symposium on EMC will be held in Wroclaw, Poland in September 1978. It will be cosponsored by URSI, as was the EMC Symposium in Montreux in 1977. Information on these important events was given in URSI Bulletin No 203.

URSI Commission E is actively interested in the scientific aspects of EMC and Mr. Hagn (Vice-Chairman) organised one of the sessions at Montreux on behalf of URSI. The keynote address on this occasion was given by Mr. Richard C. Kirby, Director of CCIR and, since it provides a useful introduction to the subject of EMC, it has been reproduced, in shortened form, elsewhere in this issue of the URSI Bulletin. It is worth noting that Mr. Kirby drew attention to the rôle that URSI should be able to play in some of the scientific aspects of the search for solutions to problems of the kind mentioned above. No doubt the URSI Commission E sessions in Helsinki will enable recommendations to be made about URSI's rôle in providing advice or assistance to CCIR in the field of EMC.

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ELECTROMAGNETIC COMPATIBILITY AND TELECOMMUNICATIONS

by

Richard C. Kirby
Director, CCIR, Geneva

Editorial Note. This is a shortened version of the keynote address given by Mr. Kirby at the EMC Symposium and Exhibition, Montreux, June 28-30 1977.

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What is the field of EMC and what future may be expected of it? As recently as 1964 a committee of eminent specialists and engineers characterised it as a "military specialty". Today, in a Symposium on EMC, we discuss virtually all aspects of interference to communication systems, noise, immunity of systems, frequency management and even "EMC and life". There is no emphasis on the military aspects of EMC, and cooperative international symposia are held in North America and in Eastern and Western Europe with good participation from all regions.

The Components of EMC

The breadth of the EMC field seems natural today. Even though the excellent term "electromagnetic compatibility" may have been of relatively recent and special origin, the operation of a radio communication service in the environment of other radio services has posed the compatibility problems of spectrum utilization for more than fifty years. International conferences from the earliest 1900's began to coordinate such problems. After the introduction of vacuum tubes and frequency control, the rapid growth in the 1920's of broadcasting stations, ship communications and new point-to-point services, created severe compatibility problems. A Radio Conference in 1927 first dealt in a substantial way with matters of interference and orderly frequency utilization. The Cairo Conference in 1938 treated an increasingly complex situation involving frequency allocations for the aviation and other new services. The Atlantic City Conference in 1947 set many of the features of present-day international frequency management. Thus the first and earliest component of EMC relates to the orderly utilization of the frequency spectrum and is more than fifty years old.

A second component field, closely related to the first but remaining distinct for many practical reasons, concerns unwanted emissions from radio or other electrical equipment. Work in this field also predates the invention of the term EMC. It covers the science of measurement of emissions, the suppression of unwanted emissions and responses by circuit design, shielding and filtering. It covers also the study of many sources of interfering radiation referred to as man-made noise. Standards in this area of unwanted emissions and unwanted responses are increasingly important for consumer protection and in international trade.

It was the third major component that gave rise to

the term "Electromagnetic Compatibility", namely the interaction of many closely spaced electronic systems, especially telecommunication systems, in the heavily congested electronic environments aboard ships and aircraft, and in concentrated radio and radar operations on land. Such interactions began to be of importance in military situations, but they are typical of the radio environment in urban areas in industrialized countries today.

A fourth major component field of EMC, increasingly recognized, concerns the effect of electromagnetic fields and waves on living organisms and on the natural physical environment, and the extent to which electromagnetic waves represent some hazard in industry or everyday life.

But my purpose is not to give you an analysis of the components of EMC. It is rather to propose to you today a much more profound expectation from this whole field for the future: EMC is no longer simply a subset of the problems of radiocommunications; in my view it is becoming, in full partnership with the development of new services, virtually the future of the radiocommunications field. This is more than a play on words. EMC represents an essential half of the mainstream of future development and growth of radiocommunications, because this growth and development is completely dependent upon more intensive use of the frequency spectrum. EMC becomes an essential element for protecting and increasing the yield from investment in radiotelecommunications.

