# UNION RADIO-SCIENTIFIQUE INTERNATIONALE
# INTERNATIONAL UNION OF RADIO SCIENCE

Comptes Rendus des Assemblées Générales de l'URSI
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## XIX General Assembly

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— Non-linear effects, Convenor : D A. Gurnett
— Ionospheric irregularities, Convenor : P. L. Dyson.

WORKSHOP ON WAVE ANALYSIS.

Convenors · D Jones, J. L. Lacoume and R. G McPherron.
— Spectral analysis.
— Polarization measurements.
— Time delays.

## Commission J. — Radio Astronomy

*Chairman* Prof. G. Westerhout (USA).
*Vice-Chairman* · Prof H. Tanaka (Japan).

### BUSINESS MEETING

About 60 people were present at the only business meeting held, on July 31. The Commission Chairman, G. Westerhout, chaired the meeting, while J W Findlay acted as Secretary

### COMMISSION J : CIRCULAR LETTER

The Chairman asked that, in the future, the Circular Letters from the Chairman to Official Members should be given wide publicity among scientists, so as to facilitate the collection of more representative opinions before the next Assembly.

### COMMISSION J PROGRAMME, HELSINKI.

The programme for the present Assembly was almost completely made up of invited papers, and the Chairman asked whether this was a good idea. After discussion, it was agreed that the all-day session on New Developments gave plenty of opportunity for contributed papers, but that in the future there should be somewhat fewer Commission J Sessions. It was also agreed that about one day of the 1981 Assembly could usefully be devoted to survey papers from some or all Commissions, and that Commission J should propose a survey paper if requested to do so.

### SYMPOSIA BETWEEN ASSEMBLIES.

J. C Ribes (France), R. Wielebinski (FRG) and F. D. Drake (USA) were invited to make proposals for future symposia which should be



recommended for support by URSI. On the advice of this Group, it was agreed to propose a Symposium on Millimetre-wave technology, especially as applied to radio astronomy, to be arranged preferably in collaboration with Commission D The Group made other recommendations relating to the procedure for the approval of symposia by the Board of Officers and the provision of financial support (See Res. J.2)

### THE URSI COMMISSIONS AND THE COUNCIL

The Commission would like to see the establishment of closer contacts between, on the one hand, the Council and the Board of Officers and, on the other, the Commissions. At present, the Chairmen of Commissions are sometimes asked to discuss organisational matters without being fully aware of the background. Also the Business Meetings of the Commissions ought to provide a channel for keeping the URSI Council fully informed about the opinions of the radio-science community

Recommendations for action were included in Res. J.1

### COORDINATING COMMITTEE ON MOON AND PLANETS

Following a discussion on the recent activities of this Committee, the general view was that URSI might well withdraw from it, and that consideration should be given to the need for the continuation of the Committee.

### DETRIMENTAL ACTIVITIES IN SPACE

Prof Wielebinski reported that he had prepared a report for the COSPAR Panel on Potentially Environmentally Detrimental Activities in Space, in which he had described the dangers to radioastronomy of radio transmissions in space and the work of IUCAF in trying to improve protection

### REVIEW OF RADIO SCIENCE

Although a great deal of work went into the preparation of successive editions of *Review of Radio Science*, it appeared that very few scientists in Commission J made any use of it. It was agreed that the volumes should be given a much wider circulation than in the past, or that publication should be discontinued (See Council Res UC.7)

### COMMISSION J REPORT.

The Chairman took the view that the reports he had received from Member Committees in support of his preparation of the Commission J Chapter in the *Review of Radio Science* were very valuable He considered

that they ought to be reproduced in full for the use of Commission J, even though no formal procedure for achieving this was available in URSI.

Accordingly he had reproduced the reports received from 22 Committees in a 170-page booklet for distribution during the Assembly. The cost was being covered partly by the purchasers and partly by a grant from URSI

The action taken by the Chairman was approved and a vote of thanks to him for his initiative was adopted

## IUCAF

It was agreed to recommend that Prof J P. Hagen and Dr J. W. Findlay should remain the URSI representatives in IUCAF, since continuity in the work of the Commission was essential in the period leading up to the World Administrative Radio Conference in 1979

## Election of Vice-Chairman

The results of the voting were as follows, in order of preference 1 V. Radhakrishnan (India), 2 R Wielebinski (FRG), 3 G G Getmantsev (USSR)

## Reports of Meetings

Prof Hagen reported on the work going on in CCIR that was of particular interest to Commission J, and on the results of the recent Plenary Assembly in Kyoto

Dr Findlay and Prof Hagen described the work of IUCAF during the last three years in preparation for the WARC in 1979 The Commission will meet its Correspondents in Helsinki and also hold a closed meeting

