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Women in Computing: Experiences and Contributions Within the Emerging Computing Industry

I. Introduction

This paper focuses on women's experiences and contributions within the emerging computer industry. The paper begins with brief summaries of a number of specific women's work in the early days of computing. Most of these women worked as computer programmers. The next section attempts to describe what it was actually like for these women working during this timeframe and the challenges they faced. Most all of the women quoted describe their experience as both exciting and rewarding. Most researchers writing on women's participation in early computing, however, focus on the "invisibility" of these women's participation and contributions in the emerging computer industry; whereby, most general descriptions of early computing depict women's participation in early computing in a distorted light. The final section emphasizes that researchers should continue adding to the literature on women in the emerging computing industry.

II. Naming Names

The following section introduces a number of women active in the early computing industry. It briefly describes the work and contributions each of these women made during the emerging computing industry. A fair amount of literature, particularly describing these women's contributions during the 1940s and early 1950s, is available. Much in particular has been written on women's participation on the ENIAC project.

The section begins with Ada Augusta Byron Lovelace's contributions during the mid-1800s and concludes with women's contributions through the mid-1900s.

Ada Augusta Byron Lovelace. A mathematician and daughter of Lord Byron, Ada Augusta Byron Lovelace contributed to the evolution of computing although her story and contributions "are not easy to qualify" (Toole, 1996). She became aware of Charles Babbage's Analytical Engine, translated from Italian a description of the Analytical Engine written by L.F. Menabrea, and added considerable notes to Babbage's design. As Ceruzzi (1983) concludes, her "notes on Menabrea's description of the Analytical Engine stand as one of the first thorough studies of the nature and power of digital computers, written a hundred years before any working computer existed".

Her series of notes included a table describing the operations necessary for solving mathematical problems; therefore, she became the first conceptual programmer for her work relating to Babbage's Analytical Engine (Gürer, 1995). As Perry and Greber (1990) note, Lovelace's "most significant contribution to computer science was to introduce a binary system in computer mathematics in place of Charles Babbage's decimal system". It is not clear, however, how much of the enhanced text is her own work outside of Babbage's, given that she and Babbage were in frequent communication. In later writings, she developed the "loop" and "subroutine" concepts. Much has been written about Ada Augusta Byron Lovelace. Her work was recognized by the Department of Defense in naming its high-level programming language, *Ada*, in her honor (Gürer, 1995).

Sister Mary Kenneth Keller. By receiving a PhD in computer science in 1965 from the University of Wisconsin, Keller is believed to be one of the first, if not the first, woman to receive a doctoral degree in computer science in the United States. During graduate school at Dartmouth, "the university broke the "men only" rule and allowed her to work in the computer center, where she participated in the development of BASIC" (Anonymous, 1995). She founded the Computer Science Department at Clarke College in Dubuque, Iowa and served as its chair for 20 years. Sister Keller was also instrumental in establishing graduate programs in computing for women (Goyal, 1996).

The ENIAC (Electronic Numerical Integrator And Computer) was developed by J. Presper Eckert and John Mauchly at the University of Pennsylvania for the U.S. Army. Completed in 1945, the ENIAC although invented for one specific wartime problem, the preparation and printing of firing tables, is described as the first general-purpose electronic digital computer (Ceruzzi, 1983). The ENIAC remained at the Moore School of Electrical Engineering at the University of Pennsylvania in active use until early 1947, when it was moved from its design and construction site to its permanent location at the Ballistics Research Laboratory (BRL) of the Aberdeen Proving Ground, Maryland (APG) (Fritz, 1994).

Much has been written concerning the development and use of the ENIAC and women's participation on the project. As Light (1999) notes, "nearly two hundred young women, both civilian and military, worked on the project as human 'computers', performing ballistics computations during the war". Many of these women were instrumental in programming the ENIAC. As Fritz (1996) notes, many women worked with ENIAC

during the "1942-1955 period covering ENIAC's pre-development, development, and 10-year period of its operational usage". The following outlines some of the specific women's participation on the ENIAC project and some of the other contributions they each made to the computing industry.

