THE IAU HISTORIC RADIO ASTRONOMY WORKING GROUP. 2: PROGRESS REPORT

This Progress Report follows the inaugural report of the Working Group (WG), which appeared in the April 2004 *ICHA Newsletter* and was published in the June 2004 issue of the *Journal of Astronomical History and Heritage* (see Orchiston *et al*., 2004, below).

1 Role of the WG

This WG was formed at the 2003 General Assembly of the IAU as a joint initiative of Commissions 40 (Radio Astronomy) and 41 (History of Astronomy), in order to:

- assemble a master list of surviving historically-significant radio telescopes and associated instrumentation found worldwide;
- document the technical specifications and scientific achievements of these instruments;
- maintain an on-going bibliography of publications on the history of radio astronomy; and
- monitor other developments relating to the history of radio astronomy (including deaths of pioneering radio astronomers).

2 New Committee Members

Since the last report was prepared we have added two further members to the Committee of the WG. As Chair of the WG, I am delighted to offer a warm welcome to Richard Wielebinski from the Max Planck Institute for Radioastronomy, representing Germany, and Jasper Wall (University of British Columbia), who represents Canada.

3 Further Publications on the History of Radio Astronomy

Balick, B., 2005. The discovery of Sagittarius A*. In Orchiston, 2005b, 183-190.

Beekman, G., 1999. Een verjaardag zonder jarige. *Zenit*, 26(4), 154-157.

Cohen, M., 2005. Dark matter and the Owens Valley Radio Observatory. In Orchiston, 2005b, 169-182.

Davies, R.D., 2003. Fred Hoyle and Manchester. *Astrophysics and Space Science*, 285, 309-319.

Gordon, M.A., 2005. *Recollections of "Tucson Operations". The Millimeter-Wave Observatory of the National Radio Astronomy Observatory*. Dordrecht, Springer. Pp. xvii+221.

Gunn, A., 2005. Jodrell Bank and the meteor velocity controversy. In Orchiston, 2005b, 107-118.

Holpp, W, 2004. The century of radar. From Christian Hülsmeyer to Shuttle Radar Topography Mission. See: www.100-jahre-radar.de

Jarrell, R., 2005. "Radio astronomy, whatever that may be." The marginalization of early radio astronomy. In Orchiston, 2005b, 191-202.

Kellermann, K.I., 2004. Grote Reber (1911-2002). *Publications of the Astronomical Society of the Pacific*, 116, 703-711.

Kellermann, K.I., 2005. Grote Reber (1911-2002): a radio astronomy pioneer. In Orchiston, 2005b, 43-70.

Kellermann, K.I., Orchiston, W., and Slee, B., 2005. Gordon James Stanley and the early development of radio astronomy in Australia and the United States. *Publications of the Astronomical Society of Australia*, 22, 1-11.

Lovell, B., and Davis, J., 2003. Robert Hanbury Brown. *Biographical Memoirs of Fellows of the Royal Society*, 49, 83-106.

Orchiston, W., 2004. The 1948 solar eclipse and the genesis of radio astronomy in Victoria. *Journal of Astronomical History and Heritage*, 7, 118-121.

Orchiston, W., 2005a. Dr Elizabeth Alexander: first female radio astronomer. In Orchiston, 2005b, 71-92.

Orchiston, W. (ed.), 2005b. *The New Astronomy: Opening the Electromagnetic Window and Expanding our View of Planet Earth. A Meeting to Honor Woody Sullivan on His 60th Birthday*. Dordrecht, Springer. Pp. xvi + 328.

Orchiston, W., and Slee, B., 2005a. The Radiophysics field stations and the early development of radio astronomy. In Orchiston, 2005b, 119-168.

Orchiston, W., and Slee, B., 2005b. Shame about Shain! Early Australian radio astronomy at Hornsby Valley. *ATNF News*, 55, 14-16.

Orchiston, W., Davies, R., Denisse, J.-F., Kellermann, K., Morimoto, M., Slysh, S., Swarup, G., and van Woerden, H., 2004. The IAU Historic Radio Astronomy Working Group. 1: Progress report. *Journal of Astronomical History and Heritage*, 7, 53-56.

Raimond,, E., and Genee, R. (eds.), 1996. *The Westerbork Observatory. Continuing Adventure in Radio Astronomy*. Dordrecht, Kluwer Academic Publishers (Astronomy and Space Science Library, Volume 207). Pp. x+266.

