

U.R.S.I.

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**IN MEMORIAM**

**RICHARD H.T. BATES**

**1929 - 1990**

The University of Canterbury community in New Zealand, and engineering scientists throughout the world, have been deeply saddened by the death, on Sunday 4 November, of Professor Richard Heaton Tunstall Bates, D.Sc. (Eng.)(London), F.I.E.E., F.I.E.E.E., F.I.P.E.N.Z., F.A.C.P.S.E.M., F.R.S.N.Z., F. Eng.

Richard Bates was born in Sheffield, England, on July 8 1929. He attended University College (UC) London which awarded him the B.Sc. degree in Engineering in 1952. In 1972 the University of London, of which UC is a constituent college, awarded him a higher doctorate D.Sc. (Engineering).

Professor Bates worked as a research, development, and systems engineer in England, Canada and the USA. From 1952 until 1957 he was based at the Weybridge aircraft factory of Vickers-Armstrongs and in the antenna design section of Decca Radar. He married Philippa Harding on July 10, 1954. Their first two children, Jason and Emma were born before they moved to Canada, where Richard worked from 1957 until 1959 in the Air Armament Department of Canadian Westinghouse, and where their third child Philip was born. The family then moved to Massachusetts, USA, where Richard worked from 1960 until 1966 at National Co., Mitre Corporation and the Sperry Rand Research Centre, and where their fourth child, Giles, was born. In 1967 he joined the Engineering School of the University of Canterbury in Christchurch, New Zealand, where he was appointed to a Personal Chair in Electrical and Electronic Engineering in 1975.

Professor Bates' wide-ranging and ingenious contributions to engineering research made him the most highly-acclaimed engineering scientist in the Southern Hemisphere, and have substantially contributed to the now well-

secured standing of Electrical Engineering research and education in New Zealand.

In 1956, Professor Bates published the first set of computed curves for the characteristic impedance of a transmission line expressed exactly in terms of higher functions of analysis. He proposed with experimental evidence, in 1965, the "surface wave" explanation for the large dips which can occur in gain versus scan angle patterns of phased arrays. From 1967 he developed, on the basis of P.C. Waterman's extended boundary condition, the null-field method for computing diffraction by totally reflecting objects. Together with his student T.M. Peters he proposed in 1971 one of the earliest clinical applications for X-ray computer-assisted tomography. Together with his students P.T. Gough and F.M. Cady, respectively, he invented, in 1972 and 1980, the optical astronomical speckle imaging techniques called speckle holography and shift-and-add. Together with his student R.G. Lane he initiated in 1988 the recent successful demonstrations of blind deconvolution of an individual blurred image. Very recently, together with J.M. Rodenburg of the Cavendish Laboratory, he devised computer processing for realising the inherent resolution of the scanning transmission electron microscope, which may avoid the difficulties inherent in Gabor holography.

Among the many prestigious honours and awards received by Professor Bates during his career were Fellowships of no less than six learned societies. He was a Fellow of the Institution of Professional Engineers of New Zealand, the IEE, the Optical Society of America, and the IEEE. He was a Fellow and Past-President (1981-3) of the Australasian College of Physical Scientists in Medicine. He was elected, in 1976 and 1986 respectively, to the national academies of Science of New Zealand (FRSNZ) and Engineering of Great Britain (F.Eng). In 1980 he received both the E.R. Cooper Memorial Award for Physics and Engineering, awarded by the Royal Society of New Zealand, and the Michaelis Memorial Prize for Astronomy and Astrophysics, awarded by the University of Otago. In 1987 he won (together with former student Dr. A.D.

Seagar) the coveted Snell Premium prize of the Institution of Electrical Engineers. His most recent honour, received this year, was his election to membership of the MIT-based Electromagnetics Academy.

A prolific writer and charismatic communicator, Professor Bates disseminated the results of his work widely. He participated regularly (often as an invited speaker) at international conferences, and published over 300 papers in learned journals, as well as authoring a landmark book on Image Restoration and Reconstruction.

A network of expertise in Information Technology has been established in New Zealand, with strong international ties, in the form of more than 50 PhD graduates for whom Professor Bates acted not merely as supervisor, but more descriptively as mentor. These former students, who have met with an astonishing degree of success both in New Zealand and overseas, maintain regular contact through a newsletter co-ordinated by Professor Bates' wife Philippa.

Professor Bates enjoyed success at the highest levels in scholarship and research, and earned the respect and devotion of countless students. He enjoyed literature and poetry, classical music and the theatre, as both listener and, as he would have said, perpetrator. Leisure hours were spent trout fishing, jogging, tramping or enjoying rugby and cricket. Add to this a deeply-valued family of Philippa, four children, and four grandchildren, and it is of consolation that although only 61 years long, a life more full and satisfying is difficult to imagine.

Excellence, an emphasis on obligations rather than rights, and the importance of leadership (as opposed to management) were central to the philosophy of Professor Bates. His life, his achievements, the entire generation of students and colleagues whose lives have been enriched by him, and the demonstration he leaves to all New Zealanders that international acclaim is not the prerogative of dwellers in the Northern Hemisphere, are all testimony to his adherence to these guiding principles. That others, especially those in positions

of power and influence, adopt this philosophy as their own would be fitting tribute to Professor Bates.

There can be no doubt that the legend that Professor Bates has become will survive on for generations of engineers to come, and that those of his colleagues who have had the honour and privilege to be associated with him will miss him profoundly, but remember him with joy.

K. GORDON

*Professor J. Bach Andersen, Vice-President of URSI, knew Professor Bates well :*

"If you came across Richard Bates you were not likely to forget it. I came across Richard about 20 years ago when he visited Electromagnetics Institute at the Technical University of Denmark at Lyngby and I have not forgotten. He was a witty and charming person, very fond of using the English language to its extreme, which could create problems for poorly speaking Danes ; afterwards helped with a laugh. I think this was typical of Richard's attitude to his fellow scientists and students, demanding, but always helping. It must have been a good school in Christchurch, New Zealand, for today many of his former students are spread around the world continuing what Richard started.

From an URSI point of view Richard was active in the fields of many commissions. I came across his work in Commission B, where he had made contributions on fat antennas using the null field method, scattering around a dielectric wedge, and general electromagnetic reconstruction methods, especially Applied Potential Tomography. In later years he extended his work into other Commissions, especially signal processing as applied to speech, and to astronomical imaging, where he was involved deeply in phase reconstructions from amplitude measurements, a topic also applied to antennas.

For a period Richard Bates represented his country, New Zealand, in URSI and served also on the Finance Committee.

It is very sad for the scientific community to loose such an eminent scientist at the peak of his powers. When the sorrow subsides, we shall remember the joy and the fun, which was also part of Richard Bates."

