BOOK REVIEW:

Sylvia L. Boyd, *Portrait of a Binary: The Lives of Cecilia Payne and Sergei Gaposchkin* (Marco Island, FL: Penobscot Press, 2014). 507 pages. HB $35.50, from author, 40 Bigelow Avenue, Watertown, MA 02472. ISBN 0-89725-942-4.

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Sylvia Boyd's dual biography of one of the most colorful scientific couples of the 20th century has much to recommend it. As a good biography should, it not only clarifies the struggles and achievements of Cecilia Payne Gaposchkin (1900-1979; hereinafter denoted as CPG) and Sergei Gaposchkin (1898-1984; hereinafter denoted as SG) but also illuminates the historical background against which their lives were lived—in this case, including two World Wars, the Russian Revolution and civil war, the Great Depression, and the Cold War. Boyd's great strength is dispassionately pointing out and dismantling the myths about the couple, partly self-generated, that have prevailed into the 21st century.

First, a word about the book's title, which is of broader resonance than the homage it tacitly pays to SG's primary professional interest in eclipsing binaries. Very early in the book, Boyd explains that in the course of their seemingly unlikely marriage—between a refined and well-educated English woman and a haphazardly and largely self-educated Crimean born into poverty—they became "a real double star—the union of two stars that are formed together in one system, by the laws of attraction." Although the myth persists that SG contributed little to their scientific collaboration, in truth the mutual interactions of this human binary system from the time of their union in 1934 yielded "scientific work that was much more than just the sum of their two efforts."

CPG was the first graduate student of either gender at the Harvard College Observatory (hereinafter referred to as HCO), where she arrived from the University of Cambridge in 1923. Thirty-five years later she became the first woman to be promoted to tenure at Harvard University from within its own ranks. The work for which she is best remembered today is the conclusion she reached in her doctoral research under the supervision of HCO director Harlow Shapley. Payne's careful observations and calculations demonstrated in 1925 that the stars are made primarily of hydrogen and helium. This was a revolutionary finding, since the prevailing belief at the time was that the sun and other stars were made up of the same elements in the same proportions as the Earth. Shapley, however, after consultation with his own Ph.D. mentor, Henry Norris Russell of Princeton—then among the most influential of American astronomers—convinced CPG to explain away her results, even though they could find no flaws in her data or methods. She complied, writing that the "enormous abundance" of hydrogen and helium that she had detected was "almost certainly not real." Only a few years later, Russell made his own measurements of the elements in the sun's atmosphere that seemed to confirm CPG's results, but was still disinclined to reject the accepted wisdom. Eventually, when others confirmed her findings, Payne's earlier work had a transformative effect on astrophysical research.

Eager to get a more informed assessment than mine to CPG's thesis results, I corresponded with Owen Gingerich, who made these comments: "In the 1950s Otto Struve declared her thesis was the most important thesis in astronomy ever written, and in his discussion mentions nothing about hydrogen and helium. What she showed definitively was that the differing appearances of the spectral types was not the result of different chemical compositions but different physical conditions. The big problem in 1925 was the temperatures of the stars, and she defined this so well that it became a non-problem. In 1925 there were good reasons to suspect some astrophysical problem with hydrogen and helium giving a false result, particularly as her technique was unproven. Furthermore, she was looking only at the atmospheres of the stars, which were a tiny fraction of the stars' bulk. It was not until the interiors modeling of Eddington and Stromgren, I think in 1932, that astronomers realized that it made sense to accept that hydrogen and helium really were the main components of the stars and of the universe."

Although even today one often hears that Shapley and Russell insisted on neutering Payne's results because of her gender, Boyd presents compelling arguments to the contrary, of which one will suffice here. A few years later, also at HCO, Bart Bok wanted to base his thesis on research results of his that challenged work by British astrophysicist and mathematician Edward Arthur Milne. The department chair, with Shapley's support, not only kept Bok from building a doctoral dissertation on the findings but also prevented him from publishing those results in a paper. Boyd also reports that Shapley supported Payne's career in many ways over the years. Among other things, he supported her as a candidate to head the astronomy department at the University of Michigan and got the American Academy of Arts and Sciences to admit women so that she could be admitted into its membership. Even though it is true that he paid her for her work as an HCO staff member as little as he could, and considerably less than men who were her junior and sometimes not quite in her class as a researcher, Boyd explains that Shapley's budget was limited, so he paid each staff member as little as he could get away with without losing them to other institutions. In this instance, being part of a binary compromised her ability to seek positions elsewhere that would have given her leverage with the Harvard administration. While HCO provided meaningful work for SG, who in 1948 was granted tenure on the staff, another institution might have been hard put to accommodate both Gaposchkins with opportunities as favorable as they had found at Harvard, particularly since much of their research was collaborative.