Three women, **Adele Goldstine**, **Mary Mauchly**, and **Mildred Kramer**, were instrumental in programming the ENIAC. Each of these women also helped recruit and train a core group of six programmers recruited specifically for the ENIAC project. These six women were among the best "computers" selected to learn how to program the ENIAC (Goldstine, 1972). These six women were selected among a group of 100 and included **Kathleen McNulty Mauchly Antonelli**, **Frances Bilas Spence**, **Betty Jean Jennings Bartik**, **Frances Elizabeth (Betty) Snyder Holberton**, **Ruth Lichterman**, and **Marlyn Wescoff Meltzer**. They participated in many ENIAC programming projects. Although not directly involved with the work done on the Los Alamos nuclear problem conducted on the ENIAC, they did serve as operators setting switching and connecting cables for the project (Fritz, 1996). **Adele Goldstine** served as the author of the ENIAC manual – the two-volume "Technical Report on ENIAC (Gürer, 1995; Fritz, 1996).

Kathleen McNulty Mauchly Antonelli. Trained as a mathematician, left work in 1948 to marry John Mauchly. **Frances Bilas Spence** also had been a major in mathematics (Fritz, 1996) **Betty Jean Jennings Bartik,** a mathematics major, worked on ENIAC and later worked as a programmer on the UNIVAC. UNIVAC I, the first commercial electronic, digital computer in the United States, was delivered in 1951 to the U.S. Census Bureau (Gürer, 1996).

Frances Elizabeth (Betty) Snyder Holberton. Trained as a mathematician, Holberton is credited with much of the software for the first UNIVAC and had a major influence on the way various parts of the UNIVAC were designed to work - especially the magnetic tape drives. Grace Hopper considered Betty Holberton to be one of the best computer programmers she had known (Bergin, 2000). From 1942, Holberton worked at the BRL unit at the University of Pennsylvania, working as both a "computer" and supervisor. From 1947 to 1953 she worked at the Eckert-Mauchly Computer Corporation. Her later work included supervisor of advanced programming at the Applied Math Laboratory at the David Taylor Model Basin and supervisor and mathematician at the Institute for Computer Science and Technology at the National Bureau of Standards until 1983 (Lee, 1995). Known particularly for her work with sort generators, she created the first sort-merge generator for the UNIVAC I "from which Grace Murray Hopper claimed to have derived the first ideas about compilation" (Fritz, 1996). She also served on the COBOL committee when COBOL was introduced as a language (Bergin, 2000).

Of the original six programmers, only Lichterman stayed for longer than a brief period of time working on the ENIAC project. Many other women worked with the ENIAC as programmers at BRL following this initial group including **Gloria Gordon Bolotsky, Lila Todd Butler, Ester Gersten, Winifred Smith Jonas, Marie Bierstein Malone, Helen Greenman Malone,** and **Homé McAllister Reitwiesner**.

Homé McAllister Reitwiesner, educated as a mathematician, worked as a programmer on the ENIAC, EDVAC and ORDVAC. Along with her husband, George Reitwiesner, she programmed and ran the ENIAC's first significant production problem – the

diagonalization of a set of symmetrical matrices during 1951 (Fritz, 1994). She left government service in 1955 (Bergin, 2000).

Viola Woodward, trained as a mathematician, came to BRL in 1948 and worked on the ENIAC, EDVAC, ORDVAC, and BRLESC. After serving as a supervisor, programmer, and chief of the ORDVAC, she retired in 1978 after a 30-year career and returned as a consultant (Bergin, 2000).

Lila Todd Butler, a mathematician by training, joined BRL at Aberdeen Proving Ground in 1942 and worked with the ENIAC, EDVAC, ORDVAC, and BRLESC. She played a significant role in the development of FORAST (Formula and Assembly Translator) , a machine language used on the ORDVAC –FORAST "allowed the programmer to write actual machine orders in symbolic assembly language, some arithmetic formulas written in a manner similar to conventional mathematical notation, and English words for high level statements instructing the machine" (Bergin, 2000).

Admiral Grace Brewster Murray Hopper. A PhD in mathematics from Yale, Hopper is "recognized for her technical vision and expertise. In addition to being one of the first programmers on the Harvard Mark I computer, Hopper is "recognized for her contributions to programming concepts, including subroutines, translation of formula, relative addressing, linking loaders, code optimization, and symbolic manipulation" (Goyal, 1996).

"Among Grace Hopper's credits are the first compiler, the leader of the FLOW-MATIC and MATH-MATIC developments, and a major role she played (which is almost forgotten by now) in persuading the early managers to acknowledge the value of programming languages" (Bergin and Gibson, 1996).

