

## **NRAO ONLINE 57.1**

### **Stromlo Conference 12-13 May 1957<sup>1</sup>**

#### **See ESM\_26.5.pdf New Galactic Coordinates (1958 revision)**

Due to the painstakingly slow collection of data for the new galactic coordinate system during 1956 and the first half of 1957, progress lagged. However, by May 1957, Pawsey was optimistic that a report could be presented to the IAU at the next IAU in 1958 (Moscow).

In May Pawsey visited with the astronomers at Mt Stromlo where the new galactic coordinate system was discussed during a meeting in Canberra, "Coordination of Galactic Research"<sup>2</sup>, a few months after Bart Bok had arrived from Harvard to become the Director of Mt Stromlo.

"Galactic Coordinates" were discussed at length with talks presented by Bok: "Historical Notes about the Position of the Galactic Plane", Pawsey: "The Current Problem", Kerr: "The Place of Radio Investigations", Gum: "Comparison of Radio and Optical Studies" and Pawsey: "A Proposal for a Revised System".

Pawsey pointed out that the Dublin IAU resolution required an examination of the form and motions of the galaxy as well as the determination of the desirable features of a new galactic coordinate system. This new system should be "fixed" with respect to the galaxy with a "simple" relation to the form of the Milky Way. For example, the pole of the coordinates should be coincident with the "axis" of the galaxy and the zero of the longitude should be the direction of the "galactic centre".

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<sup>1</sup> The major references for this text were obtained from the Blaauw archive in Groningen: Groninger Archieven, based on the finding aide by P. Huisinga "Plaatsingslijst van het archief van Prof Dr A. Blaauw, astronoom en directeur van het Kapteyn Instituut, 1940-2008." Also from the NAA, the galactic coordinate collection in C3830 C25/7 (Parts 1,2,3) as well as Pawsey correspondence in C3830 Z3/1/6, 7, 8,9 (1955 to 1959).

<sup>2</sup> This meeting was an Australian pre-conference to prepare for the Stockholm conference 17 to 22 June 1957, "Coordination of Galactic Research". (NAA C3830 C164B for all presentations at the Mt Stromlo conference). A group from CSIRO in Sydney joined their colleagues at Stromlo to discuss the topics that would be discussed later in Stockholm. Frank Kerr was at the Stromlo meeting, a month before he departed for Europe on 4 June. He was to visit the Leiden group of radio astronomers at Leiden from 13 June to 1 December 1957. Kerr attended the Stockholm meeting during the period 17 to 22 June 1957. Arthur Hogg from Mt Stromlo was the other Australian delegate to the Stockholm conference. Kerr wrote Pawsey from Oslo on 25 June 1957 with a positive report of the Stockholm conference; he had been apprehensive about the organisation of this meeting: "In fact, the actual agenda bore very little relation to the original outline. There was in general a very good exchange of ideas ..." NAA C3830 F1/4/KER/2.

Kerr's presentation revealed his insight into the basic problem of HI research:

Because the Galaxy is more transparent for radio than for light waves, radio studies can give the mean position of the whole galactic plane, rather than just the portion surrounding the sun. Of the two radio methods, line and continuum, the former can give the position of individual small regions of the equatorial surface of the Galaxy, whereas the latter yields an integrated result over a whole line-of-sight. Also, a plane derived from line radiation work refers to a known sub-system of the galaxy, which is not the case for the continuum.

Kerr showed that, due to the low resolution of the continuum surveys, the continuum determination of the galactic ridge line was less accurate. The 21 cm data was superior even though the equatorial surface was distorted in the outer region due to the Magellanic Clouds:

... [T]he inner parts are very flat [in HI] ... [T]he concept of the [HI] "**principal plane of the Galaxy**" [our emphasis] is useful. This may be defined as the mean plane of the flat inner parts of the hydrogen layer, or (with little change) as the mean plane of the whole galactic hydrogen layer ... The discrete source Sagittarius A has a special relevance to these discussions.<sup>3</sup> If it can be shown that this source is at the centre of the Galaxy, its position should be used as the zero of a new scale of longitude ... [Piddington and Minnett and then McGee and Bolton had suggested that the source was to be associated with the galactic centre.] Van Woerden, Oort and Rougoor have recently obtained new [HI] absorption results which indicate that [Sgr A] is at least within 2 kpc of the centre, and is probably in fact at the centre.

