

# CSIRO's First Statistician: Frances Elizabeth 'Betty' Allan

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## Introduction

Few research organisations can boast such unique statistical beginnings as CSIRO: the first three biometricians in the fledgling CSIR were all women, and all three had trained at Rothamsted Experimental Station under R.A. Fisher or F. Yates, two of the founders of modern statistics. The first of these was Frances Elizabeth Allan. On return from Rothamsted, she took up duty with CSIR on 29 September 1930, seventy-five years ago.

Over the next decade she championed and demonstrated the usefulness of biometrics – the application of statistics to biology, often now called biostatistics – throughout the organisation and beyond. Her work was highly valued; she devoted her energies to helping other researchers rather than establishing her own scientific reputation. She is remembered by those who knew her as kind-hearted, considerate and easy to work with.

Allan's marriage and therefore, by law, her retirement, occurred at more or less the same time as the formal establishment of a Biometrics Section in CSIR, forerunner to the present-day CSIRO Mathematical and Information Sciences.

Allan's legacy is a CSIRO Division which employs scores of statisticians from Australia and overseas. These people are working on problems and conducting research with an impact that Betty Allan would certainly be proud of.

## Formative years

Frances Elizabeth (Betty) Allan was born on 11 July 1905, in Melbourne. She was one of four daughters of Edwin Frank Allan and Stella May (née Henderson). Her parents<sup>2</sup> were both university graduates, her father from the University of Oxford and her mother from Canterbury University College, New Zealand. They came to Australia from New Zealand in 1903 when her father was appointed to the staff of the Melbourne *Argus* as foreign affairs leader-writer and parliamentary journalist. Later noted for his masterly summaries of cables during World War I, he was himself a gifted mathematician. Her mother, the first woman in New Zealand to begin a law course, was for over 30 years a journalist with the *Argus*, and wrote a weekly *Women to Women* column under the pseudonym *Vesta*. Her writing shows a well-researched, calm and logical consideration of potentially emotional subjects such as maternal mortality, domestic service and child welfare problems, and was unique in an Australian daily paper at that time. Stella Allan had a full

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<sup>2</sup> Much of the information about her parents is taken from an article on Stella May Allan written by Patricia Keep (another of her daughters) in the Australian Dictionary of Biography, Vol. 7. B. Nairn and G. Serle (eds.), Melbourne University Press, 1979.

family and social life, but found time to become deeply involved in community affairs, an interest later shared by her daughter, Betty. With her parents' close friends including such people as Sir George Julius (first Chairman of CSIR) and Alfred Deakin and his wife Pattie, we can imagine Betty's childhood to be an intellectually stimulating one, imbuing her with a well balanced view of life and its potential.

Betty (as she was known from an early age) completed her schooling at Melbourne Church of England Girls' Grammar School where she was taught by a very talented mathematics teacher, Winifred Waddell. She was awarded a Senior Government Scholarship to enter the University of Melbourne in 1923. Here she studied pure and mixed mathematics under Professor J.H. Michell, Mr R.J.A. Barnard (father of Dr Mildred Barnard, later to be the third biometrician appointed to CSIR) and Mr Gunnar Gunderson. She completed each subject with honours, sharing the Dixon and Wyselaskie Scholarships in her final year. Following her undergraduate degree she completed a Diploma of Education in 1926. For these four years she lived at Janet Clarke Hall, Trinity College, where she held Resident Scholarships, and where her good grounding in mathematics was enriched by her tutors, Professors C.E. Weatherburn and E.J.G. Pitman.

In 1928 she completed an M.A. degree under Michell's supervision, engaging in hydrodynamical research into the wave motion of superposed liquids, and resulting in her first paper [1]<sup>3</sup>. Michell considered she showed "uncommon mathematical courage and perseverance in carrying work to a conclusion".<sup>4</sup> He also thought her "very exceptionally free from the instability commonly attributed to her sex",<sup>5</sup> a comment which says as much about Michell as it does about Allan! For this work she was awarded the Nanson Prize for Postgraduate Research and a Fred Knight Research Scholarship. This gave her a fare to England, and so she made arrangements to go to Newnham College, Cambridge, to further her studies.