Strom, R., 2005. Radio astronomy in Holland before 1960: just a bit more than HI. In Orchiston, 2005b, 93-106.

Swarup, G., 1986. The story of the Ooty Radio Telescope. In Cowsik, R. (ed.). *Cosmic Pathways*. New Delhi, Tata McGraw-Hill. Pp. 349-360.

Van Loon, B., and Hin, A., 2004. Scanning our past from the Netherlands: early Galactic radio astronomy at Kootwijk, and some consequential developments. *Proceedings of the IEEE*, 92, 1004-1006.

Van Woerden, H., 2000. Vijftig Jaar Toponderzoek. *Zenit*, 27(5), 196-200.

Wakker, B.P., de Boer, K.S., and Van Woerden, H., 2004. History of HVC research – an overview. In Van Woerden, H., Wakker, B.P., Schwarz, U.J. and de Boer, K.S. (eds.). *High-Velocity Clouds*. Dordrecht, Kluwer Acadmeic Publishers. Pp. 1-24.

Wielebinski, R., 2003. The new era of large paraboloid antennas: the life of Prof. Otto Hachenberg. *Advances in Radio Science*, 1, 321-324.

4 Up-Coming Publications

(1) Conference Proceedings: An interesting new book for historians of radio astronomy is:

> Orchiston, W. (ed.), 2005. *The New Astronomy: Opening the Electromagnetic Window and Expanding our View of Planet Earth. A Meeting to Honor Woody Sullivan on His 60th Birthday*. Dordrecht, Springer. Pp. xvi + 328.

This contains papers on the history of radio or radar astronomy by Bruce Balick, Marshall Cohen, Alastair Gunn, Rich Jarrell, Ken Kellermann, Wayne Orchiston, Wayne Orchiston & Bruce Slee, and Richard Strom (see the reference list above), which collectively account for 53% of the text of the book. Other papers in the book relate to astrobiology (2 papers), the history of space astronomy (3), the history of gamma ray astronomy (1), transits of Venus (1), and sundials (2 papers). *The New Astronomy* is in the process of being published, and copies can be ordered from Springer or through your local bookseller.

(2) JAH^2: The next three issues of the *Journal of Astronomical History and Heritage* (June 2005, December 2005 and June 2006) will feature a series of research papers on the history of radio astronomy. Altogether, there will be about a dozen different papers, most deriving from the history of radio astronomy sessions at the 2003 IAU General Assembly. Authors of these papers include Ron Bracewell, Bruce McAdam, Doug Milne, John Murray, Wayne Orchiston, Bruce Slee, Richard Strom, Woody Sullivan, Hugo van Woerden and John Whiteoak. For additional details, or offers of further papers, please e-mail Wayne Orchiston at the following new address: Wayne.Orchiston@jcu.edu.au

5 Recent Meetings

(1) JENAM-2003: From 27 to 30 August 2003 a symposium on "Radio Astronomy at 70: From Karl Jansky to Microjansky" was held in Budapest, Hungary. Although the bulk of the papers were on contemporary radio astronomy, the first session of the conference was devoted to historical issues and three papers were presented:

- Graham-Smith, F. "Early years of radio astronomy in Europe."
- Burke, B. "Early years of radio astronomy in the US."
- Gunn, A. "Jodrell Bank and the pursuit of cosmic rays."

These papers, and others presented at the Conference will appear in the following proceedings, which are currently in press:

> Gurvits, L., and Frey, S. (eds.), 2005. *Radio Astronomy at 70: From Karl Jansky MicroJansky*. EDP Sciences, in press.

For further information on this conference or the proceedings, contact Leonid Gurvits (lgurvits@jive. nl).

(2) Woodfest: In June 2004 a meeting spanning astrobiology, the history of astronomy and sundials was held at the University of Washington, Seattle, to celebrate Woody Sullivan's 60th birthday. Many of the history of astronomy papers related to radio and radar astronomy (see those by Balick, Cohen, Gunn, Jarrell, Kellermann, Orchiston, Orchiston & Slee, and Strom in the foregoing list of references). For further details of this conference e-mail Wayne Orchiston.