As we discuss in ESM\_26.5.pdf, the new HI data showed there were "HI absorption lines at higher negative velocities which likely arose in a small disk in rotation around the galactic centre" (Oort and Rougoor, 1960), providing strong evidence that Sgr A was at the galactic centre.

Gum showed that new solutions for the galactic pole position using distant Cepheid variable stars (3 kpc) agreed with the new HI determined pole to within 0.2 degrees. Determinations of the pole with various optical objects provided solutions which moved closer to the HI pole position as the distances of the stars from the sun were increased.

In Pawsey's second talk, he summarised his proposal for the pole and the zero point:

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<sup>3</sup> Note that at this date the highest resolution image of the galactic centre had an angular resolution of only about one degree. The presence of the Sgr B sources was not known and would only be detected by Frank Drake in early 1959, a 3.5 cm image with a beam of 6.5 arc min. The substructure of the Sgr A region had not been observed when describing the status quo pre-1958 IAU in Moscow.

A pole defined as perpendicular to the mean disk of the interstellar atomic hydrogen averaged over the circle from the centre out to the sun.<sup>4</sup>

A longitude zero defined by the 180<sup>th</sup> meridian circle passing through the radio source Sgr A as measured in the radio continuum [at 20 cm]. (This is well within the uncertainty of the galactic centre.)

This system has sufficient merit over the current one to justify its introduction ... [A]nd the letters L and B [are to] be used for longitude and latitude respectively. [See Additional Note 1 for a discussion of the complex process of choosing a new name for the coordinates.]

A vigorous discussion followed with major criticisms from Bok and Buscombe. The latter asserted, "I do not feel convinced that there is a real need to make any change, even in the position of the galactic pole."<sup>5</sup>

Bok criticised many of the proposals:

I would personally object strenuously to a galactic pole fixed only with respect to the hydrogen clouds of the Milky Way, and even more strenuously to one fixed only by 21 cm ... [His objection was that the optical data was being essentially ignored.]

... No one knows now with absolute precision the direction toward the Galactic centre and there is certainly no reason to suppose that the direction of the source Sagittarius A as fixed by radio data gives a perfect determination of the direction toward the centre. As I see it the approach should be to continue to use as a zero point the intersection of the newly fixed galactic circle [the revision of galactic latitude by -1.4 degrees, which Bok did accept] and the celestial equator, a point in the sky that is perfectly fixed, and which could be frozen once and for all<sup>6</sup> ... One would then determine, hopefully with increasing accuracy, the position of the galactic centre ... but this particular direction would at all times remain open to further investigation and improvements in precision.

I believe that we should not attempt to attach too great a dynamical or cosmological significance to galactic latitude and longitude. They are simply coordinates of a

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<sup>4</sup> This was to be dealt with later as the Leiden and Sydney HI observations results were to be merged.

<sup>5</sup> No evidence has been found that provides details of Buscombe's strong objections.

<sup>6</sup> Gum pointed out a major problem in a note after the conference as well as a letter to Bok from RPL on 7 May 1957. The problem of using the intersection of the new galactic circle (the -1.4 degree correction in latitude) and the celestial equator (as done in the Ohlsson pole of 1932) would lead to longitudes differing by about 0.5 degree compared to the 1932 system. Confusion was thus quite likely. The choice of zero at the position of Sgr A had the advantage that the difference in longitudes would be roughly 32 degrees, not a fraction of a degree.

convenient nature through which to describe galactic phenomena. In order to compare results given by different investigators, it is essential that all of us in the field use the same system of coordinates.

Given Pawsey's high regard for Bok, Pawsey was receptive to the criticism. On 23 May 1957, Pawsey wrote Bok a thank you letter:

... [M]ay I, on behalf of the Radiophysics Lab folks, express our gratitude for the very generous hospitality we received ... [M]ay I say that I think the conference helped enormously towards establishing close collaboration between our two groups of astronomers<sup>7</sup> in Canberra and Sydney. It gave us all, perhaps for the first time, a perspective regarding what the other organisation is doing, and can do in the future. I also believe that, with the report which you inspired [written by Rogers and Gum], this conference is likely to have a significance in Stockholm and will do its bit towards balancing astronomy between the two hemispheres.