## **Cambridge and Rothamsted**

In 1928, Sir John Russell, Director of Rothamsted Experimental Station, the internationally renowned agricultural research centre in the U.K., visited Australia. At this time, R.A. Fisher was head of the Statistical Department at Rothamsted, and had laid the foundations for experimental design and analysis which were to revolutionise much agricultural research. Dr A.C.D. (later Sir David) Rivett, Chief Executive Officer of CSIR, wrote that:

"Russell found it fairly easy to arouse our enthusiasm in the type of work which is being done at Rothamsted by Mr Fisher".<sup>6</sup>

At that time there was no-one in Australia versed in Fisher's methods, so the Executive Committee of CSIR decided to offer a studentship in "the study of statistical methods applied to agriculture" under the auspices of the Science and Industry Endowment Fund.

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<sup>3</sup> Numbers in parentheses refer to the bibliography at the end of the article.

<sup>4</sup> CSIRO Archives, series 3, item PH/ALL/61c, letter from Michell to Secretary, CSIR, 29 July 1928.

<sup>5</sup> *ibid.*

<sup>6</sup> CSIRO Archives, series 3, item J6/16, letter from Rivett to F.L. McDougall, 28 August 1928

This fund was set up by the Commonwealth Government in June 1926, at the same time as the CSIR was constituted from the former Institute of Science and Industry. The Fund had the dual purposes of training students in scientific research and assisting existing researchers, and it was administered by the Executive Committee of CSIR. Studentships were tenable for two years, usually taken overseas, and were only granted to graduates of distinction. Recipients were bonded to CSIR for three years on their return to Australia. Early recipients included Dr Ian Clunies Ross (later Chairman, CSIRO), Dr J.R. Vickery (later Chief of the Division of Food Preservation) and Mr W.R. Wiley (later Officer-in-Charge of the Dairy Research Section).

When the studentship was advertised in July 1928, Allan had already arranged to go to Cambridge. She could only do this by borrowing the necessary money, and as the studentship would relieve her of this obligation she applied for it.<sup>7</sup> There was a strong field of candidates, and she was awarded it on the recommendation of Professors Michell and Pitman. This news was waiting for her when she arrived in London.

Russell and Rivett agreed that Allan should spend her first year at Cambridge and then go to Fisher at Rothamsted. Her studies at Cambridge covered mathematics and statistics under Udney Yule, and also courses in applied biology and general agriculture at the Cambridge School of Agriculture, taken by Professor Engeldow.

At the end of the Cambridge academic year she attended a summer school at Heidelberg University, where she undertook an intensive course in the German language, before visiting fellow statisticians in Germany and elsewhere in Europe to get an appreciation of agricultural statistics in Europe. She found the subject “still far behind certain other countries, especially England”.<sup>8</sup> In Denmark she found differences between Danish and English methods of layout of experimental plots, particularly with regard to randomisation. She concluded her tour with a study of calculating machines under L.J. Comrie at H.M Nautical Almanac Office.

Once settled at Rothamsted she began familiarising herself with the work of the Statistical Department, as well as considering several particular problems, the first being to devise a mathematical proof of a numerical method of curve fitting using orthogonal polynomials given by Fisher in “Statistical Methods for Research Workers”[2]. While at Rothamsted she published two other papers: a short note giving a table of percentile points of the transformed correlation coefficient from a sample of four pairs of observations [4], and probably her best known paper [3], with Dr J. Wishart, on the estimation of a single missing value in a randomised block or latin square experiment.

After her time at Rothamsted, Fisher wrote that she had “shown herself to have a rare gift for first-class mathematics, and at the same time exceedingly helpful and congenial in co-operative work within the laboratory”.<sup>9</sup> He considered her “one of the very few fully

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<sup>7</sup> CSIRO Archives, series 3, item PH/AILL/61c, letter from Allan to Rivett, 21 July 1928

<sup>8</sup> CSIRO Archives, series 3, item J6/16, Report by Allan to Trustees of the Science and Industry Endowment Fund, 31 January 1930.