## THE NEW LOCATION OF THE SECRETARIAT

*The Secretariat has recently moved to the University of Ghent. The sequence of events which led to this move is discussed in the present short note.*

To begin with, a bit of history. Most of us know that the Secretariat has been located in Belgium since the birth of URSI, in 1919. The successive Secretaries General, up to 1978, have been R. Goldschmidt, M. Philippson, A. Dorsimont, E. Herbays and C.M. Minnis. In the mid-seventies, the tight financial situation of our Union made it imperative to transform the function of Secretary General into an honorary one. To facilitate the transition to this new structure a search for a Belgian candidate was instituted. It was successful. Professor Hontoy, of the University of Brussels, accepted the responsibility, and was elected Secretary General at the Helsinki General Assembly in 1978. Professor Hontoy had to combine his new function with a full load at the University, but his task was alleviated by the proximity of his laboratory to the Secretariat, which allowed frequent visits to the latter. Furthermore, it had been decided that many of the traditional duties of the Secretary General would be taken over by the Board. Things did not work out that way, however. A few months after Helsinki, Professor Hontoy was taken gravely ill, and in June 1979 decided that he could not discharge his duties properly, and that he should resign. The Board, looking for a possible Belgian successor, asked me to take over, on an emergency basis. After some hesitation, old-fashioned "patriotic" feelings led me to accept, but for a limited time (in my mind at least). The situation was, indeed, particularly difficult because of the separation between Ghent and Brussels. Although modest by international standards, it made sufficiently frequent visits to the Secretariat quite difficult, if not impossible. As a result, the Secretary General could not follow problems on a daily basis, and react with the necessary speed. The administration survived, however, partly because of the generous efforts of Dr. Minnis, who gave extended assistance with the finances of the Union, but mostly because of the selfless devotion to duty of Mrs. Stevanovitch. Our well-known Executive Secretary has been with



URSI from February 1, 1958 until her retirement at the end of last year. During this long period of service she has been a "living archive" for Board and Secretariat, and a source of constant and valuable advice. Her services to URSI have been invaluable.

Notwithstanding this devoted support, I started looking for a new Secretary General as soon as 1982. The Board was kept fully informed about this search, and unanimously supported these efforts, as well as subsequent ones. The problem turned out to be a difficult one, and it is only in 1987, at the Tel Aviv General Assembly, that the problem of my succession, and the need to find a new location for the Secretariat, were made public. The reasons for the switch, scheduled to take place in 1990, were simple. Both Mrs. Stevanovitch and I were approaching retirement age. Furthermore, the physical location of the Secretariat had become a problem. From 1980 to 1987 we were hosted by the Technical Services of the European Broadcasting Union. In 1987 these moved to Geneva. From 1987 to 1990, Professor Melchior, Director of the Royal Observatory of Belgium, very generously allowed us to establish our offices in the house of the Director, which he did not occupy at the time. This solution was temporary, because Professor Melchior was due to retire in 1990, and also because the building needed a serious overhaul, which would put it out of commission in 1990. Everything therefore pointed to a completely new start for the Secretariat in 1990, in a yet to be determined country. Before the end of the Tel Aviv General Assembly, however, various delegations approached me to express their interest in a "Belgian" solution, which would perpetuate a tradition, and make for an easier transition. To cut a long story short, a new search was initiated, and Professor Lagasse, who had just become Director of the Laboratory of Electromagnetism and Acoustics of the University of Ghent, was approached, and accepted to be considered. Professor Lagasse is an authority in the field of Optoelectronics, an area in which URSI feels a strong effort should be made. His Laboratory, the new home of the Secretariat, is a large unit, with a personnel of about 65, including some 12 Ph.D's and 25 graduate students. It is a beehive of activity. Managing such a large group is a heavy load, and Professor Lagasse

could not run the Secretariat without the support of a smoothly-running administrative unit. He therefore preferred not to be a candidate in 1990, given the heavy challenge of both the move of the Secretariat to a new venue, and the impending retirements of both the Executive Secretary and the Secretary General. Given this situation, I offered to serve for another year or two, in order to help with the transition. Such a partial mandate, however, was not looked upon favourably by a few Member Committees, since it is not normal policy. As a result I was elected for a full mandate, covering the triennium 1990-3. My main responsibility is to create a suitable administrative frame allowing Professor Lagasse to take over in 1993 with a minimum of effort. We have kept our excellent accountant and auditor, and have enlisted the help of an administrative secretary, Miss Heleu, who has a teaching degree in Germanic languages, and good expertise in informatics. Our furniture and archives were moved from Brussels to Ghent on January 24, and are now housed in two comfortable offices and a storage room, all part of the Laboratory of Electromagnetism. Professor Lagasse has put the extensive facilities of his unit at our disposal, including fax, word processor and additional secretarial help, if needed. Even when Miss Heleu and I are absent, the Secretariat can be accessed through the Laboratory's secretarial office, unless the University is closed. This happens in the two weeks including Christmas and New Year, the two days preceding Ash Wednesday, and the week of July 21.

While these administrative transition takes shape, Professor Lagasse, who has been appointed Assistant Secretary General by the Board, intends to devote most of his energies to the Committee on Long Range Planning, chaired by President Jull. The Committee's brief is to explore every facet of URSI's activities, in the spirit of the Corsendonck meeting of 1987, and to make suitable recommendations for improvement of our operations at the 1993 General Assembly.

February 1991  
J. VAN BLADEL

## NEWS FROM MEMBER COMMITTEES

### Egypt

The Member Committee is the Academy of Scientific Research and Technology, 101, Kasr Al-Ainy St., Cairo. The Secretary, Professor Ibrahim Salem, lets us know that the Committee organizes a yearly Conference, and that the next one, the Ninth, will be held on February 18-20, 1992.

## NEWS FROM THE COMMISSIONS

### Commission B

*Professor Gardiol, Chairman of Commission B, has started a Newsletter, which he hopes to publish two or three times a year. The first one came out in January 1991. Its main contents :*

- Terms of reference and specific interests of Commission B
- Report of Business meetings at the Prague General Assembly
- Names and addresses of the official members of Commission B in the various Member Committees of URSI
- Presentation of the Laboratory of Electromagnetism and Acoustics of the Ecole Polytechnique Fédérale de Lausanne.

Professor Gardiol welcomes news items suitable for future issues. Copies of the Newsletter can be obtained directly from him, at the address :

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Commission K

Fourteen Member Committees have nominated their official members of the new Commission on "Electromagnetics in Biology and Medicine".

Argentina : Professor V. H. PADULA-PINTOS  
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National Radiological Protection Board  
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**REPORTS ON SCIENTIFIC SESSIONS OF COMMISSIONS AT THE  
PRAGUE GENERAL ASSEMBLY**

*It was decided in Prague that the Reports would not be incorporated in the Proceedings of the General Assembly, but would be printed in the URSI Bulletin. Professor Matthews, Chairman of Commission C, submitted the following text for his Commission.*

"Commission C sponsored eleven scientific sessions. Other sessions were jointly sponsored. The Commission session papers were, with a few exceptions, by invitation. The majority of invited speakers were able to attend to present their papers. The sessions were well attended, with interest in the Commission sessions being much greater than at previous Assemblies. This may reflect the increase in emphasis on systems aspects of telecommunications. It also reflects the work of session Convenors to enrol good speakers.