## Titles of Scientific Sessions

J 1, J.2 New developments in observatories and laboratories, Organizer . G Westerhout, USA; Chairman · G Westerhout (USA) and H Tanaka (Japan)

J 3 Very-long baseline interferometry, Organizer and Chairman · T A Clark (USA)

J.4 Search for extraterrestrial intelligence; Organizers . K I. Kellermann (FRG) and N S Kardashev (USSR), Chairman K I Kellermann (FRG)

J 5. Millimetre wave electronics, Organizers . S Weinreb (USA), M. Morimoto (Japan) and J W. M Baars (FRG), Chairman J W M Baars (FRG)



J.6. Physics of nonthermal radio sources, Organizer R. G. Strom (Netherlands)

J 7. Recent developments in antennas for radio astronomy; Organizers · J. W Findlay (USA) and J W M. Baars (FRG), Chairman J W. M. Baars (FRG).

J 8 Solar and planetary radio and radar astronomy, Organizers D B. Campbell (USA) and M Pick (France), Chairman : D. B Campbell

J.9 Spectral line research; Organizer and Chairman . B E Turner (USA)

BJ.1 Recent developments in radio astronomical antennas, Organizers : J W M Baars (FRG) and J W. Findlay (USA), Chairman J W Findlay (USA)

## Chairman's Report on the Activities of Commission J

A very full programme of scientific sessions was presented Nine half-days were organised by Commission J alone, and one half-day jointly by Commissions B and J In general about 100 people attended each session

Sessions J.1 and J 2 occupied the first day and were devoted to the traditional reports on new developments in observatories and laboratories. In these Sessions, which are open (time permitting) to short papers describing new antenna or receiving systems and current observing programmes, 31 papers were presented by scientists from 12 different countries Putting this Session at the start of the Assembly allowed participants to have further discussions, about the topics presented, during the whole period of the Assembly The Session was considered to be very successful and it should be continued at future Assemblies.

Session J.3 was a review of the status of very long base-line interferometry A decade has elapsed since the first successful demonstrations of vlbi techniques, which have been applied in a number of very different scientific fields. Some extra-galactic radio sources have shown variations in their nuclear regions at apparent velocities in excess of the velocity of light, while others show collimated jets a few parsecs in length, colinear with double structures of hundreds of kilo parsecs in length OH and $H_2O$ maser sources have been mapped and show the collapsing shells surrounding stars in their earliest stages The vlbi technique has shown that it now rivals centuries of optical astrometry, and is capable of positional determinations at the 0.01 arc second level Geodetic observations on baselines of thousands of kilometres are already at the sub-decimetre level necessary to

measurements of continental drift, crustal deformation, polar motion and UT1. Transportable vlbi terminals now permit field "surveying" at accuracy levels superior to those obtained using classical techniques. New vlbi hardware has been demonstrated which will permit an order-of-magnitude increase in sensitivity. "Real-time" vlbi using satellite data links has been demonstrated.

Ten papers were presented in Session J 4 on the search for extra-terrestrial intelligence (SETI) Following a review of the problem and relevant technology by B M Oliver (USA), Oliver and S Gulkis (USA) reviewed the plans for the NASA-Ames targeted search, and the NASA-JPL cell sky search respectively. J Tarter (USA), F. Drake (USA) and R. Wielebinski (F R. Germany) then described their observations of nearby stars and galaxies using several novel techniques In other papers the problems of optimum frequencies and signal signatures were discussed. The Session was one of the two most widely attended sessions of Commission J (over 150 participants); this reflects the growing world-wide interest in SETI and the rapidly improving technology which now makes meaningful searches possible

All the speakers in Session J.5, on millimetric-wave electronics, had been invited and all the papers were surveys The attendance was good, with a noticeable proportion from outside the direct radioastronomy circle The well-presented papers provoked numerous questions and considerable discussion The main points of the day were

(1) the need for flexible multifrequency operation, together with easy access to the front-ends (Morimoto);
(2) the routine use in actual observations of wide-band (100 MHz) acousto-optic spectrometers (Robinson),
(3) the achievement of a cooled-mixer receiver at 80 GHz with an almost theoretical noise temperature of 320K (Schneider),
(4) difficulties in obtaining the desired performance of parametric down converters, coinciding with growing insight into the characteristics of the device (Weinreb);
(5) optimistic prospects for Josephson-junction mixers with noise temperatures between 50K and 200K in the frequency range 30-300 GHz (Migulin);
(6) promising developments in BWO and Impatt oscillators for frequencies above 100 GHz, the main problems at present are harmonic radiation of BWO and high noise of Impatt devices (Lacroix)

