ASTRONOMY 73

Published daily for the Fifteenth General Assembly of the International Astronomical Union, Sydney, Australia. 21–30 August 1973

Monday *20 August*

WELCOME TO THE FIFTEENTH GENERAL ASSEMBLY

Today and tomorrow over 800 astronomers from 46 countries will gather in Sydney for this, the Fifteenth General Assembly of the International Astronomical Union.

Your hosts, the Australian Academy of Science and Australian astronomers throughout the country, welcome you. We are very conscious of the honour to Australia in being selected as the first country in the southern hemisphere to hold an IAU General Assembly.

The information kit issued to you on registration contains a number of items to help you find your way around and to make your stay here as enjoyable as possible.

In addition, members of the Local Organizing Committee and the IAU Executive Committee, with a veritable army of local helpers, are available to provide you with any advice and assistance you may need.

So, if you need anything at all, look for the people wearing red or orange name badges; you will find them only too willing to help.

Australia is still an isolated country in many ways and it has been said that we are not yet ready in some respects, to receive overseas visitors in the way they are accustomed. Maybe this is true, but we would like to show that what we lack in experience of welcoming visitors we make up in readiness to help.

We hope that, for everyone, the Fifteenth General Assembly of the International General Assembly is a rewarding and enjoyable experience.

From Heidelberg come Doctors R. Wielen, W. Gliese, W. Fricke, F. Henn, and T. Lederle.

New Schmidt telescope

One of the world's largest astronomical cameras was opened at Siding Spring Observatory, New South Wales, on Friday August 17, by Professor Bengt Strömgren, President of the International Astronomical Union.

The United Kingdom's 48-inch Schmidt telescope, together with the building dome and ancillary instruments, was built for the UK's Science Research Council at an estimated final cost of £930,000 sterling (1.7 million dollars Australian). The officer in charge is Dr V. C. Reddish.

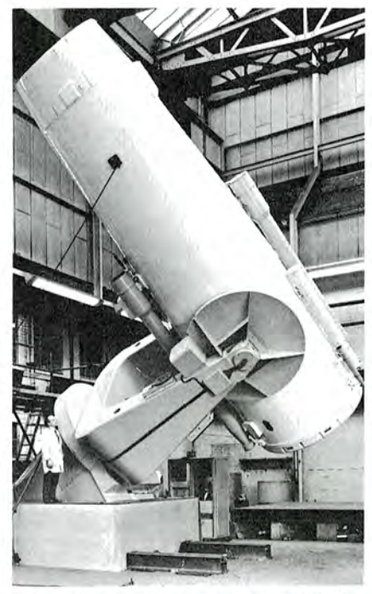
Initially the telescope will be used to undertake a detailed survey of the southern sky extending from 20 degrees south of the equator to the southern pole. Subsequently the telescope will be available to astronomers to undertake a wide range of investigations.

The 48-inch Schmidt telescope is a short focus wide angle telescope operating at about F2.5 and capable of photographing an area of the sky six degrees across – twelve times the diameter of the moon – on a single photograph. Its large size and excellent optics give it great penetrating power and it has already recorded galaxies which until now have been beyond the reach of telescopes in the southern hemisphere. It is particularly suited for mapping the sky to search for unusual objects and for exploring the distribution of galaxies of stars in distant parts of the universe.

The UK's telescope is located on a site at Siding Spring Observatory provided by the Australian National University which has acted as the Council's agents for the building and site works. The telescope has been designed and manufactured for the SRC by Sir Howard Grubb Parsons and Co. Ltd.

It resembles the 48-inch Schmidt instrument of the Hale observatories at Palomar, the drawings of which were generously made available to the Council. The rotating dome to house the telescope was supplied and erected by the Boller and Chivens Division of the Perkin Elmer Corporation in conjunction with the L and F Machine Company of California. A vacuum mirror aluminising plant to accommodate the telescope's 72-inch diameter mirror has been supplied and installed at Siding Spring by Edwards High Vacuum of Crawley Sussex (England).

The southern sky survey is to be carried out by a Science Research Council Unit in conjunction with the European Southern Observatory (ESO) whose Schmidt telescope in Chile recently came into operation. The surveys, in the blue and red wavebands, are expected to be completed in late 1975. It is believed that with the improvements which have taken place in optics and in photographic emulsions it will be possible for these surveys to detect stars and galaxies about one magnitude fainter than in the survey carried out by the Palomar telescope.



The telescope during construction in the British factory of Sir Howard Grubb Parsons and Company Limited.

Have a look at Sydney

Sydney is one of the most historical cities in Australia but to get some appreciation of what it was like in its early days of settlement you need to visit the 'Rocks Area'.

Those with energy can walk there, but there are bus tours or taxis to take you to the Information Centre, recognised as the best starting point. The building in which the centre is located was once the City Coroner's Court and there is a display area there, a film can be seen and maps and brochures are available.

Walk over the road then in Playfair Street to Atherton Place (c.1880) Sydney's shortest street, then return to George Street where you can see some of the elegant and more interesting old buildings. A brochure will explain the story of each of these and give you directions to find each of them. As you stroll along, browse in the antique shops, watch colourful candles being made or add some collages to your souvenirs.

In restored Argyle Terrace you can rest for a time in the coffee shops or have a meal in the Old Spaghetti Factory before you go on to explore the Mining Museum, take a look at an old Police Station or linger in the hallowed atmosphere of St. Patrick's Church (dedicated 1844) the oldest Catholic Church in the city.

For further information, or to make a booking, contact Pioneer Tours, Oxford Square (corner Riley Street) or talk to the Ansett-Pioneer representative at the Congress centre.

Rotational synthesis telescope

During the assembly we will publish descriptions of the activities of various astronomical centres.

The Fleurs radiotelescope is a new rotational synthesis telescope recently built and put into operation by the Electrical Engineering School of the University of Sydney. It has the highest resolving power of any telescope which can observe the southern skies. At present the resolving power is 40 arc-seconds at a wavelength of 21cm but plans are in hand to improve this by a factor of two. The telescope will be used by the Schools of Electrical Engineering and Physics of the University, and by astronomers from organisations in Australia and other countries.

The new telescope is similar in principle to the earliest radiotelescope used for earth-rotational synthesis observations of the Sun twenty years ago in Sydney, but is very much more sensitive. Unlike synthesis radiotelescopes in the northern hemisphere, the Fleurs instrument is made up of a large number of relatively small steerable paraboloids which are all fixed in position. Mapping of 2 square degrees of sky is possible in less than one day.

The instrument is unique in several ways. It makes use of 64 small paraboloids constructed for use in a 'grating-cross' by the CSIRO Division of Radiophysics in 1952 and later given to the University of Sydney. Four larger paraboloids have been added to this to form a pair of 'compound interferometer' arrays one of which lies in an east-west direction and the other in a north-south direction. These arrays operate independently. The north-south array (not yet operational) will allow radio maps to be made close to the celestial equator, a thing not possible with synthesis telescopes that are arranged in an east-west line.

The sixty-four channel radio receiver which forms an important part of the telescope has a number of novel features including computer-generated phase-rotating pilot signals in each channel of the receiver.

Editorial note

Astronomy 73 is produced for the Local Organizing Committee by Dr R. X. McGee, Dorothy Braxton and Jack Sandry.

The editors are very grateful for the contributions that have already been received and would welcome more. But our printing schedule is tight, so if you could give us one clear working day between receipt and required publication date we would be grateful. Changes of programme and very urgent material can be submitted up to 1500 hours on the day before publication.

The Mitsubishi Electric Corporation recently supplied this 7 metre radiotelescope to the Japanese Enterprise for International Telegraph and Telephones.

Local films

A programme of Australian films will be shown at the Union Theatre at 2000 hours on Tuesday, August 21.

The films have been chosen to give the visitor an idea not only of the diversity of the Australian experience but also the stage of development reached by local documentary film makers.

The programme is a long one, broken into two parts. From 2000 hours until 2200 hours, the first five films will be shown.

These will include *Paddington Lace,* which was made to capture the spirit of Sydney's Paddington, which in recent years has become the place to live to avoid the conventions and predictability of suburbia.

Combining film shot on coral islands with extensive underwater footage, *Great Barrier Reef* presents a dazzling introduction to the Great Barrier Reef, off the North Coast of Queensland, and its creatures. The film has been described as 'a fascinating combination of art and science, evoking with cinematic skill and scientific accuracy the beauty of a unique natural area.'

After supper at 2200 hours, a further three films will be shown.

The National Gallery of Victoria, one of the most attractive features of the city of Melbourne, is the subject of *The Gallery*.

The very latest

- A joint meeting of Commissions 4, 14, 31, and 40 will be held on Tuesday, August 28, to discuss a meeting of the Consultative Commission on the Definition of the Metre, sessions cd, room LT11.
- Buses for the various excursions on Saturday, August 25, will now depart as follows.

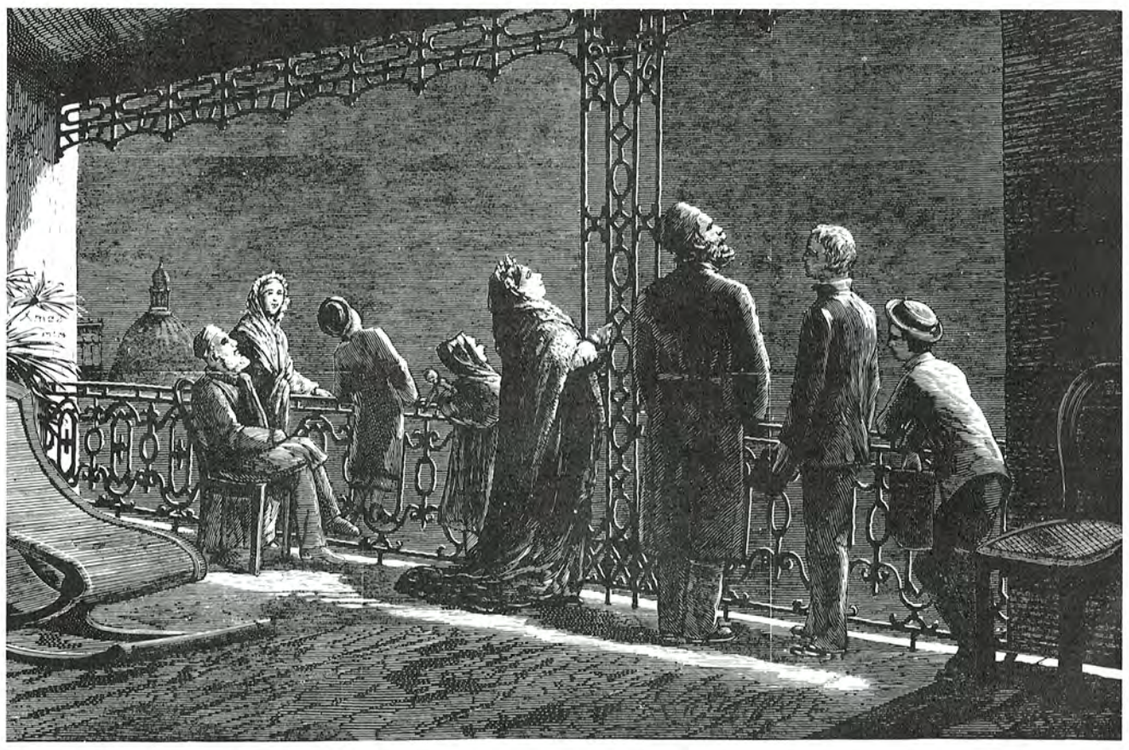
For the Fleurs Radio Observatory, at 1245 hours, immediately after the morning session, from the Carslaw Building. Lunch will be provided at Fleurs.

For the Sydney Harbour cruise, Koala Bear Park, and downtown Sydney, from the Women's College at 1400 hours and from the Wentworth Hotel at 1415 hours.

- The excursion to Parramatta has been cancelled.
- A meeting of Commission (28) W.G., the Working Group on Galaxy Photography, will be held on Tuesday August 28, session a, room LT11.

Early astronomy in Australia — 1

Australia does not have a long history of European settlement, but for a large part of that history, astronomy has played a part. A scene in Phillip Street, Sydney, when the early settlers were waiting for a lunar eclipse. ('Illustrated Sydney News', 24 December 1881. Picture: courtesy Australian National Library)



Cosmic ray studies

Radio emissions from extensive air showers are being investigated at the Buckland Park Field Station where a scintillation array for detecting showers and determining their parameters has been installed. The Cosmic Ray group at the University of Adelaide (Professor Prescott, Drs. Clay, Gregory and Patterson) has recently discovered a hitherto unsuspected component of the radio emission at 100kHz. The pulses observed commonly exhibit large signal to noise ratios (Nature – in press). The characteristics of such radiation may be favourable for the construction of a large radio array for the detection of ultra high energy primary particle ($E>10^{19}$eV) events. Pulses such as those observed with the present equipment may also provide valuable information regarding the mass spectrum of primary particles.

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Tuesday *21 August*

Delegates register for congress

Participants of the Fifteenth General Assembly of the IAU, the first to be held in the southern hemisphere, began registering at the University on Sunday. Many more flew in yesterday from the 46 countries represented and the remainder are expected today.