(3) ICOA-5: In October 2004 the Fifth International Conference on Oriental Astronomy was held in Chiang Mai, Thailand, and Richard Strom and Richard Stephenson organized a special session on "Supernovae: Historical Records and Observations". Among the papers presented were:

- Dickel, J.R. "Current observations of the remnants of Kepler's SN of 1604 and other historical supernova remnants."
- Orchiston, W., and Slee, B. "Early Australian observations of historical supernova remnants at radio wavelengths."

These papers will appear in the following proceedings, which are currently in preparation:

> Chen, K.-Y., Orchiston, W., Soonthornthum, B., and Strom, R. (eds.), 2005. *Proceedings of the Fifth International Conference on Oriental Astronomy*. Chiang Mai, University of Chiang Mai Press.

6 Up-coming Meetings

(1) Cambridge, England, 2005: The Historical Astronomy Division (HAD) of the American Astronomical Society will meet 4-8 September, 2005 (Sunday-Thursday) at the Umney Theatre, Robinson College, University of Cambridge.

This will be a joint meeting with the Division of Planetary Sciences (DPS) of the AAS. The HAD program will include nine, 90-min. sessions of papers. One or two of these sessions will be on the history of radio astronomy, and are being organised by Professor Woody Sullivan.

A Sunday evening reception will open the meeting; HAD papers will be on Monday, Tuesday, and Wednesday; with the conference DPS/HAD banquet on Wednesday; and on Thursday a final plenary session will be followed by tours of Cambridge sites relevant to the Conference.

Housing will be at St John's College and Robinson College. The Conference registration fees are $290 (full Conference) or $145 (one day) for members of DPS, AAS, or RAS, until June 30; see the Conference web site (http://www.dps2005.org/) for non-member & student/emeritus rates, and for accommodation charges. The deadline for advance registration, reservation of accommodation, and submission of abstracts is 1 July 2005. For general Conference details see the DPS web site or e-mail Peter Abrahams (had2005@europa.com).

Meanwhile, if you would like to present a paper on historic radio astronomy, please e-mail Woody Sullivan (woody@astro.washington.edu) as soon as possible for further details. Note that this Conference is open to non-AAS members.

(2) Prague, Czech Republic, 2006: The Twenty-Sixth General Assembly of the IAU will be held in Prague during 14-25 August 2006, and we are hoping to hold between two and four quarter-day meetings of the Historic Radio Astronomy Working Group. These will provide an opportunity for those interested in the history of radio astronomy to discuss their latest research, with emphasis on the development of radio astronomy in Europe, and the status of radio astronomy worldwide fifty years ago when 'big science' first began to impact on radio astronomy. For general information about the General Assembly consult the following web site: http://www.astronomy2006.com, and further information about the WG meetings contact Wayne Orchiston@jcu.edu.au

7 Research by Working Group Members

Ron Bracewell (Stanford University) has been researching the history of radio astronomy at Stanford as part of his efforts to ensure the preservation of the early radio telescopes at Site 515 (see below), and he is also preparing a paper for publication in the *Journal of Astronomical History and Heritage*.

Miller Goss (National Radio Astronomy Observatory, USA) and *Dick McGee* (ex-Australia Telescope National Facility) continued their biographical study of Ruby Payne-Scott, one of the world's first female radio astronomers. During WWII, Payne-Scott worked on radar developments whilst employed by the Commonwealth Scientific and Industrial Research Organization's (CSIRO) Division of Radiophysics in Sydney, and following the war carried out pioneering research on solar radio astronomy. She left Radiophysics in 1951 in order to start a family. Following Miller and Dick's paper at the IAU General Assembly in Sydney, the Australian Broadcasting Commission (ABC) took a special interest in Ruby Payne-Scott. She featured in the 'Science Show' on 14 February 2004, which included interviews with both Miller and Dick, and Miller was also interviewed on the ABC television program, 'Rewind Moments', which was screened on 7 February 2005.

Alastair Gunn (Jodrell Bank, University of Manchester) continued his research into the early development of radar (meteor) astronomy and radio astronomy at Jodrell Bank, and he and *Rod Davies* began a review of surviving historically-significant radio telescopes and associated equipment at this site.

Ken Kellermann (National Radio Astronomy Observatory, USA) is editing an English language version of the 1985 book, *History of Radio Astronomy in USSR*, which Denise Gabuzda is currently translating. This new English edition will be published by Springer. *Slava Slysh* (Lebedev Physical Institute. Moscow) says that this book "… contains some less known details of the early days of radio astronomy in USSR …", and he hopes the new edition will be updated and enlarged.