A fascinating tutorial lecture was given by Chua on "Nonlinear Networks and Chaos". This presented the topic with vivid video illustrations which captured the attention of the large audience.

The following reports are based on the summaries provided by the session convenors.

C1. Digital Communication Systems and Technology (28 Aug 1990)

Convener: C.F. Kurth, USA.

This session consisted of four review papers on recent research and development for communication systems. Messerschmidt started by describing some techniques for extending the transmission rate on subscribers loops from 144 kb/s, ISDN speed, to a potential rate of 1,544 Mb/s. This may require some



compromises such as half-duplex transmission, limits on the range and bridged top's. The extension also requires extensive use of digital signal processing, coding techniques and new modulation methods. Adaptive digital equalizers, trellis coding and more sophisticated signal constellations for QAM signals are the key to extending the signal rate without major increases in bandwidth. The use of a multicarrier modulation technique was also mentioned. This would partition the band into many sub-channels, to each of which these methods could be applied. With a much smaller bandwidth per channel, less sophisticated equalisers are required. Steele reported on research work for high capacity portable communication systems. The idea of picocellular and micro-cellular radio systems for urban and rural areas, and satellite communications for sparsely populated areas, were persuasively presented. The user has an inexpensive unit for interfacing into a network of radio systems. These are connected by optical LAN's to the ISDN. Usually the mobile radio bands will use frequencies below 5 GHz. Higher bands up to 12 GHz may have to be utilized. The network when densely populated by picocellular radio systems, requires relatively low power transmitters unlike the high power stations now used for mobile radio systems. The low power transmitters lend themselves to inexpensive technologies. With highly integrated receivers using digital signal processing, fading, dispersion and noise can be combated successfully. The networks will provide a wide range of services, such as speech, high fidelity audio, teleconferencing, facsimile and data, all in packet formats. As the network also must be able to track the user who roams, massive book keeping problems result.

A review of recent development which are the result of an extensive deployment of digital technologies over the last two decades was presented by Maruta. As the initial 1,544 Mb/s T1 carrier systems, using shielded pair cables, have changed to Gb/s rate systems on optical fibres so extensive changes have occurred in the system capacity and quality, and also in media and application topologies. End-to-end digital transmission is now used. Digital signals generated at a user terminal can reach any far-end terminal without going through

analogue transmission facilities. With such end-to-end digital transmission capability, network providers can offer various new services to the user. The key for this is the deployment of digital cross-connect systems, DCS. These replace back-to-back multiplexers and reduce the need for intermediate distribution frames and labour-intensive jumpers between frames. Remotely configured DCSs can provide an economical way to add, drop and connect selected signals. They provide faster network rearrangement units and quick healing of defective network routes by automatic control of the network. They provide the right bit, at the right time, at the right location, with the highest reliability. The development is primarily conducted by industry. Economic VLSI integration is necessary and international standardisation requires a sustained effort by all parties involved.

Recent developments in the area of digital radio systems were presented by Nossek. While bandwidth comes at a premium, developments must aim at high bandwidth efficiency with compatibility with the existing infrastructure. The conceptual design of a new generation of high capacity digital radio systems must be based on flexible multilevel QAM radio modems. High performance and cost effectiveness must be achieved through extensive use of VLSI digital signal processing. Fully digital implementation of key functions such as adaptive time domain equalization, adaptive cross polarization, interference cancellation, pulse and spectrum shaping, linearization of high power amplifiers, and forward error correction incorporating "soft channel information" is very important. The first three signal processing functions can be realised with "Application Silicon Circuit" technology. The next two functions are directly related to the modulation format but knowledge of the distortion and error mechanisms enables economic monolithic solutions.

## C2. Mobile Radio Communication Systems (29 August 1990)

Convener: P.A. Matthews, UK.

The session on Mobile Radio Communication was opened by Matthews who gave an overview of developments in mobile and personal communications. Mobile and personal communication systems operate at frequencies from HF upwards, and provide a variety of services although current developments are concentrated on cellular and personal communication systems. Developments in mobile satellite communications were outlined by Bultitude who concentrated on Canadian systems. Digital mobile radio systems can be of very variable quality and Cook described a method of estimating bit-error rates that could be used to optimise the performance of working links. Mobile radio systems suffer from the effects of multipath propagation. Ikegami described measurements of multipath propagation and bit error rates in urban areas and the relation between them. A directive antenna system was used to identify the signals reflected or scattered by different obstacles. Because of the delays introduced by multipath propagation it may be necessary to use equalisation in digital transmission systems. The adaptive equalisation techniques proposed for the pan-European cellular system were discussed by Lopes. The control of transmission in mobile radio networks is a complex problem because of the time varying topology of the network. Chlamtac described an adaptive algorithm for optimising transmission in such networks. This method deals with the nodes neighbouring the topological changes to minimise the time taken to adapt the network.

### C3. Information Theory and Coding (30 August 1990)

Conveners: I. Csiszar, L. Gyorfı, Hungary.

Recent results and new directions in mathematical information theory used for or with potential applicability to various communication problems were discussed in this session.

An interesting new direction in information theory is the study of the performance of communication channels when the goal is the identification, not

the transmission, of messages. It was reported that this more limited goal leads to a striking increase in capacity. All classical "transmission" problems have an "identification" counterpart. Their mathematical theory is in certain respects easier than the classical. A key issue is to generate the maximum amount of common randomness available to both sender and receiver.

An important problem in source coding is how to deal with events not carrying relevant information, for example gross errors or system failures. It was shown that methods of robust statistics can effectively handle this problem. Paying a small penalty in performance when such events are not present, it is possible to attain good or acceptable system performance when the classical methods would lead to complete breakdown.

In various communication systems, such as satellite communications, the Ungerbroch "set partitioning" method of convolutional coding has been very effective. However this method is non-linear. Linear codes with similar or better performance would be very desirable. A new mathematical theory leading to such linear codes was outlined. It was shown by several examples that the resulting codes can outperform previous codes.

Finally, a model of communication in the presence of unpredictable disturbances, perhaps caused by an adversary, has been considered. Such a channel is known as the arbitrarily ranging channel. Recent progress in the mathematical theory of such channels was reviewed. It was shown to apply also to the apparently unrelated subject of computer memories with some defective memory cells.

#### C4. Speech Coding (31 August 1990)

Convener: D. Wolf, FRG.

