NRAO ONLINE 30

Conflict: Ruby Payne-Scott - Martin Ryle, Reality of Type III Bursts

An impact of the Pawsey visit to the Cavendish Laboratory of the University of Cambridge in 1958 (see Chapter 17) was the interaction of Ryle with Payne-Scott over the reality of the "isolated bursts".

In *Under the Radar*, (2009, "Under the radar: the first woman in radio astronomy: Ruby Payne-Scott." Vol. 363. Springer Science & Business Media), Goss and McGee (pages 146-149 and Appendix D, "Ryle, Payne-Scott, Bracewell and Bolton: 'Solar Bursts' from Aircraft") have provided details of these interactions in 1948-1950. Also see NRAO ONLINE 60 Proposed Coordination of Solar Work 1946 and NRAO ONLINE 20.

Before his departure in 1947, Pawsey and Ryle exchanged letters about the frequency delays ("seconds of time") for Type III bursts (then called the "isolated bursts" or the "unpolarised bursts"). Ryle (17 June 1947) had doubts about the reality of the existence of these bursts that appeared first at high frequencies and then moved to low frequencies at a rate of about 20 MHz/sec [1]. On 3 July 1947, Pawsey responded: "With response to the 'seconds delay' cases, I am not entirely happy about the evidence." In the survey paper of 1950, Pawsey was much more certain, using the Payne-Scott data from her unpublished report (RPL 9, the report on the Dover Heights data from July-August 1946, including two figures from her RPL 9).

During the visit of Pawsey to the Cavendish in 1948 (See Chapter 17 and ESM_17.1), Pawsey made a proposal to establish a collaboration with the Cavendish solar noise group; he was also anxious to ensure the priority of the RPL claim to the time delays in the solar bursts. The Cavendish did not believe in the ordered motions of "high frequency precedes low". (See NRAO ONLINE 20)

Already in 1948, there were growing signs of distrust between these two main groups working on solar radio noise.

After the 24 June 1948 letter to Bowen proposing RPL-Cavendish coordination, Pawsey received no response from Sydney while he was still at Cambridge. On 12 November 1948[2], Pawsey asked Ratcliffe about the previous discussion with F.G. Smith. Payne-Scott had a draft paper ready ("Bursts of Solar Radiation at Metre Wavelengths") showing the clear distinction between

[1] NAA, C3830, A1/1/1 Part 2
[2] NAA, C3830, A1/1/1 Part 3

the circularly polarised Type I bursts and the unpolarised Type III bursts. The latter showed a clear-cut frequency drift from high to low frequency with a timescale of seconds. "I would suggest that Smith might hold off making definite plans a little further until he obtains information concerning Miss Payne-Scott's paper." This confusing letter elicited a response from Ryle to Pawsey on 23 November 1949, after Pawsey had been back in Sydney for over a year:

> During your last visit to Cambridge [1948] we discussed our programme, and among other things the question of our continuing work on solar bursts. You were writing [12 November 1948] to find out how your [sic, our] experiments on the correlation of bursts on adjacent frequencies were going. We have done nothing further on the subject, but I think that there is much important work to be done and if it does not overlap with your programme I should like to start it up again with a new member of the team [Smith was then concentrating on radio star position investigations]. There is no immediate hurry, as he will be fully occupied for the next two to three months, but I should like to get him thinking about his own line of experiments soon, and the analysis of solar bursts is the first choice at the moment. Please remember us to your wife. We often wondered if your family recognised you again [after the 13-month absence in 1947-1948]!

A week later Ratcliffe wrote to Pawsey (30 November 1948): "I note also that you are going to send an advance copy of a draft … by Miss Payne-Scott on the characteristics of variable components. We shall be glad to see this paper and, as you suggest, not make any definite plans for further work along these lines until we have seen it."[3]

Then on 9 December 1948, Payne-Scott replied to Ryle:

> Dr Pawsey asked me some time ago to send you an account of my work on solar bursts, as you were planning experiments on similar problems … [Y]ou will see that one of the main points is the distinction between variations (bursts) in the circularly polarised "enhanced radiation" and "unpolarised bursts". It is the latter that show good correspondence on different frequencies and time-delays. Much of the past confusion originated because no distinction was drawn between the two kinds of short-period variation in solar noise.