<sup>9</sup> CSIRO Archives, series?. Item H7/275, General testimonial for Allan written by Fisher, 27 November 1930

qualified for advanced statistical work in general, with a knowledge of field experimentation in particular.”<sup>10</sup>

## CSIR



With such good reports of her work at both Cambridge and Rothamsted, the Executive Committee of CSIR had no hesitation in exercising their option on Allan’s services. By this time Australia was in the grip of the Depression; the Commonwealth Government had decided that in view of the very critical state of the country’s finances, no new appointments would be made. Allan was therefore initially appointed on probation for twelve months, and was subsequently placed on the permanent staff.

When CSIR was established in 1926, the Executive Committee decided on five areas of research for immediate attention: animal pests and diseases, plant pests and diseases, forest products, food preservation and fuel research. By the end of 1930, six divisions had been established to work in three of these areas: Animal

Nutrition, Animal Health, Plant Industry, Economic Entomology, Soil Research and Forest Products. The Executive Committee decided to place Allan in the Division of Plant Industry in Canberra, and so on 29 September 1930, she took up duty with CSIR on an annual salary of £400. Although it was to be over ten years before a Section of Biometrics would be formally established within CSIR, this was its real beginning.

Almost from the outset, Allan was giving statistical and mathematical assistance and advice to researchers not only in her own Division, but also in the other Divisions and in outside organisations as well. Over the ten years she spent with CSIR, the list included the Waite Agricultural Research Institute, the state Departments of Agriculture, Gatton College, The School of Agriculture at the University of Melbourne, the Australian Forestry School and various other committees and institutions. She regularly visited other Divisions in Melbourne, Adelaide and Sydney, and the research stations in Griffith and Merbein.

The range of research programmes on which she consulted and collaborated was indeed broad. It includes work on plant diseases, genetics, seepage in the Murrumbidgee Irrigation Area, and problems of noxious weeds (Division of Plant Industry); control of blowflies and oriental peach moths (Division of Economic Entomology); effects of various supplements on sheep (Animal Nutrition); strengths of different types of packing cases (Forest Products) to name very few.

Many of these investigations involved the use of statistical techniques which now appear routine, such as randomised block and latin square designs and their consequent analyses

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<sup>10</sup> *ibid.*

of variance, regression and correlation, but it must be remembered that the subject was a rapidly developing one at the time, and these techniques were both novel and, in terms of their impact on research programmes, powerful. Amid her consulting she found time to keep abreast of current developments, and used and recommended such innovations as factorial treatment structure and covariance as they became available.

One of the tasks which Dr B.T. Dickson, the Chief of the Division of Plant Industry, set for her on her appointment was the collection and collation of climatic data affecting the Division's research. Over the years several papers emanating from research in the Division acknowledged her help in this area. She was reclassified to Research Officer in 1935.

Apart from her direct help with biometrical matters, she was also active in teaching others of their use and practice. After a week's visit to the Division of Forest Products in September 1933, the Chief, I.H. Boas, wrote to Rivett:

“I feel sure that there will be in future a far better appreciation of the need for careful examination of experimental results and this will lead to better planning of projects”.<sup>11</sup>

In 1936 she gave a series of 16 lectures on statistical methods to about 25 officers of the Canberra-based divisions.

### **Other institutions**

Nor was her teaching limited to CSIRO. In the same year Pat McGovern of the Queensland Department of Agriculture and Stock spent three months at the Division of Plant Industry training under Allan. Barbara Shield from the same Department came the following year. Both McGovern and Shield had outstanding mathematical ability, graduating with Masters degrees from the University of Queensland.

Again, in 1936, she was invited to write a series of four papers [6,7,9,10] for the Australian Institute of Agricultural Science on the application of statistical methods to agriculture. She was a foundation member of the Canberra Branch of the Institute.

She held two external teaching posts as well. She lectured at the Canberra University College in the Theory of Statistics in 1932, and in Pure Mathematics from 1935 to 1937. She told Rivett that these lectures would not be difficult to fit in with her CSIR work, as pure mathematics was “actually a very easy subject – to my mind much simpler than Statistics!”.<sup>12</sup> Rivett encouraged her to lecture as he was anxious to assist the development of the University College; it was affiliated with the University of Melbourne, taking its first students in 1930 and amalgamating with the ANU in 1960.