Some of the astronomers have already been in Australia for a week or so to attend symposia in Perth and Canberra, to visit Siding Spring for the opening of the 48-inch Schmidt telescope or to tour observatories in various parts of the country.

Early arrivals included the IAU President, Professor B. Strömgren, who on Friday flew to Siding Spring to officially open the Schmidt telescope and Dr. Bart Bok, a former director of Mt Stromlo Observatory and one of the best known astronomers in Australia.

Now president of the American Astronomical Society, Bart Bok is accompanied by his wife who shares her husband's interests on a professional basis. During their stay in Sydney they will be reading proofs of the fourth edition of one of the books on which they have collaborated, *The Milky Way.* For Dr Bok, the holding of the congress in Australia is an important step forward. 'It's something I lobbied for for a long time,' he said on his arrival on Sunday.

Equally enthusiastic about having the Congress in Sydney was the IAU's General Secretary, Professor C. de Jager, Professor of Astronomy at Utrecht University and President of COSPAR, an international space agency. 'It's high time we met in Australia,' he said. 'This country has done so much for astronomy.'

Professor C. de Jager, Secretary General of IAU's Executive meets his Dutch-born colleague, Dr Bart Bok, a vice-president of the IAU and former director of Mt Stromlo Observatory.

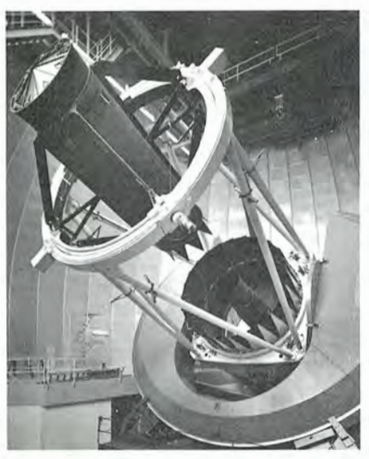
While many of the women attending the Congress are here as wives of astronomers and have a separate programme, others will be taking part in a professional capacity. One of the best known among them is Dr Margaret Burbidge who is Director of Greenwich Observatory. Dr Burbidge, who is on the Board of Directors of the Anglo Australian Telescope, lives in the United States but commutes regularly to England.

Professional interests apparently die hard among astronomers and a number of the participants are actually retired but still retain a close association with their former work and colleagues. Among the best known of these is Dr Jan Oort of the Netherlands who remains one of Europe's best known astronomers.

Between 700 and 800 are expected to attend the Congress. The number is smaller than usual but according to Professor de Jager, this was to be expected because of the time of the extraordinary meeting of the congress being held in Poland in a few weeks time. This conference has been arranged to mark the 500th anniversary of the great astronomer, Copernicus, and some of the European members, particularly those in the eastern countries, will be attending that meeting in preference to coming south to Australia.

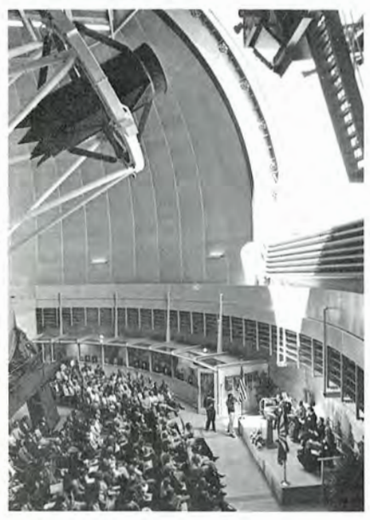
Kitt Peak National Observatory dedicates Mayall 4-metre telescope

The dedication in June of the 4-metre (158-inch) Mayall Telescope at Kitt Peak National Observatory was the occasion for celebration not only of the successful completion and operation of a new frontier instrument for optical astronomy, but also, in a broader perspective, of Kitt Peak's evident and growing maturity as a world centre for astronomical research.



The Mayall telescope showing the 4-metre fused quartz mirror at centre of horseshoe (lower right) and prime-focus observing cage (upper left).

These two themes – the coming on line of the world's second largest reflecting telescope, with the promise of becoming a superb research instrument, and its part in fulfilling the ambitious plans laid in 1958 with the establishment of Kitt Peak as a national observatory – ran through both the formal remarks and informal discussions during the two days of dedication activities in Tucson, Arizona.



An international gathering of more than 250 invited guests took part in the ceremonies which were highlighted on June 20 by the formal naming of the 4-metre telescope in honour of Nicholas U. Mayall, director of Kitt Peak from 1960 until his retirement in 1971. In attendance were representatives of universities, observatories, and research centres from all parts of the U.S. and 15 other nations throughout the world. Greetings were also received and read on the occasion from many other individuals and institutions, nationally and internationally.

Not unnoted was the coincidence that the celebration was taking place both during the 500th anniversary year of Copernicus' birth and also during the 25th anniversary of the dedication in June 1948 of the 200-inch telescope on Mount Palomar in California. Kitt Peak director Leo Goldberg remarked in this connection, "If the development of modern astronomy began with Copernicus, it has experienced its most spectacular growth during the past 25 years, and it is no accident that the 200-inch telescope began operating at the beginning of this period."

In his dedication address, the director of the National Science Foundation, H. Guyford Stever, who was recently appointed by President Nixon as science advisor, recalled "the two decades of deliberation, decision-making, and difficult work to create a national astronomical observatory that would fill many requirements". Among these, contained in recommendations to NSF by a number of advisory panels of astronomers, were that the observatory should be a cooperative inter-university observing centre serving all branches of astronomy; that it should include facilities for photoelectric, photographic, and spectrographic studies; that it be located at a site with more favorable winter and spring weather than on the Pacific Coast; and that it should allow equal observational opportunities for all astronomers and all institutions, the major criteria for use being the competence of the investigator and the scientific merit of his problem.

Greetings on the occasion from the international astronomical community were brought in remarks by Bengt Strömgren of Denmark, president of the International Astronomical Union. He pointed to the very active tradition of cooperation that exists among astronomers on a national as well as international level, noting the part that Kitt Peak has played in this cooperative endeavour, both through its management by an association of U.S. universities and the active exchange it carries out with astronomers and observatories throughout the world. Dr. Strömgren also read greetings received from scientists abroad who could not be present. Edward Khachikyan, of the Armenian Byurakan Astrophysical Observatory in the Soviet Union, then a visitor at Kitt Peak, read a letter of congratulations, with comments on the importance of the new telescope for galactic astronomy, from the president of the Armenian Academy of Sciences, V.A. Ambartsumian.

The Mayall 4-metre telescope at the Kitt Peak National Observatory.

Have a look at Sydney

To get a panoramic view of the city there's no place like the Skywalk. This is a fully enclosed level on top of Australia Square Tower, the tallest building in Sydney.

Look north across the Harbour Bridge to the mushrooming North Sydney area or south to see historic Botany Bay. To the east there is the controversial Sydney Opera House and the views of Sydney harbour itself. To the west there are the upper reaches of the harbour, the intricate pattern of rivers stretching westwards to the Blue Mountains.

Skywalk is equipped with telescopes to give you closer views of all the areas. It is open from 10.00 a.m. to 10.00p.m. daily and there's a coffee shop to relax in when you've had enough of the sights.

For further information, or to make a booking, contact Pioneer Tours, Oxford Square (corner Riley Street) or talk to the Ansett-Pioneer representative at the Congress centre.

Greetings from Mitsubishi

We wish to extend our warm greetings to the participants in the Fifteenth General Assembly of the International Astronomical Union.

The IAU and Mitsubishi companies, the Mitsubishi Electric Corporation (MELCO) and Mitsubishi Australia Limited have many interests in common. Building on many years of experience with various types of steerable antennas, we are now actively engaged in the construction of radio/optical telescopes.

Since the spring of 1971 MELCO has been working the on Anglo-Australian 150-inch optical telescope which is now being installed at the site in Siding Springs, New South Wales.

In this project, Mitsubishi is responsible for the detailed design, fabrication, and installation of the mount/drive/control systems. The telescope mount has now been installed after a four-month-long complete testing schedule, including shop erection.

The drive/control systems are scheduled to be completed later this year. The experience we have gained in this project will be invaluable in future work on radio telescopes.

In this field we have already provided a 6-metre diameter radio telescope for millimetre wavelength use at the Tokyo Astronomy Observatory and a 7-metre diameter radio telescope for the Japanese enterprise for International Telegraph and Telephones. We are currently engaged in the development of radio telescopes with diameters up to 45 metres.

Also under development is a radio-telescope having an extremely short wavelength and its reflector an extremely high surface accuracy. A wind-tunnel test has been performed on a 1:100 model.

In closing, we wish the Fifteenth General Assembly every success.

Australian art

A display of Australian art will be opened today in the War Memorial Gallery of the Fine Arts building of the University.

Most of the artists represented are Australians but one or two of them were born in Europe and have since come to live and work in this country.

The 26 paintings which will be on display have been lent to the Congress through the courtesy of the Rudy Komon Gallery and are for sale.

Almost all the artists are well known and have had work hung in both State and National galleries in Australia. Many have exhibited overseas.

The exhibition, which has been arranged by the Women's Committee, will remain open until 29 August.

UV astronomy in Adelaide

Astronomical measurements by the Space Group of the Department of Physics of the University of Adelaide (Professor Carver, Dr. Horton) are concerned mainly with the measurements of ultraviolet flux using photon ion chambers mounted on rockets and satellites. One group of measurements consists of determination of the absolute solar flux in the wavelength regions 1216Å, 1420 - 1480Å and 1580 - 1650Å. Observations of the integrated ultraviolet flux from the entire solar disc indicate a solar temperature minimum of (4570 ± 50) K. Instruments designed to measure fluxes in the extreme ultraviolet between 500Å and 900Å are presently being constructed. Soft X-ray flux measurements at 44Å and 60Å are also being carried out.

A second group of measurements concern the ultraviolet solar flux reflected from the lunar surface. Wavelength ranges studied are 2300Å - 2900Å and the Lyman-α line (1216Å). Recent observations show that the lunar albedo decreases sharply towards shorter wavelength, falling to 0.7% at 2400Å and 0.3% at 1216Å (Carver, Horton, O'Brien and O'Connor – to be published in "The Moon").

A further planned experiment is designed to measure radiation fluxes in the extreme ultraviolet due to the helium corona of the Earth's upper atmosphere and may be of sufficient sensitivity to detect fluxes from stellar sources. This experiment is being flown in conjunction with vacuum ultraviolet detectors of the USNRL.

The very latest

- Commission 48 will hold its administrative meeting in Room LT8 on Saturday 25 August, session b, and its scientific meeting in Room LT8 on Wednesday 29 August, sessions c, d.

- Commission 10. A public lecture by atmospheric experimenters will be given in Room LT5, session b.

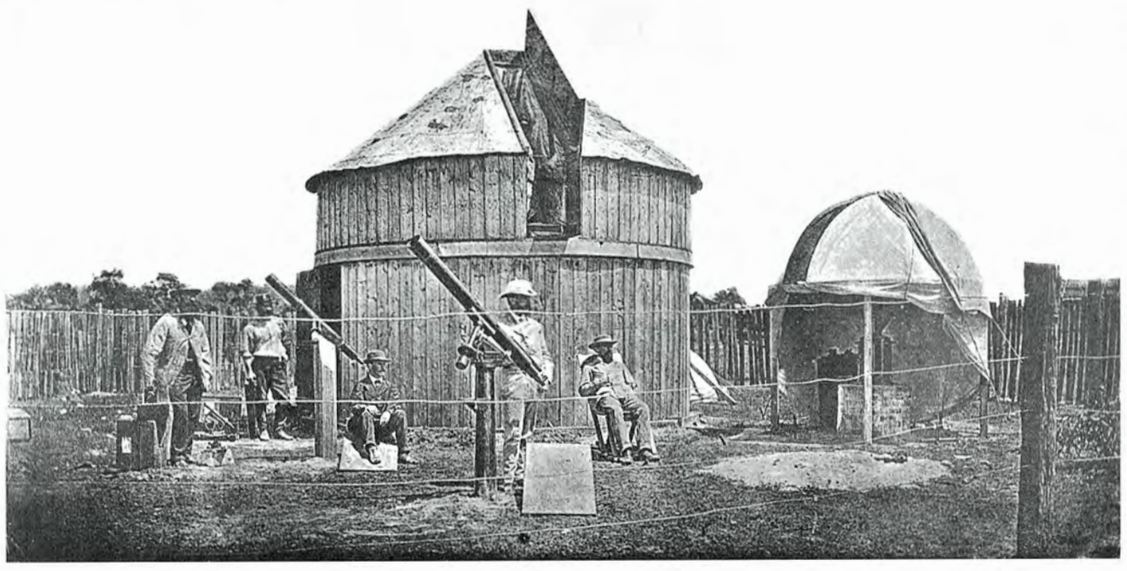
- Finance Committee. The first meeting (short session) of the Finance Committee, in Room T15 on Tuesday 21 August, begins at 1600 and not at 1630.

- Buses will be available to take people home to city hotels after interval at tonight's film showing. A second bus will be available at the end of the screening.