Spectrum Utilization

I will speak mainly about what I have termed the Spectrum Utilization component. The ITU and especially the CCIR are heavily engaged in this topic because a high degree of international cooperation is essential.

CCIR studies the technical aspects of compatible use of the spectrum both as regards specific situations, involving particular radiocommunication services, and also as regards general principles for spectrum utilization. The CCIR issues technical recommendations and reports. It is national Administrations, and international radio conferences which use these in the development of national and international frequency planning and regulation.

Each CCIR Study Group concerned with a particular radio service is deeply engaged in at least two facets of the question. The first is the quantitative specification

of the impairment of service which corresponds to various levels of co-channel or adjacent channel interference. The second is the provision of guidance for the sharing of frequency bands with the same or other services, usually in terms of channeling alternatives, description of interfering spectra, criteria for siting, and various methods for coordination and for measurement essential to planning these specific services. Examples include elaborate coordination criteria for the siting, in relation to each other, of earth stations for satellite systems, and terrestrial microwave radio relay stations.

I mentioned that the CCIR also studies more general principles of spectrum utilization and methods of monitoring and measurement. This is the work of Study Group 1.

There is, for example, a draft recommendation giving new definitions of interference of a technical/legal nature. Up to the present, the Radio Regulations use the term "harmful interference", and it is defined as an "emission, radiation or induction which endangers the "functioning of a safety service or seriously degrades, "obstructs, or repeatedly interrupts a radiocommunication "service operating in accordance with the Radio Regulations". Why the changes? First, there is the need for definition of a level of permissible interference, which corresponds to the quantitative level of interference or to sharing criteria that could be used for planning purposes. Secondly, the existing definition of harmful interference specifies that interference is an emission or radiation. The new draft, by considering interference to be an effect rather than an emission, tends to shift a share of responsibility toward the receiver. This has major legal implications in many national regulations, so it is not sure whether the new definition will ultimately be adopted. Study Group 1 is also preparing a completely new method of classification and designation of emissions, according to their necessary bandwidth, their modulation and additional characteristics such as coding and multiplexing. This new method is intended for presentation to the World Administrative Radio Conference in 1979.

Also among the most fundamental and most difficult of Study Group 1 studies is that of "definition of spectrum use and efficiency". A new report provides preliminary definitions of these terms and illustrates their application with an example calculation of spectrum efficiency for terrestrial point-to-point radio relay systems.

The definition of spectrum use includes not only bandwidth but also space and time, and the concept of efficiency involves the ratio of information transferred to spectrum space used. This Group has also prepared a report on new uses of the spectrum using lasers to generate coherent electromagnetic waves in the frequency range from millimeter waves to the ultraviolet region.

One of the most important practical topics is the mathematical modeling of large systems sharing the spectrum so as to assess the interference probabilities and utlimately to achieve a degree of optimization.

Study Group 1 is also responsible for monitoring and measuring methods, and considerable progress has been made recently in the methods of measurement of spectra and bandwidth of emission.

There is also a study devoted to safety aspects of radio-frequency radiations from transmitting stations; unfortunately, not much progress has yet been made in CCIR on this subject.

The activities of Study Group 1 derive from participation by many countries and represent an important focus for international effort on electromagnetic compatibility.

Some Scientific Aspects of EMC

There is a tendency to regard EMC as a very complex engineering problem, but not as science. Most of the problems in CCIR have been in the very complex engineering category. However, it is clear that some important science is needed in EMC and I would expect URSI to make important contributions in this field.

First, classical communication theory deals mostly with a single system, with coding and signal design for noise immunity. The power and bandwidth trade-offs are considered usually for a single system, though it may be a multichannel one, and the optimization criteria are stated in terms of information flow and fidelity for that system. In EMC, however, there is a need to emphasize a special domain of communication theory for electromagnetic compatibility, in which the optimization criteria concern the total information flow through an aggregate of systems which share a specified portion of the spectrum. The spectrum, of course, has to be defined in terms not only of bandwidth but also of space and time. Thus, one can investigate the optimum parameters for a lattice or other

arrangement of FM or other spread-spectrum systems operating together and sharing the same spectrum. In practice, of course, such systems may be dissimilar and may have different individual criteria for performance.