Her second teaching job was at the Australian Forestry School in Canberra, where she was a part-time lecturer in biometrics. She first taught there in 1936, and then each year from 1938 until her death in 1952. In 1937 she published an article on the use of statistics in forestry research [13]. In noting her death, the Annual Report of the Forestry and Timber Bureau for 1952 records that she maintained a great interest in her classes and

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<sup>11</sup> CSIRO Archives, series 9, item B1/6/16, letter from Boas to Rivett, 4 October 1933.

<sup>12</sup> CSIRO Archives, series 3, item PH/CAL/5, letter from Allan to Rivett, 5 March 1935

was well known to foresters throughout Australia for her work on statistics. As a measure of the respect in which she was held by the School, forestry students were the pall-bearers at her funeral.

## Helping others

During this period, Rivett had close associations with all Divisions and Sections of CSIR. He dealt directly with Allan on biometrical matters, thought highly of her, and was convinced of the usefulness of her work. In 1934 he wrote:

“. . . she has demonstrated beyond cavil the necessity for associating work along her lines with every investigation which the Council undertakes.”<sup>13</sup>

In 1933 he expressed concern to Dickson, and to Allan, that she was not being given “sufficient opportunity to do the best type of research work of which she is capable”,<sup>14</sup> and asked them both to consider suitable projects which might be “likely to lead rather more readily to publication of value”.<sup>15</sup> Dickson found difficulty in this, and replied that “the work Miss Allan is doing is so valuable that were she to do little else it would be quite justified in the long run”,<sup>16</sup> words which were proved true in hindsight. In any case little came of Rivett’s suggestion because in 1937, when Mildred Barnard was working in Melbourne, Allan wrote:

“When Dr Barnard was appointed, it was hoped that she might be able to assist in the work in Canberra, and thus give me more time to devote to fundamental aspects of statistics.”<sup>17</sup>

Because of CSIR’s critical financial position during the first half of the decade, Allan did not get an assistant in Canberra until shortly before her retirement, and so had no time to do any statistical research.

Her attitude to consulting is summed up in a 1937 report<sup>18</sup> she wrote for Rivett on the biometric work of the Council. On the problems of finding new staff she said:

“It is not easy to find the right person. What is required is someone who has the necessary qualifications, and is yet prepared to devote his energies to helping other officers rather than establishing an independent scientific reputation for himself. Officers are apt to be afraid of a biometrician who is anxious to obtain kudos from any help which he gives them.”

That she herself had the necessary qualities is testified by Rivett:<sup>19</sup>

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<sup>13</sup> CSIRO Archives, series 3, item PH/CAL/5, General testimonial for Allan written by Rivett, 22 May 1934.

<sup>14</sup> CSIRO Archives, series 9, item B1/6/16, letter from Rivett to Dickson, 20 October 1933.

<sup>15</sup> Ibid.

<sup>16</sup> CSIRO Archives, series 9, item B1/6/16, letter from Dickson to Rivett, 8 November 1933.

<sup>17</sup> CSIRO Archives, series 9, item B1/3/36, Allan to Rivett: Report on the Biometrical Work of the Council for Scientific and Industrial Research, 31 August 1937.

<sup>18</sup> Ibid.

<sup>19</sup> CSIRO Archives, series 3, item PH/CAL/5, General testimonial for Allan written by Rivett, 22 May 1934.

“Not only is her work of first-class quality, but she has a most delightful personality which would make her welcome in any group of research workers.”

Rivett’s testimonial was requested by Allan in May 1934, when she applied for a position as agricultural statistician with ICI at Jealott’s Hill in England. She wrote to Rivett:<sup>20</sup>

“I do not want it interpreted as a sign that I am dissatisfied with my present position and work. The work is very interesting ... and ... I have always liked the life in Canberra. ... Nevertheless, if the opportunity arose for a better position, or for one bringing more experience or more contacts, I should not feel justified in dismissing it without some thought on the matter. ... In any case, I should never be content to leave the Council unless some satisfactory arrangement could be made for carrying on the statistical work here.”