"Hopper was responsible for developing the FLOW-MATIC programming language, the only implemented business data processing language in use at the time. The COBOL community,…partially supervised by Hopper, used FLOW-MATIC as a model. For this reason, Hopper is often referred to as the grandmother of COBOL" (Gürer, 1995). During her work on the Mark I, Hopper was the editor and a major contributor to a 500-page volume which described how to setup the Mark I and outlined the operating principles of computing machines (Lee, 1995). She also served as the head of the UNIVAC programming effort (Goldstine, 1972).

She was "admired and respected not only for her technological achievements but also for her energy, enthusiasm, and willingness to serve as a mentor" (Gürer, 1996). Hopper was often referred to as "Amazing Grace" for her many successes and accomplishments in academia, the U.S. Navy, and in business (Lee, 1995). As Rossiter (1998) notes, before her recall by the Navy to active duty in 1967, Grace Hopper had written almost 50 articles on computer programming – several becoming classics in the field. She was also one of the most requested speakers among computer professionals (Gürer, 1995).

Adele Mildred (Milly) Koss. Milly Koss is noted as one of the first programmers of the UNIVAC I (Goyal, 1996). Among her awards, she received the Association for Women in Computing Augusta Ada Lovelace Award in 2000. After receiving a degree in mathematics from the University of Pennsylvania, her career included over 47 years in the computer industry. Her career began as a programmer on the UNIVAC I under Grace Hopper's supervision at the Eckert-Mauchly Corporation. "While working with Hopper she developed the Editing Generator in 1952 and was a member of the group developing the first compilers, the A0 and A2" (Association for Women in Computing Website).

Her later work included work at the Burroughs Corporation, developing a sort generator for the TRANSAC (one of the first transistorized computers) while at the Philco Corporation, work at the Control Data Corporation and Raytheon, and 27 years at Harvard University until her retirement in 1994 (Association for Women in Computing Website).

Ruth Haueter Cahn was the "sole woman engineer to work on SEAC". The SEAC (Standards Eastern Automatic Computer) was the first operational stored-program computer in the United States and was in use for 14 years until 1964. Cahn designed the automatic unit; along with Sid Greenwald, she incorporated the cathode-ray tube memory; and implemented many other hardware functions (Gürer, 1996).

Jean Sammet "worked on COBOL, developed Formac, and wrote a definitive book on programming languages (Goyal, 1996).

Judith Levenson Clapp served as a programmer on the Whirlwind machine developed at MIT. The whirlwind was the first real-time computer and the first to use time-sharing [Goyal, 1996; Gürer, 1995). She helped program "a prototype of one of the first nonnumerical applications of computers: an air defense system that received inputs from radar, tracked flying aircraft, and directed the courses of other aircraft" (Gürer, 1995).

Thelma Estrin, PhD in electrical engineering was "one of the initial two engineers who worked under Gerald Estrin in the design and development" of the WEIZAC (Weizman Automatic Computer) constructed in the early 1950s in Israel. The WEIZAC was "the first large-scale electronic computer outside of the United States and Western Europe". Her later work focused on applying the computer to bioengineering problems (Gürer, 1995).

Ida Rhodes worked on the Mathematical Tables Project sponsored by the National Bureau of Standards. "She was a pioneer in the analysis of systems of programming. She designed the C-10 language in the early 1950s for the UNIVAC I and designed the original computer program used by the Social Security Administration" (Weiss, 1972).

Mina Rees. A University of Chicago PhD in mathematics, "through her thoughtful and forward-looking efforts, the Office of Naval Research played a key role in the post-war computer world" (Goldstine, 1972). "The Mathematical Branch of the Office of Naval Research , under the leadership of Rees, was instrumental in establishing the Association for Computing Machinery in 1947" (Gürer, 1995).

A *draft* of a table that lists women who worked in the emerging computer industry is offered in Appendix A as Table 1.

III. Women's Experience Working in the Emerging Computer Industry

The preceding section offered brief summaries of a number of specific women's accomplishments and work in the emerging computer industry. The following section attempts to describe what it was like for some of these women working in the emerging computer industry. Examples of some of these women's work experiences are offered. The section is set in the context of the timeframe in which the women worked.