Secondly, it seems that some of the best science of computer utilization and statistical mathematical modeling may be challenged by the need to model and analyse some of the extraordinarily complex band-sharing situations involving a variety of signal characteristics. Already, some of the statistical-physical models of Middleton concerning man-made noise and "intelligent interference" may be relevant.

Thirdly, there remains the need for more fundamental and more useful methods of measurement of electromagnetic wave fields, for both signals and noise, involved in spectrum occupancy. Unless meaningful in situ measurements can be made in pretty much the same terms that predictions are made by the mathematical models, our band-sharing predictions will remain rather theoretical.

A fourth and profoundly important scientific problem related to electromagnetic applications concerns biological effects. I emphasize these because of the scientific difficulty and the importance of interdisciplinary effort. This is not to minimize the importance of other physical effects in the environment, such as ionospheric modification, and various hazards to safety but I believe these are relatively more amenable to understanding. The biological hazards represented by non-ionizing radiations, especially microwaves, have long been the subject of quiet controversy and there is some disparity among the safety criteria in different countries. While no one, as far as I know, would suggest that these effects attain anything like the level of the important effects of X-rays, it is clear that non-ionizing radiation can have biological effects, and it is a responsibility of governments, industry and concerned professionals to ascertain and publicize the facts.

Mr. Kirby concluded by summarizing the main points of his address and expressing his wishes for a successful Conference.

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MEASUREMENTS IN TELECOMMUNICATIONS:

Lannion, France, 4-6 October 1977

This is the title of the 653 page book, edited by the Centre National d'Etudes des Télécommunications, and containing the contributions to the Symposium on Measurements in Telecommunications: 47 in French and 66 in English. During the Symposium, organized on behalf of URSI Commissions A, C and E by the French Society of Electrical and Electronics Engineers (SEE) and the French URSI Committee (CNFRS), simultaneous translation was available. The lion's share of the organisational work was taken by Dr. J. Le Mézec, ably assisted by his colleagues and secretarial staff at CNET. The selection of papers was the responsibility of Drs Richardson and Altschuler, respectively Chairman and Vice-Chairman of the Scientific Committee which included 32 other members. The Symposium was held in Lannion, at the Centre des Loisirs de Trégastel, a seaside resort on the coast of Brittany.

The meeting stressed the interest of URSI in telecommunications, a fairly new subject for Commission A (Electromagnetic Metrology). Among many international authorities, the Directors of CCIR and CCITT and the President of URSI were members of the Honorary Committee, and the latter two were present for part of the time. Mr. Rutkowski (CCIR) and Mr. Baillod (CCITT) sketched, in their opening addresses, the measurement techniques in which their organisations were specially interested.

Measurements characterizing traffic and grade of service, including the estimation and monitoring of loads, studies of models and simulators were the subject of one session. The statistics of ineffective attempts, and numerous other statistics affecting traffic and maintenance were considered, and these covered the French electronic switching system (E10) and other systems.

Next came measurements on digital systems: for example, error rates and jitter. Very high bit-rates in the range 400 - 1200 Mbit/s impose special requirements on measurements in the USA and Japan. Successive transmissions are not independent in their susceptibility to errors, but accurate confidence limits can be derived from the Anderson-Burstein and the Edgeworth distributions, the former a variation of the Poisson distribution.

The use of superconducting devices in measurements,

such as Josephson junctions and super Schottky diodes was discussed. IEEE and IEC have agreed on the standardization of pulse measurements. An automatic pulse measurement system, based on an 18 GHz sampling oscilloscope was developed by the US Bureau of Standards and is also used at CNET in Lannion. Noise measurements on transistors in the range 2-12 GHz were considered. Computer-operated sets measure insertion loss and phase from 50 Hz to 12 GHz.