- Joint Discussion 111, Monday 27 August. The introduction will now be given by Dr G. Cayrel de Strobel under the title 'The ages of stars in the neighbourhood of the sun'. Professor J. Oort, who was to have given the introduction, has asked to be excused.

Early astronomy in Australia — 2

Australia does not have a long history of European settlement, but for a large part of that history, astronomy has played a part. Astronomers waiting at Eden on the south coast of New South Wales for the Transit of Venus, December 1874. This was one of the observation stations set up in Australia for the event which aroused the interest of astronomers all round the world. (Picture: Courtesy Australian National Library)



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Wednesday *22 August*

Commissions meet to discuss the metre

Astronomers have always taken a keen interest in the fundamental standards and constants of physics because of pressing practical requirements. It was the demands of solar and stellar spectroscopy that led to the establishment of the first accurate scales of wavelength, and following the interferometric measurements of A.A. Michelson at the end of the 19th century, the IAU adopted the wavelength of the red line of cadmium as the standard to which all wavelengths should be referred. Subsequently, from 1950 onwards, Commission 14 has been very active in the investigations and discussions that led to the wavelength of the orange line of Kr 86 being adopted as the international standard of length, replacing the platinum-iridium metre formerly accepted.

The wavelength of the Kr–86 line was considered to be reproducible to 1 part in 10^8, but in recent years gas lasers have given radiations with, it seems, far more reproducible wavelengths when they are stabilised by reference to the wavelength of an absorption line in a reference gas. For example, the 3.39μm line of the helium-neon laser can be stabilised against absorption in methane and the red line by absorption in iodine.

Partly because the frequencies of stabilised lasers are highly stable, it has been found possible to compare the frequencies of two lasers at widely different frequencies by harmonic comparison using a point junction diode as a mixer and harmonic generator. In this way, the frequency of the 3.39μm line of the helium-neon laser has been measured in terms of the caesium standard frequency, making use of the submillimetre HCN laser and the far infra-red water and carbon dioxide lasers for intermediate steps.

The upshot of these recent developments is that a better standard of wavelength than the Kr–86 line can now be foreseen and also, by combining measurements of the wavelengths of stabilised lines in terms of the Kr–86 standard with measurements of frequency, a new value of the speed of light can be established. The Kr–86 standard has, in fact, been shown by these studies to be reproducible to better than one part in 10^8, indeed, the new value of the speed of light, expressed in terms of the Kr–86 wavelength and the caesium frequency standard, is considered to be accurate to $\pm 4 \times 10^{-9}$.

The new developments and their implications for the standard of wavelength were discussed earlier this summ er at a meeting of the Consultative Committee for the Definition of the Metre, a sub-committee of the International Committee for Weights and Measures.

Dr. A.H. Cook, President of Commission 14, attended the meeting of the Consultative Committee as the representative of the IAU; other members of the IAU are also members of the Consultative Committee and at their request, the General Secretary has arranged for a joint meeting of Commissions 4, 14, 31 and 40 to be held on Tuesday 28 August at which these members will report on the discussions in the Consultative Committee, explain their significance for astronomy, and if it seems suitable introduce draft resolutions. Any new standard of wavelength will of course affect spectroscopists, though not very seriously; more important will be the adoption of a new value of the speed of light, because all astronomical distances are in effect, measured as times of transit of light or radio waves.

The European Southern Observatory on La Silla Mountain early in 1973. In the foreground is the dome of the Schmidt telescope, aperture 160 cm (100 cm corrector plate). In the background from left to right are the domes of the double astrograph (40cm), the photometric (1m) telescope, the spectroscopic (1.52m) telescope and the 50cm telescopes of ESO and Copenhagen Observatory.

The European Southern Observatory

The agreement under which the European Southern Observatory has been established came into force in January 1964 and by 1966 Belgium, Denmark, France, the German Federal Republic, The Netherlands and Sweden were participating in the project. The project was to make available to European astronomers first class observing facilities in the place where their use would be most effective – in the southern hemisphere. The Southern Headquarters are at Santiago de Chile and the Observatory is established on La Silla Mountain, 600 kilometres to the north. The general administrative services and the office of the Director General are in Hamburg and the Telescope Project Division whose main object is the design and supervision of the construction of a 3.6-m telescope is near Geneva.

Astronomers of member states are allocated observing time on the telescopes, with travelling and lodging expenses paid by the Observatory organisation so that the freedom to use observing time is not limited by the financial means of the home institution. Up to April 1973 observing time had been granted for 190 programmes proposed by visiting astronomers, including a small number from non-member States.

Research, both by the visiting astronomers and by staff in Chile, includes investigations of the Galaxy with special emphasis on the structure in the galactic plane and properties of individual galactic clusters. Considerable attention is also given to the Magellanic clouds, observations of which are favoured by good observing conditions in the period November to April.

Special projects on stellar objects include chemical abundances, variable stars and stellar magnetic fields. A major programme for the Schmidt telescope will be the extension of the Palomar Schmidt Survey in the blue and red to the southern hemisphere. The production of the sky atlas, based on the negatives taken at La Silla, is to be done by the Sky Atlas Laboratory at Geneva. This programme is closely coordinated with the plans for the Schmidt telescope to be established in Australia by the United Kingdom's Science Research Council.

The main instrument of the Observatory will be the 3.6–m telescope which is expected to be operational in 1976. This is designed for use at the prime focus as well as with cassegrain and coude facilities. For prime focus observations the observer will be seated in an observing station at the top of the telescope. For cassegrain observations he will also move with the telescope in a cassegrain cage and the coude laboratory will be immediately below the floor of the telescope building. It is expected that an important aspect of programmes of the telescope will be observational cosmology.

A group of early arrivals at the IAU has a chance to talk for a few minutes before the serious business of the Congress begins.

From left: Dr M.K.V. Bappu, India, Dr G. Contopoulos, Greece (both Vice-Presidents), Professor B. Strömgren, President, Professor F.K. Edmondson, President of Commission 20, Indiana, USA, and Dr Leo Goldberg, Kitt Peak Observatory, USA.

Reception tonight

A reception will be held tonight at Sydney Town Hall for the members of the International Astronomical Union.

The guests will be welcomed by the Minister for Science, Mr W. L. Morrison, the Lord Mayor of Sydney, Alderman Griffin, the Acting Vice Chancellor of the University of Sydney, Professor W. M. O'Neil and the foreign secretary of the Australian Academy of Science, Dr J.P. Wild. The President of the International Astronomical Union, Dr Bengt Strömgren will respond on behalf of the guests.

The function will begin at 1830 hours between 1730 and 1800 hours. Transport has been arranged to leave Carslaw Building.

Tomorrow a reception has been organized by the State Government for the Executive of the International Astronomical Union, national representatives, and Presidents of Commissions. This will be held at the State Government Offices and transport has been arranged from the Carslaw Building.

Have a look at Sydney

Sydney is famous for its beaches, particularly Bondi and Manly. A visit to Manly can serve a double purpose – stop off long enough to see Marineland with its killer sharks, giant stingrays and enormous turtles. Divers handfeed the creatures before your eyes.

Taronga Park Zoo is a 'must' for any visitor to Sydney, a chance to see Australia's unique wildlife in natural settings. The zoo is easily reached by ferry and bus and inquiries at your hotel desk or the conference centre will give you all the information you want on how to get there. Wear comfortable shoes to walk up and down the hills.

If you like animals, there is an African Lion Safari you can enjoy at Warragamba Dam. This is Australia's big game reserve and you can drive through the area and see 70 lions roaming free – no bars, no cages, no danger! As an added attraction there is the Dolphinarium where dolphins demonstrate their remarkable intelligence. Contact your hotel receptionist or the New South Wales Tourist Bureau for information on coach trips.

For further information, or to make a booking, contact Pioneer Tours, Oxford Square (corner Riley Street) or talk to the Ansett-Pioneer representative at the Congress centre.

The very latest

- 'Discovery 73', the major science programme presented on ABC television, which was videotaped at the Assembly yesterday will be seen on Channel 2 tonight at about 2000 hours.
- The meeting of Commission 6 on Thursday 23 August has been changed from session b to session d, room LT8.
- Meetings of Commission 20 will be held on Friday 24 August, sessions c and d, room LT8. The first session will be administrative and the second devoted to priorities for the observation of minor planets. This replaces the joint meeting with Commissions 15, 21 and 22, originally scheduled to meet all day.
- Commission 28, the working group on Magellanic clouds will be held on Tuesday 28 August, session b, LT11. Please contact C. Fehrenbach (4013).
- Commission 6 will hold its administrative meeting in room LT8 on Thursday 23 August session d.
- The open meeting of the working group on Numerical Data will be held Tuesday 28 August sessions c, d room LT12 instead of Thursday 23 August.
- The joint meetings of Commissions 27, 40, 42, 44 and 48 (variable x-ray sources) and 35, 42 and 48 (black holes, x-ray sources and radio stars in binary systems) are now combined into one meeting which will last all day on Thursday 23 August in room LT5. Invited speakers are: Tananbaum, Wade, Liller, Rees, Wilson and Kondo. There will be several other speakers and time for discussion.
- The Administrative session of Commission 48 (high energy astrophysics) will be held on the morning of Saturday 25 August in room LT4. There will be an additional scientific session on the afternoon of Wednesday 29 August in room LT8. Anyone interested in contributing to this session should contact M.J. Rees (7024) as soon as possible.
- Commission 24 (photographic astronomy astrometry) will hold two meetings on Friday 24 August, session ab in room LT7: the administrative meeting and the meeting on the southern hemisphere. On Wednesday 29 August, the commission will hold two meetings, 'reduction from relative measurements to absolute values', and the follow up to symposia 54 and 61.
- Pocket Programme:

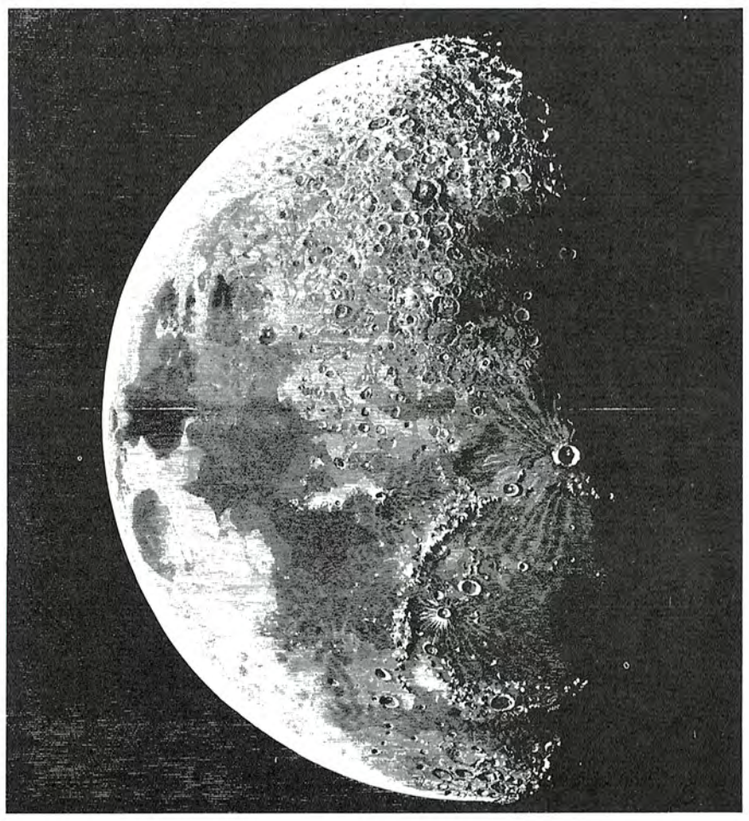
Thursday 23 August –

The pocket programme for the late sessions of Thursday 23 August should read –

	0930	1130	1414	1615
LT7	W.G. (Num.Data)	W.G. (Num.Data)	25	55
LT8	–	6	–	–
LT9	–	–	30	30
LT10	14, 29, 45		12	12
LT11	16	16	19	19
LT12	–	–	34	34

Early astronomy in Australia — 3

Australia does not have a long history of European settlement, but for a large part of that history, astronomy has played a part. An early photograph of the moon, taken from the Great Melbourne Telescope and published in the 'Australian Sketcher' in 1874. (Photo: Courtesy Australian National Library)



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ASTRONOMY 73

Published daily for the Fifteenth General Assembly of the International Astronomical Union, Sydney, Australia. 21–30 August 1973

Thursday *23 August*

Telling the IAU story

It may be difficult for scientists taking part in the IAU Assembly to believe it, but there are still people who do not know the difference between astronomy and astrology.

But after this Congress the communications gap on that score should be lessened if the amount of publicity given to the Assembly proceedings is any indication of how this can be brought about.

On Tuesday the Carslaw building had television cameras installed in a number of places, a studio was set up in one of the rooms, there were journalists from newspapers, radio and television present most of the day and press photographers were never far distant.

Among them was the ABC Science Unit which made a special presentation for their 'Discovery 73' series. In this, a half-hour programme shown on Channel 2 last night, producer Ron May, science editor, Mike Daley and journalists Robin Williams and David Ellyard introduced a number of Assembly personalities to Australian viewers.

