NRAO ONLINE 58.2

Colin Stanley Gum (1924-1960)

Colin Stanley Gum played a major role in the specification and especially the determination of the new galactic pole in the years 1956 to 1960. His short life of only 36 years (from 1924 to 28 April 1960) ended in a tragic ski accident in 1960, just after the five papers describing the new 1958 galactic system to *Monthly Notices of the Royal Astronomical Society* had been submitted.

Colin Gum received his Honours B.Sc. degree in physics from Adelaide in 1949, and then moved to Mt Stromlo Observatory in January 1951. He obtained his MSc. degree from Adelaide University later in 1951, based on work at Stromlo. While Gum was a graduate student at Mt Stromlo, he worked with Claborn ("Cla") Allen to make a 200 MHz all-sky image of the southern Milky Way. (Fig.1) They used the Yagi antenna loaned to Stromlo from RPL for solar observations carried out by Martyn at 200 MHz. (See NRAO ONLINE 24 Fig.1 for the Mt Stromlo 200 MHz instrument.)

One of the major rationales for the all sky image was to provide a calibration comparison for the 200 MHz solar observations using the bright radio emission from the centre of the Milky Way. . Compared to modern standards, the 25 degrees resolution is poor; however, the image was not superseded for some years. The image shows the non-thermal background of the Galaxy, with the major concentration at the galactic centre. Allen and Gum were the first professional optical astronomers to carry out work in radio astronomy.[1]

Gum's PhD thesis, "A Study of Diffuse Southern H-alpha Nebulae" was submitted in June 1954.[2] The degree was granted in 1955. Gum had used a makeshift camera (a f:1 Schmidt with a 10 cm aperture and an 11 degree field[3]) to detect 85 sources (40 were newly detected) in the Hα

[1] As pointed out in Chapters 12 and 14, Allen provided continual advice to the new radio astronomers in Sydney. Haynes et al (1996, page 164) have pointed out: "This was the first significant collaboration between optical and radio astronomers anywhere in the world."

[2] Based on obituaries by Pawsey (1960) and Bok (1961). The historical studies by Frame and Faulkner (2003, "Stromlo: an Australian observatory." Allen & Unwin, p. 124) and Haynes, Haynes, Malin and McGee (1996, *Explorers of the southern sky: a history of Australian astronomy*. Cambridge University Press, pages 298, 302) have also provided details of Gum's career.

[3] Allen had developed the camera in 1946 for the 130-foot nebular spectrograph, just before he left for University College London in 1951. In 1952, the spectrograph was damaged in a bush fire at Stromlo but the camera survived. Gum used this camera for his survey, having inherited this from his former supervisor. Also, Gum was one of the first astronomers to apply colour separation techniques in optical astronomy, a generation before David Malin perfected the technique at the Anglo-Australian Observatory in the 1970s.

emission lines, HII regions (in the 1958 revision system) over the longitude range 220 to 20 degrees.[4] These gaseous regions were excited by the uv radiation from the hot O and B stars, marking the site of newly formed stars. His exposure times were typically 20-60 minutes and he reached emission measures as low as 600 $cm^{-3}pc$. The most memorable discovery was the large emission nebula in the constellation Vela-Puppis, the "Gum Nebula", a large faint object with a size exceeding 30 degrees.[5] A fascinating book of 213 pages was published in 1973 (*The Gum Nebula and Related Problems,* a symposium of 18 May 1971 at NASA Goddard, editors Maran, Brandt and Stecher). The first contribution was by Frank Kerr, who worked with Gum in the years 1956 to 1959 at CSIRO Division of Radiophysics. Kerr contributed personal reminiscences in his text "Colin Gum and the Discovery of the Gum Nebula". Gum had been in competition with Bok and others who were working at the same time in South Africa at the Harvard Boyden Observatory. "The stress probably contributed to a nervous breakdown that [Gum] suffered." [6]

The submission of the thesis did not go smoothly. He submitted the thesis in June 1954, "the first by a student submitted to the Department of Astronomy by the usual means." (Frame and Faulkner 2003, page 124)[7]. As Ben Gascoigne pointed out to Haynes et all (1996, page 165), "the thesis was rejected by both Woolley at Stromlo and Plaskett at Oxford, but a third examiner was appointed and his enthusiastic report assured Gum his degree". The publication was in 1955, *Monthly Notices of the Royal Astronomical Society* (vol 67, page 155) "A Survey of Southern HII Regions". Gum set an example for surveys of the southern Milky Way that were carried out later with higher sensitivity and a wider angular coverage by Alex Rogers, Colin Campbell and John Whiteoak, whose well-recognized RCW catalogue has remained a valuable resource in the present era.(Rodgers et al,1960, p. 103)

---

[4] Data obtained at both Stromlo and also a site testing station in the Flinders Range in South Australia. In addition slit spectra were obtained with the nebula spectrograph for some of the fainter HII regions.