Speech coding plays an important role in digital communication systems, for example in digital mobile radio. In this session an overview of the

present speech encoding schemes for medium and low bit-rates ranging from 4.8 Kb/s to 16 Kb/s was given. Current interest is focused on CELP-schemes that are based on linear prediction, vector quantification and the principle of analysis by synthesis. The most promising idea uses stochastic excitation sequences in the synthesis process. Reininger demonstrated by tape recordings the high quality of low-bit-rate speech achieved with bit-rates as low as 4.8 Kb/s. In parallel to the development of the algorithms and appropriate hardware implementation, CCITT standards for 16 kb/s and 8 kb/s speech are in preparation. Cox reported on the standardisation procedure for a low delay 16 kb/s coder. Braun described the proposals for, and the specifications of, the forthcoming "half-bit-rate" GSM pan-Europe codec operating on bit-rates between 6.5 and 8 kb/s. Fessler presented the layout of a universal device for processing both GSM speech and wideband speech (50 Hz - 7 kHz). A single chip solution was announced for the next year (1991).

The papers of Waibel, Vich, and Hoge provided insight into particular fields of speech coding research. Improvements can be expected by considering physiological and psychoacoustic aspects of the problems. Significant progress could also be made using ideas based on the articulation process. In this field more efforts should be made in understanding the relationship between articulation and phonetic features. Also the results obtained in speech recognition could fruitfully stimulate new approaches in speech coding.

#### C5. Digital Signal Processing (31 August 1990)

Convener: H. Babic, Yugoslavia.

The session on digital signal processing had papers covering the main topics in the field. Two covered interesting aspects of digital filter design that were not well supported by existing literature. They pointed out the possibilities and applications of all-pass lattice structures and the design of systems with a prescribed phase response.

Two papers covered numerical procedures based on sampling and discretisation of continuous systems. A new transform that enables an exact relation between discrete and continuous systems was proposed. The use of multi-dimensional digital wave filters as a way for the integration of Maxwell's equations was also proposed.

Both papers opened new vistas and provided lively discussions. The main issue was the stability of the numerical procedure. The authors' defence was based on the passivity of the digital wave filter structure.

There was an interesting paper on image processing when the noise has an impulsive character. Another discussed the errors in processing the errors caused by quantisation in floating point digital realisations, important for short word lengths.

#### C6. Spread Spectrum Techniques (3 September 1990)

Convener: A. Baier, FRG.

This session included eight invited papers. The high quality of the presentations and the expertise of the audience shown in the discussions made this session a success. The topics covered ranged over spread spectrum techniques for system identification, measurement of multipath radio propagation, frequency hopping and multiple access spread spectrum systems, and digital signal processing in spread spectrum systems.

The contributions clearly revealed that frequency hopping with channel coding represents the most promising technique for future commercial multi-user communication systems. Applications are primarily seen in the field of mobile radio communications and in systems utilizing the power mains network as transmission medium. In particular, the introduction of trellis-coded modulation and other advanced channel and waveform coding schemes is expected to offer

the potential for making spread spectrum communication systems more bandwidth efficient and economic. This is a basic prerequisite for commercial applications. It is felt that major research effort should be directed to this field. Combined channel and waveform coding could also be a preferred topic of future URSI symposia on spread spectrum techniques.

### C7. Neural Networks : Analysis, Synthesis and Implementation (3 September 1990)

Convener: A.N. Michel, Yih-Fang Huang, USA.

The session contained seven papers. In the first Vittoz explored the potential of CMOS VLSI analogue circuits for the implementation of neural systems. In particular he showed that several possible modes of operation of the transistor can be exploited to build efficient cells, neurons, on a small area with low power consumption. This makes possible the implementation of very large networks capable of carrying out real time signal processing. Appropriate architectures to alleviate the connectivity problem were also addressed. The paper included examples of working chips, including a silicon retina, and a motion detector.

Much of the present interest in artificial neural networks was stimulated by the observation that these structures were able to solve combinatorial optimization problems such as the travelling salesperson problem. This type of application leads to networks with symmetric feedback coefficients. Perhaps the most widely used network in these types of applications is the Hopfield neural network. In the analysis and design of such networks, for example the outer product method, a quadratic energy function is used to show that equilibrium states correspond to local minima. Vandewalle and Vandenberghe considered neural networks with nonsymmetric feedback connections. Networks of this type can be used in the solution of more general mathematical programming problems known as variational inequalities. The paper addresses the dynamics, the stability of an equilibrium state, of such networks.

Hasler addressed several different types of artificial neural networks and their implementation. He identified two principal areas of applications for such networks. These were the classifier and the optimizer circuits. The main tool for explaining the dynamics of these applications is the Lyapunov function approach. For networks with symmetric connections, such a Lyapunov function, which turns out to be the content function of the network, can always be found. It can be used in the synthesis of optimization networks. The paper included different types of circuits for a variety of optimization problems.

Kam, Fishchl and Chow, presented a linear programming technique to design Hopfield bipolar asynchronous neural networks. The authors applied a merit method to two architectures. These were a fully interconnected network which classifies an N-digit pattern into a category represented by an N-digit pattern, and a two-layer network that classifies an M-digit input into an l-digit output category.

Sandberg presented a structure theorem according to which finite sums of the form

$$\sum_1 \kappa_1 \sigma \left[ \sum_m \eta_{1m} Q_m (\cdot) + \rho_1 \right]$$

are dense in an important sense in certain sets of input-output maps  $G(\cdot)$ . These take a subset  $U$  of  $X$  into  $X$ , where  $X$  is a set of real-valued functions of several variables. Here the  $Q_m$  are linear,  $\sigma$  is any element of a certain family of maps of  $R$  into  $R_f$ , and the  $K_1$ ,  $\rho_1$ , and  $\eta_{1m}$  are real constants. The author provided motivation for studying this problem and the showed in particular that this result is applicable is the analysis of neural networks.

Michel provided a comparative analysis of four different design techniques for artificial neural networks for associative memories, including the outer product method, the projection learning rule, the eigenstructure method,



and a technique that is applicable to networks with nonsymmetric interconnecting structure. The paper pointed to inherent advantages and disadvantages of these methods and identified areas where these methods have been applied.

Gygi, Matthews and Moschytz showed that a multi-layer perceptron consisting of cascaded arrays of linearly combined fixed non-linearities, can approximate arbitrary nonlinear vector functions. Equivalently, it can approximate arbitrary complex closed decision regions in a feature space. Network training with deterministic as well as stochastic data by the back propagation algorithm was described. Applications of the results to electromyogram pattern recognition and nonlinear system identification were compared with classical methods.

#### C10. VLSI - CAD (29 August 1990)

Convener: E.S. Kuh, USA.

The Session on VLSI-CAD consisted of seven invited papers that covered most relevant areas of current research in computer aided design of very large scale integrated circuits. Topics included floorplanning, layout optimization, circuit and fault simulation, analog circuits, computational geometry and applications of artificial intelligence to VLSI design.

Algorithm development is crucial to the design of ICs. Thus computer science has played a major role in VLSI-CAD. Artificial intelligence and computational geometry are two such examples. Examples were given in the two papers presented in the session to show the usefulness of AI approach to logic synthesis and routing and to indicate the power of computational geometry to some layout problems.