[3] NAA, C3830 A1/1/1 Part 3. Ironically Ratcliffe also mentioned in this letter the "need [to] maintain complete uniformity of publication in matters concerned with radio noise". At this point (Nov 1948) Ryle was convinced that the Cygnus source was moving in declination. "You say that Bolton has also found out this point … You will see therefore that I am inclined to accept Bolton's attitude to the subject, i.e. that they should both publish separately." Since neither group ever confirmed these "movements", it was fortunate that neither group did coordinate publication. By 1950 the declination determinations at Cambridge (Smith) and Sydney (Mills) had converged to the modern value (Sullivan, 2009).

In summary she told Ryle about the "spectrum analyser" project being built by McCready and Wild to determine simultaneously time-frequency dynamic spectra from 50 to 100 MHz (in the end this was to be 70 to 130 MHz). The controversies were to be solved in the next few years based on the ground-breaking work by Paul Wild from February-June 1949 at Penrith, leading to a characterisation of the properties of Type I, II and III bursts.

Ron Bracewell returned in late 1949 from a three year visit to Cambridge working with the ionosphere group with PhD advisor Jack Ratcliffe. He had left Sydney in August 1946. Ron Bracewell told M. Goss in 1997 about his back channel communication with Ruby Payne-Scott from Cambridge after December 1948. At the Cavendish Laboratory in Cambridge, Ron took some of the solar noise data and traced the 175 MHz recordings. He asserted to Goss that Ryle had written to Payne-Scott telling her sarcastically: "… [T]hese bursts did not occur in Cambridge, but any that did were certainly due to aeroplanes, as he knew from having a loudspeaker on line" [Bracewell's version]. After tracing some of the data, Ron sent these to Payne-Scott in early 1949. Ryle had claimed that these data showed "solar bursts" (i.e. really aircraft) similar to those she had observed at both Dover Heights and then Hornsby in 1947-1948 (Goss and McGee, 2009).

John Jaeger, a professor at the University of Tasmania in Hobart (Phd Cambridge), became involved. Jaeger had been visiting Cambridge earlier in 1949. On 15 November 1949, Ryle wrote Jaeger in Tasmania about the Type III burst controversy; clearly this had been discussed at length during Jaeger's visit[4]. Ryle wrote: "We do not claim that the 'unpolarised bursts' are polarised; it is just we cannot see them at all." Again, Ryle came to his accusation: "… [W]e have quite a large number of 'unpolarised bursts' which correlate with the presence of light aircraft."

By 29 December 1949, Pawsey was thoroughly exasperated. Stimulated by the letter to Jaeger, he wrote to Ryle:

> Bracewell brought out a number of tracings of your records and these show phenomena which are like the bursts which we measure here. I am enclosing some rough tracings of Bracewell's tracings [thus <u>tracings of tracings</u> were posted back to Cambridge] which are good examples. The point of our observations is that we get occasional large solar bursts which look just like the bursts shown on your records … [and they were not circularly polarised].

Pawsey then challenged Ryle that there were no "unpolarised bursts" observed at Cambridge: "Will you compare this remark [that these bursts did not occur in the northern hemisphere] with the record marked number 2 which seems to us a normal sort of record? My impression is

[4] Jaeger had left a copy of the letter for Pawsey in December 1949 at RPL in Sydney. NAA C3830 A1/1/1 Part 4.

that the disagreement is something to do with terminology …" Pawsey claimed yet again that the radio telescope was not detecting interference from nearby aircraft!

On 21 March 1950, Ryle replied to Pawsey. He sent a new copy of the record number 2 (see Goss and McGee, page 283). He continued his claim that these were

> Light aircraft doing circuits from Cambridge aerodrome. I think the [solar activity] at the same time was coincidental. I wish we had known that Ron was tracing these records … as we could, I think, have saved confusion … [T]hese records selected by Ron were by no means typical (if only because of the bad flying weather here!) … I think that this analysis shows that if bursts of radiation from the undisturbed sun on 175 Mc/s., they are extremely rare phenomenon (compared with the figure of approximately one per day given by Ruby Payne-Scott for lower frequencies) … We … [are] fairly convinced about our … 175 Mc/s. results.