[5] Brandt, in the Gum Nebula proceedings, suggested a much larger size, 90 degrees in galactic longitude and 40 degrees in latitude. He pointed out that the hot stars Gamma Vel and Zeta Pup could only provide of order 10 percent of the required ionisation; thus a fossil HII region was the likely cause, originating from a smaller supernova remnant such as the Vela X supernova remnant.

[6] Haynes et al, (1996, page 164). Frame and Faulkner (2003, page 124) have described this event "Gum … suffered periodically from mental illness."

[7] As Susan Davis has pointed out (*Historical Records of Australian Science*, "R.v.d.R.Woolley in Australia", vol 6 (1), page 59, 1982) in 1949 Woolley had been appointed to an honorary chair of astronomy at ANU, with the right to supervise students. "Woolley used this position to turn the observatory into a de facto department of astronomy." Gum was one of two research fellows appointed in 1951; in this year Woolley also started a series of courses in astronomy with lectures by among others Hogg, Gasoigne, Woolley and de Vaucoleurs. The full incorporation into the Australian National University was a tortuous process, lasting from 1953 to 1957. The ANU would name a full professor of Astronomy earlier in November 1955, the same time as the opening of the 74 inch Grubb-Parsons telescope. This date was only a month before Woolley departed to the UK to become the Astronomer Royal on 7 December 1955.

In 1956, Gum became one of the first PhD **astronomers**[8] (our emphasis) at RPL, where he worked for three years, recruited by Pawsey. Kerr (1971) has described his period there:

> He spent three years there in my group [in fact in Pawsey's group.] … [H]e was concerned with 21-cm studies, and his most notable work was carried out as a member of the IAU Sub-commission which had the task of defining the new galactic coordinate system. This system is primarily based on the so-called principal plane of the neutral HI layer, as derived from the Leiden and Sydney 21-cm surveys of the 1950s. Colin Gum actually carried out the least-squared solution to determine the best position of this plane and was closely involved with the final choice of the coordinate system. A large variety of solutions was computed under slightly different assumptions, to gain a better understanding of the accuracies involved.

As we have seen in the main text, Gum's contributions to the new coordinate system were decisive; after the Moscow IAU he was made a member of the Sub-commission 33b. In the course of 1959, he was an active participant as a co-author on three of the five *Monthly Notices* papers. (See ESM_26.5, NRAO ONLINE 57.1, 57.2,57.3,57.4 and Chapter 26).

On 29 July 1959, he left Sydney for a Carnegie Institution of Washington Fellowship in Pasadena at the Mt Wilson and Palomar Observatories. His departure was dramatic. By chance he was a passenger on the first commercial flight of a jet aircraft from Sydney across the Pacific, a Boeing 707 QANTAS flight which departed on Saturday 29 July 1959 via Fiji, Honolulu and California. "The passengers received special VIP treatment." (Kerr 1971). Joe Pawsey and Alex Shain had gone to the Mascot Airport in Sydney for a farewell. But they arrived too late to see Gum. On 13 August 1959, Gum wrote Pawsey from Mt Wilson and Palomar Observatory: "I am sorry that there was not a chance to speak to you, but QANTAS had asked us to make our farewells by 3 PM and assemble on the tarmac for the christening ceremony prior to our departure at 4 PM." [9]

Gum immediately started a trip across North America, visiting Yerkes Observatory (host was G. Kuiper) and Wisconsin (Art Code) and finally at the American Astronomical Society in Toronto from 30 August to 2 September 1959. In the short period of only nine months, he was a Carnegie Fellow (until April 1960). During this time, he worked on observations of interstellar polarisation in external galaxies. But on 12 March 1960, he wrote to Pawsey and Bowen that the Mt Wilson Observatory had terrible weather since his observing had started in October 1959. Fewer than 10 per cent of his nights had experienced clear weather, much worse than Stromlo in the winter months of June-September! In his last letter to Gum from 21 March

[8] Soon followed by Campbell Wade from Harvard (1957-1959). See Chapter 28 and ESM_28.3.pdf
[9] NAA C3830 F1/4/GUM

1960, Pawsey remarked in a moment of whimsy: “I laughed at your comparison between Mt Wilson and Stromlo. Are you Jonah?”