Spectral and time-domain measurements were discussed as well as signal processing and automation of measurement. In this area digital filters, fast Fourier transforms and digital synthesis are important concepts. For the measurement of time and frequency, one has to agree on the required frequency stabilities, and the methods of realizing them. Caesium standards, replaced if necessary by quartz oscillators, are a possibility. The mutual comparison of atomic standards and of secondary standards was treated. A phase-locked loop with a perfect integrator can be used for the measurement of frequency stability and phase noise. Statistical descriptions of oscillator stability were given. Control of a quartz oscillator by an ammonia absorption line at 23870 MHz was tried. Synchronisation of atomic standards via the Symphonie satellite and via ATS-1 was discussed, and compared with the results of a comparison with a transported standard clock or the arrival of standard pulses from a Loran installation. Public television can be used for accurate time comparisons over distances of several hundred kilometres (standard deviation $\pm$ 0.006 μs). Accurate and fast frequency measurement can be based on frequency multiplication and frequency conversion, and a counting frequency meter.

The sessions on the design and monitoring of distribution networks included contributions from India, France and F.R. Germany. Automatic measurements of cable tolerances, psophometric noise measurement on telephone circuits, quality of inter-urban and international circuits and of digital circuits were all subjects for discussion. The large number of possible measurements leads to a strong desire for automation. Time multiplexing, data compression, packet switching and properties of PMC systems all have their own measurement problems.

High-frequency measurements on cables, accurate measurements of dimensions, dielectric properties, conductivity and attenuation, as well as echo-characteristics

of coaxial cable are required. In automated measurement micro- and mini-computers play a rôle.

Measurements of optical fibre characteristics made at Bell Telephone Laboratories, CNET and National Bureau of Standards were discussed. An optical signal generator using acousto-optic Bragg diffraction was described. The impulse response and the dispersion of optical fibres were measured.

At microwaves one is interested in waveguide analysis, in measurements in the range 40 to 90 GHz, in space applications of non-linear amplifiers, and in measurements of fundamental and second-harmonic response of IMPATT diodes at 10 GHz.

With regard to antennas, polarization measurements, measurements of near fields, group propagation time, and measurements of impulsive fields radiated by a horn antenna were discussed. For satellites the measurement of EIRP, available carrier power on the down link, gain and noise at the earth terminals are important.

In the discussion on interference, CISPR measurement apparatus and methods of measurement played an important rôle. Advanced mobile American equipment can make measurements from 20 Hz - 40 GHz. The electromagnetic field created by lightning was measured automatically.

Pseudo-random noise signals are used for measurements on microwaves. Bandwidth and out-of-band radiation are measured. Immunity measurements, based on TEM cells and the like, are made in the Netherlands and Switzerland.

Ionospheric and tropospheric transmission measurements, fading analysis and sounding signals were discussed.

The assessment of speech quality has given rise to a number of objective and subjective methods. Subjective measurements made by a large number of listeners are very time consuming. The speech transmission index (STI) proposed by Steeneken and Houtgast, of the Dutch Institute for Perception at Soesterberg, gives an equivalent result within 90s. Seven octave-bands ranging from 125 Hz to 8000 Hz can be modulated separately. The band under test is modulated by a random envelope corresponding with the envelope of running speech. After transmission the signal is passed through an octave filter corresponding to the octave band under test. Envelope detection and low-pass

filtering give the envelope function which is sampled by an analog-to-digital converter for at least 4s for each modulation frequency. From these measurements the speech transmission index can be derived. The weighting of the data was done in such a way as to obtain an optimal correlation between the STI and the subjective intelligibility score.

Earlier efforts based on the calculation of the articulation index (from the results of narrow-band analysis of voice and noise signals) failed for coded voice signals.