An ABC news team which earlier flew to Siding Spring for the opening of the 48-inch Schmidt telescope, has also been present to interview other scientists.

One of the best known astronomers to Australian viewers, Dr Bart Bok, the former director of the Mt Stromlo Observatory was 'captured' by 'This Day Tonight' for a television appearance when he was in Perth last week.

Earle Bailey of Channel Seven and Rick Anderton from Channel Nine have both been around the Assembly doing interviews for their national network news programmes.

A number of features have already appeared in the Australian press about the Assembly. Miss Jane Ford, science writer for 'The Sydney Morning Herald' is likely to become a familiar face before the end of the activities and most of the other Sydney newspapers will be well represented to cover IAU activities and personalities.

Above left, Rick Anderton of Channel Nine interviews Dr Margaret Burbidge, Director of Greenwich Observatory, for a national news programme. The cameraman is Stephen Richards and the audio operator is Dennis Parker. Below, Robin Williams (left) science journalist and Mike Daley, science editor of the ABC (in typical pose) discuss the programme 'Discovery 73' which was made in a special TV studio in Carslaw building on Tuesday and shown on Channel 2 last night.

Over the last three years

The IAU has fallen a victim of the inflation that is rocking almost every country in the world.

This, states the annual report of the Executive Committee, prompted the Executive's decision to abandon some of its former 'acts of generosity' such as the free distribution of its Translations to Members and forced it to demand 'the increase of the unit of contribution payable to Adhering Organisations'.

The other trend which showed up during the three year period of 1970-73 was the expansion of IAU activities.

These embraced an increase in individual membership and an increase in the number of Commissions and Adhering Organisations. Relations with other international and national organisations became more involved while the number of scientific meetings sponsored by the Union doubled in comparison with the period 1967-69.

The number of Union publications increased and for 1973 work had to be completed for two Assemblies – one in Australia and the other in Poland.

Since 1970 two more countries, Cuba and Uruguay have joined the Union bringing the number of Adhering Countries to 46. The Republic of South Korea has also expressed interest concerning admission.

Membership of individuals has shown a steady increase; the total was 2509 on 1 February this year and some 600 other astronomers will be proposed for membership during the present General Assembly.

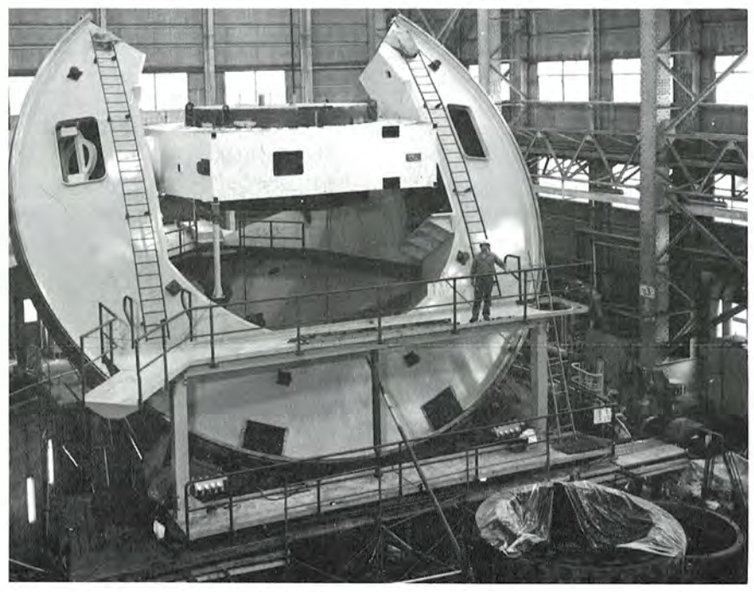
Fundamental astrometry at Heidelberg

One of the aims in fundamental astrometry is to provide the local inertial frame of rest for the measurement of motions of celestial bodies and the earth. In practice, it is given by a fundamental system of positions and proper motions of stars. For the determination of the system, absolute observations of positions of stars and of members of the planetary system are required which determine the position of the equator and the vernal equinox. Such observations have always been made by a number of observatories distributed over the whole world. For their reduction accurate values of the constants of precession, mutation, and aberration have to be known.

At present, a group of astronomers at the Astronomisches Rechen-Institut, Heidelberg, is starting work on a new fundamental system that they want to complete, if possible, before 1980. In the group are a few members of the team that has already compiled the present conventional system known as the Fourth Fundamental Catalogue (FK4). These are Drs. W. Fricke, W. Gliese, and Dr. T. Lederle. A number of younger colleagues will assist them in the large undertaking that consists in the analysis and exploitation of recent observations made at about 40 observatories and laid down in about 200 catalogues.

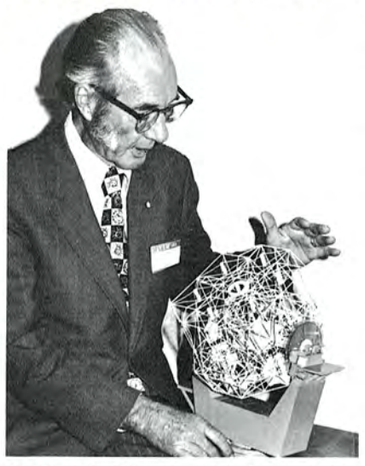
The aims of the programme are manifold. They include the elimination of large scale inhomogeneities still present in the conventional system, the improvement of the individual positions and proper motions of the fundamental stars, and the improvement of the position of the equator and equinox. Moreover, new fundamental stars shall be added to represent the system down to 9th visual magnitude.

Last but not least, one of the aims will be to extend the fundamental system down to very faint objects which are optical counterparts of extragalactic radio sources. The new radio astrometric techniques have opened the way for the establishment of an extragalactic reference frame represented by positions of compact radio sources. The positions of the optical counterparts then serve to link the classical fundamental system with an extragalactic reference frame. The result of the Heidelberg programme will largely depend on the active cooperation with astronomers in the fields of optical and radio astrometry who just met in Perth, Western Australia, for a discussion of 'New Problems in Astrometry' in IAU Symposium No. 61.



The telescope mount of the 150-inch Anglo-Australian telescope, built by Mitsubishi Electric Corporation, and currently being installed at Siding Spring, New South Wales.

Multi-mirror telescope



Dr Fred L. Whipple with the model of the multiple-mirror telescope.

A model of 'the telescope of the future' which is being built in the desert country of Arizona is attracting considerable interest at the Congress.

The model of the telescope, a multiple mirror project known as the MMT, has been brought to Australia by one of its 'inventors,' Dr Fred L. Whipple, Phillip Professor of Astronomy at Harvard and Director Emeritus of the Smithsonian Astrophysical Observatory in Cambridge, Mass.

With a light-collecting area equal to that of a conventional 176-inch reflector, the MMT consists essentially of six 72-inch reflectors mounted in a hexagonal array around a common core. The light from the primary mirrors (each f/2.7) will be reflected by their respective secondaries and brought to the system's common central axis by two plane-mirror reflections.

The six-barrelled tube structure will have an altazimuth mounting resulting in a system that is compact and rigid.

Nearly all observational astronomers feel a strong need for increased light-gathering power which can be obtained by using a larger collecting area or more sensitive detectors or both.

The problems involved in achieving this power are becoming increasingly difficult and the costs associated with it extremely high . . . even to duplicate the 200-inch Hale telescope would now cost an estimated $US20 million. Dr Whipple believes that the multi-mirror telescope, which is being built at a total cost of about $US400,000, may well be the answer.

The MMT is being constructed on Mt Hopkins at an altitude of 8600 ft. Philco-Ford Western Development Laboratories, who constructed the model, have started erecting the basic mounting and drive system and the mirrors are now being ground by the University of Arizona.

Design work is also being completed on the optical support system and on the building which will house the telescope. Unlike buildings of conventional telescopes which are domed-shaped, this one will be 'barn' shaped and the whole building with its ancillary rooms will rotate.

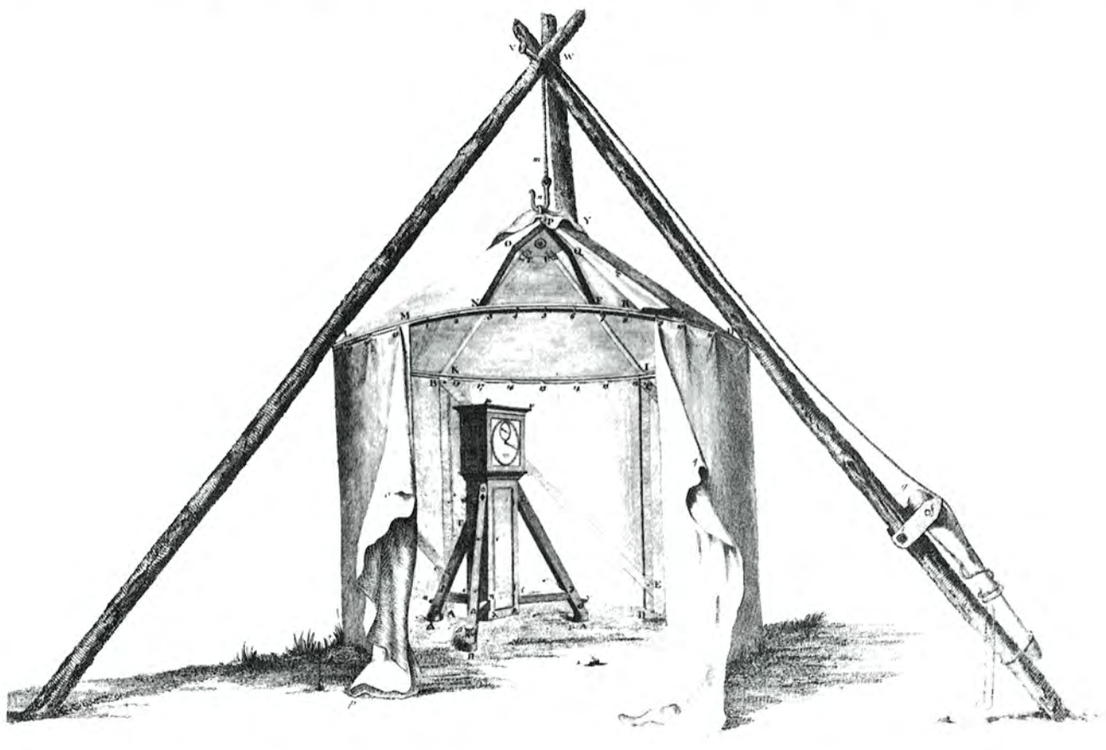
The idea of the MMT stems from Dr Whipple and a fellow scientist, Dr Adan Meinel of the University of Arizona who, along with his wife, Marjorie, has recently received much international publicity for the idea of a 'solar farm' which they believe could produce enormous quantities of solar energy.

Funding for their telescope is to come from the U.S. Government through the Smithsonian Institute and from the Arizona State Government through the University of Arizona.

Both Dr Whipple and Dr Meinel will be speaking on the subject of telescopes on Monday when the model of the MMT will be demonstrated.

Early astronomy in Australia — 4

Australia does not have a long history of European settlement, but for a large part of that history, astronomy has played a part. An astronomical observation post – Cook's second voyage to Australia. (Photo: Courtesy Australian National Library)



The very latest

- There will be a scientific session of Commission 47 (preceded by a short business meeting) in the afternoon of Monday 27 August in room LT9. Those interested in contributing to this session should contact M.S. Longair (7013) or M.J. Rees (7024).
- Symposium 60: Would all registered participants for Symposium 60 who have not yet checked at the Symposium 60 desk in the general office, please do so as soon as possible.

- A meeting of the Canadian Delegation will be held in room T14 on Friday, 24 August at 1315. K.O. Wright.
- Commission 15 will hold its administrative session in room LT11 on Friday, 24 August, session b.
- Commission 21 will hold its administrative session in room LT10 on Friday, 24 August, session c.
- Commission 22 will hold its administrative session in room LT10 on Friday, 24 August, session d.
- Commission 43 will hold its meeting on Special Problems in Magneto-Hydrodynamics in room LT10 on Saturday 25, session b (1115) instead of on Wednesday, 29 August.
- Commission 47 will hold its meeting in room LT9 on Monday 27 August, sessions c, d.
- A joint Meeting of Commissions 34 and 35 on Cloud fragmentation will be held in room LT10 on Tuesday, 28 August, session d.
- The joint meeting of Commissions 4 and 31 on UTC, scheduled for Saturday 25 August at 0930 will be held the same day, 25 August, at 1115 in room LT8.
- Contrary to previous announcements the meeting of the SCOSTEP Working Group on Flare Built-up Studies will now take place on Saturday 25 August. 0915 (exactly) till 1100 (exactly) in room LT4, Carslaw Building.
- A joint meeting of Commissions 8, 24 and 33 will be held on Saturday, 25 August, session a, in LT5. B.J. Bok will report on the astrometry symposium in Perth, followed by discussion.
- Commission 33's administrative session will be held on Saturday, 25 August, session b, in LT5.
- The item from Wednesday's 'Astronomy 73' which said 'The function will begin at 1830 hours between 1730 and 1800 hours', has been referred to the Ephemerides Commission.