In Session J 6, on the physics of non-thermal radio sources, J A Högbom reviewed the status of observations of strong extragalactic radio sources,



and presented examples of projected magnetic field distributions and spectral index variations. Magnetic fields generally run parallel to the total intensity contours but, in the narrow jet-like features emanating from some galactic nuclei, there are also examples of fields perpendicular to the direction of extension. C A. Norman discussed theoretical aspects of the stability of beams, and the likely relationship of fine scale structure to particle acceleration in extragalactic sources and supernova remnants. In a review of low-frequency variability of quasars and radio galaxies, R. Fanti presented recent results which underline the ever present problem of variations that are both too rapid and too large in magnitude to be explained by existing models. V Radhakrishnan discussed the status of pulsar observations and recent theoretical advances. Recent polarisation measurements on the Crab nebula, presented by A. S Wilson, place stringent limits on the circularly polarised emission, and have important implications for the object's magnetic field structure. In short communications, very large galaxies were discussed by R. Wielebinski, R G. Strom and E. B. Fomalont, while W. van Breugel and W M Goss presented observations of several double radio sources

On August 3, an open workshop on large digital correlators was convened by P. Dewdney (Canada). About 25 people attended and each participant was asked to summarise the activities in this field in his institution B. Clark (NRAO, USA) outlined the operation of the VLA correlator system and reviewed progress to date. R Frater (CSIRO, Australia) explained the design principles of the asynchronous correlator system being developed in Australia by J. Ables with a view to using it in the planned Australian Synthesis Telescope. J O'Sullivan (Netherlands) reviewed the design of the extension to the Dwingeloo Spectral Line Correlator, and outlined progress B. Oliver (USA) explained the operation of the "Million-channel Spectrometer" being developed in the USA at Stanford F. Biraud (Meudon, France) reported on the eight-level correlator system being constructed for the Nançay radio telescope. P. Dewdney (Canada) presented some ideas on the configuration of cross-correlator systems, in aperture synthesis telescopes, leading to simplified design and sampling rates slower than the Nyquist rate

Discussion also took place on the following topics :

(1) Progress which other institutions have made using the VLA correlator integrated circuits. Apparently they have not been available long enough for anyone to finish building a complete system with them.
(2) Calibration of correlators; elimination of bad channels and interference.

(3) Possible dynamic range problems in the pre-filtering part of the Million-channel Spectrometer.

(4) Bandwith limits to digital correlator systems were discussed, especially in relation to the acousto-optical system

Session BJ.1 was organised jointly by Commissions B and J, and dealt with recent developments of new antennas The first few speakers reviewed progress in the last three years in the design or building of large new antennas and systems. The VLA in New Mexico is more than half-completed The use of antennas separated by distances of several thousand kilometres as interferometer pairs has developed to the point where source structure in the milli-arcsecond range can be mapped At millimetre wavelengths several antennas have operated for some years, some as interferometer pairs and some as single dishes Plans are being made for future antennas and arrays at these wavelengths. The final paper described the measurement of the shape of a 25 metre antenna by a radio-holographic method, a technique which shows considerable promise for the future The Session was a very successful one and about 150 persons attended

Session J.7 dealt with recent developments in antennas for radioastronomy The papers had been chosen by the session organisers from the contributions offered Several antenna experts from outside Commission J attended the Session The main topics were millimetre-wave telescopes and synthesis interferometers. Most impressive was the achievement of a 25 μm accuracy for a 10 m antenna by CalTech Japan has just started the construction of a national facility comprising a 45 m dish for use from 1 to 100 GHz, and a two-dimensional synthesis array with five 10 m antennas for the range 22-150 GHz

The new Onsala 20 m mm-telescope operates beyond specifications, while the improved inner 17 m section of the Parkes telescope makes it the most powerful mm-telescope in the southern hemisphere, it is useful up to 90 GHz The Jodrell Bank 4-element (to be extended to 6-element) radio link interferometer will close the gap in resolution between VLA and VLBI systems. The Ooty Synthesis Telescope at 327 MHz and the modified fan-beam synthesis Molonglo instrument (843 MHz) will add powerful mapping capabilities for galaxies, especially in the southern hemisphere There is still progress, albeit slow, in feeds and, in particular, in their polarisation characteristics At Bonn, powerful methods and software packages have been developed to improve the mapping capabilities of a single dish in the presence of atmospheric disturbances and/or antenna side-lobes



Session J.8 was devoted to radio and radar observations of the sun and planets. M. Pick (Observatoire de Paris) reviewed (*a*) the effects of coronal holes and arches on our understanding of the radio emission from the sun, (*b*) the recent high resolution observations which have been made with the Westerbork synthesis array, and (*c*) the uses to which bursts are being put in probing the corona and interplanetary medium. M. Kundu (Univ. of Maryland) and K. Kawabata (Univ. of Nagoya) elaborated on the high resolution work, while K Sheridan (CSIRO) discussed recent work being done at Culgoora The current state of our knowledge of the inner and outer planets obtained from radio observations was reviewed by D Muhleman (CalTech) and S Gulkis (JPL), while I. de Pater (Leiden Observatory) discussed her very nice observations of the radiation belts of Jupiter using the Westerbork array. D Campbell (NAIC) and R Jurgens (JPL) described the recent observations of the rings of Saturn, the Galilean satellites of Jupiter, and Venus E. Gerard (Observatoire de Paris) gave a brief description of recent measurements of OH in comets