The measurement of the effect of digital speech interpolation (TASI-SPEC) is also of interest. In adaptive differential PMC systems, slope overload and granularity play a rôle, and both effects should be measured separately. The evaluation of nonlinear distortion was also discussed.

There are analogous problems in the evaluation of subjective picture quality after digital coding of visual signals (e.g. by differential PCM). Quantization noise is important. Perceptibility and acceptability threshold are defined. Sixteen-level DPCM can be used with very little degradation for portraits, and with small but tolerable degradation for graphics. A good correlation between objective measurements and subjective quality is of paramount importance, but methods to achieve this are still under consideration.

As Dr. Richardson said in his final address: "Such "meetings as this broaden the experience of all partici- "pants, and improve everyone's idea of the relationship "between the world's measurement organisations and the "world's communications organisations".

Many unsolved problems remain in the field and it was agreed that more symposia of this kind were desirable. The major importance of measurement problems in telecommunications was stressed by the representatives of both CCIR and CCITT.

The success of the Symposium may lead to repeat performance either in Lannion, which has several attractive features, or elsewhere in a few years time.

A limited number of copies of the volume mentioned at the beginning of this report is available. Orders should be sent to:

Colloque URSI Mesures
CNET
Route de Trégastel
F - 22301 Lannion, France.

The cost is US$45 or 215 French francs.

February 1978 F.L.H.M. Stumpers

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The following comments on the Lannion Symposium have been reproduced, by kind permission, from the December 1977 issue of Telecommunications.

At a recent meeting on the subject of measurements in telecommunications, held at Lannion, France under the auspices of Commissions A and C of the Union Radio-Scientifique Internationale (URSI), stress was laid upon the need to establish and maintain a continuing rapport between the world's measurement organizations and its communication organizations.

Dr. John M. Richardson, Director, Office of Telecommunications, US Department of Commerce, stressed the relationship between developing telecommunication technology and new measurement requirements. As an example, he noted that dispersion in optical fibers has forced invention of new measurement methods and instruments. Continuing, he touched upon the complexity of national telephone networks which require a staggering variety of measurements. But, telecommunications spreads far beyond the telephone - into broadcasting, navigation, radar, mobile radio, and even into remote sensing. Consequently, no one can be an expert in all aspects of telecommunications.

The great differences in maturity of measurement science within the many fields of telecommunication indicate the need for "a period of incubation" before any one technique can be selected. Richardson noted that the properties of pulses have now been specified but new devices, such as the Josephson junction, call for new measurements by new methods. He drew attention to the trend toward measurement of digital rather than analog quantities which emphasizes the need to measure telephone traffic congestion and bit-error rates far more than the old quantities of voltage and impedance. Unsolved problems exist such as the incomplete statistical description of

frequency stability, or the numerical aperture of an optical fiber, or the complete characterization of speech signals.

Dr. Richardson introduced something rarely considered yet perfectly obvious: the purpose of two-fold measurement - to advance technology by devising ingenious methods to observe new phenomena and to achieve lowered costs of services and satisfactory maintenance of them. In other words, the interest of the user of communication services is at stake.

Dr. Helmut Altschuler, senior scientist at the National Bureau of Standards, mentioned in the opening session, the gap between measurement discipline and practice. He noted that such gaps impede the efficient delivery of the measurement products of the national and university laboratories, as well as the need to provide to industry basic standards of measurement. It was his hope that continuing conferences such as at Lannion, would do much to narrow the gap.

In his concluding remarks, Dr. Richardson expressed his hope that future meetings would devote more time to subjects such as switching or the alternatives of packet telephone and radio networks. Practical subjects such as performance of keyboards, facsimile, and the more advanced terminals, measurement of broadcast coverage and of satellite beams are of great importance, as is measurement of security of communications links. As a final thought, Richardson stressed that the delivery of results of telecommunications measurement work will contribute to greater consumer choice of services and to more economic provision of them.