Many have pointed out the lack of history of women in computing (Campbell, 1996; Gurer, 1995; Light, 1999; Perry and Greber, 1990; Borg, 1996). As Goyal indicates, women were the prominent early users of computers (1996). And as Light notes, "the

omission of women from the history of computer science perpetuates misconceptions of women as uninterested or incapable in the field" (1999).

The tradition of women as "computer" has been traced as far back as Babbage's time when male astronomers were assisted by women in their calculations (Ceruzzi, 1991). As stated by Ceruzzi, prior to 1935, a "computer" usually referred to a human person (mostly women) "who evaluated algebraic expressions with the aid of a calculating machine" (Ceruzzi, 1983). Much has been written of the women working as "computers" during the ENIAC project. During this time, a "computer" was the person doing computing; the ENIAC itself was referred to as the "computor" to distinguish it from a person (Fritz, 1994).

Much of the previous section of the paper focused on the computing industry during World War II and immediately following the war's end, and in particular focused on women's computing work relative to the ENIAC project. As Gurer emphasizes, two themes emerge in her interviews with early women programmers. These themes included, first, the *excitement* of working in the early days of computing and, second, the *concern of balancing* job and family responsibilities (1995).

The following includes direct comments from a number of women programmers about what it felt like to be working in the emerging computer industry.

> "Unfortunately, I never really reached that height of excitement again [in later jobs] when I couldn't wait for the next day to begin" - Jean Bartik in the video "Women in the History of Computer Science".

> "The Eckert-Mauchly Company was flexible, open, such a wonderful, creative, rewarding job. They shared all their information. They taught us what we needed to know…" [Working at Eckert-Mauchly] set in motion a way of thinking about what the computer could do for the programmer in how the computer could help the programmer program not just what the computer could do for industry" – Milly Koss

in video "Women in the History of Computer Science". Koss [UNPUBLISHED] offers an account of her work from 1950 to 1953 at the Eckert and Mauchly Computer Company and describes what it was like for a woman working in the computer industry during this time. From her own account she found it an open, flexible, gender blind working environment.

"So I stayed in computers all my life, because I was so excited about the whole thing" – Betty Holberton in Bergin, 2000.

"Let me tell you what it was like working on the ENIAC and being part of this. I thought I'd died and went to heaven, I really did. It was the most exciting thing that you can imagine, because from the very beginning, the people that we talked to, and who trained us, had the vision and inspiration of where this was going to lead eventually. And we talked about it constantly" – Jean Bartik in Bergin, 2000.

"I found computing to be a good field for women and feel progress has been made in the 50 years since I entered the field. I also believe that women are no less well-treated in this field than in other ones, perhaps better treated" – quote from Betty Campbell (1996), a mathematician by training, who worked during World War II as a human computer.

As Gurer concludes, "when early women programmers were asked how they were treated, most responded that they received the same treatment and respect as the men. They felt that it was not until later years that the field of computer science became less than ideal in its treatment of women. The cause of this transformation is perceived as the absorption of the male hierarchical business structure as the size of companies involved in hardware and software products grew larger" (1995).

Many have focused on the second theme emphasized by Gurer (1995) that emerged in her interviews with early women programmers –the concern of balancing job and family responsibilities (1995). The impact of World War II on the computing industry and women's employment during the war cannot be ignored. For most of the women employed during World War II, it was assumed they were in temporary job positions, would be replaced by men returning from war, and would quit their jobs to marry and raise children.

The state of the computer within this historical context should also be emphasized. As Rees notes, "although the World War II computers, and particularly the ENIAC, were impressive machines, the questions of how much effort should be put into their further development at the end of the war was controversial. Some influential people were of the opinion that there would never be enough work for more than a few of the large computers" (1982). Therefore, not only was the longevity of these *women* working in the computing industry being questioned, but the issue was further complicated in that the longevity of the *computing industry* was likewise being questioned.

Taking these points, many have documented the negative situations these women faced. Kay McNulty states that she started in 1942 at APG at the Moore School of Electrical Engineering at the University of Pennsylvania as a "SP-4…a subprofessional level 4…even though she had her degree in mathematics at the time" (Bergin, 2000).

Many have noted that the ENIAC programming work required a high level of mathematical skill even though the women doing the work were paid at the subprofessional grade (Light, 1999). Kay McNulty and Fran Bilas were hired as SP-4s despite their degrees, according to McNulty's report to Fritz. McNulty further noted that "the girls were told that only "men" could get professional ratings. The time came later in World War II when no more men were available, and women were "pushed" into supervisory positions. Finally, in November 1946, many of the women received professional ratings" (Fritz, 1994).