As IC chips become smaller in device and feature size and larger in chip dimension, interconnect will constitute a much larger percentage of the chip area. Thus it is crucial to optimize timing performance in layout design. Unfortunately,

layout design is net-oriented while timing is path-oriented. In the paper presented on timing driven layout, the problem was formulated in terms of mathematical programming with net bounding box constraints and critical path delay constraints based on a graph representation. The model used for interconnect was the lumped capacitance model with the half-perimeter bounding box wire length. The results are useful for small-cell ASIC designs such as standard-cell and sea-of-gates.

The circuit simulation problem for GaAs digital circuits is difficult because it must include dissipative transmission lines with lumped elements. This implies that the usual circuit simulation techniques in the time domain need to incorporate the frequency domain characteristics of transmission lines. By using waveform relaxation with clever partitioning of circuits into sub-circuits, it is possible to develop a fast algorithm to find the solution. The same technique can be extended to the analysis of MCM (multi-chip modular), a vital area that needs to be solved in VLSI system design.

While digital ICs have advanced tremendously during the past decade, analogue ICs seem to lag behind. However, in one area, the switched capacitor network, major progress has been made in both analysis and synthesis. These techniques need to be generalized to more general analogue circuits, such as those with frequency dependent gains and switches that must include inductance for high frequency applications. A theory has been developed and a programme implemented that can provide frequency response and sensitivity, coupled with an optimizer for design purpose.

#### C11. Simulation (4 September 1990)

Convener: J. Vlach, Canada.

The session on simulation covered various modern aspects with emphasis given to special applications. It started with analogue, digital and

device modelling, going on to mixed mode simulation and ending with problems related to transmission lines and optical techniques. Since the most difficult practical problem is the insufficient speed of simulation, various attempts are made to make it faster, especially by using several processors. Each specialized presentation introduced an overview of techniques."

## ANNUAL REPORT OF IUWDS

URSI supports two of the services grouped into the Federation of Astronomical and Geophysical Services (FAGS), namely :

- the Sunspot Index Data Centre
- the International Ursigram and World Days Service.

*Dr. R. Thompson, Chairman of IUWDS, sends the following report on the 1990 activities of his Service.*

### 1. Introduction

The International Ursigram and World Days Service (IUWDS), a joint service of URSI, IAU and IUGG and a permanent service of the Federation of Astronomical and Geophysical Data Services (FAGS), provides information rapidly to the world scientific community to assist in the planning, coordination and conduct of scientific work in disciplines affected by the sun-earth environment.

Two basic mechanisms have been selected to accomplish this programme. Firstly, IUWDS prepares the **International Geophysical Calendar** each year. This calendar gives a list of "World Days" which scientists are encouraged to use for carrying out their experiments. Secondly, there is the **International Ursigram Service** for assisting those who need a specific state of solar activity, earth atmosphere or magnetosphere at the time of their experiment. Both programmes are designed to be very flexible and can be easily adjusted to fit the needs of the scientific community.

In addition, on behalf of COSPAR, each month IUWDS summarises the status of satellite orbits around the earth and of space probes in the interplanetary medium in the **Spacewarn Bulletin**. Future launches are announced, actual launches are reported, new satellites receive an international

designation, decays in the earth atmosphere are predicted and announced, and finally series of satellites useful for international participation are listed. This bulletin is produced by the World Data Center-A for Rockets and Satellites.

The present solar cycle has proved to be a very active one, both in terms of sunspot number and also in the number of severe disturbances to the sun-earth environment. The active solar cycle combined with the increasing sensitivity of modern technology to events in the sun-earth environment has emphasised the relevance and importance of the services co-ordinated by IUWDS.

## 2. The International Ursigram Service

The International Ursigram Service operates through a number of Regional Warning Centres (RWC) and Associate Regional Warning Centres (ARWC) scattered all around the world. Warning Centres are located in : Boulder (USA), Darmstadt (Germany), Moscow (USSR), Paris (France), New Delhi (India), Ottawa (Canada), Prague (Czechoslovakia), Tokyo (Japan), Sydney (Australia) and Warsaw (Poland). At its meeting held in July, 1990, IUWDS approved an application for China to join the IUWDS organisation. The Chinese application was based around a group of scientific institutes located throughout China.

In its own geographic area, each RWC collects all the data and reports available concerning the state of the sun-earth environment. In some cases, these come from observatories operated directly by the Regional Warning Centre. In many cases, they are gathered from regional scientific institutes and universities.

The data accessible by IUWDS are very diverse and highly regarded by the scientific community. The types of data include :

- spectroheliograms and filtergrams
- observations of magnetic field structures on the sun
- optical observations of sunspot regions

- observations of solar coronal holes by radio and infra-red techniques
- quiet sun emission from radio to X-ray wavelengths
- reports of flares observed by a wide variety of methods
- solar radio observations, both at fixed frequencies and frequency scans
- solar X-ray data
- the flux of solar particles recorded by satellites, by riometers in the polar cap and by neutron monitors
- geomagnetic activity as measured by 3-hourly K indicates and by reports of sudden storm commencements
- ionospheric data giving critical frequencies of the F and E layers
- cosmic ray data and reports of Forbush decreases.

These data and reports (about 150 data sets from around 100 Institutes or Observatories) are coded according to the IUWDS code book and distributed daily, on request to users and to other RWCs. Data exchange is generally via a daily, or more frequent, telex message. In the last few years, new modes of communication have become possible. Some of these, such as electronic mail, facsimile transmission and the electronic transfer of images are being incorporated into the IUWDS data exchange programme.

Information transmitted through the IUWDS network is analysed by Regional Warning Centres which produce a number of "summary" reports and forecasts. The "Geoalert", a forecast of solar-geophysical conditions for the next few days, is a particularly important one of these reports. Each RWC prepares its own forecast ("Geoalert") and sends it to the World Warning Agency (WWA) in Boulder each day. The WWA then issues a Geoalert which is distributed world-wide each day at 0300 UT through the IUWDS network and through the WMO (World Meteorological Organization) network. Many RWCs also relay the WWA Geoalert to users within their own region.

The IUWDS network is also used for the prompt distribution of the preliminary values of the International Sunspot Number which is prepared monthly at the Royal Observatory of Belgium. In addition, IUWDS relays the geomagnetic "aa" indices which are computed each week at Meudon from two antipodal stations. IUWDS contributes to the production of these indices by supplying the Royal Observatory of Belgium and the "Institut de Physique du Globe" (Paris, France) with some of the raw data reports.

### 3. Publications

The **International Geophysical Calendar** is distributed free of charge throughout the world. The present distribution is approximately 2,000 copies produced at a nominal cost.

The **Spacewarn Bulletin** is also distributed free of charge throughout the world. Approximately 600 copies are produced.