On 31 March (note only 10 days later, the airmail turnaround time was quick) Pawsey had lost patience again: "I think I shall retire from the controversy concerning 'isolated bursts' and 'unpolarised' bursts. I shall pass on your letter to Ruby Payne-Scott and others who have been taking actual observations recently." Payne-Scott and Ryle did not continue the exchange. Paul Wild's impending publications concerning Type II and Type III bursts (1950 September and December issues of the *Australian Journal of Scientific Research*) buried this contretemps. The Wild and McCready paper showing the swept frequency display of Type III bursts (the terms "unpolarised bursts" or "isolated bursts" immediately disappeared from the literature) had already been submitted on 10 March 1950. Ironically as reported by Suzuki and Dulk (1985): "Type III bursts are probably the most intensively studied form of radio emission in all of astrophysics." During sunspot maxima a typical rate of occurrence is about three bursts per hour with less frequent bursts during sunspot minima. The sun was still active in 1949-1950 with the next sunspot minimum around 1954.

John Bolton arrived in Cambridge in mid-May 1950 on his trip to Europe and North America. A surprising aspect of his visit was that he joined the Ryle, Payne-Scott, Pawsey conflict about the reality of the Type III bursts (at this late date) as an advocate of Ruby Payne-Scott. As pointed out in ESM_17.1 in Chapter 17 (Ruby Payne-Scott and J.G. Bolton), the period 1947-1949 was characterised by the increasing conflict between Bolton and Payne-Scott, eventually leading to her being "exiled" to the Hornsby site, an event that was to be very productive for her science during the year 1948. Bolton wrote a report in 1950 (31 May 1950, "Visit to the Cavendish Laboratory -Radio Astronomy, Solar Noise").[5]

[5] NAA C3830 F1/4/BOL/1.

Bolton reported:

> Ryle's definition of an isolated burst is as follows: "According to Ruby Payne-Scott [i.e. Payne-Scott's definition] isolated bursts occur when the Sun is perfectly quiet- i.e. thermal level present and no sunspots. They are on average about ten times the thermal level, last a few seconds, have a rapid rise and an exponential decay and occur about one per day- but not in Cambridge."

Bolton looked at a large number of records. There were a few bursts with peaks of three times the quiet sun level. These events had a sharp rise shape with an exponential tail [as Payne-Scott had also found] lasting some minutes. "I pointed that these could be bursts but Ryle said that the Sun was not absolutely quiet at the time [and that Type I noise storms would be expected]." Clearly Bolton thought that the Cambridge data likely showed Type III bursts; they were weaker at 175 MHz compared to Payne-Scott's data at 60, 65 and 85 MHz at Hornsby. "There is no listening watch kept on the character of the radiation [in order to recognise radio frequency interference]." Bolton finished this section of the report with a whimsical sentence: "I do not think Ryle has sufficient evidence to deny the existence of isolated bursts, on the evidence of the Cambridge records one can only give the Scottish verdict – NOT PROVEN."[6] [his upper case]. As we have pointed out, all this discussion was moot at this point since the Wild and McCready paper was soon to be published. Ruby Payne-Scott's evidence concerning the observations aspects of Type III bursts has stood the test of time.

Sullivan (2009, page 326) has pointed out that in 1949-1950 Ryle, in unpublished notes, began to doubt the reality of any solar radio bursts as he became convinced of the ionosphere cause for radio star scintillation. Based on the exchange with Payne-Scott and Pawsey over several years, the "aircraft-solar-burst" controversy may have influenced him. Within a few years, Ryle had lost interest in most solar noise problems except for imaging of the quiet sun. (See NRAO ONLINE 20).

[6] One of three possible Scots verdicts: guilty, not guilty or not proven. For the latter, the judge or jury is unconvinced that the suspect is innocent, but has insufficient evidence to the contrary.