This international symposium, the first of its kind, brought together almost two hundred measurement experts and communications specialists who were banded together to create a better understanding of current trends in instrumentation, to create a cross-fertilization between the several techniques involved, and to generate a synthetic view of the problems of measurements. Particular recognition should be given to the work of personnel of the Centre National d'Etudes des Télécommunications (CNET), to assure success of the conference and to Monsieur J. Le Mézec, Chairman of the Organizing Committee and Assistant Scientific Director of the Centre.

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EUROPEAN GEOPHYSICAL SOCIETY

Strasbourg, France, 29 August-1 September 1978

The Fifth Meeting of the EGS will be held in the Université Louis Pasteur, Strasbourg and the main objective will be to review and discuss topics, in the field of upper atmospheric physics, to which European scientists have recently made significant contributions. In addition to the General Scientific Sessions, there will be several specialist symposia, the titles and convenors of which are listed below.

1. The Bow Shock

   Dr. J. Lemaire Dr. M.J. Rycroft

   Particular attention will be given to the plasma physics describing the conditions which exist at the shock front.

2. Auroral Acceleration Processes

   Dr. R. Armstrong Dr.D.A. Bryant

   It is intended to examine theoretical models and experimental observations in space and in the laboratory relating to the acceleration of charged particles in the aurora.

3. Aeronomy and dynamics of the lower ionosphere

   Dr. G.M. Brown Dr. E.V. Thrane

   It is hoped to bring together recent experimental and theoretical results pertaining to the chemistry, structure and dynamics of the D and E regions.

4. There will also be a Symposium on Geophysical Fluid Dynamics at which basic fluid dynamical processes in meteorology, oceanography and planetary interiors will be discussed.

All participants are required to register. Further information may be obtained from:

The Programme Committee
Fifth EGS Meeting
Institut de Physique du Globe
Université Louis Pasteur
5 rue René Descartes
F - 67084 Strasbourg Cedex, France.

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3rd WORLD TELECOMMUNICATION FORUM

The Forum (sponsored by the International Telecommunication Union) will be held in Geneva, Switzerland during the period 23-26 September 1979. The theme will be "The integration of the world's communications network - Technologies of the eighties".

In addition to 15 plenary and parallel sessions, with 150 invited and carefully selected papers, a special session will be devoted to the 50th anniversary of CCIR.

Original unpublished papers relevant to the theme are invited. Authors should send one-page abstracts (100-200 words) before 30 September 1978 to one of the addresses given below. If an abstract is accepted by the Review Board, the author will be expected to submit the full text (not exceeding 6,000 words) before 15 January 1979 for reproduction in the Forum Proceedings. Papers should be submitted preferably in English, French or Spanish, and the oral presentation should be planned not to exceed 20 minutes.

Abstracts and papers should be sent to

Professor Dr. F.L. Stumpers
Chairman, Technical Programme Committee
World Telecommunication Forum
N.V. Philips' Gloeilampenfabrieken
Research Laboratories
Eindhoven (Netherlands)

or to

Mr. W.G. Wolter
Chairman, Management Committee
World Telecommunication Forum
International Telecommunication Union
Place des Nations
CH-1211 Genève 20 (Switzerland).

In the USA and Canada, abstracts should be sent to

Mr.A.E. Joel, Jr.
Past President, IEEE Communications Society
Bell Telephone Laboratories
Room 2C-632
Holmdel N.J. 07733 (United States).

Further information is available from

International Telecommunication Union (ITU)
Place des Nations
CH - 1211 Geneva 20 (Switzerland).

ANTENNAS AND PROPAGATION

An International Conference on Antennas and Propagation will be held at the Institution of Electrical Engineers in London from 28-30 November 1978. The aim of the Conference is to promote interaction between those who are active in the fields of antenna theory and design, and electromagnetic wave propagation. It is intended to cover the entire radio spectrum used for telecommunication, navigational and radioastronomical purposes.

The working language will be English and there will be no simultaneous interpretation. The programme and registration forms will be published in June 1978. Copies will be sent on request on application to

IEE Conference Department
Savoy Place
London WC2R OBL
United Kingdom.