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ASTRONOMY 73

Published daily for the Fifteenth General Assembly of the International Astronomical Union, Sydney, Australia. 21–30 August 1973

Friday *24 August*

A new look at the Sun

The first observations of the solar corona were made optically by eclipses; then came the technique of artifical eclipsing and the coronagraph. An entirely new method is now available for obtaining pictures of the corona, that is by the use of its radio emissions at metre wavelengths. The main difficulties of this method are posed by the needs (1) to obtain high enough angular resolution requiring a 'telescope' aperture of about one thousand wavelengths or 3 kilometres, and (2) to form, almost simultaneously, complete two-dimensional radio pictures as by a photographic plate. These problems have been met by the Culgoora radioheliograph in northern N.S.W. This instrument has now been in operation for more than 5 years. In his Invited Discourse last night Dr J.P. Wild presented some highlights among the wide range of results so far obtained. He used some 60 slides and 5 film sequences to demonstrate the results.

Fortunately from a physics point of view, phenomena which show strong emission in the radio pictures (unlike optical coronagrams) are generated by high-energy phenomena requiring the production of energetic electrons. Such electrons are often found trapped in magnetic fields, so that they act like tracer particles in radioheliograph pictures to reveal, for instance, the formation and eruption of huge magnetic arches which tower to million-kilometre heights above sunspot groups.

Dr J.P. Wild

The most important solar eruptions are the solar flares and it is in this field that the radioheliograms help to bring a stark clarity in explaining the diverse side effects of flares seen in the optical and X-ray spectrum and through geophysical phenomena. The radio observations show that most of the effects of large flares are due to an initial explosive instability that gives rise to (1) short bursts of high energy electrons at the start of flares – these cause the X-ray bursts and simultaneously the sudden ionospheric disturbances such as short-wave fade-outs; and (2) a long-range shock wave which spreads out from the flare causing prominence eruptions, particle acceleration and ultimately geomagnetic storms and aurorae on earth. Both the electron bursts and the shock wave are vividly portrayed by radioheliograph motion pictures and the remarkable way by which both can induce new disturbances at other far-distant centres of activity can be studied in detail.

One of the most interesting problems under study at the present time is a third class of flare effects brought about by subsonic jets of gas ejected from the flare centre. There is evidence that occasionally when such jets interact with the coronal magnetic field, self-contained blobs of coronal matter ('plasmoids') are caused to travel outwards along the radial field structure into interplanetary space. Such blobs are seen on the radioheliograph out to distances of up to 5 or 6 solar radii.

The above photograph shows the solar corona observed at the recent eclipse of 30 June 1973 from the National Science Foundation site at Lake Rudolph, Kenya, by J. Rush, L. Lacey, and H. Hall of High Altitude Observatory. A radially graded neutral density filter in the focal plane of the 2 metre focus camera largely removes the large intensity difference between the inner and outer corona and allows the entire corona to be recorded with a single exposure. Polar north is up and east is left. (High Altitude Observatory, Boulder, Colorado, is a Division of the National Centre for Atmospheric Research and is supported by the National Science Foundation.)

Accolades from ESSCO

We believe that accolades are due to all the participants and organizers of the Fifteenth General Assembly of the International Astronomical Union. Once again you meet in an atmosphere of peace, to share the results of your scientific efforts and to plan your future research. Such exchanges must inevitably accrue to the benefit of all mankind.

As our clients, we hope to supply you with tomorrow's radio telescopes. Meanwhile, we continue to learn from you so that we can focus our technology and resources toward satisfying your needs. All of us at ESSCO send you our very best wishes for a successful Fifteenth General Assembly.

Catalogue revised

A revised new General Catalogue of Nonstellar Astronomical Objects has been published by the University of Arizona Press. The catalogue is a revised edition of the original NGC catalogue issued in 1888 which was published under the auspices of the Royal Astronomical Society.

The task of revising this significant astronomical work was undertaken by two American scientists, Mr Jack W. Sulentic, a graduate student in astronomy at the University of Arizona and Dr William G. Tifft, Professor of Astronomy at the same University.

The work was begun by Mr Sulentic in 1964 and he was joined by Dr Tifft in 1969. The book was completed last year and is now available through the publishers.

The new version corrects many of the errors and discrepancies of the original catalogue and provides much new information particularly through its close ties with the Palomar Sky Survey.

Information is given on identification, types of object, equatorial and galactic co-ordinates, rectangular co-ordinates on the Palomar Sky Survey, magnitudes, both original and new descriptions and cross references into all major catalogues.

Dr Tifft, who is a participant at the Assembly, has a copy of the catalogue with him and will be happy to discuss it with any other interested scientist before his departure tomorrow. His registration number is 8180.

Proposed executive

The election of the Executive will take place on Thursday 30 August.

The proposed executive is as follows.

President
Professor L. Goldberg U.S.A.
Vice Presidents
Mr J.G. Bolton Australia
Prof. Ch. Fehrenback France
General Secretary
Prof. G. Contopoulas Greece
Assistant General Secretary
Professor E.A. Müller Switzerland
Continuing Vice Presidents
Professor B.J. Bok U.S.A.
Sir Bernard Lovell U.K.
Professor E.A. Mustel U.S.S.R.
In advisory capacity
Professor B. Strömgren, Denmark, Immediate Past President
Professor C de Jager, Netherlands, Immediate Past General Secretary.

The very latest

- The Joint Meeting of Commission 25, 27, 34, 37 and 40 on Monday afternoon 27 August in room LT5 is now entitled 'Very Compact HII Regions'. There is still time available for a few short contributions. Prospective speakers should contact M.W. Feast (7009) or F.D. Kahn (7012).
- JDV, 28 August (Morning only) 'Short Timescale Phenomena.' Speakers are G.R.A. Ellis: Jovian Radio Bursts; J. Ables: Review of Pulsars; and P.A. Sturrock and F.G. Smith: Two opposing theories of pulsar emission. Comments on the physics of the pulsar magnetosphere are expected from F.D. Kahn, L. Mestel and J.D. Piddington. Chairman M.S. Longair. Editors A.G. Lyne, F.G. Smith.
- Commission 28 (extragalactic astronomy) will continue its scientific meeting on Friday 24 August session a, b in room LT5.
- Commission 48: session on Saturday 25 August at 1115 in room LT4. In addition to the administrative meeting, this session will also include a paper by L.E. Peterson on 'gamma-ray flares' and other contributions.
- Commission 31 (Time) – Programme of Remaining Meetings.

Friday, 24 August,
Morning (0930) LT12
Meeting 2, jointly with Commission 4
Report by Director, BIH
Report by Director, BIPM
Report by President, Commission 31, on URSI General Assembly
Discussion on Velocity of Light.
Mid-morning (1130) LT12
Meeting 3, jointly with Commission 19
Astronomical Time and Latitude/Instruments

Saturday, 25 August
Mid-morning (1115) LT8
Joint meeting with Commission 4
"UTC" Question
Report by Chairman, CCIR Working Party 7/1 on experience with the new system

Monday, 27 August
Morning (0930 and 1130) LT9
Meeting 4 and 5
Reports on advances in Timekeeping (Clocks) and Relativity Clock Experiment
Resolutions adopted, organisation of mutual cooperation, priorities

Tuesday, 28 August
Morning (0930) LT11
Joint meeting with Commissions 4, 14, 40
Discussion on meeting of the Consultative Committee on the Definition of the Metre

Wednesday, 29 August
Morning (0930 and 1130) LT11
Meeting 6 and Special Session
Review of advances in time dissemination
Special Session on 'Applications of Precise Time in Astronomy'

- Commission 10 – Public Session
Dr Leo Goldberg will present a summary of preliminary results from the Skylab-ATM Solar Experiments on behalf of the ATM experimenters. This will be the first public presentation of these impressive new results. Tuesday, 28 August, Session b (1115 - 1245), room LT5.
- A meeting of the New Zealand delegation will be held room LT13 at 1600 on Monday 27 August. F.M. Bateson (5801)
- If you have booked for a theatre on Saturday evening please make a note of the time at which your bus will leave.
For the Independent Theatre, Bus No. 888 departs Women's College 1915, Wentworth Hotel (Phillip Street) 1930.
At the end of the performance your return bus will be waiting nearby.
For the Nimrod Theatre, Bus No. 666 departs Women's College 1920, Wentworth Hotel (Phillip Street) 1930.
At the conclusion board your bus in Victoria Street, where you alighted.
For the Ensemble Theatre, Bus No. 777 departs Women's College 1930, Wentworth Hotel (Phillip Street) 1945.
At the end of the performance your return bus will be waiting nearby.

Joint meeting on molecular radioastronomy

It is now eight years since the first stimulated radio emission from the hydroxyl molecule was detected by the radio astronomy group at Berkeley; since then, many hydroxyl sources have been found, sources of stimulated emission from water have been observed, the curious behaviour of formaldehyde has been noted, and radio emission from or absorption by more than 30 molecules has been discovered. As with all astrophysics, the interpretation of the astronomical observations requires data from experiements in the laboratory and from theoretical calculations; in this case, very precise frequen cies of transitions for identification, probabilities of emission of radiation, and cross sections for processes of excitation, formation and destruction of molecules.

Now, when such a wealth of astronomical data is becoming available, seems a good time to consider how far existing information suffices for interpreting those data, and what new information about molecular spectroscopy is needed.

A joint session of Commissions 14 and 40 has therefore been arranged for the morning of Saturday 25 August, to discuss modecular radio astronomy. Two speakers, Dr. B.J. Robinson and Dr. B.E. Turner, will discuss molecular data that the radio astronomer needs, while Dr. D. R. Johnson will discuss current experimental programmes.

Dr J.D. Mulholland of the University of Texas finds time to look through the scientific book display in Room T7, Level 3.

Book display

A comprehensive display of books and journals on subjects related to astronomy has been arranged by the University Co-operative Bookshop Ltd in Room T7 on Level 3. There are about 150 titles in this section, many of which have been flown in to Australia from overseas publishers specially for the occasion.

Several hundred copies of 'Astronomy and Astrophysics', a journal published by Springer-Verlag on behalf of the Board of Directors of the European Southern Observatory, are available for free distribution.

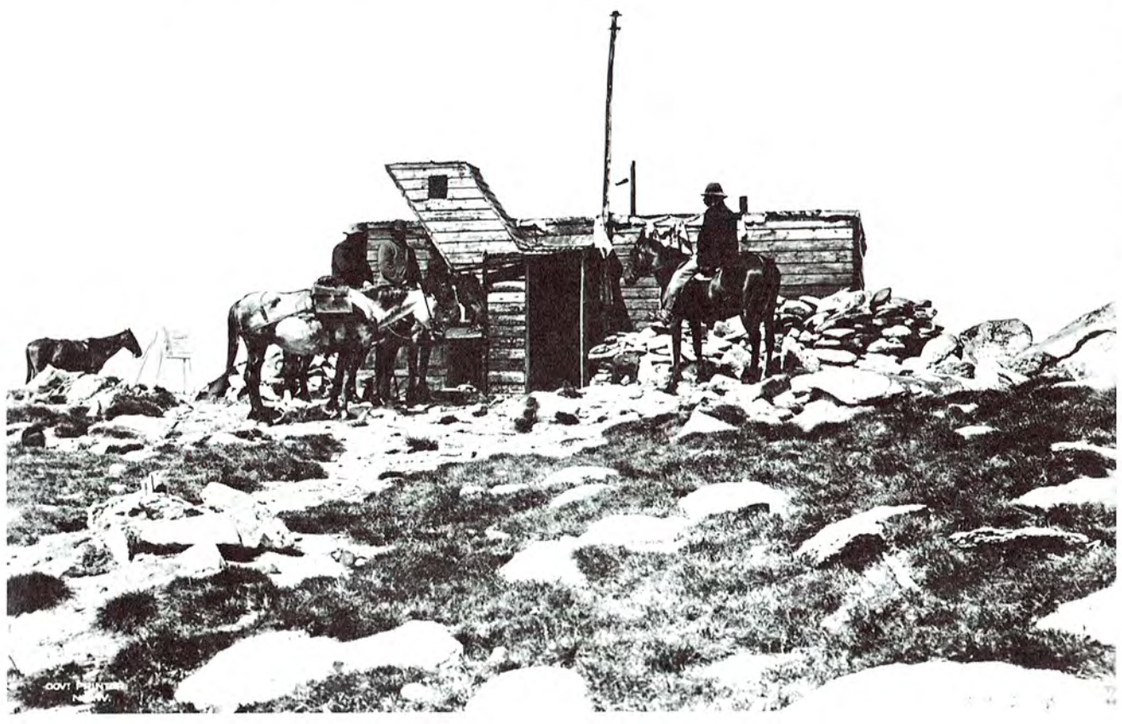
Volume XVA, 'Reports on Astronomy,' which are the IAU transactions, is available to members at a cost of $A39.90 and to non-members for $A59.90.

The collection also includes 'The Milky Way' by Dr Bart Bok and his wife, Priscilla, and 'The Radio Universe' by J.S. Hey.