Boyd tells SG's personal and professional story very movingly against the dramatic backdrop of many seemingly unsurmountable obstacles. Against all odds, in 1931, this determined man, who at age seven had fixed upon the unlikely goal of becoming an astronomer after seeing newspaper coverage of an expedition of Russian astronomers to Egypt to view the total solar eclipse of 1905, succeeded in earning a doctorate in astronomy from the University of Berlin. "At thirty-three, after an inadequate education, after surviving world war, civil war, famine, epidemics, the loss of his family to disease and hunger, exile, … privation, discrimination and every other difficulty, … he was an astronomer." The story of his making his way to an August 1933 meeting of the German astronomical society in Göttingen, despite his being suspected of being a Communist spy at a time when Nazism, with its determination to eradicate Communism,

was on the rise, is compelling in itself. There he met Cecilia Payne, in Europe to heal a heart broken in an unrequited romantic relationship. They were immediately attracted to each other, despite their contrasting backgrounds. Before returning to HCO, Payne wrote Shapley that she found SG's work "good but not brilliant," but that she had never before encountered someone "more determinedly bent on a scientific career." She urged HCO to make room for SG, which Shapley agreed to do, while she arranged for SG to get the documents he would need to enter the US as a stateless person. (He could not return to Soviet Russia, where he was suspected of being a White Russian spy!).

When Shapley broke the news of the Gaposchkins' marriage at an HCO staff meeting, many there viewed their union as a "misalliance." From the outset of SG's arrival in Cambridge and in the years following his death, the story circulated that he was incapable of significant work and "that he was kept on the staff as a favor to Cecilia." Boyd argues convincingly, however, that SG did make important contributions to the field, both independently and collaboratively. Soon after SG's arrival at HCO, his independent work on eclipsing binaries proved solid enough for Shapley to publish the findings. Russell sometimes commented to Shapley that SG's work lacked "mature critical judgment," but he appreciated that SG's contributions could be "new and valuable." One major Gaposchkin collaboration began in 1937, when the Milton Fund of Harvard Observatory provided support for a program to study all variable stars then known to be brighter than tenth photographic magnitude at maximum. SG directed assistants in measuring the brightness of stellar images on the photographic plates, while CPG was in charge of reducing the measurements to derive the period of variation and the light curve. In 1955 the last results of the Milton Bureau variable star work was published in the Harvard Annals, where the collaborative effort was designated "one of the most important events of recent years" in the field. After Shapley retired as director of HCO in 1952, the Gaposchkins began to collaborate in his field of interest, the Magellanic Clouds, using plates that had been taken for Shapley at Boyden Station, HCO's southern hemisphere installation, in Bloemfontein, South Africa. After the Gaposchkins officially retired in the mid-1960s, they continued the work, funded first by the NSF and then by the Smithsonian Astrophysical Observatory (which had moved from Washington, DC, to Cambridge in 1955 to affiliate with HCO). The division of labor was similar to that for the Milton Bureau, with SG measuring the magnitudes of Magellanic Cloud variable stars on the plates, and CPG deriving the periods and light curves. The results of their work on the variable stars of the Magellanic Clouds were still in use decades later. As Boyd emphasizes, "few pieces of research remain useful for thirty or forty years." So much for the critics who claim that SG was a good-for-nothing.

Boyd's book reflects the effort of many years spent interviewing people who knew the Gaposchkins and combing the archives of HCO and Harvard University for letters and other material that give a sense of immediacy to the story. It makes for interesting and informative reading. Nonetheless, I found the book's scholarly apparatus frustrating. The bibliography, a scant two-and-a-half pages titled "Books Referred To," does not include all the titles it should, with the most obvious missing item being CPG's own *The Dyer's Hand: An Autobiography* (which was reissued in 1984 by the Gaposchkins' daughter, Katherine Haramundanis, whose name also does not appear in

the list). I also find the absence of a chronology of significant years and events for each of the biographical subjects a serious omission. We learn, for example, on page 1 that Sergei was 35 when the couple eloped and Cecilia 33, but not until page 3 do we learn her birthdate (May 16, 1900), and Sergei's not until page 26 (July 1898). We have to wait until the final pages of the last chapter to learn the dates of their deaths (CPG on December 7, 1979; SG on October 17, 1984). I found the absence of an index a significant impediment, although Owen Gingerich's copy of the book includes one, so we have concluded that the copy I read is "mutant." As a biographer of Marie Curie, I also detected an error in Boyd's text. In Chapter 17, Boyd asserts, "In the 1930s Marie Curie became director of the laboratory of radioactivity at the Curie Institute of Radium." In fact, as early as 1909, the Pasteur Institute and the University of Paris began discussions about founding a Radium Institute, and within a few years the arrangements were made, with Curie herself from the outset being named director of the radioactivity laboratory. I wonder how many other little errors regarding topics about which I know less have crept in. These shortcomings notwithstanding, I recommend Boyd's *Portrait of a Binary* to readers of this newsletter—though make sure, when writing to order a copy from her, to ask for a one with an index.