Ken Kellermann also reports that the National Radio Astronomy Observatory Archives actively seeks out, collects, organizes, and preserves institutional records and personal papers of enduring value which document NRAO's historical development, institutional history, instrument construction, and ongoing activities, including its participation in multi-institutional collaborations. As the national facility for radio astronomy, it also includes materials on the history and development of radio astronomy in the United States, particularly if such materials are in danger of being lost or discarded by other institutions or individuals. During 2004, the Web pages chronicling Nan Dieter Conklin's career as the first woman in US radio astronomy were completed; Grote Reber's correspondence and papers currently at NRAO were indexed and a finding aid was published on the Web; the papers of John Findlay are being indexed; and an inventory of both the Findlay and NRAO Director's Office files was completed. A Web page presenting Doc Ewen's informal recollections of events in US radio astronomy history is in process, while the papers of John Kraus will be sent to the NRAO Archives, where they will be processed and made available to researchers. The NRAO Archives is located at the NRAO headquarters in Charlottesville, Virginia. The web page can be found at http://www.nrao.edu/archives/, and includes links to NRAO Archives resources and to the NRAO Archives Policy.

A biographical study of the late Gordon Stanley—and the key role he played in the early development of radio astronomy in Australia and California—was carried out by *Ken Kellermann*, *Wayne Orchiston* (Anglo-Australian Observatory) and *Bruce Slee* (Australia Telescope National Facility), and was published in an Australian astronomical journal.

Wayne Orchiston (Australia Telescope National Facility), *Woody Sullivan* (University of Washington) and *Jessica Chapman* (Australia Telescope National Facility) have been collaborating on a book titled *The Foundations of Australian Radio Astronomy*, which will be published by Springer (New York) in 2006. This well-illustrated volume makes excellent use of the ATNF's unique collection of historical photographs of Australian radio telescopes and associated equipment, radio astronomers, and field stations. The book focuses on the nine field stations and twenty or so remote sites located in and near Sydney that were maintained by the CSIRO's Division of Radiophysics between 1945 and 1961.

In addition, *Wayne Orchiston* (Anglo-Australian Observatory) and *Bruce Slee* conducted further historical research on the Division of Radiophysics field stations and prepared a major review paper on these and a number of short papers on individual field stations. Wayne also prepared a bibliography on the history of radio astronomy in Australia, and he assembled a national master-list of surviving historically-significant Australian radio telescopes.

Meanwhile, *Bruce Slee* began reviewing the range of non-solar research carried out between 1968 and 1988 with the Culgoora Circular Array (aka Culgoora Radioheliograph). He also participated in the ABC's television program, 'Rewind Moments', about Ruby Payne-Scott (with whom he used to work back in the 1940s).

Govind Swarup (National Centre for Radio Astron -omy, India) reports that Dr Indira Chaudhary, an historian, is recording oral history interviews with radio astronomers at the Centre. "She has already interviewed me five times," he said, "and plans another five sessions. That material may get … put into a written semi-edited version in a year or so." In the course of the next year Govind plans to begin researching the history of the Giant Metre Wave Radio Telescope near Pune, with a view to writing this up.

Woody Sullivan (University of Washington) reports that he "… remains frustrated that his detailed treatment of the early (through 1953) history of worldwide radio and radar astronomy remains at the 80-90% completion point, where it has been 'stuck' for the past decade. But the good news is that he has a sabbatical year beginning in January 2006, and the first item on the 'to-do' list is to finish this book!" Woody also remarks: "It has been satisfying to see that recent visitors to Seattle have been making good use of his huge archive of materials on early (pre-1965) radio

astronomy. These were Ken Kellermann, Miller Goss, and in particular, Wayne Orchiston, who spent two months in late 2003 expressly to study portions of this material, especially dealing with Australia."

Hugo Van Woerden (Kapteyn Astronomical Institute, University of Groningen, The Netherlands) and *Richard Strom* (ASTRON, The Netherlands) have been researching the history of Dutch Wurzburg dishes and the Dwingeloo Radio Telescope. During the 1950s, as many as eight different Wurzburg-Riese radar antennas from WWII were being used in The Netherlands for radio astronomical research. Parts of six of these have survived, and currently two are in museums in Germany, and four are at a museum, a public observatory and a planetarium in The Netherlands. Hugo and Richard are also building up a bibliography on the history of radio astronomy in The Netherlands.