At the beginning of 1960, Gum began a new stage of his career. On 5 January 1960, he wrote Pawsey telling him of a new opportunity: an offer of a Senior Lectureship at the School of Physics at Sydney University to assist in starting the new optical programme (see below). On 4 March 1960, Gum wrote Pawsey (for the first time “Dear Joe”[10]) with the news that the official offer from the university had come through. “I feel quite sorry about having to do this, but I think the University position gives me something that I want. I am glad however that I shall be near RPL. I am planning to take a quick trip to Europe lasting about 3 weeks, in order to talk with the telescope manufactures.” The expected duration was 6 to 27 April 1960; he was awaiting Harry Messel’s approval. Gum expected to make a final decision about the nature of the new telescope by the end of April. He also hoped to attend a Royal Astronomical meeting in early April in the UK. A week later, Gum sent a letter to Pawsey and Bowen with an un-official notice of resignation from CSIRO, written by hand.[11] He told the colleagues in Sydney that he would be at the RAS meeting and Herstmonceux conference on 8 to 12 April 1960 followed by a visit to Leiden on 13 to 15 April. The visit to the Netherlands was planned around a visit with the prominent Dutch engineer (designer of the Dwingeloo and later the Westerbork antennas), Ben Hooghoudt, in Leiden as well as the engineering firm of Rademaker BV near Utrecht. However, Gum seemed more interested in the copy of the Kitt Peak 36-inch telescope from the Boller and Chivens Firm in Pasadena, California. The Kitt Peak group at AURA (Associated Universities for Research in Astronomy) were willing to provide the design to the University of Sydney.

The original plan was to leave Leiden on 16 April and spend four days in Groningen and then visit German firms in Hamburg and W Berlin, returning to Leiden on 21 April to return to the US on 25 April.

However, his plans changed. He left from Leiden for Germany later in the month, intending to ski at Zermatt in Switzerland before the visit to the German firms. He perished on 28 April 1960 in a tragic ski accident. The Adelaide newspaper *The Mail* published on 30 April a picture of Colin Gum with the headline “SA Man Dies in Ski Fall”. “He was killed when he fell over a precipice. British United Press said he left the normal route and fell on to rocks.” When Goss arrived in Australia in 1967 at RPL as a postdoctoral fellow, several colleagues told him that Gum had possibly failed to understand the warning signs in German and French. In 2010, Corrie

[10] This is the first time the salutation was not “Dear Dr Pawsey”.

[11] The official typed letter was sent two days letter to Bowen: “ ... [M]y association with CSIRO and the Lab was an extremely happy one. However, I feel that the position in the astronomy school in the University is just what I want.” But he would be close to RPL on the university grounds, enabling renewal of personal and scientific friendships.

Hooghoudt (the widow of Ben, whose death had been about 15 years earlier) told Goss that she took Colin Gum in her car to the train station in Leiden in late April 1960 as he departed for Switzerland; a few days later, she heard the tragic news of his death.

Haynes et al in 1996 (page 298) pointed out a number of background issues that were impacted by the tragic death of Colin Gum in 1960. They enumerated the complex connections between the optical telescope planned by Gum, the Hanbury Brown-Twiss optical interferometer project and surprisingly even the Mills Cross:

> [In the late 1950s, Messel, the new head of Physics at Sydney University, wanted to start a programme in optical astronomy; a problem was competition with other more established astronomy groups in Australia.] … [I]n March 1958 Messel convened … a summit meeting with Bart Bok of the Mount Stromlo Observatory [having arrived in Australia in March 1957), Taffy Bowen, Chief of the CSIRO Division of Radiophysics, Ronald Giovanelli of the CSIRO Division of Applied Physics, Richard Twiss, who was still at the Division of Radiophysics, Harley Wood, the NSW Government Astronomer, and other members of the School of Physics. In order not to duplicate research efforts, it was agreed that the development of astronomy [at Sydney University] should focus on two projects, the Hanbury Brown-Twiss optical interferometer and another smaller project in optical astronomy that should, in the first instance, not aspire to more than one full-time astronomer (Twiss) with a suitable telescope, probably a 48-inch Schmidt, to be located at Mount Bingar [in central New South Wales at elevation 450m], which fitted in well with Bok's plans at that time for the development of Mount Stromlo … A few weeks after this meeting, at the fifth annual dinner of the Science Foundation on 25 March 1959, Messel announced the formation of the University of Sydney Astronomy Department with two fields of research [radio and optical], each, requiring its own major instrument.
>
> Typically, Messel was quick to set up both projects. He appointed Colin Gum, formerly of the Mount Stromlo Observatory and the Radiophysics Laboratory, as Senior Lecturer in charge of optical astronomy and immediately despatched him to Europe to investigate the feasibility of the Department's acquiring a 40-inch reflector instead of the 48-inch Schmidt proposed by Bok.
>
> Gum's death in a skiing accident in Switzerland on 28 April 1960 ended not only his own promising career but the whole project, and Messel's vision of an optical astronomy centre on the classical model of a single large optical telescope was never to materialise.