Jill Smith, in summarizing the work of many women pioneers working during World War II (all of whom worked on the ENIAC) emphasizes that "these women were working six

days a week, on two shifts (the day shift and the night shift) throughout the war, with only two holidays – Christmas and the Fourth of July" (Bergin, 2000).

Light offers a compelling description of what it was like for women working on the ENIAC project. Like others, Light emphasizes the high skill level required of the women working on this project. At the same time, Light indicates that "women seem to have vanished from the ENIAC story, both in text and in photographs" (1999).

During the early-mid 1940s, women were seldom involved in the design of hardware. This does not mean, however, that women did not work with the hardware. Contributions of Ruth Haueter Cahn and Thelma Estrin were noted in the previous section. And as Jean Bartik notes (in Fritz, 1996), during the ENIAC project "the six of us programmers all got together to discuss how we thought the machine worked. … Since we knew both the application and the machine, we learned to diagnose troubles [with hardware] as well as, if not better than the engineer."

Baker, writing on general employment problems of women during the 1960s indicated that the great majority of young women put marriage and family first and work second and that "the employed woman is a greater risk than the employed man" given her likelihood to leave work to marry and raise a family. As Baker concludes, for the working woman, "she may have talent, but the sincerity of her interest is usually in doubt"(1964).

Rossiter describes women's opportunity in the computing industry at IBM in the 1940s through the early 1960s as being channeled into low-level, semiprofessional "women's work". During the 1940s, when IBM was competing with front-runner Remington Rand, "bright, personable young women, recent *graduates in mathematics* from good colleges"

were being recruited as customer service representatives. The aim of these jobs was to instruct and reassure IBM customers in use of the machines (1995).

Rossiter points out that actual data on the position of computer programmer ("the main entry job to computer science in the 1950s and 1960s") is difficult to obtain. She does report that a 1950 Bureau of Labor Statistics report indicates that "men are preferred as programmer trainees…although many employers recognize the ability of women to do programming, they are reluctant to pay for their training in view of the large proportion of women who stop working when they marry or when they have children" (1995). Rossiter describes management's frustration in various computer companies during the 1950s and 1960s in hiring women as programmers due to the high level of turnover (1995).

Vehviläinen describes Finnish women's experience in the computing industry from the late 1950s to early 1970s. She notes that currently, there are very few women information technology students among Finland's technical universities. She notes that the first computer in Finland was not installed until 1958 in the Post Bank of Finland. She describes women's work in the computer industry during the late fifties and sixties as "men took care of the managing and expert jobs as well as the development of expertise, and women worked in large numbers in the keypunch and operator jobs, at the bottom of the hierarchy" (1999).

It would appear that women's contributions to software development was enormous. One of the most interesting gaps in the literature is the absence of detail about the work Adele Goldstine performed during the ENIAC project. Although often mentioned, descriptions of her contributions are vague. For example, "Adele Goldstine seems to

have provided key leadership in designing software for the ENIAC… she was a math major…and obviously played a key role in the story" (Fritz, 1996) – the story is not described. And, it "is unclear whether Goldstine [and Mauchly and Kramer] became "visible" because their husbands' visibility [on the ENIAC project] accorded them extra attention, because these men somehow facilitated their wives' careers, or because the women themselves campaigned for recognition" (Light, 1999). In general, as Gurer notes, "although the history of computer science is well documented, one finds very few, if any, women mentioned in the standard texts on the history of this field" (1995).

As Perry and Greber note, it seems possible that, while most of the early hardware development was done by men, women created much of the necessary software (1990). Light examines how the job of programmer, perceived in recent years as masculine work, originated as feminized clerical labor (1999). Light concludes, "the ENIAC project made a fundamental distinction between hardware and software: designing hardware was a man's job; programming was a woman's job" (1999).

As Mahoney (2001) points out, the evolving field of computer programming was once dominated by women but the jobs were taken over by men to the effect of one being able to name most of the prominent women in the emerging computer industry. Granted, there were not that many women described in the preceding section of this paper, particularly if one considers the few number of women mentioned in the early years of computing who were not involved on the ENIAC project. Although the emphasis on the women who participated in the ENIAC project adds to a compelling history of women in computing, many other women surely were working during the 1940s through the 1960s other than those so frequently mentioned in the few references on these early pioneers.