Rivett was concerned at her possible loss to CSIR: “. . . if you are disappointed in your application, you must console yourself with the feeling that we shall be uncommonly glad to keep you with us”.<sup>21</sup> It is now ironical that the fact that she was a woman helped to keep her at CSIR; subsequently she wrote to Rivett:<sup>22</sup>

“Dr Wishart . . . tells me that they definitely do not want a woman, and although my application is as good as any, Mr. Page [ICI] will appoint a man if there is anyone at all suitable. . . . I cannot say that I am altogether sorry. There is such a wonderful field opening out for biometrical work in Australia as people begin to realise the need for it, that I should hate to go away from here just now.”

In April 1940 Allan married Dr Joseph (Pat) Calvert, a botanist and plant physiologist with the Division of Plant Industry. At that time Commonwealth Government regulations decreed that women were deemed to have retired on marriage; because of the need to find a replacement for her, the Minister agreed to allow her to work until the end of 1940, which she was happy to do. Rivett had already had discussions with Dr E.A. Cornish, statistician at the Waite Agricultural Research Institute, about the possibility of his joining CSIR’s biometric staff, and Allan recommended that Cornish succeed her as the Council’s Chief Biometrical Officer.<sup>23</sup> After a delay because of the international situation, the post was advertised; Allan applied for it, but Cornish was appointed with Allan’s blessing, and began with CSIR in January 1941.

## The Biometrics Section

We can trace the development of the embryonic Biometrics Section from Allan’s appointment to the Division of Plant Industry in 1930. Expansion of the Council’s biometric work was foreshadowed in January 1934, when Rivett raised the issue with the Executive Committee, who agreed with him that development of biometrical work was very desirable. The CSIR Annual Report for 1933/34 no longer records the biometrical

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<sup>20</sup> CSIRO Archives, series 3, item PH/CAL/5, letter from Allan to Rivett, 18 May 1934.

<sup>21</sup> CSIRO Archives, series 3, item PH/CAL/5, letter from Rivett to Allan, 22 May 1934.

<sup>22</sup> CSIRO Archives, series 3, item PH/CAL/5, letter from Allan to Rivett, 27 June 1934.

<sup>23</sup> CSIRO Archives, series 3, item PH/CAL/5, letter from Allan to Rivett, 28 March 1940. “I still feel that the best person to recommend for the head of the Biometrics Section is Cornish. He is far above anyone else in Australia, and his Australian experience makes him more suitable for the Council’s work than a newcomer from overseas.”

work of the Council under the Division of Plant Industry, but rather under a heading of “Other Investigations”, distinct from any particular division, although Allan is still listed on the staff of the Division of Plant Industry.

It was almost four years after Allan’s appointment that CSIR gained its second biometrician. In May 1934 Helen Newton Turner, who had since September 1931 been a “typiste-secretary” at the Division of Animal Health’s McMaster Laboratory in Sydney, had her designation changed to “secretary and statistician” following the interest she had shown in biometrics and mathematics.



A year later in April 1935 the Executive Committee considered the question of establishing a separate Section of Biometrics. The proposal was put to them by B.T. Dickson, Chief of the Division of Plant Industry, “because of the importance of the (biometrical) work and of Allan’s efficiency in doing it”.<sup>24</sup> The Executive Committee decided against the proposal but they did however approve the appointment of a machinist to assist Allan.

In July 1936 a third biometrician, in the person of Dr Mildred Barnard, was appointed to the Council. Barnard was at that stage completing two years of study at the University of London under Fisher and Pearson, and at Rothamsted Experimental Station under Frank Yates. She returned to Australia later in 1936.

There must be few other research organisations in which the first three biometricians were women! After a short period working in Canberra with Allan, Barnard went to Melbourne to service the Divisions of Forest Products and, by then, Animal Health and Nutrition. The staff list as at 30 June 1937<sup>25</sup> lists both Allan and Barnard under “Other investigations – Biometrics” with Allan designated “in charge of Section”. Turner is still listed under the Division of Animal Health and Nutrition. The financial statement for the year ending 30 June 1937 is also the first to make a separate entry for the Section.<sup>26</sup>

In March 1939 Allan told the Executive Committee she did not think the statistical work of the Council could be developed until an independent Biometrics Section was established, as difficulties were being experienced in attracting suitably qualified officers for biometrics work.<sup>27</sup> Rivett was in favour of the move, and told Turner, then in England on a studentship, that he thought there was a good deal to be said for the idea.<sup>28</sup> By the end of June, he had apparently acted on the matter, in a letter to Turner, Allan wrote:<sup>29</sup>

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<sup>24</sup> CSIRO Archives, series 605, item B6/19, letter from Dickson to Rivett, 15 February 1935

<sup>25</sup> CSIR Annual Report for 1936/7.