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URSI MEMBER COMMITTEES AND COMMISSIONS

URSI Inf. Bull. No 204 (December 1977) included the names and addresses of the Presidents, Secretaries and Official Members of URSI Committees according to information received up to 15 November 1977. The names and addresses given below represent later additions or modifications to this earlier list.

A full list will be published in Bulletin No 207 (December 1978) and any additions or modifications should be notified to the URSI Secretariat before 15 November 1978.

URSI Member Committees

NIGERIA:

President: Dr. I.E. Owolabi, President NAPRS, Department of Electronic and Electrical Engineering, University of Ife, Ile-Ife.

Secretary: Dr. G.O. Ajayi, Department of Electronic and Electrical Engineering, University of Ife, Ile-Ife.

NORWAY:

President: Dr. B. Landmark, Royal Norwegian Council for Scientific and Industrial Research, Space Activity Division, Wdm Thranesgt 98, Oslo 1.

Secretary: Mr. G. Skovli, Directorate of Civil Aviation, Storgatan 10 b, Oslo 1.

SOUTH AFRICA:

President: Dr. F.J. Hewitt, Deputy-President, CSIR, P.O. Box 395, Pretoria 0001.

Secretary: Dr. J.A. Brink, CSIR, P.O.Box 395, Pretoria 0001.

URSI Commissions

Commission A - Electromagnetic Metrology

Belgium: Prof. J. de Prins, avenue Stanley 7, 1980 Tervueren.

Norway: Prof. Dr. A. Tonning, University of Trondheim, Norwegian Institute of Technology, Gløshaugen, 7034 Trondheim.

South Africa: Mr. R. Turner, National Physical Research Laboratory, CSIR, P.O.Box 395, Pretoria 0001.

Commission B - Fields and Waves

Norway: Prof. Dr. T. Wessel-Berg, University of Trondheim, Norwegian Institute of Technology, Gløshaugen, 7034 Trondheim.

South Africa: Dr. J.A.G. Malherbe, Faculty of Engineering, University of Stellenbosch, Stellenbosch 7600.

Commission C - Signals and Systems

Australia: Prof. D.G. Lampard, School of Electrical Engineering, Monash University, Clayton, Vic. 3168.

Norway: Prof. Dr. T. Hagfors, University of Trondheim, Institute of Radio Technology, Gløshaugen, 7034 Trondheim.

South Africa: Prof. H.C. Viljoen, Faculty of Engineering, University of Stellenbosch, Stellenbosch 7600.

Commission D - Physical Electronics

Norway: Prof. Dr. A. Tonning, University of Trondheim, Norwegian Institute of Technology, Gløshaugen, 7034 Trondheim.

South Africa: Prof. L. van Biljon, Department of Electrical Engineering, University of Pretoria, Hillcrest, Pretoria 0083.

Commission E - Interference Environment

Norway: Mr. K.N. Stokke, TTR, Norwegian Telecommunication Administration, Universitetsgt. 2, Oslo 1.

South Africa: Mr. R.W. Vice, Director, National Institute for Telecommunications Research, P.O.Box 3718, Johannesburg 2000.

Commission F - Wave Phenomena in Non-ionized Media

Vice-Chairman: Prof. A.T. Waterman, Jr., Durand 203, Stanford, Calif. 94305, USA.

Australia: Mr. E. Sandbach, Telecom Research Laboratories, 59 Little Collins Street, Melbourne, Vic.3000.

Norway: Dr. D. Gjessing, NDRE, 2007 Kjeller.

South Africa: Mr.R.W. Vice, Director, National Institute for Telecommunications Research, P.O.Box 3718, Johannesburg 2000.

Commission G - Ionospheric Radio and Propagation

Australia: Prof. J.D. Whitehead, Department of Physics, University of Queensland, St. Lucia, Qld 4067.

Norway: Dr. E. Thrane, NDRE, 2007 Kjeller.