The Stromlo meeting had provided Pawsey an opportunity to launch a "trial balloon" concerning his thoughts on the new galactic coordinate system. He was deliberately provocative, telling Blaauw on 22 May: "I understand Dr Bok has already posted you an account of our Stromlo discussion. Will you take this letter as superseding the discussion notes with regard to my own views. I deliberately set out to provoke discussion at Stromlo." In Fig. 1, we show an image of some of the participants at Stromlo on 13 May during the visit to Mt Stromlo.<sup>8</sup> An additional photo from this date is shown in Fig. 2, Twiss, Gascoigne and Bok.

#### Additional Note 1

### **The choice of the name of the new coordinate system – "galactic coordinates (1958 revision)"**

In a one-month period in mid-1958, Blaauw, Westerhout and Pawsey struggled to find a new name for the revised coordinate system. The original name "l", "b" was based on the Dutch terms for longitude (lengte) and latitude (breedte). As is explained in the main text, Pawsey had proposed in the May 1957 Stromlo meeting to use L and B (cap letters) for the new coordinates. "It is suggested that the coordinate system be designated '1958 galactic

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<sup>7</sup> Pawsey was comfortable describing all attendees as "astronomers" with no mention of "radio astronomers". Since his co-invention of the term "radio astronomy" in early 1948 (ESM\_17.1.pdf) the distinction between the two groups had decreased.

<sup>8</sup> The meeting had started on Sunday afternoon. The second and third sessions were also held at University House on Monday with an evening dinner at the Boks' house at Stromlo, followed by a tour of the observatory. Pawsey is not in the photo; he was likely having dinner with his family in Canberra.

coordinates' or 'Moscow galactic coordinates' and the letters L and B be used for longitude and latitude respectively". Apparently, at this conference there was no consensus for adopting the new terminology.

On 20 May 1958, Blaauw wrote (in Dutch) to Prof Dr Pierre Henri van Laer, a Catholic priest and professor of philosophy at Leiden University.<sup>9</sup> He explained that a new term was needed, also providing the astronomical background. The new term had to be internationally acceptable and could well be based on classical (Greek or Latin) terminology. The term had to be distinct from the existing l and b. And the first letters must signify the physical quantity. (Longitude and latitude did not lead to a useful abbreviation in: "l and l".) Blaauw even confessed in a postscript that he had considered **p, q** (p for PASSUM in Latin, - "step"- and q as the next letter in the alphabet!).

Van Laer wrote a fascinating letter to Blaauw on 1 June 1958:

Je brief van 20 Mei heb ik enkele dagen laten rusten, in de hoop dat Ik een geode inval zou hebben. Dit is echter tot nu toe niet gebeurd. .. Het lijkt mij niet gemakkelijk om nieuwe termen te verzinnen, die aan gestelde eisen voldoen. Een.. verklaring geven van bestaande termen.... Is daarentegen niet so moeilijk.

I let your letter of 20 May sit for a few days, in the hope that I would have a sudden inspiration. Alas, that has not happened up to now. It seems to me that is not an easy matter to invent new terms that fulfill the stated requirements. To provide an ... explanation of existing terms ... is in contrast not so difficult.

But Prof van Laer rose to the challenge and wrote a page of complex (and unwieldy) suggestions. He began with Greek terms for longitude: **mekos**---μήκος (length) and latitude: **euros**---ευρώ. For another suggestion, he proposed **c-longitudo** for longitude measured from the Centre of the galaxy. He was at a loss to think of the appropriate single letter for latitude. Finally, he suggested abscissa and ordinate – the new terms would be **ag** and **og** – the G for galactic.

On 2 June 1958, Pawsey mentioned to Blaauw for the first time that "L" and "B" might be the new names. Blaauw did not respond. On 18 June 1958, Westerhout announced that he was in favour of **G** and **g** for the new galactic coordinates. Pawsey immediately objected on 27 June:

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<sup>9</sup> Van Laer (1906-1989) became a priest in 1930 and received a Phd in physics in 1938 at Leiden, working in the field of superconductivity. He became a professor in Leiden in 1946, specializing in the philosophy of science and mathematics. Blaauw mentioned that he often used (altijd onder mijn bereik- always within reach) van Laer's book about nomenclature, *Vreemde Woorden in de Sterrenkunde en Namen van Sterrenbeelden en Sterren* (Unusual Words in Astronomy and Names of Constellations and Stars) from 1942.