<sup>26</sup> *ibid.*

<sup>27</sup> Minutes of CSIR Executive Committee Meeting 419, 20 March 1939.

<sup>28</sup> CSIRO Archives, series?, item H3/216, letter from Rivett to Turner, 24 March 1939.

<sup>29</sup> CSIRO Archives, series 605, item B6/25, letter from Allan to Turner, 28 June 1939.

“You ask about the formation of a biometrics section in the CSIR This has been done, though at present you are still classified on Dr. Bull’s staff, not in the biometrics section.”

So the Section was apparently established sometime in the period 24 March – 28 June 1939. The exact nature of the “establishment” remains obscure however, as the Executive Committee minutes of the period do not mention it.

Allan did not favour the idea of a highly centralised section, having earlier indicated that she thought it necessary that all bigger centres have a biometrician who could become thoroughly familiar with the problems in that place.<sup>30</sup>

The year 1940 saw considerable change in the biometrical staff of the Council. In February, G.A. McIntyre began in Canberra; in September E.J. Williams returned from a studentship in England, and went to Melbourne to replace Barnard, who resigned in October, following her marriage to S.A. Prentice the previous year. At the end of December Allan, now Mrs Calvert, resigned, and Cornish took over as Chief Biometrical Officer in January 1941. On 13 March 1941 the Executive Committee transferred all the biometricians and supporting staff in other Divisions of the Council to the Biometrics Section.<sup>31</sup> The Section then consisted Cornish and Williams in Melbourne with support staff Misses M. Pate (“computer”) and Cooper (Junior Assistant); McIntyre supported by Miss R.N. Prowse (“computer”) in Canberra; and Turner with Miss M. Hornby (Technical Officer) in Sydney.

## **Life after CSIR**

Following her resignation from CSIR, Allan continued her lecturing at the Forestry School, and carried out some part-time research in the Bureau of Census and Statistics. In 1945 she declined an offer from Rivett of six month’s work concerned with chemical warfare at Proserpine in Queensland, as her son Allan was then at nursery school and it would have been impossible to take him with her.

Allan inherited her mother’s interest in community affairs. She was one of the earliest members of the Canberra Nursery Kindergarten Society, serving as Secretary in 1943-44, and was President of the Canberra Mothercraft Society in 1945-46. She took an active part in the activities of the Canberra Association of Women Graduates from its inception in 1944.

She died suddenly on 6 August 1952, aged only 47 years. Her obituary in the “Canberra Times” describes her as “one of Canberra’s best known mathematicians (who) had taken a prominent part in local educational and community activities for many years”<sup>32</sup> and noted that her funeral service was attended by representatives of several diplomatic missions.

In compiling this history, one of the pleasures has been in talking to former colleagues and friends of Betty Allan. They remember her as gentle, kind-hearted and considerate,

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<sup>30</sup> CSIRO Archives, series 9, item B1/3/36, Allan to Rivett: Report on the Biometrical Work of the Council for Scientific and Industrial Research, 31 August 1937.

<sup>31</sup> Minutes of 473<sup>rd</sup> CSIR Executive Committee Meeting.

<sup>32</sup> Canberra Times, 8 August 1952.

easy to work with, and always willing to help people. Combined with her mathematical and statistical abilities, these traits contributed to her undoubted success as CSIR's first biometrician. She set a high standard for those who have followed after her, and for this we owe her much.

### **Acknowledgements**

I am indebted to Colin Smith and Michael Moran, CSIRO Archivists, for access to early CSIR records and their interest in this history. My appreciation to those who generously gave of their time and recollections: Mrs Winifred Radford, Mr William Hartley, Mrs Phyllis Nicholson and Dr Mildred Prentice. Thanks too to Liz Gorry who retyped this article for the 75<sup>th</sup> anniversary of statistics in CSIRO, and to Carrie Bengston for helpful discussions about it.

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