

Film Review: *Top Secret Rosies*

Reviewed by Judy Green

Top Secret Rosies: The Female Computers of World War II

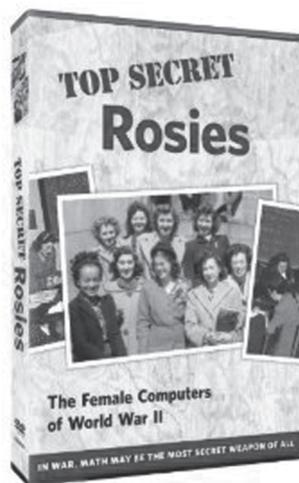
High-definition video documentary,
running time 56:40

Producer/Director: LeAnn Erickson

Website: <http://www.topsecretrosies.com>

Top Secret Rosies: The Female Computers of World War II is a documentary that focuses on four women who worked as “human computers”, computing individual ballistic trajectories for the Army at the University of Pennsylvania’s Moore School of Electrical Engineering. These trajectories were then compiled into tables at the Army’s Aberdeen Proving Ground (APG). Three men are also featured: two who were members of the Army Air Corps and one, Joseph Chapline, who worked with John Mauchly at the university. Several historians also appear giving commentary.

The film gives a flavor of the wartime experiences of the seven principal interviewees and explores how they felt about their work. We learn from the women something of what it was like to work on the tables, and we learn from the men in the planes something of what it was like to use the tables for dropping bombs. We also learn that some of the calculations were done by hand, some were done using calculating machines, and some were done using the university’s differential analyzer, an analog electromechanical computing machine used to solve differential equations. Unfortunately, but understandably, we do not learn precisely what went into creating the tables or what sort of calculations the women were doing. Other technical details that would interest



mathematicians are also not included. Nonetheless, the film is interesting and informative. It is particularly suitable for an audience that might not be aware of the pervasiveness of mathematics, in military applications and elsewhere. However, by mislabeling the women in the film as mathematicians, it does somewhat distort the role

of women in the mathematical sciences in the mid-twentieth century. Furthermore, while *Top Secret Rosies* shows a piece of history not usually seen, it does not show anything of the history of mathematics or the history of women in mathematics, as is claimed in some reviews of the film.

The title of the film is clearly meant to evoke a comparison with “Rosie the Riveter”, a World War II symbol of women who worked in shipyards and aircraft factories and did other jobs previously done mainly by men. This comparison is not really appropriate since it was not unusual for women to do computations before the war. Furthermore, in the 1930s about 15 percent of all the American Ph.D.’s in mathematics were granted to women, and there were at least two hundred American women with Ph.D.’s in mathematics at the start of World War II.¹ Many of these women, most notably

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¹See Judy Green and Jeanne LaDuke, *Pioneering Women in American Mathematics: The Pre-1940 Ph.D.’s* (Providence, RI: American Mathematical Society and London Mathematical Society, 2009).

Grace Hopper² (Ph.D., Yale, 1934) and Mina Rees³ (Ph.D., Chicago, 1931), were involved in the war effort. In 1938 another mathematician, Gertrude Blanch (Ph.D., Cornell, 1935), was hired by the WPA's Mathematical Tables Project to train both women and men, many without high school diplomas, to do the computations necessary to compile mathematical tables using only paper and pencil.⁴ Furthermore, in referring to the human computers, a male employee of the Ballistic Research Laboratory at Aberdeen noted that "women were regarded as capable of doing the work more rapidly and accurately than men."⁵

Of the four Rosies of the film, only three joined the project in 1942. That spring the "Blumberg Twins", Doris Blumberg (later Polsky) and Shirley Blumberg (later Melvin), graduated from the Philadelphia High School for Girls and were encouraged by their high school principal to apply to work in the newly forming group at the Moore School. Marlyn Wescoff (later Meltzer) had just received a degree from Temple University in secondary education with a minor in business. Although these three women are referred to as mathematicians, when they started working at the Moore School, none of them had taken any college mathematics courses. The film's website reports that Wescoff's degree was in mathematics education⁶ despite the fact that in 1995 Marlyn Wescoff Meltzer reported that her major was "called social studies and English" and that she was hired because she "could operate an adding machine."⁷ While the Blumberg twins and Meltzer clearly had significant mathematical talent, labeling them as mathematicians echoes a common misconception that anyone who does computations must be a mathematician.

²Grace Hopper joined the U.S. Naval Reserve in December 1943 and worked on the Mark I computer at the Bureau of Ships Computation Project at Harvard University. She is best known as the creator and developer of the first compilers, as an advocate for making computers accessible to large numbers of people, and as the oldest officer on duty in the armed services when she retired as a rear admiral in 1986.