I don't like the **Gg** suggestion because (i) I don't know which is which and (ii) I think mixed capital and small letters confusing. It is difficult to distinguish verbally- but I have no good ideas.

This long drawn out discussion ended with suggestions by Pawsey on 4 July 1958 that the terms could be l and b (no change ) or l' and b' (that is l prime etc) and Westerhout on 15 July to use "for the time being":  $l_{new}$ ,  $b_{new}$  . (At this later period, Westerhout was opposed to the LB and Gg proposals<sup>10</sup>.)

At the meeting during the IAU on 19 August 1958 in Moscow, the decision was made to keep the old l and b; the sub-Commission decided in 1959 to recommend that in the transition period the terms l' and b' be used for the old system and l<sup>II</sup> and b<sup>II</sup> for the new one. This usage was prevalent in the 1960s, eventually disappearing to be simply l and b.

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<sup>10</sup> Westerhout had changed his mind; earlier on 18 June 1958 he wrote Blaauw and Pawsey that he favoured the Gg system.



Fig. 1 Back row from left: Heinz Gollnow, Ben Gascoigne, Alex Shain (RPL), Bengt Westerlund, Alex Rodgers, Kurt Gottlieb, Colin Gum (RPL), Roland [sic Richard] Twiss (RPL, moved to University of Sydney 1959), Ted Dunham, Antonin Przybylski, Eric Hill (partly obscured, RPL), Jane Basinski, Bart Bok. Sitting from left, Pamela Morris, Helen Bailey (her photo collection, later Helen Bailey Bayly), Priscilla Bok, Arthur Hogg and Bernard Mills (RPL). The RPL visitors are identified, all other participants are from Mt Stromlo Observatory, 12-13 May 1957. Photo taken by Joy Bailey (mother of Helen Bailey, the camera of her father Prof Victor Bailey of the University of Sydney)). Used with permission of Helen Bailey Bayly in January 2021.

<https://openresearch-repository.anu.edu.au/handle/1885/111661>

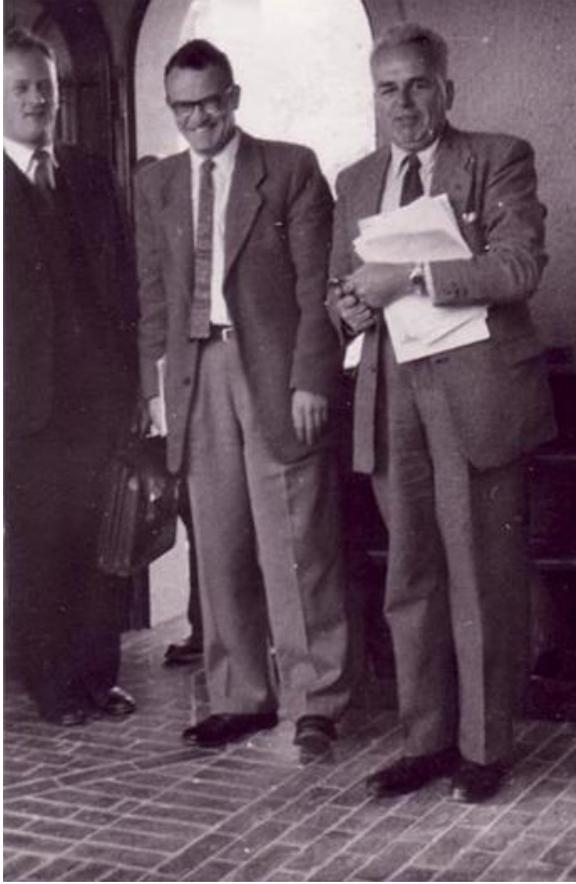


Fig. 2. Mt Stromlo visit on 13 May 1957. From left Twiss, Gascoigne and Bok. From the Helen Bailey collection

[http://www.mso.anu.edu.au/gallery3/index.php/before2003/helen\\_bailey/Mail0001](http://www.mso.anu.edu.au/gallery3/index.php/before2003/helen_bailey/Mail0001).