The **Geoalerts** and the abbreviated Calendar records are published monthly in "Solar and Geophysical Data" which is distributed to 2,000 users.

The daily Geoalerts and Ursigram messages, distributed daily by telex, are "real-time" information. These are obsolete after a few days and only a summary is printed as the "IUWDS Alert Periods" in the Solar-Geophysical Data Books published by World Data Center-A. However, the production and distribution of Ursigrams is a very important part of the current expenses of the RWCs. This expense is borne by the host institutions.

The **IUWDS Code Book** has been updated and reprinted in a loose leaf format. Further updates occur on a regular basis as new codes are introduced or existing ones are changed. The updates are supplied to RWCs and ARWCs for distribution as required.

#### 4. IUWDS Activities during 1990

##### 4.1. IUWDS Steering Committee Meeting

A meeting of the IUWDS Steering Committee was held on July 3 in conjunction with the COSPAR Congress at The Hague in the Netherlands. The meeting was attended by representatives of IUWDS Centres and other interesting parties. During the meeting, reports were presented from IUWDS Warning Centres outlining recent developments and their requirements for data exchange through the IUWDS network.

##### 4.2. Admission of China to IUWDS

Two representatives from China, Meiqing Gao and Li Qibin, attended the IUWDS meeting in the Netherlands and presented a proposal that China be admitted to membership of IUWDS. IUWDS has been keen that China should join the organisation to increase the availability of important solar-terrestrial data to the world-wide community. To ensure suitable representation from all interested parties within China, the Chinese have formed an IUWDS committee bringing together a wide range of institutes within China. Professor Li Qibin has been appointed the first chairman of this committee which brings together the following Chinese institutes : Beijing Astronomical Observatory, Yunan Observatory, Purple Mountain Observatory, Institute of Geophysics, Peking University, Centre of Space Science and Applied Research, China Institute of Radiowave Propagation, and Wuhan Physics Institute. Beijing Astronomical Observatory will be the communications centre responsible for receiving IUWDS data and delivering it to groups in China.

The Chinese proposal was warmly received and accepted by IUWDS. Discussions also took place on the mechanism of data exchange between centres. These contacts will be greatly expanded over the coming years.



#### 4.3. The Next IUWDS Solar-Terrestrial Predictions Workshop

IUWDS has sponsored a series of scientific workshops to bring together scientists, forecasters of the solar-terrestrial environment, and the users of those forecasts. Previous workshops in this series have been held in Boulder (1979), Meudon (1984) and Sydney (1989). The next workshop will be held during May 18-22, 1992 in Ottawa, Canada. This meeting is being arranged by the associate regional Warning Centre in Ottawa. A feature of this meeting will be a special session on the effects of the solar-terrestrial environment on technological systems, and the forecast requirements for those systems. Circulars are being sent to interested scientists and further details can be obtained from :

Dr. R.L. Coles  
Geophysics Division  
Geological Survey of Canada  
1 Observatory Crescent  
OTTAWA, ONTARIO, K1A 0Y3  
CANADA

#### 4.4. Proceedings of the Leura Solar-Terrestrial Predictions Workshop

The last Solar-Terrestrial Predictions Workshop was held in Leura, near Sydney, Australia in October 1989. Papers, both invited and contributed, have been collected into a volume - the Proceedings of the Workshop. Collection and collation of material has been completed by the Sydney Warning Centre. The publication of the volume is being undertaken by the Boulder Centre and copies are expected to be available by March 1991. As was the case with the volumes from earlier Workshops, these proceedings will prove to be of substantial benefit to the scientific community and will encourage interest and progress in the field.

#### 4.5. Publication of Prediction-Related Papers

The IUWDS Workshops have provided an important outlet for scientific papers on the subject. However, IUWDS is keen to encourage the publication of papers of a "predictions" nature in the wider scientific literature. To this end,

Pierre Lantos (of the IUWDS Meudon Centre) has negotiated with the journal "PAGEOPH, Pure and Applied Geophysics", to obtain better access for these types of papers. Upon the recommendation of the IUWDS Steering Committee, PAGEOPH have appointed Pierre Lantos (Meudon) and Gary Heckman (Boulder) to the editorial panel of the Journal. IUWDS will be circulating information about publication in the Journal to the scientific community early in 1991.

Discussion has also taken place on the possibility of sponsoring special sessions devoted to the subject of solar-terrestrial predictions to be held at major conferences such as at URSI, COSPAR, IAGA and IAU meetings. Arrangements for such sessions will be commenced during 1991.

#### 4.6. Data Exchange

The IUWDS Meeting at The Hague highlighted the changing nature of data exchange within the network. Once dominated by coded data and telex transfer, data exchange is now moving towards new technologies. Much important data are being obtained in image format and the exchange is occurring by facsimile, electronic mail networks or by direct dial-up between computers. Several centres have begun operating "bulletin boards" through which their data can be transferred more rapidly within the IUWDS network and to the users of the data. Many centres are also using computers to process and distribute data through telex systems. These trends are expected to accelerate over the next few years.

#### 4.7. User Interaction

Another trend highlighted during the year was the increasing interaction between IUWDS centres and the users of solar-terrestrial data. The "predictions" workshops sponsored by IUWDS have fulfilled this need on an international basis and this interaction will be an important theme at the Ottawa meeting in

1992. Individual centres have increasingly become more involved with data providers and users within their regions. This is resulting in a wider range of data being available and increasing its relevance to users.

5. IUWDS Steering Committee Membership

The present list of IUWDS Officers is as follows :

IUWDS Chairman	R. Thompson	RWC Sydney
IUWDS Secretary/ Secretary for Ursigrams	G. Heckman	RWC Boulder
IAU Representative		
FAGS Representative	E.A. Tandberg-Hanssen	NASA/MSFC
IUGG Representative/ Secretary for World Days	H. Coffey	NOAA Boulder
URSI Representative	B.M. Reddy	ARWC New Delhi

### MEETING ANNOUNCEMENTS

The "Commsphere Symposium", due to be held on 23-25 April in Hezliya, Israel, has been rescheduled to 16-19 December.

As a reminder, some of the forthcoming URSI-sponsored meetings are

- International Conference on Antennas and Propagation, 15-18 April, York, United Kingdom.
- International Symposium on Recent Advances in Microwave Technology, 22-25 May, Reno, Nevada, USA.
- International Geoscience and Remote Sensing Symposium, 3-6 June, Espoo, Finland.
- North America Radio Science Meeting, 24-28 June, London, Ontario, Canada.
- International Conference on Phenomena in Ionized Gases, 8-12 July, Barga, Italy.

The following meeting has just been co-sponsored by URSI :

- Fifth SCOSTEP/URSI Workshop on Scientific and Technical Aspects of MST Radar, 6-9 August, Aberystwyth, Wales, United Kingdom.