Session J.9 was devoted to spectral line investigations. Apart from the traditional HI (21 cm) and HII recombination lines, in the last 10 years molecular line studies have revolutionised our understanding of the interstellar medium, because of their unique ability (in the microwave spectral region) to probe the previously unknown dense component Molecular line studies have inspired three main areas of research : (*a*) galactic structure, (*b*) the physical properties and evolution of dense interstellar clouds, (*c*) the "new" subject of astrochemistry These areas were addressed by review speakers.

W. B. Burton (USA) summarised the galactic distribution of HI and CO showing, in particular, how the molecular species are found predominantly in a "ring" between galactocentric radii 4 and 8 kpc · very different from the flatter HI distribution The galactic centre is now believed to contain a rotating, expanding, tilted disk, as revealed in a complementary way by CO and HI together

The physics of interstellar clouds was reviewed by P J Encrenaz (France) Such clouds range from small ones ($\sim$ 100 $M_0$) to "giant" clouds ($\sim 10^6$ $M_0$), and may or may not contain hot regions which signal the existence of embedded young stars or protostars Temperatures range from 10K to 100K (hot spots) and densities from $\sim 10^2$ to $10^9/cm^3$ Clouds do not generally rotate perceptibly, nor collapse at anything approaching free-fall rates, despite greatly exceeding the Jeans gravitational instability criterion. Magnetic fields are generally believed, in some way, to prevent rapid collapse

The specific study of condensed regions in interstellar clouds which are forming stars was reviewed by B. Zuckerman (USA) who traced the evolution of such regions from the starting point where, for massive stars, collapse is triggered by external pressures from other hot nearby stars, supernova remnants, gravitational density waves, etc. The relation of molecular masers, compact IR and HII sources in relation to the protostellar objects, was discussed. At the opposite end of the stellar evolutionary pattern, molecular studies of carbon stars, planetary nebulae, and intermediate types of object, have revealed a possible evolutionary path for evolved N-type super-giants, on the giant branch of the Hertzsprung-Russell diagram, to planetary nebulae It appears that the carbon-rich evolved stars which have been studied via CO and other molecular species, do indeed evolve to planetary nebulae, leaving other types of evolved stars (O-rich Miras ?) to evolve via the supernova route.

These major areas of research were complemented by short papers on various other topics. The local HI distribution is becoming better understood as a result of the study of several hundred absorption line sources by the Nançay telescope. M31 has been newly studied in both HI (synthesis studies in Penticton) and CO. H109$\alpha$ recombination line studies by the Westerbork Synthesis Telescope appear to reveal pressure-broadening in the lines more convincingly than before Various specific observations of HCN and $HCO^+$ both at Onsala and in Japan have shown new details in sources as wide ranging as Sgr A in the galactic centre, and Orion A locally Finally, studies of the time variability of both OH (Illinois) and SiO (Japan) masers in Mira-type stars are providing new insights into the dynamics of the circumstellar dust shells of these stars



# RESOLUTIONS AND RECOMMENDATIONS OF THE COUNCIL

## UC.1. — Modifications to Statutes (General Assembly)

The URSI Council,

*considering* Res. C.1 (Item 10) adopted at the XVIIth General Assembly of URSI,

*resolves* to make the following modifications to the Statutes :

Art 53(*b*) : *Delete* "and Scientific",

Art. 53 . *Add* "(*e*) Scientific Meetings of the Commissions, and Symposia";

Art. 54(*f*) : *Delete* existing text, and substitute the following "Repre-"sentatives invited in accordance with Art 56",

Art. 55 : *Delete* existing text and substitute the following "Scientific "Meetings of Commissions, and Symposia, are open to all scientists "(including students) who have registered as participants at the beginning "of the General Assembly The total number of registrants may be restric-"ted by the host Committee so that the meeting can be accommodated "within the facilities available",

Art. 56 *Delete* existing text and substitute the following "The President "of the Union can invite representatives nominated by international orga-"nisations to attend the General Assembly as observers"

## UC.2 — Modifications to Statutes (Membership)

The URSI Council,

*considering*

(*a*) that membership of URSI is at present restricted to Committees formed in territories that already adhere to the International Council of Scientific Unions;

(*b*) that the Board of Officers has proposed the removal of this restriction,