The remaining project, the optical interferometer, did go ahead, finally opening with the main observing projects in May 1965, under the leadership of Hanbury Brown and collaborations with Richard Twiss and Cyril Hazard , starting in 1961. Brown had moved to Australia in February 1963. (Haynes et al 1996).[12]

The connection with the Super-Cross (see Chapters 31 and 32) and the "Colin Gum" project was ironic. The Science Foundation for Physics had previously set aside £80,000 for the optical telescope, the construction of the new observatory for the 40-inch telescope. With Gum's death in April 1960, "Messel persuaded the Foundation not only to transfer this funding to the construction of Mills's telescope but to increase the amount to £100,000." (Haynes et al, 1996, page 302).

In summary, the admiration that Pawsey, Bok and Kerr had for Gum was expressed in the obituaries of 1960 and 1961 and the retrospective of Kerr, a decade later. Pawsey (1960) "His death is deeply regretted by his colleagues in Australia, both radio and optical, and is a very serious loss to Australian science."[13]

Bok in 1961 (*Memoirs of the Royal Astronomical Society*, March 1961): " Colin Gum was one of the best liked and most admired of younger Australian astronomers and many of us have a deep sense of personal loss at his too early death. Australia is still very short of first class astronomers trained and educated in the country, and his death is a severe blow to the development of Australian astronomy … For a person of his age, Colin Gum leaves behind a solid and impressive bibliography of significant contributions … [H]e has left his permanent mark on the development of astronomy."

Kerr (1971): "He had a short scientific life, but he completed several important studies in both optical and radio astronomy, and his name is well entrenched in the sky through the famous nebula … " An equally important contribution is the major role Gum played in the 1958 galactic coordinate system. (ESM_26.5.pdf)

[12] Hanbury Brown described his experience with the new instrument in 1974 in his book *The Intensity Interferometer. It's Application to Astronomy*

[13] Gum's death was the second tragic loss of a young colleague of Pawsey's. Earlier in 1960, on 11 February, Charles Alexander ("Alex") Shain died in Sydney at age 38. See Chapter 30. The Pawsey children (Hastings and Stuart) remembered the major impact these two events had on their father.

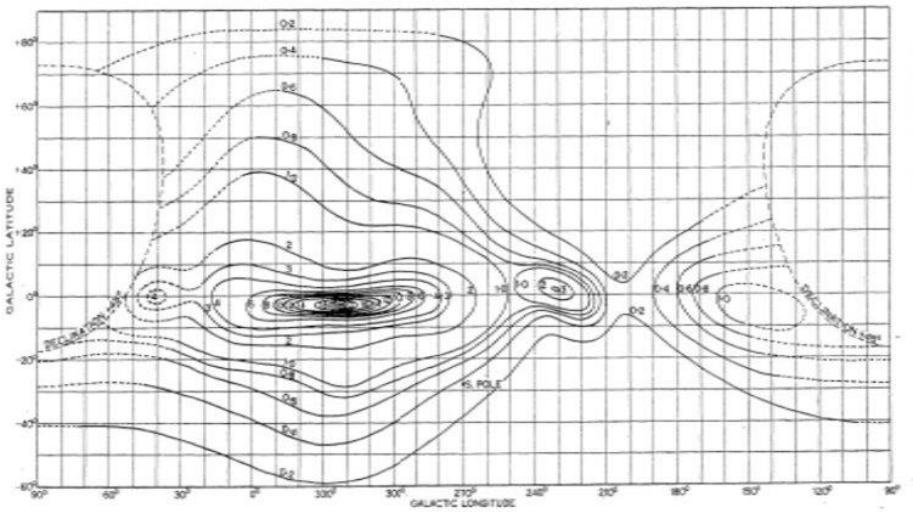

Fig. 6.—Distribution of galactic electromagnetic radiation at 200 Mc/s. [Minimum of sky taken as zero.] Unit = 10^{-41} watts m.$^{-2}$ (c/s.)$^{-1}$ (steradian)$^{-1}$.

Fig 1 200 MHz image of the southern sky made by Gum and Allen (1950, *Australian J Scientific Research*, vol 3, 224 “Survey of Radio-Noise at 200 MHz”). Observations from Mt Stromlo, beam width 25 deg. Coordinates are the old galactic longitude and latitude. The antenna is shown in Fig1. NRAO ONLINE 24