The topics under discussion are :

- Meteorological applications
- Interpretation of radar returns from clean air
- Techniques for studies of gravity waves and turbulence
- Co-ordinated studies using MST/ST radars and other ground-based or space-borne techniques
- Structure and dynamics of lower and middle atmosphere at (a) equatorial and (b) polar latitudes
- Hardware design for MST/ST radars and lower troposphere profilers
- Interferometer, RAS and other new MST/ST radar techniques
- Signal processing and data analyses
- Progress on existing or planned MST and ST radars.

Details can be obtained from the co-conveners : L. Thomas, Physics Department, University College of Wales, Aberystwyth, Dyfid , Wales, U.K.; D. Eccles, the SERC Rutherford Appleton Laboratory, Chilton,

Oxfordshire, U.K.; and C.H. Liu, Department of Electrical and Computer Engineering, University of Illinois, Urbana, Illinois, USA.

Other meetings which have been brought to our attention :

- IEEE Conference on Custom Integrated Circuits, 13-15 May, San Diego, California, USA
- IEEE International Conference on Acoustics, Speech and Signal Processing, 14-17 May, Toronto, Ontario, CANADA
- IEEE National Aerospace and Electronics Conference, 20-24 May, Dayton, Ohio, USA
- INTELSAT Symposium on Global Satellite Communications, 28-31 May, Nanjing, CHINA
- ISHM 8th European Hybrid Microelectronics Conference, 29-31 May, Rotterdam, The Netherlands
- IEEE International Conference on Communications, June, Hamburg, Germany
- IEEE Microwave and Millimetre Wave Monolithic Circuits Symposium, 9-10 June, Boston, Massachusetts, USA
- IEEE Microwave Symposium, 9-14 June, Boston, Massachusetts, USA
- AGARD/EPP Lecture Series 177 on Electromagnetic Interference and Electromagnetic Compatibility, 10-11 June, Kjeller, Norway
- SAMPE 5th International Conference on Electronic Materials and Processes, 18-20 June, Los Angeles, California, USA
- IGI 9th Annual European Fibre Optic Communications and Local Area Network Conference, 19-21 June, London, U.K.
- IEEE International Conference on Communications, 23-26 June, Denver, Colorado, USA
- IEE 5th International Conference on HF Radio Systems and Techniques, 21-24 July, Edinburgh, U.K.
- SPIE 36th Annual International Technical Symposium on Optical and Optoelectronic Applied Science and Engineering, 21-26 July, San Diego, California, USA

- 42nd International Astronautical Congress, 5-11 October, Montreal, Canada  
For information, please contact :

International Astronautical Federation  
3-5 rue Mario-Nikis  
F-75015 PARIS, FRANCE

- First European Symposium : Fluids in Space, 18-22 November, Ajaccio, France. Organized by CNES and ESA.

For information, please contact :

SOCFI  
14, rue Mandar  
F-75002 PARIS, FRANCE  
Tel. (33) 1-42.33.89.94  
Fax (33) 1-40.26.04.44  
Telex 214 403

## COURSES AND LECTURE SERIES

### Joint lectureship programme of ICSU. Roster of lecturers

Available from the Secretariat. Possible candidate-lecturers from the URSI Community can obtain details from ICSU or from the Third World Academy of Sciences at the address :

c/o ICTP  
P.O. Box 586  
I-34136 TRIESTE  
ITALY  
Phone (39) 40-2240 325  
Fax (39) 40-224559.

### Systèmes spatiaux de localisation et de navigation

Cours international de technologie spatiale organisé du 27 au 31 mai 1991 à Toulouse par le Centre National d'Etudes Spatiales. Renseignements à obtenir depuis :

EUROPA ORGANISATION / CTS 91  
40, Boulevard des Récollets  
F-31400 TOULOUSE  
FRANCE

### 17th Antenna Symposium

Queen Mary and Westfield College, London, 11-12 April 1991. Eight lectures . For information :

Mrs. Caroline Dunn  
Department of Electronic Engineering  
Queen Mary and Westfield College  
Mile End Road  
LONDON E1 4NS  
UNITED KINGDOM  
Tel. (44) 71-975 5346  
Fax (44) 71-981 0259

## ON THE TITLE OF MEETINGS

*A note on the correct choice of title, written by M. Freemantle, has appeared in the January 1991 issue, of "Chemistry International". Some of the proposed definitions, reproduced with permission, are :*

- Assembly : This type of meeting is generally regarded as the act of assembling or the putting together of parts. It is also a deliberative or legislative body. They are principally business or administrative meetings rather than scientific meetings.
- Colloquium : This is variously described as a conference, a meeting for discussion, or a seminar. The key probably lies in the French and Latin origins of this word which imply speaking, conversing and therefore oral contributions.
- Conference : This is an appointed meeting for instruction or discussion. The emphasis is on conferring or possibly consultation. Thus, at a scientific conference, scientists confer or consult with one another.
- Congress : This is the act of getting together. Typically, several sections or symposia on very distinct scientific topics are held in parallel sessions.
- Convention : This term is generally defined as the act of convening or an assembly - especially of representatives of delegates for some common object.
- Meeting : This is the common denominator of all the other terms. It means coming face to face with or into the company of one or more other persons.



**Seminar :** This is a group or small class of advanced students working on or discussing a specific subject of study or research under a teacher. It is also a discussion group or conference of specialists on any specific topic.

**Symposium :** This is where meetings terminology gets a little interesting. Historically a symposium is a drinking party or more specifically, an ancient-Greek after-dinner drinking party with music, dancers or (and I repeat 'or') conversation. A symposium is also defined as a collection of views and contributions on one topic.

**Workshop :** This is a group of people working on a creative or experimental project.

**BOOKS PUBLISHED BY MEMBERS OF THE URSI COMMUNITY.**

Compatibilité électromagnétique

*Edité en 1990 par Dunod, à Paris, sous la direction de Pierre Degauque et Joël Hamelin (ISBN2-04-018807-X). Préface de Paul Delogne. Co-auteurs : A. Azoulay, B. Besnault, M. Blanchet, B. Demoulin, M. Gaurrand, Y. Le Guillou, F. Molinet et J. Piponnier.*

Cet ouvrage de 654 pages (Collection CNET-ENST) brosse un tableau général de la phénoménologie et de l'approche quantitative du sujet. A la table des matières :

- Chapitre 1 : Domaine de la comptabilité électromagnétique
- Chapitre 2 : Sources de bruit naturel
- Chapitre 3 : Bruit industriel
- Chapitre 4 : Sources d'origine nucléaire
- Chapitre 5 : Gestion du spectre des fréquences et réglementation
- Chapitre 6 : Caractérisation des câbles blindés
- Chapitre 7 : Couplage aux lignes et aux câbles en présence du sol ou d'un plan de masse.
- Chapitre 8 : Couplage d'une onde plane à des antennes filaires
- Chapitre 9 : Pénétration dans les structures tridimensionnelles et couplages
- Chapitre 10 : Mesures en compatibilité électromagnétique
- Chapitre 11 : Moyens de simulation et d'analyse de systèmes soumis aux effets des perturbations électromagnétiques impulsionnelles.