Richard Wielebinski (Max Planck Institute for Radioastronomy, Bonn) has been recording oral history interviews with German radio astronomers, and reviewing archival material on German radio astronomy in various repositories (in the process unearthing some wartime reports on radar by people who later were involved in radio astronomy). He has also begun developing a bibliography on the history of German radio astronomy, and is planning a digital picture gallery of various German radio telescopes.

8 The Preservation and Destruction of Historically-Significant Radio Telescopes

1) Stanford University: down a dirt road off Highway 280 in California is Site 515, where Ron Bracewell and other scientists from Stanford's Space, Telecommunications and Radioscience Laboratory (STAR Lab) established a major radio astronomy field station in 1956. The first instrument on this site was an array of 32 small parabolic antennas, each 10-ft in diameter, arranged in the form of a cross. From 1961 this array was used to generate daily microwave maps of the Sun, and for the next eleven years (i.e. one complete solar cycle) these were forwarded to the US Air Force and distributed around the world. Subsequently an interferometer comprising five 60-ft antennas was constructed, and this was used to study the angular diameters, temperatures and polarization of radio galaxies.

Towards the end of the 1970s the site was abandoned, and the radio telescopes and associated buildings began to deteriorate. In June 2004 Stanford University's fire inspector visited the site, finding weed-choked meadows, dilapidated buildings and rusting instruments. He declared Site 515 a fire hazard, and called for its clean-up.

Professor Channing Robertson, Senior Associate Dean in the School of Engineering subsequently called a halt to demolition of the antennas until 30 June 2005 in order to give the newly-formed Friends of the Bracewell Observatory (FoBO) time to mount a rescue effort. FoBO proposes to save and restore this site at no expense to Stanford University, and to upgrade the existing antennas so they can be used to track Stanford's SSDL CubeSat satellite. Between tracking missions, the facility will:

- Offer hands-on radio telescope facilities for the general public
- Be used for educational programs and mentoring in amateur radio astronomy
- Be available to amateur organizations, schools, and individuals for special projects

FoBO now has more than 60 volunteers, and pledges of funding which will allow the restoration of the first 60-ft antenna, its up-grade to satellite-tracking status, and initiation of the 'public program' bullet-pointed above. For further information, and offers of assistance, please contact Dr Bob Lash, Co-organizer Friends of the Bracewell Observatory (bob@bambi.net). See, also, the following web site, which includes some nice colour photographs of the dishes and control room: www.bambi.net/stanford_dishes/rescue.html

2) The Chris Cross: In stark contrast to the promising future for Site 515 in California is the fate of the historic Chris Cross radio telescope in Australia. This antenna comprised 64 parabolic antennas, each 19-ft in diameter, arranged in the form of a cross, and was erected at the Fleurs field station of the CSIRO's Division of Radiophysics in 1957. Initially, this cross-grating interferometer was used to generate daily solar isophote maps at 1420 MHz, but once the site was taken over by the University of Sydney's School of Electrical Engineering the array was converted into the Fleurs Synthesis Telescope (FST) with the addition of six 45-ft parabolas. With a 20 arcsecond beam, this array was used to study southern radio galaxies, SNRs and emission nebulae.

The FST was closed down in 1988 when the Australia Telescope Compact Array was comm.-issioned, and the Fleurs field station passed to the Engineering Faculty at the University of West-ern Sydney as a teaching facility. The FST dishes then began to deteriorate, and in 1990 a decision was made to preserve the large dishes and the 12 centrally-located Chris Cross dishes from the solar array. The remaining Chris Cross dishes were then offered to local astronomical societies, four were removed from the site, and the remaining ones were bulldozed. Undergraduate students were involved in cleaning and painting the surviving Chris Cross dishes, and on 22 November 1991 a ceremony was held at the site to commemorate their preservation.

In early 2005, CSIRO staff discovered that these surviving Chris Cross antennas had recently been destroyed. Apparently the dishes were beginning to rust, and a local farmer, concerned that children playing on them could be injured, requested they be bulldozed. The area is part of the University of Sydney's farm operations, and the site manager simply sanctioned this request—without even bothering to discuss this matter with any of the University's radio astronomers or other members of the IAU Historic Radio Astronomy WG employed by the Australia Telescope National Facility. As a result of this regretable action, the world has lost a pioneering radio telescope that for more than three decades made important contributions to solar, Galactic and extra-galactic radio astronomy. Currently, the rusting six large antennas remain, and efforts are being made to ensure that two of these are preserved.