³During the war Mina Rees worked for the Applied Mathematics Panel, which enlisted civilians to assist the military with war-related work. Later she served as the head of the mathematics branch of the Office of Naval Research and was the first president of the Graduate School of the City University of New York.

⁴See David Alan Grier, "Gertrude Blanch of the Mathematical Tables Project", *IEEE Ann. Hist. Comput.* **19** (1997), no. 4, 18-27.

⁵W. Barkley Fritz, "The women of ENIAC", *IEEE Ann. Hist. Comput.* **18** (1996), no. 3, 13.

⁶Short backgrounds of the seven people featured in the film can be found at http://www.topsecretrosies.com/Top_Secret_Rosies/Project_Background.html.

⁷*Ibid.*, Fritz, "The women of ENIAC", 22.

The film does not include anything about the mathematical training the women of the project received. However, in 1995 Marlyn Wescoff Meltzer indicated that at some point she attended classes that included trigonometry and calculus.⁸ One of the other women who came to the project without any college-level mathematics training was Betty Snyder (later Holberton), a journalism major who later became a well-known computer programmer. In a 1973 interview for the Smithsonian Institution's Computer Oral History Project, Betty Snyder Holberton indicated that she learned about the program from an ad saying "they needed girls to do mathematics and they would train you."⁹ As part of her participation in the ballistics project, Holberton spent three months studying "mathematics eight hours a day, six days a week."¹⁰ One of the three months was spent on calculus.

Although it is not clear if the women without college degrees participated in any mathematics training, it is clear that for the ballistic tables project the Blumberg twins and Meltzer executed algorithms that other people had formulated. Thus they were part of a project in which individuals with varying levels of mathematical training produced mathematical tables in a team setting. The WPA's Mathematical Tables Project and the Army's ballistic tables project were far from being the first projects of that kind. In 1977 Uta C. Merzbach described the phenomenon as presented by Charles Babbage in the chapter "On the division of mental labour" of his book *On the Economy of Machinery and Manufacture*:

Babbage...related the story of the French mathematician Baron de Prony (1755-1839), who was charged by the French government with the production of the logarithmic and trigonometric tables necessitated by the French attempt to extend use of the decimal system to the division of the circle into 100 parts. While pondering the organization of this massive undertaking, Prony is said to have chanced upon a copy of Adam Smith's *Wealth of Nations*. Scanning the introductory chapter, on the division of labor, it occurred to Prony to divide the "manufacture" of the mathematical tables in a fashion analogous to that

⁸*Ibid.*, 23.

⁹Jean J. Bartik and Frances E. (Betty) Snyder Holberton interview. Interview by Henry Tropp, April 27, 1973, Washington, DC. Computer Oral History Collection, Archives Center, National Museum of American History, Smithsonian Institution. Transcript at http://invention.smithsonian.org/downloads/fa_cohc_tr_bart730427.pdf, 2.

¹⁰*Ibid.*, 5.

which Smith described for the manufacture of pins. Prony...established three sections of work. To the first section he assigned five or six distinguished mathematicians. Their sole function was to select, from numerous available analytic expressions for a certain function, that formula most easily computed by a large number of individuals working simultaneously. To the second section he assigned seven or eight competent mathematicians charged with giving numerical values to the formulas selected by the first section, on which the actual computations would be based. The members of the second section also verified subsequent calculations by analytic means. To the third section Prony assigned 60 to 80 individuals who needed no mathematical knowledge beyond the ability to add and subtract. This section carried out the required computations.¹¹

What was different about the ballistic tables project was that the group that carried out the computations used two different methods of computing. Doris Blumberg was one of six computers who used the Moore School's differential analyzer that could compute in fifteen minutes what Shirley Blumberg and Marlyn Wescoff's group needed sixty hours to compute.

The second half of *Top Secret Rosies* introduces another Army project that was located at the University of Pennsylvania's Moore School—the development of the ENIAC, the first fully functional electronic general purpose digital computer. Once the ENIAC became close to operational, there was a new call for women mathematics majors to join the group at the Moore School. One of those answering that call was the fourth Rosie of the film, Betty Jean Jennings (later Bartik). Jennings had studied mathematics at Northwest Missouri State Teachers College and joined the project in April 1945. A few months later, she and Marlyn Wescoff became part of a team of six women who were to set up problems for the first test of the ENIAC.¹² This team was drawn from those who carried out the computations needed to produce

¹¹Uta C. Merzbach, Georg Scheutz and the First Printing Calculator (Washington, DC: Smithsonian Institution Press, 1977), 6–7. http://www.sil.si.edu/smithsoniancontributions/HistoryTechnology/pdf_10/SSHT-0036.pdf.