Singular Electromagnetic Fields and Sources

*by J. Van Bladel. Published in 1991 by Oxford University Press.*

(ISBN0-19-856200-4). The contents of this monograph, 237 pages long, are :

- Chapter 1: Delta functions and distributions
- Chapter 2: Concentrated sources
- Chapter 3: Green's dyadics
- Chapter 4: Singularities at an edge
- Chapter 5: Singularities at the tip of a cone

Appendices : Double layers - dyadic analysis - modal expansion in a cavity  
- modal expansion in a waveguide - basis functions -  
variational principles.

### Electronics, Computers and Telephone Switching

*A Book of Technological History by R.J. Chapuis and A.E. Joel Jr. Published in 1990 by North-Holland in the Series "Studies in Telecommunication" (ISBN0-444-88042-9).*

This technological history traces all the events and developments that have occurred in the switching industry over the past 30 years of innovative development. It will recall to all those engaged in this branch of telecommunications the breakthroughs made within their own company, as well as those achieved in parallel elsewhere.

Given its analysis of the forces at work within so competitive an industry, the book may be used as a valuable reference - or even as a working document. From an historical viewpoint it is an in-depth examination of the factors that have influenced - and the results achieved - in the development of electronic central office telephone switching systems, among the most costly and complex systems in commercial use in the world today.

The book explores the technology and marketing decision-making in a world wide industry where product purchases represent long-term decisions and where the rate of change of the technology has been increasing.

## FROM THE ARCHIVES OF URSI

The URSI Bulletin first appeared in 1938. Because of World War II its publication was interrupted between April 1940 and November 1946. As a result, there was no March 1941 Bulletin, and we can't backtrack fifty years. However, the issues of forty, thirty, twenty and ten years ago are available.

The March-May 1951 issues give data on the logistics of the ionospheric sounding stations in Australia and New Zealand. They also contain a long report on the preparations made for the radio observations of the solar eclipse of February 25, 1952. There is also a summary of the talks held at the 1951 Plenary Assembly of the CCIR to improve the collaboration between URSI and CCIR. The URSI group was composed of Messrs. Dellinger (President), David, Decaux, Lejay, Sacco and Smith-Rose. It was assisted by Professor van der Pol.

The March 1961 issue contains resolutions approved by the URSI radio astronomers, in which they express their worries concerning plans to inject resonant dipoles in orbit around the earth, for space communication purposes. The issue also contains the answers of URSI to two CCIR documents, a preparation to a special URSI meeting on Satellite Communications, and reports on various URSIGRAM activities.

The March 1971 issue was an important one, devoted mainly to the report (including recommendations) of the URSI Working Group on Reorganisation, chaired by Professor Beynon, and formed after the 1969 General Assembly in Ottawa. The role of URSI within the scientific community was under intense scrutiny at the time. The Working Group wrote the following report :

*"Considering*

(a) that the present applications of radio and closely related techniques to scientific research extend over a wide range of disciplines and are consequently of interest to at least three Unions besides URSI;

(b) that it is possible to envisage the future application of these techniques in other fields of scientific research;

(c) that the development of fundamental theories and basic techniques in radio science and their exploitation in other branches of research constitute a strong cohesive force among radio scientists;

(d) that it is desirable to maintain, within ICSU, a single forum for the discussion of all aspects of radio science and its applications;

*the Working Group recommends*

1. that URSI should remain in being as a Union concerned primarily with radio science;

*and considering also*

(e) that a Union concerned with radio science has a duty to encourage the applications of radio science over a wide range of disciplines and should avoid giving undue emphasis to the applications in any one field;

*the Working Group expresses the opinion*

2. that, in the interest of science as a whole, it would be undesirable to transfer the present URSI responsibilities for the stimulation and coordination of studies in radio science to a Union whose interests cover only the applications of radio science in particular fields;

3. that, in consequence, the transfer of these responsibilities to a new Union dealing with the physics of the Earth's environment should be avoided."

The problem of the individual membership was already with us at the time, since the Working Group also recommended

"that serious consideration be given to the controlled admission of individual scientists to URSI, including such questions as the conditions of admission and the privileges of such members, and the practical consequences for URSI of the admission of a large number of individual members."

The Board of Officers, having looked at this recommendation, reacted as follows:

"The Board recognises that some thought must be given to the disadvantages as well as to the advantages of admitting individual members to URSI. It was suggested that the effectiveness of a small Union such as URSI might be reduced if it became a very much larger body as a result of the admission of individual members.

An alternative worth considering would be to arrange for appropriate individual scientists to be admitted as members of Working Groups dealing with subjects in which they have an active interest and to which they could contribute their ideas. It was considered necessary to examine the possibility of charging a small individual membership fee to cover the cost of, for example, copies of the *URSI Bulletin* and the Proceedings of Assemblies, additional administrative expenses, etc. A fee of \$5 per year, with a reduction for members under 30 years, was suggested for further consideration."

The March 1981 Bulletin was very short. It carried obituaries of our distinguished colleagues B. Decaux, G. Goubau and R. Rivault, and an article devoted to the Sunspot numbers.

## **REVIEW OF RADIO SCIENCE 1987-9**

Copies of this volume are available from the Secretariat, at a price of 20 U.S. dollars (mailing charges included). Cheques should be made out to "Radio Science Press".

## **DOCUMENTS DISTRIBUTED AT THE PRAGUE GENERAL ASSEMBLY**

Professor Zima lets us know that 90 complete sets of General Assembly Materials are available, and can be obtained by paying the mailing costs, which amount to \$8. He also has 400 copies left of the Book of Abstracts, which can be obtained at a cost of \$10.

Prof. V. ZIMA  
Institute of Radioengineering & Electronics  
Czechoslovak Academy of Sciences  
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CZECHOSLOVAKIA

## **LAYOUT OF THE BULLETIN**

The present Bulletin has been composed, for the first time, by means of the word-processing facilities of the Secretariat. Any criticisms and suggestions for improvement are welcome.

## **BERKNER MEMBERSHIP**

*This membership has been created by AGU, the American Geophysical Union, in honour of L. Berkner, who was President of URSI from 1957 to 1960. The details are as follows :*

"Full AGU memberships, with all their advantages, are available at no cost in a programme to help scientists in countries with low gross national product per person. This programme is a living memorial to Lloyd Berkner, whose devotion to the encouragement of young scientists and stimulation of international activities will long be remembered. Up to 250 such Berkner memberships may be awarded each year with each award being for a three-year period. Recipients may not have been a member of AGU nor be at an institution where there is more than one AGU member". Applications and further details are available from :

AGU MEMBER PROGRAMMES  
2000 Florida Avenue, N.W.  
WASHINGTON, DC 20009  
USA  
Tel (1) 202-462 6900  
Fax (1) 202-328 0566