9 Obituaries

Further to the obituaries listed in our initial report, it is with sadness that we announce the deaths of the following colleagues:

- Hendrik Christoffel (Henk) van de Hulst (born 19 November 1918, died 31 July 2000).
  Obituaries: Blaauw, A., 2002. *Proceedings of the American Philosophical Society*, 146, 419-423; Habing, H.J., 2001. *Astronomy & Geophysics*, 42(1), 1.33-1.35; Welther, B.L., 2000. *Bulletin of the American Astronomical Society*, 32, 1688-1689.
- Bob Duncan (born 1929, died 19 April 2004).
  Obituary: Sim, H., 2004. *ATNF News*, 53, 4-5.
- John D. Kraus (died 18 July 2004, aged 94).
  Obituary: see below.
- Brian Robinson (born 4 November 1930, died 22 July 2004).
  Obituary: Sim, H., and Orchiston, W., 2005. *ATNF News*, 54, 11-13.
- Christiaan Alexander (Lex) Muller (born 1923, died 8 August 2004).
  Obituaries: Van Woerden, H., Hin, A.C., Raimond, E., and Schipper, B.A.P., 2005. *Zenit*, 32 (1), 27-28; Van Woerden, H., Hin, A.C., Raimond, E., and Schipper, B.A.P., 2005. *Proceedings of the IEEE*, in press.
- Fred L. Whipple (born 5 November 1906, died 30 August 2004).
  Obituary: Yeomans, D.K., and Veverka, J., 2004. *Nature*, 432(7013), 31.
- Vladimir Kotelnikov (died 11 February 2005, aged 96).
  Obituary: see below.

Ken Kellermann kindly forwarded the following biographical details about *John Kraus*, which, although from an amateur radio source, do provide some information about his radio astronomical activities.

"Radio astronomer, antenna designer, cosmic explorer and author, John D. Kraus, W8JK, of Delaware, Ohio, died July 18. He was 94. While he enjoyed a worldwide reputation, Kraus is best known in Amateur Radio circles for his bi-directional wire beam antenna—often dubbed the '8JK array'. Other important Kraus designs include the corner reflector and helix antennas. The Michigan native was a pioneer of radio telescope design and the father of the 'Big Ear' radio telescope ...

A graduate of Michigan State University, he joined the faculty of the Ohio State University in 1946, serving as a Professor of Electrical Engineering and Astronomy, and founding and directing the OSU Radio Observatory. In that capacity, Kraus designed and oversaw construction of the 'Big Ear' on the campus of nearby Ohio Wesleyan University.

Kraus' classic textbook, *Antennas*, now in its second edition, has been an engineering school staple for decades and can be found in virtually every antenna engineer's library. Among his other titles are *Electromagnetics*, *Radio Astronomy*, *Big Ear*, *Big Ear Two* and *Our Cosmic Universe* …

Kraus was a Fellow of the IEEE and a member of the National Academy of Engineering. In 1966, Dayton Hamvention honored Kraus as the recipient of its Special Achievement Award. In 2001, CQ added Kraus' name to the inaugural class of its Amateur Radio Hall of Fame.

In 1978, after the 'Big Ear' detected the still-unidentified "Wow!" signal that suggested the possibility of intelligent life elsewhere in the Universe, Kraus launched *Cosmic Search*, a magazine devoted to the search for extraterrestrial intelligence. The 'Big Ear' fell victim to development pressures and was torn down in 1998."

Nicholai Kardashev and Slava Slysh, kindly sent the following brief report on *Vladimir Kotelnikov*: "With deep regret we inform you that on Friday 11 February 2005, Vladimir Kotelnikov died. He was in his 97th year. Academician Kotelnikov was a creator of the Scientific Radioastronomical Council, one of the pioneers of planetary radar exploration, a founder of the statistical theory of radio reception, and an author of numerous scientific papers and books. He was awarded Lenin and State Prizes, twice obtained the title 'Hero of Socialist Labour', was decorated with the order 'For Merits of the Nation' of the first grade, and received many other national and foreign awards. He was an Honorary Member of the Scientific Council of Astronomy."

On behalf of our international colleagues, we express our condolences to the relatives and friends of these distinguished radio astronomers who have recently been taken from us.

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