South Africa: Prof. J.A. Gledhill, Department of Physics, Rhodes University, P.O.Box 94, Grahamstown 6140.

Commission H - Waves in Plasmas

Norway: Dr. B. Maehlum, NDRE, 2007 Kjeller.

South Africa: Prof. A.D.M. Wolker, Department of Physics, University of Natal, King George V Avenue, Durban 4001.

Commission J - Radio Astronomy

Argentina: Dr. E. Bajaja, Instituto Argentino de Radioastronomia, Casilla de Correo No 5, 1894 Ville Elisa, Prov. de Buenos Aires.

Norway: Ass. Prof. Øystein Elgarøy, University of Oslo, Astrophysics Institute, Blindernvn, Oslo 3

South Africa: Dr. G.D. Nicolson, Head, Radio Astronomy Observatory, c/o National Institute for Telecommunication Research, P.O.Box 3718, Johannesburg 2000.

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EDWARD THOMAS PIERCE

1916-1978

It is with great regret that we announce the death of Dr. E.T. Pierce in San Francisco on 22 February 1978. Mr. George Hagn (Vice-Chairman, URSI Commission E) has kindly compiled the following appreciation which was received just before this issue of the Bulletin went to press.

Edward Thomas Pierce was born in Llandudno, Wales in May 1916. He earned the BSc in 1937 at the University of Wales, and served as an officer in the British Supply Ministry doing ballistics experiments from 1940-45. After World War II he completed his formal education at Cambridge University with a PhD in meteorological physics (1951). From 1950-57 he served as a teacher and Senior Assistant at the Cavendish Laboratory where he invented (among other things) a lightning-flash counter of a type still in use today. He joined the Vickers Group Research Establishment as a Senior Scientist for a year, and then emigrated to the USA where he held senior scientific posts with Avco Mfg. (1959-60) and Stanford Research Institute (1960-75). On leave of absence from SRI in 1975, Dr.Pierce helped found the US Office of Naval Research branch office in Tokyo. He left SRI in 1976 to join the Severe Storms Laboratory at Norman, Oklahoma but, in 1978, rejoined SRI International (formerly Stanford Research Institute) as a consultant.

Dr. Pierce was active in several URSI Commissions, and represented IUGG in the Inter-Union Commission on

Radio Meteorology from 1968-1973. He attended numerous URSI General Assemblies prior to that in Lima (1975), which he missed owing to his work in Japan. He was a Fellow of the Royal Meteorological Society, and a member of the American Geophysical Union, the American Meteorological Society, and the Society of Terrestrial Magnetism and Electricity of Japan. Dr. Pierce was elected Honorary President of the International Commission on Atmospheric Electricity in 1975 and he helped organize the Thunderstorm Research International Program.

Dr. Pierce was a recognised authority on atmospheric electricity, but all of us who had the pleasure of knowing him personally and working with him will miss the sense of joy and humor he brought to doing sound, useful science. Others who knew him only through his publications will miss the clear, lucid style through which he shared his findings. In addition to his personal contributions, he had a true talent for the review of an entire field and for the winnowing out of the major significant items and their relationships. Indeed, who else among us could have so easily identified the scientific linkage between such disparate (even apparently frivolous) topics as waterfalls, American bathrooms, and super-tanker explosions. In many ways he was ahead of his time. It is our loss that his numerous articles on astrophysics, gas discharge phenomena, nuclear explosions, meteorology, wave propagation, lightning, and radio noise were not pulled together in the book he had contemplated.

Dr. Pierce was proud of his Welsh background and spoke and wrote the language fluently. It was his custom, at the end of the working day, to enter the significant events in a journal, in Welsh. He loved the company of his friends and was always ready to prowl the bright lights with them after scientific meetings. He was a talented pianist and any time a vacant piano was available, he entertained his company with pleasant cafe piano numbers.

Dr. Pierce is survived by his wife, Hiroko, of Watsonville, California and a cousin in Wales. He is missed by us all.