¹²Three of the other four women programmers had been mathematics majors [Frances Bilas (later Spence), Ruth Lichterman (later Teitelbaum), and Kathleen McNulty (later Mauchly then Antonelli)] and one [Frances Elizabeth Snyder (later Holberton)] had been a journalism major.

the tables because the task of setting up problems was viewed as clerical.

It is in the discussion of programming the ENIAC that *Top Secret Rosies* is most likely to present mathematicians with new insights into the work that was done by the women. It is made abundantly clear that their work was much more than clerical and that computer programming in 1945 was not at all like computer programming today. Rather, we learn that the ENIAC consisted of many separate units, and programming it involved connecting one unit with another to get a path that would solve a specific problem.¹³ Soon after the end of the war five of the six programmers went to Aberdeen to be trained.¹⁴ Jean Jennings Bartik later wrote:

We spent much of our time at APG learning how to wire the control boards for the various punch card machines: tabulator, sorter, reader, reproducer, and punch. As part of our training, we took apart and attempted to fully understand a fourth-order difference board that the APG people had developed for the tabulator.¹⁵

They also learned “how each unit of the ENIAC worked, what the switch settings meant, how the different units operated together to perform the operations of multiplication and division, how the information was read into the ENIAC from the card reader, and so on.”¹⁶

At about the same time that the six women went to Aberdeen to learn about the ENIAC, two physicists from Los Alamos came east to see if the ENIAC could help perform a calculation needed for the development of the hydrogen bomb. The film includes a wonderful description by Jean Jennings Bartik of the installation of that program, the first to be installed on the ENIAC. She tells us that Herman Goldstine¹⁷ stood in front of the ENIAC and gestured like an orchestra conductor calling out commands to the women who were throwing

¹³A short description of the ENIAC written by Adele Goldstine can be found in the first chapter of a 1946 technical report, “A Report on the ENIAC (Electronic Numerical Integrator and Computer)”, issued by the University of Pennsylvania. <http://ftp.arl.army.mil/~mike/comphist/46eniac-report/chap1.html>.

¹⁴Fran Bilas did not attend the original training.

¹⁵Fritz, “The women of ENIAC”, IEEE Ann. Hist. Comput. **18** (1996), no. 3, 19–20.

¹⁶W. Barkley Fritz, “ENIAC—A problem solver”, IEEE Ann. Hist. Comput. **16** (1994), no. 1, 28.

¹⁷Herman Goldstine was the mathematician (Ph.D., Chicago, 1936) who, while on active duty at the Army's Ballistic Research Laboratory in Aberdeen, was appointed liaison between the Army and the Moore School.

switches and plugging cables into the units they had been assigned.

The six women programmers were working on the same sort of problem they had been doing earlier, i.e., calculating a trajectory. They were divided into three groups of two: Jean Jennings and Betty Snyder were to figure out how to get the ENIAC to do the calculation, Marlyn Wescoff and Ruth Lichterman were to calculate the trajectory using calculating machines, and Fran Bilas and Kay McNulty would do the calculations using the differential analyzer. Despite this division of labor, all the women discussed how to program the ENIAC, and it was during these discussions that the idea of repeating parts of the program first surfaced. In her 1973 interview Jean Jennings Bartik explained:

When we first started everybody was trying to program a trajectory. ...We didn't know how to do it at all, so everybody was trying, and we were interchanging ideas of how to do it. But, Kay McNulty was the first person that taught me the concept of repeating sections of program. So it was very practical in terms of doing this trajectory problem because with the idea of not having to repeat a whole program, you could just repeat pieces of it and set up the master programmer to do this. And I do remember that that was crucial because we were running out of switches.¹⁸

The first public demonstration showed that the ENIAC could calculate the trajectory of a shell faster than the shell traveled along that trajectory. Although this successful demonstration was the result of the work of six women, none was invited to the celebratory dinner, nor were they mentioned in any of the press releases about the demonstration.

While things today are better for women, mathematicians and others, than they were in the 1940s, it took awhile for the women of this film to be recognized. Nonetheless, many may come away from the film thinking that before World War II women not only did not work as computers or mathematicians but they also thought themselves incapable of doing such work. Listening to the four Rosies, one has the impression that such thoughts never entered their minds.

¹⁸Jean J. Bartik and Frances E. (Betty) Holberton interview transcript, 38. In 1997 all the ENIAC programmers were inducted into the Women in Technology International (WITI) Hall of Fame.

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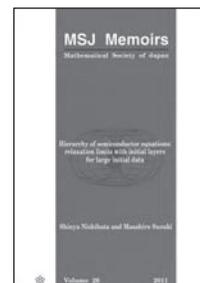
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