The cover of a new book by Sir Bernard Lovell, 'Out of the Zenith' is on display. The book is not expected to arrive in Australia until December, but it is a more technical publication than its predecessor 'The Story of Jodrell Bank.' The new book describes the remarkable discoveries which have been made since the Jodrell Bank telescope was completed in 1957 and the new worlds of scientific knowledge which have opened up since investigations began into radio galaxies, quasars and pulsars.

Early astronomy in Australia – 5

Australia does not have a long history of European settlement, but for a large part of that history, astronomy has played a part. A wintry scene in 1900 at Clement Wragge's weather station, Mt Kosciusko, in the Snowy Mountains region. (Photo: Courtesy Australian National Library)



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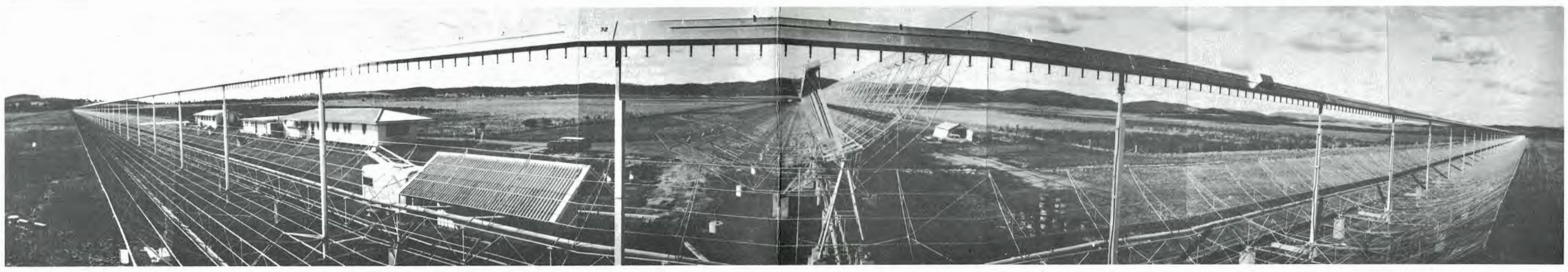
Monday *27 August*



Cooperation between Cornell and Sydney University astronomers

The unique organization known as the Cornell-Sydney University Astronomy Centre was founded in 1964 by the Universities of Cornell in New York State, U.S.A. and Sydney. Both universities jointly use all their facilities for work in astronomy, astrophysics and related fields. The joint directors of the centre are Professor T. Gold and H. Messel.

Cornell University under contract with the U.S. National Science Foundation operates the 305 metre radio and radar telescope of the Arecilio Observatory in Puerto Rico. The School of Physics, University of Sydney, has two main instruments: the stellar interferometer at Narrabri, NSW, directed by Professor R. Hanbury Brown F.R.S. and the giant Mills Cross (pictured above) at Molonglo Observatory at Hoskingstown, NSW, directed by Professor B.Y. Mills. The School of Electrical Engineering, University of Sydney, headed by Professor W.N. Christiansen operates an important antenna array at Fleurs, NSW, which acts as a 21 cm grating cross for radio emission maps of the Sun and as a rotational synthesis telescope of 40 arc seconds resolution. The two groups have closely related installations for the observation of cosmic rays and infrared radiation, experimental studies of planetary surface phenomena and of plasmas.

The Cornell 30 sm telescope is engaged in work on pulsars, distributions and classification of radio sources, galactic structure, emission from planets, solar observations, lunar occultations of radio sources, scintillations and the study of galactic objects.

The reflector is built in a natural bowl and is shaped to be part of a sphere. Tall towers support receiving and transmitting feed aerials which can be sited to cause a shift in the telescope beam of up to 20° from the Zenith.

The stellar interferometer is operated by the Chatterton Astronomy Department. It has a programme of measuring the angular diameters of single hot stars. 24 stars have been measured to date and a preliminary temperature scale has been published. Interesting stars such as αCMa (Sirius), αVir (Spica) and the Wolf Rayet Star and Velorum have been studied in detail.

Two large reflectors (each of 252 individual mirrors) of focal length 36 feet are mounted on circular rail ways tracks of 300 feet radius.

The Sydney University Cross is controlled by the Astrophysics Department. It operates at a single frequency of 408 MHz and has been used for surveys of the Milky Way and the Magellanic clouds, pulsar searching and the positioning of radio sources.

The arms of the cross are 1 mile in length and consist of modules of 40 feet wide cylindrical paraboloids of wire mesh. The East-West area is tiltable through ±55° from the zenith, the North-South "beam" is moved by electrical phasing of individual dipoles. The instrument has a reception bandwidth of 2.5MHz and a beam-width at the zenith of 2.8 arc minutes. The sensitivity is approximately 5×10^{-28} wattsm^{-2}Hz^{-1} for a single observation. Operation at 110 MHz is under preparation.

Allied work associated with the Astronomy Centre includes (1) at Cornell, theoretical astronomy and astrophysics, atmospheric and ionospheric radio investigations, radar astronomy, experimental cosmic ray studies, infrared astronomy and planetary and lunar surface laboratory investigations. In addition facilities such as a computing centre, a shock tube laboratory, the nuclear reactor laboratory and surface physics studies are available.

(2) at Sydney, ionosphere study, electronics and communication engineering, power engineering, control, computers and circuit theory, the Besser Computing Department, departments of theoretical physics, plasma physics and nuclear (high energy cosmic rays).

Astronomers and teachers

The General Assembly of the IAU is a meeting place for the professional astronomer. However, a Commission devoted to the teaching of astronomy must also meet with educationists and teachers if it is to remain alive to its responsibilities. In a new departure for both Commission 46 and the IAU, a meeting between the Commission and Australian Teachers of Science was arranged for 20 August 1973 in the Stephen Roberts Theatre. The response from the Australian teachers was most encouraging. While the majority of teachers attending came from New South Wales, the remainder of the Commonwealth was well represented.

For the Commission, Dr D. McNally discussed the relationship of astronomy with the physical sciences and Prof. W.G. Wenzel spoke about an approach to astronomy by means of limited topics and of the value of practical work carried out by means of using photographic materials. For the teachers, Mr H.K. Carey of the New South Wales Department of Education gave an introduction to Australian science education and in a pithy address, Mr R.H. Wilkinson of the University of Melbourne described the heights and depths of astronomical teaching. He gave the Commission an account of the production of the astronomical material for the Junior Schools Science Project.

JSSP material can be seen in the exhibition staged by Commission 46 in the Book Shop (T7). Mr J. Alexander of the Lindfield Demonstration School described how new approaches to primary school teaching allowed the natural interest of children in astronomy to develop. In perhaps the most original research aid of the day, 10 of his pupils gave some account of their project work in Australia.

Mr T. Dickson of Killarney Heights High School gave the Commission an account of astronomy at secondary level and staged a fascinating display of teaching aids available to teachers from Australian sources. The meeting was concluded by a lively discussion.

It was an enjoyable and successful day. At the lowest level the meeting provided a forum and focus for the teachers. However, the speakers provided a great deal of stimulating ideas and there was a vigorous exchange of information on available aids and material. The meeting may also have given a further impetus to efforts to prepare astronomical teaching materials for secondary education and for in-service courses in astronomy for teachers.

The Minister for Science, Mr W.L. Morrison, and his wife with the President of the International Astronomical Union, Professor B. Strömgren and Mrs Strömgren at the Reception to welcome Assembly participants. In addition to Mr Morrison, the Lord Mayor of Sydney, Alderman David Griffin, the Acting Vice-Chancellor of the University of Sydney, Professor W.M. O'Neil, and the Foreign Secretary of the Australian Academy of Science, Dr J.P. Wild, welcomed the guests.

Asiago reflector for Padua

During the last month (July 1973) a new telescope was put into operation at Asiago (University of Padua, Italy) – the f/3 parabolic mirror has a diameter of 182 cm and at the present the observations are carried out at the cassegrain faci (fg and f/16). The optics have been furnished by Grubb-Parsons while the mounting was completely made in Italy, under the supervision of Prof. L. Rosino, director, and Prof. Barbieri. The new telescope flanks the already operating 122 cm reflector and the 90/65 cm Schmidt. Its use will be mainly in the field of extragalactic research.

News item

R.F. Garrison and W. Krzeminsky report that photometric and spectroscopic observations from Las Campanas Observatory, European Southern Observatory, and Cerro Tololo Inter-American Observatory of CD-33°12119 = AS 231 indicate that it is an extremely heavily reddened, peculiar, variable star and is a possible identification for the X-ray source GX354+0. Preliminary reductions give V=10.20, nonvariable; B-V–2.10, with 0.1 mag. range of variation; U-B=1.20, with 0.3 mag. range of variation. Time scale of variation is of order minutes. Spectrum resembles A-Type supergiant, but with P-Cygni emission in Balmer lines and very strong interstellar features. 3U catalogue position of X-ray source (E. Schreier, private communication) is 1.3 arc min. North and 20 sec East.

Greek telescope

Since 1971 a new 30-inch Cassegrain reflector with asymmetric mount is in operation at the Stephanion Observatory ($\phi = +37°45'15''$, $\lambda = -22°49'44''$, H = 800m above sea level) in Greece. This telescope which belongs to the Department of Geodetic Astronomy, University of Thessaloniki (Director: Prof. Dr L.N. Mavridis) is equipped with a Johnson dual channel photoelectric photometer and a Meinel spectrograph. The research programmes carried out with this telescope refer mainly to the study of cepheids and flare stars as well as of the late-type stars.

Precise time

A Special Session of Commission 31 on 'Applications of Precise Time in Astronomy' will take place on Wednesday 29 August, beginning at 0930 in room LT11 of the Carslaw building.

The advent of atomic timekeeping and its rapid development has rendered the possibility of producing most uniform and accurate time scales, and that independently from observations of astronomical events. The measurement of precise time is no longer the sole domain of astronomers. However, astronomical observatories and astronomers have played a very important part in the development of atomic timekeeping and related techniques. Commission 31 of the IAU was the first body to recommend, in 1967, the establishment by the Bureau International de l'Heure of an international atomic time scale.

This activity of astronomers has by no means only a traditional background. Astronomical research would in many fields be less exhaustive or even impossible without the application of high precision clock time. Outside astronomy no need exists so far for clock time of greatest uniformity extending over very long time intervals.

It must be noted that, on the other hand, there are new fields of research which demand the immediate knowledge of astronomical time with high or even highest precision.

The Special Session is to serve as a forum of discussion and mutual information between Commission 31 to which 'Time' is entrusted, and specialists in various fields of application of precise time of different types. It is to draw the astronomers' attention to the fact that the advent of atomic timekeeping has opened up in astronomy new and unforeseen opportunities, and it is to give general information on the timing aspects of new developments.

In the beginning, a review will be given on Advances in Time Dissemination. Then the following members will speak at the meeting:
L.V. Morrison (Ephemeris Time, Atomic Time and the Secular Acceleration of the Moon);
J.D. Mulholland (Lunar Laser Ranging);
K.I. Kellermann (Very Long Baseline Radio Interferometry);
R. Wielebinski (Pulsar Research);
H.F. Fliegel (Time as Used in Space Research).

Interested members of the Union and their guests are kindly invited to attend the Special Session of Commission 31.

The very latest

• From Commission 46. Are you feeling just a little weary of high level papers? If you are, why not join Commission 46 in LT4 at 0915 and 1115 tomorrow Tuesday, 28 August, for a programme of educational and teaching films on Astronomy. The programme includes 'Exploring the Milky Way', 'The Birth and Death of a Star', 'A new Look at the Sun', 'The Solar Atmosphere', 'Fields of Space', and many more.

• The A.F.E.S. Graduates Fellowship (NSW) is presenting a Public Lecture by Professor R.L.F. Boyd in the Stephen Roberts Theatre, University of Sydney, Monday 27 August, at 2000. Professor Boyd, who is Professor of Physics in London University and Head of the Mullard Space Science Laboratory of University College, will be speaking on the subject: 'Kinds of Knowledge'.

• Correction to timetable. Joint Meeting of Commissions 4, 14, 31 and 40 on the Definition of the Metre: 28 August at 0930 in LT9.

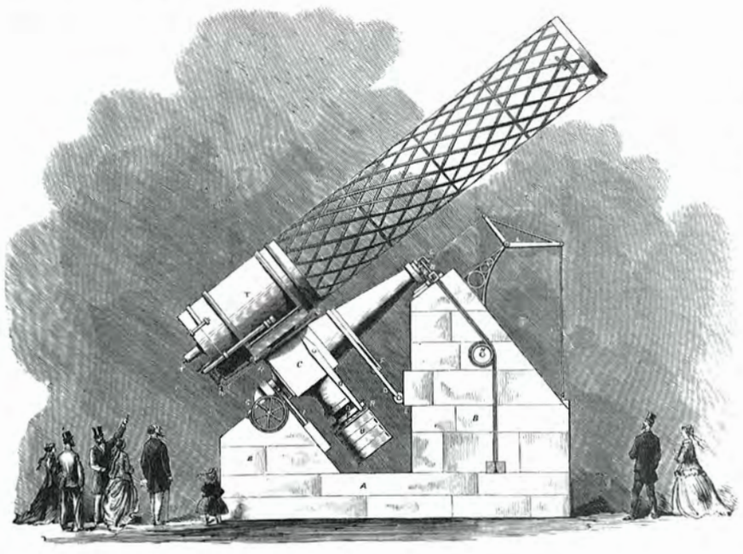
Postscript

All mail being posted through the special branch of the Post Office, which has been set up in Carslaw building for the Assembly, is being hand cancelled with a special post mark.