IV. Current Environment and Conclusion

The previous section focused on women's experience working in the emerging computer industry. The following brief section discusses what this has meant for women working in the current computer industry.

Many references indicate that men far outnumber women in both computer related college courses and as computer science majors (Adam, 1995; Jepsen, 2001, Klawe and Leveson, 1995). As Estrin notes, computer science did not emerge as an academic discipline until the 1960s and evolved into a discipline for men (1996). At the same time, Goyal notes that many young women prefer to enter into computing jobs because computing is a relatively young field and "therefore has had less time and opportunity to develop strong and hardened stereotypes and discrimination than other disciplines" (1996).

It is unfortunate that womens' roles in the early history of computing is not better recognized. If it were, perhaps it would compel more school age women and girls toward computer science and information systems classes as preparation for careers in information technology.

As Perry and Greber note, women often participate in the early stages of a new technical field, but once a field has stabilized and demonstrated its intellectual (and financial) potential, women are excluded…the history of the computer seems to bear out this contention" (1990). Or as Light concludes, "the result is a distorted history of technological development that has rendered women's contributions invisible and promoted a diminished view of women's capabilities in this field. These incomplete

stories emphasize the notion that programming and coding are, and were, masculine activities" (1999).

Hopefully, researchers will continue to add to the current literature describing women's participation in the early computing industry. Appendix B offers additional sources for this topic for later research.

Appendix A

TABLE 1

NAME		YEARS	PARTIAL SUMMARY OF COMPUTING ACCOMPLISHMENTS
1.	Ada Augusta Byron Lovelace	(1815-1852)	Early computer pioneer; 1st conceptual programmer
2.	Sister Mary Kenneth Keller		1st woman, or one of first, to receive Ph.D. in Computer Science in U.S.
3.	Adele Goldstine	-1964)	ENIAC lead, Author of ENIAC manual
4.	Mary Mauchly		ENIAC programmer, supervisor, trainer
5.	Mildred Kramer		ENIAC programmer, supervisor, trainer
6.	Kathleen McNulty Mauchly Antonelli	(1921-	Original ENIAC programmer
7.	Frances Bilas Spence	(1922-	Original ENIAC programmer
8.	Betty Jean Jennings Bartik	(1924-	Original ENIAC programmer, UNIVAC I programmer
9.	Frances Elizabeth (Betty) Snyder Holberton	(1917-	Original ENIAC programmer, UNIVAC I programmer
10.	Ruth Lichterman		Original ENIAC programmer
11.	Marlyn Wescoff Meltzer		Original ENIAC programmer
12.	Gloria Gordon Bolotsky		ENIAC programmer
13.	Lila Todd Butler		ENIAC programmer
14.	Ester Gersten		ENIAC programmer
15.	Winifred Smith Jonas		ENIAC programmer
16.	Marie Bierstein Malone		ENIAC programmer
17.	Helen Greenman Malone		ENIAC programmer
18.	Homé McCallister Reitwiesner	(1925-	ENIAC programmer
19.	Viola Woodward		ENIAC, EDVAC, ORDVAC, BRLESC programmer, ORDVAC supervisor
20.	Admiral Grace Brewster Murray Hopper	(1906-1992)	Harvard Mark I programmer, wrote Mark I manual, UNIVAC I programming lead, developed first compiler, FLOWMATIC and MATH-MATIC development, mentor
21.	Adele Mildred (Milly) Koss		UNIVAC I programmer
22.	Ruth Haueter Cahn		SEAC Engineer
23.	Jean Sammet		COBOL committee, developed Formac, programming language text
24.	Judy Levenson Clapp		Whirlwind programmer
25.	Thelma Estrin		WEIZAC engineer
26.	Ida Rhodes	(1900-1986)	Math Tables Project, SEAC, & UNIVAC programmer
27.	Mina Rees		ONR, helped establish ACM
28.	Wilma Wyatt Sigmund		ENIAC programmer
29.	Inez Hazel		Whirlwind programmer
30.	Lilian Jay		UNIVAC I programmer
31.	Frances Morello		UNIVAC I programmer
32.	Gertrude Blanch		Math Tables Project
33.	Ethel Marden		SEAC, UNIVAC programmer
34.	Florence Koons		SEAC, UNIVAC programmer

Appendix B

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