The mark, which has been designed by the Postmaster-General's Department, in collaboration with the local organising committee of the IAU, features the name of the Assembly and some stars of the southern sky as well.

Early astronomy in Australia — 6

Australia does not have a long history of European settlement, but for a large part of that history, astronomy has played a part. The Great Melbourne Telescope as it was pictured in the 'Illustrated Melbourne Post' in 1888. (Photo: Courtesy Australian National Library)



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ASTRONOMY 73

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Tuesday *28 August*

Polyatomic molecules in space

Dr C. Townes gave his Invited Discourse at the Great Hall last night. He discussed 'Interstellar molecules'. While four important diatomic molecules have been known in interstellar space for some time, the discovery of microwave lines of polyatomic molecules, beginning in 1968, stimulated intensive study of molecular phenomena in interstellar clouds, and has led to the rapid discovery of many molecular species. The 25 molecules which have so far been found in interstellar space include ones as complex as acetaldehyde and cyanoacetylene, and other organic forms which have long been taken as appropriate starting points for the synthesis of life. These molecules are closely associated with dust grains in dark interstellar clouds, grains which protect them from dissociating in ultra-violet radiation and which, probably along with ion-molecule reactions, are important in their formation

Molecular excitation in interstellar space characteristically deviates from thermodynamic equilibrium; excitation and relaxation due to collisions compete with radiative processes in ways which frequently result in heat engine cycles. Some such cycles refrigerate the molecular distribution in its various energy levels, others superheat the distribution and consequently produce maser amplification, giving enormously powerful sources of microwave radiation.

Molecular transitions in the microwave range provide for the first time useful probes into the interior of dark and cool interstellar clouds, yielding information on the cloud densities (ranging from about 10^2 to 10^8 molecules/cm^3), dimensions, velocities and turbulent motions, and temperatures. Usually, these clouds are prevented from rigid collapse primarily by their turbulent motions, but are quite non-uniform and are breeding grounds for condensations and new stars, condensations whose dynamics and behaviour can be revealed to some extent by their molecular microwave emission. Molecular spectra also are yielding substantial information about the relative abundances of isotopes of the common elements, and hence of the past nuclear processing to which interstellar matter has been subjected. To a first approximation the relative isotopic abundances of O, C, N, and S in interstellar matter turn out to be rather similar to those found on earth, but some differences are beginning to be apparent.

Improved equipment and future work offers some provision for the use of molecular microwave spectra to examine the chemistry and nuclear history of other galaxies.

Southern atlas

The European Southern Observatory (ESO) and the UK Science Research Council (SRC) have joined forces to prepare and publish a two-colour photographic atlas of the southern sky. It covers an area from declination -90° to -20° and is made up of 606 fields at 5° centres.

The scale of photographs will be the same as the Palomar Observatory Sky Survey and the limiting magnitudes will be similar.

The atlas, which will cost $A3000, will be published on transparent film protected in transparent envelopes.

Each copy of the atlas will consist of 606 prints from blue plates (IIIa-j) taken with the SRC 48-inch Schmidt telescope at Siding Spring and 606 prints from red plates (098-04) taken with the ESO 1m Schmidt telescope on La Silla, Chile.

Glass positives of the original plates will be made in Australia and Chile and all atlas prints will be made in the ESO Sky Atlas Laboratory in Geneva.

An invitation to subscribe to the atlas was sent to all major observatories at the beginning of the year and as a result of the interest aroused, the first edition has been almost completely taken up.

For further information about the atlas, please make inquiries in the Bookshop in room T7.

For most of his time at the Assembly, Dr P.E. Palmer has been involved in astronomical interests, but each morning and some afternoons of last week he took time off to get in training for the N.S.W. 25 km road championship. This took place on Saturday but Dr Palmer found the local competition too strong to take winning honours.

A keen athlete in his home country, Dr Palmer has been running up to 15 km each day. This, he claims, has not been unusual for he keeps in practice in Chicago and runs regularly for the university track club. In his younger days, Dr Palmer competed in national collegiate events but modestly claims 'never with outstanding success.'

Ceres watchers

During the night of 4 September the moon will be passing in front of the asteroid Ceres, one of the more important minor planets. The occultation by the seven-day-old moon will be visible in New Zealand and the south eastern part of Australia and the Department of Astronomy of the University of Texas is asking for the co-operation of both professional and amateur astronomers during this period.

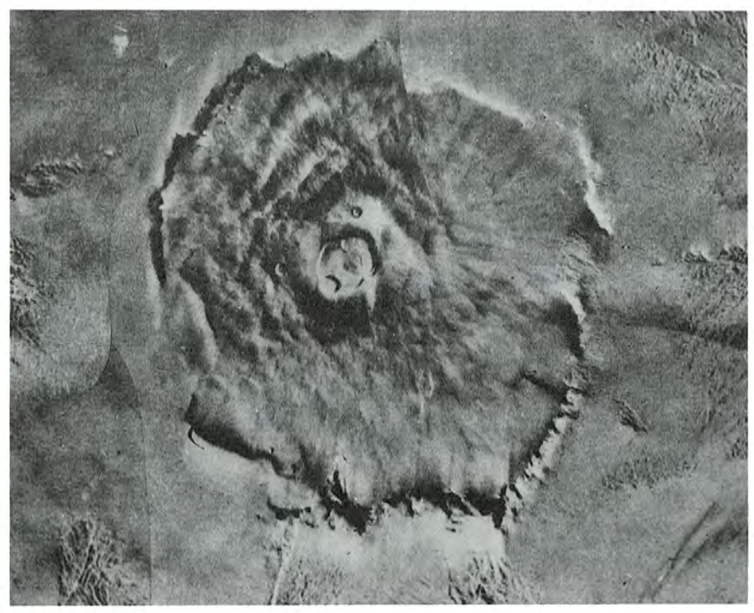
In the hope that a number of observations will be made by scientists and amateur enthusiasts Dr David W. Dunham and Dr J.D. Mulholland have prepared some material on the occultation and the predicted time of its disappearance. This will be available on the notice board in the main coffee lounge.

The scientists say that because of the relatively large inclinations of the four brightest asteroids to the eliptic, lunar occultations of these objects are rare, especially in conditions as favourable as they are being predicted for this event.

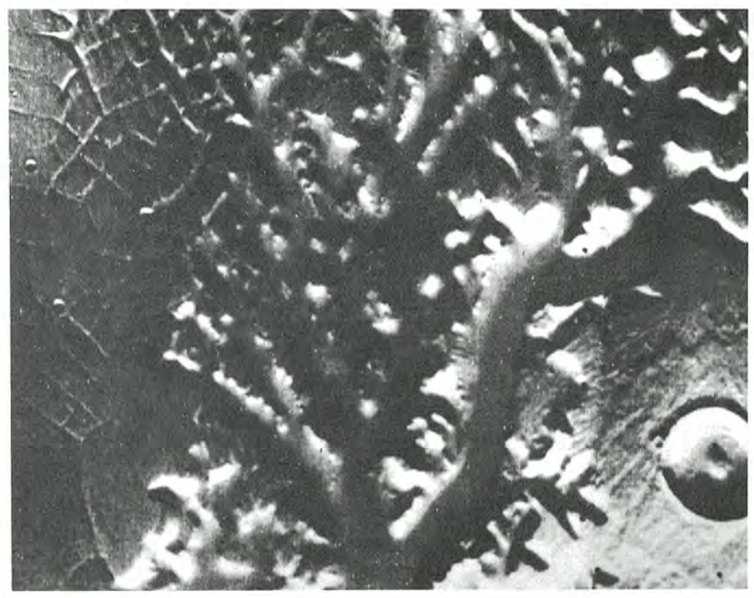
The sightings will be nearly central for New Zealand so conditions should be similar in both the North and South Islands. In Australia, conditions will vary markedly with a considerably longer duration nearer the northern geographical limit.

If enough observations can be made, the University is hoping to gain a more accurate idea of the size of Ceres and possibly discover, for the first time, its true shape.

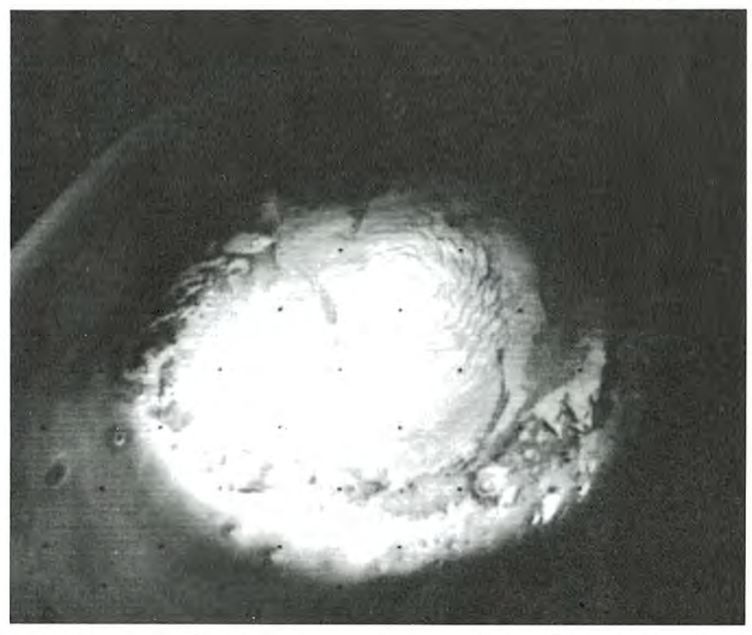
According to the Royal Greenwich Observatory, there will not be another occultation of one of the first four minor planets until July 1975 when Pallas will be involved.



These photographs taken by Mariner 9 were supplied by Professor C. Sagan, Professor of Astronomy and Director of the Laboratory for Planetary Studies, Cornell University, U.S.A. Nix Olympica, the largest of the volcanic constructs known in the solar system. It is about 500 km across and about 30 km high.



Series of collapse features, probably excavated by high velocity winds. The peak winds on Mars are estimated to have velocities of at least half the speed of sound.



The Martian north polar cap made of some still-disputed combination of CO_2 and H_2O frost. The temperature is about 140° absolute.

Ephemerides

It is very useful to many to be able to know where and under what conditions ephemerides of bodies in the solar system, star catalogues or lists of reduced observations are available. The International Information Bureau on Astronomical Ephemerides which was created by IAU three years ago under the auspices of Commission 4, has already been circulating this kind of information to about one hundred and fifty observatories, institutions or individual astronomers. The particulars are given on information cards that are distributed freely to all those interested (seventy seven cards have been issued so far).

If you wish to be put on the mailing list or if you have data that could be of interest to others, please contact Dr B. Morando (Box No. 4027), director of the Bureau, here at Sydney during the General Assembly, or write to the following address:

Dr B. Morando,
Bureau International d'Information sur les Ephémérides Astronomiques,
3 rue Mazarine 75006 Paris France.

Mrs Colleen Sparks (left) and Mrs Dianna Coulman with one of the displays of Australian wildflowers in the IAU coffee lounge.

Behind the scenes

Two years ago a women's committee comprising Mesdames W.N. Christiansen, R. Hanbury Brown (secretary), R. Giovanelli and J.P. Wild, started to work out the best ways they could cope with behind-the-scene organisation to look after 150 invited women guests who would be attending the IAU Assembly with their husbands.

Later they co-opted three more, Mesdames R. Bray, D. Coulman and J. Davis, each of whom in turn asked for more volunteers to assist them with various responsibilities.

The result has been that the guests have enjoyed a full programme during their Sydney stay and have had a chance to see aspects of life in Australia which might not otherwise have been available had they been left to their own devices.

One aspect of the women's work has been the arranging of flowers in the coffee lounge each day, and the display of Australian wildflowers has not only been admired but the women have been deluged with questions about them.

Organised by Mrs Coral Loughhead and Mrs Coulman, the wildflowers which have included waratahs, banksias, a native rose-wattle and boronia have been brought to Sydney from Woy Woy while all the women have been robbing their own gardens to keep up a plentiful supply of other blooms.

Each woman guest was presented with a small pot made by Mrs Arthur Higgs and where the guests were staying in the University colleges, these were in their rooms for them on arrival filled with flowers.

The very latest

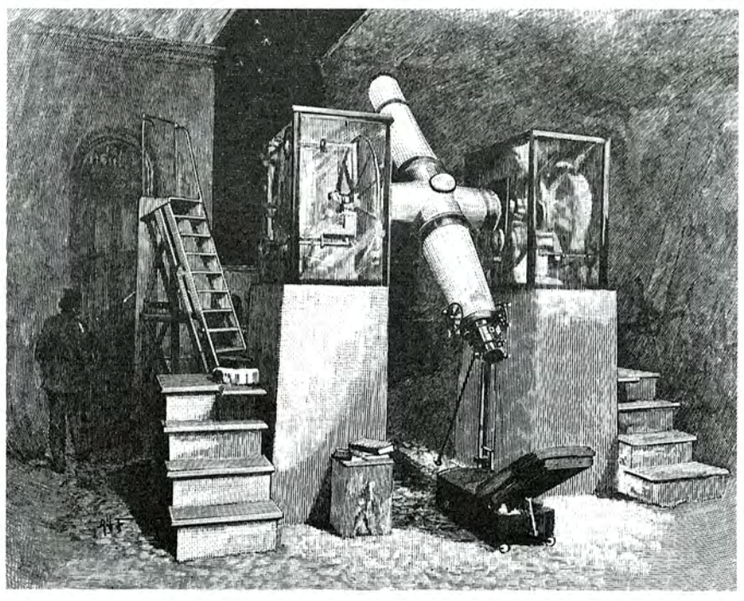
- An open meeting on numerical data arranged by members of the Working Group on Numerical Data is to be held this afternoon, sessions c and d, in room T15 on the 7th floor. All interested IAU participants are invited.
- Organ Recital, Great Hall, 1330 Tuesday 28 August
- Commission 28 will hold a final session for reports from observatories on Wednesday 29 August, session a (9.15 a.m.) in room LT5.

● Australian honoured

The Working Group on Lunar Nomenclature, Commission 17, has recommended that a crater be named in honour of John Tebbutt (1834-1916), a distinguished Australian amateur astronomer. Tebbutt's work, which ranged over many fields, such as comets, asteroid positions, nebulae, and novae, is generally recognized to have been of professional quality. The crater selected, previously known as Picard J, lies at longitude + 53.5, latitude + 0.5.

Early astronomy in Australia — 7

Australia does not have a long history of European settlement, but for a large part of that history, astronomy has played a part. A telescope in readiness for the Transit of Venus, 1874, at the Melbourne University. (Photo: Courtesy Australian National Library)



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ASTRONOMY 73

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Wednesday *29 August*

Early stages of the Universe

In his invited discourse last night, Dr D.W. Sciama assumed that the microwave background does have a black body spectrum (adding that we still badly need satellite observations at wavelengths below the expected at about one millimetre). It was also assumed that this background was thermalised by interaction with the general matter content of the times denser than it is to-day; the corresponding age of the universe would have been about 300 years. It would be possible to extrapolate further back in time if the helium in the universe had a cosmological origin. The relevant nuclear reactions would have occurred at an age of about 100 seconds, when the material density was about 3×10^{25} times greater than the present density, and the temperature about 10^{90} K. (This assumes that the black body background was already present at that time). To go still further back scientists must rely entirely on general relativity, which tells them that the universe must have had a singularity at some earlier time (or times).

A further important property of the early stages of the universe can be deduced from the observed isotropy of the microwave background, which is good to 0.1 per cent. This tells astronomers that the universe itself has been isotropic to this precision, at least back to the time when the background was last scattered, that is, back to when the age of the universe lay between 10^7 and 5×10^8 years (this range corresponding to the uncertainty in its present density).

This picture of the early stages of the universe gave rise to at least three important problems: (1) What is the ultimate origin of the black body radiation field and why does it contain between 10^8 and 10^9 photons for every proton in the Universe (this quantity

being time-independent when the expansion is adiabatic)? (2) Why was the early Universe so isotropic? (3) How can the initial singularity (or singularities) be eliminated? Possible solutions to these questions were discussed by Dr Sciama in the lecture, but it was emphasised that all these problems were still quite open.

Astrometry's future . . .

Dr Bart Bok reports

During the week of 12 August, IAU Symposium No. 61 on New Problems in Astrometry, with 65 in attendance met at the Westos Motor Hotel in Perth, Western Australia. Walter Fricke was the chairman of the Scientific Organizing Committee. S. Vasilevskis was the Vice-Chairman, and W. Gliese and C.A. Murray were the secretaries; B.J. Harris was in charge of local arrangements.

There obviously is a need to review now the problems of the accepted fundamental reference system of star positions and proper motions. The basic Fourth Fundamental Catalogue (FK4) has been *the* reference catalogue for the past 10 years. It needs up-dating and especially it should be made more readily useable in discussions of positions and motions referred to faint galaxies and in making use of radio galaxies as basic reference points for fixing precision stellar positions. The Organizing Committee had sensibly picked six areas for special discussion. I shall report briefly in each of these in the order of the Perth presentations

1. Reference systems
2. Southern hemisphere

The FK4 Catalogue needs to be replaced by FK5. Gliese reported that 150 good new catalogues of position have become available since 1950 and these must obviously be incorporated in FK5. We require first of all individual corrections to positions *and* to proper motions of the stars in FK4, and we need urgently a supplement to include fainter stars. The principal difficulties continue to be in the zones of declination south of -35°, but the situation for the south has changed radically during the past decade. When FK4 was prepared, we had only the positions and motions from the Cape Observatory in Union of South Africa to depend upon. The U.S. Naval Observatory has finished making 125,000 observations of southern stars with equipment at El Leoncito Station in Argentina. We now have basic data from 45,000 absolute positions determined by the Chilean and Soviet astronomers working together at Cerro Calan Observatory near Santiago and an additional 110,000 observations have been obtained at the Bickley Observatory in Western Australia, made jointly by astronomers from Hamburg and from Perth. All groups agree that large corrections should be made to the FK4 positions in the South Polar Cap. The present plan is to include in FK5 all observations to be made up to 1975 and issue FK5 about 1980. There will be 3000 to 5000 stars in the Supplement.

The needs of radio astrometry and of positions and motions relative to galaxies will receive special attention

3. Radio Astrometry

A new baby has burst forth full-grown upon the astometric scene: radio astrometry! Present at Perth were C.M. Wade, B. Elsmore, C.C. Counselman and several other radio astronomers to report on the successes to date. Very dependable positions for radio sources, with precisions in α and in δ of ± 0". 1 *and higher,* are now available for close to 100 radio sources, spread evenly over the sky to about 40° southern declination. The observations have been made to date principally with the aid of connected element radio interferometers involving moderate base lines of a few kilometers. Some work – promising ultimately precisions of the order of ± 0".005 – has also been done with the aid of Very Long Baseline Interferometers, some of them intercontinental. Absolute values for the declinations can be formed from the measurement of precise radii for the daily circles described by the radio sources, and *differences* in right ascensions can also be readily measured which is especially important since long arcs can be measured as precisely as short arcs (differences of time!). The zeropoints of right ascension are found either from observations of positions of radio stars (Algol, β Lyrae and P Cygni are on the list and more are promised!), or by referring the radio positions of optically identified compact galaxies with radio emission, and of quasars, to FK4 calibrated positions.

To make possible the effective use of the radio positions already measured, or about to become available, optical astronomers must provide (FK4 and FK5 Supplement) high calibre positions for many optically identified radio galaxies and especially for *all* radio stars. Furthermore we obviously need a system of faint standards (V = 16 to 19 more or less) for stars near radio galaxies. This will be done soon!

Once again, the southern hemisphere is being discriminated against: the radio interferometers that have been most effective to date have been in the northern hemisphere (Cambridge, England and Greenbank, West Virginia). This situation *must* be remedied with minimum delay, for we stand much to lose by neglecting once again the southern hemisphere at this early stage.

One of the great things that developed from the meeting at Perth was that it brought together the optical and the radio astometrists – who realize that one cannot succeed without the other.

This item will be continued tomorrow.

Observing in Chile

During the last ten years, astronomers from many parts of the world have become familiar with the dark clear skies of the Chilean Andes. From there, a truly spectacular view is obtained of that part of the Universe which can only be studied from the southern hemisphere. To take advantage of the special opportunities for astronomical research in Chile, a number of national groups have built and equipped new observatories there. These are all situated in the climatically favourable zone, several hundred kilometers in extent, north of Santiago, the Chilean capital. In this zone, the Andes come quite close to the sea and with the nearby dry Atacama desert and the cold Humboldt oceanic current, there are many mountains in the area on which observing conditions of the very highest quality are found.

One such site which is now in an advanced stage of development is that of the Cerro Tololo Inter-American Observatory. This Observatory is operated as an observing facility by a group of 12 United States universities under a contract with the National Science Foundation. The initial site survey for the Observatory was begun in 1959 by Dr Jurgen Stock. In 1962, the Cerro Tololo site, 2,200 metres above sea level and about 50km south east of the coastal town of La Serena, was finally decided upon for future development. Observations had already begun there on a trial basis a year before with a small 40-cm telescope. This 40-cm telescope is still being used today for research work on stars brighter than twelfth magnitude. Dr. Stock became the first director of the new Observatory and played a large part in its early development.

Since 1962, the number of telescopes on Cerro Tololo has increased impressively. The largest telescope now operating is a 1.5 metre Ritchey-Chrétien reflector which features a wide 1°.5 field for direct photography. This instrument also incorporates a large Coudé spectrograph. There are a number of smaller telescopes. The 90-cm reflector is used for photometric and spectroscopic work at its Cassegrain focus. There are two 40-cm reflectors used primarily for photometry. In addition, the University of Michigan's Curtis Schmidt telescope and a 60-cm reflector of the Lowell Observatory are now operating on Cerro Tololo. At the present moment, the 1-metre telescope of Yale University is being installed at the Tololo summit. The major project now underway is, however, the completion of the 4-metre telescope. This telescope is identical in design to the one recently brought into operation at the Kitt Peak National Observatory in Tucson, Arizona. The dome for the Cerro Tololo telescope was completed in 1972 and the telescope mounting is now being erected. The large Cer-Vit mirror is still being polished in Tucson and current plans call for its acceptance and testing later this year. The first observations with the new telescope are expected to be made during the latter part of 1974 and the telescope should be operating smoothly and be in routine use within a year after that. The 4-metre telescope will certainly provide a major impetus to the research activity at Cerro Tololo. The first instrument for the new telescope, a prime focus camera, has already been completed and first photographs of some of the many spectacular objects in the southern sky should be taken soon after the installation of the primary mirror. Other standard instruments such as photometers and a Cassegrain camera and spectrograph are now being fabricated and are expected to be ready for use at the same time that the telescope itself is completed.

Current research interests at Cerro Tololo tend to concentrate on the fields of galactic and extra-galactic research. These are especially profitable areas of investigation in the southern hemisphere at present. The availability of new telescopes and improved instrumentation have made possible significant studies of faint stars and galaxies which previously were beyond reach. However, the most exciting times are yet to come when the new large reflectors now being built in Australia and Chile are pointed at the southern skies. It is fair to expect a whole series of astronomical breakthroughs to follow, comparable in magnitude and scope to those which have resulted from the great telescopes of the north.

The summit of Cerro Tololo on a clear night looking south towards the 4-metre telescope dome. During the exposure of several hours duration, the stars made long arcs about the south celestial pole.

Itapetinga Radio Observatory

The Itapetinga Radio Observatory, operated by the Centre of Radio Astronomy and Astrophysics from Mackenzie University (CRAAM), Sao Paulo, Brazil, has recently put in operation a 13.7-m millimetre-wave precision radiotelescope, inclosed in a 23-m radome. It is the first instrument of this kind in the southern hemisphere, and presents a number of unique technical features.

The antenna has been originally conceived to be operated inside a space frame radome with good efficiency at K-band. Its structure is then very light, and temperature variation effects on the structure are minimized – not being observed, actually, in tests performed. The temperature inside the radome can still be raised, avoiding dew condensation in humid evenings. Exceptionally good pointing and tracking accuracies have been obtained – the antenna altazimuth mount being driven on line by a small computer. The absence of winds or severe temperature distortions keeps the system performance uniform any time of the day, and any season of the year.

The system has been used mostly at 22.2 GHz, showing no effect of the surface errors on the antenna efficiency. It can be used with acceptable efficiency at frequencies up to 100 GHz – and CRAAM will complete this year two other receivers, for 10 GHz and 48 GHz. The works recently done in the continuum were related to solar maps and studies of active regions, continuous measurements of radio sources of small angular sizes both galactic and extra-galactic, and extended investigations of tropospheric effect on radio projection in the K-band. With the use of a provisional and simplified spectral receiver, several successful observations of celestial water vapour sources were already done, and this constitutes another important research directive for the Itapetinga radio telescope.

The Itapetinga radio telescope is a project supported by Brazilian government research agencies. It is one of the largest millimetre-wave instruments yet built, and provides the southern hemisphere with an important tool for radio observations at wavelengths not yet explored in this part of the sky, for continuum works, and for molecular spectral researchers.

The Itapetinga 13.7-m radio telescope, inside a 23-m radome, for mm-waves, recently installed near the town of Atibaia, São Paulo, Brazil.

The very latest

- Commission 48 (high energy astrophysics). Speakers at the session on Wednesday afternoon (1415, Room LT8) will include M.P. Savedoff, F. Drake, L.E. Peterson, R.C. Catura, D.G. Wentzel and F. Meyer.

Early astronomy in Australia – 8

Australia does not have a long history of European settlement, but for a large part of that history, astronomy has played a part. The Sydney Observatory was built in the early days of the settlement of the colony of New South Wales. This picture, taken in 1892, shows the observatory as it was then but its exterior appearance has not altered significantly throughout the years. (Photo: Courtesy Australian National Library)

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