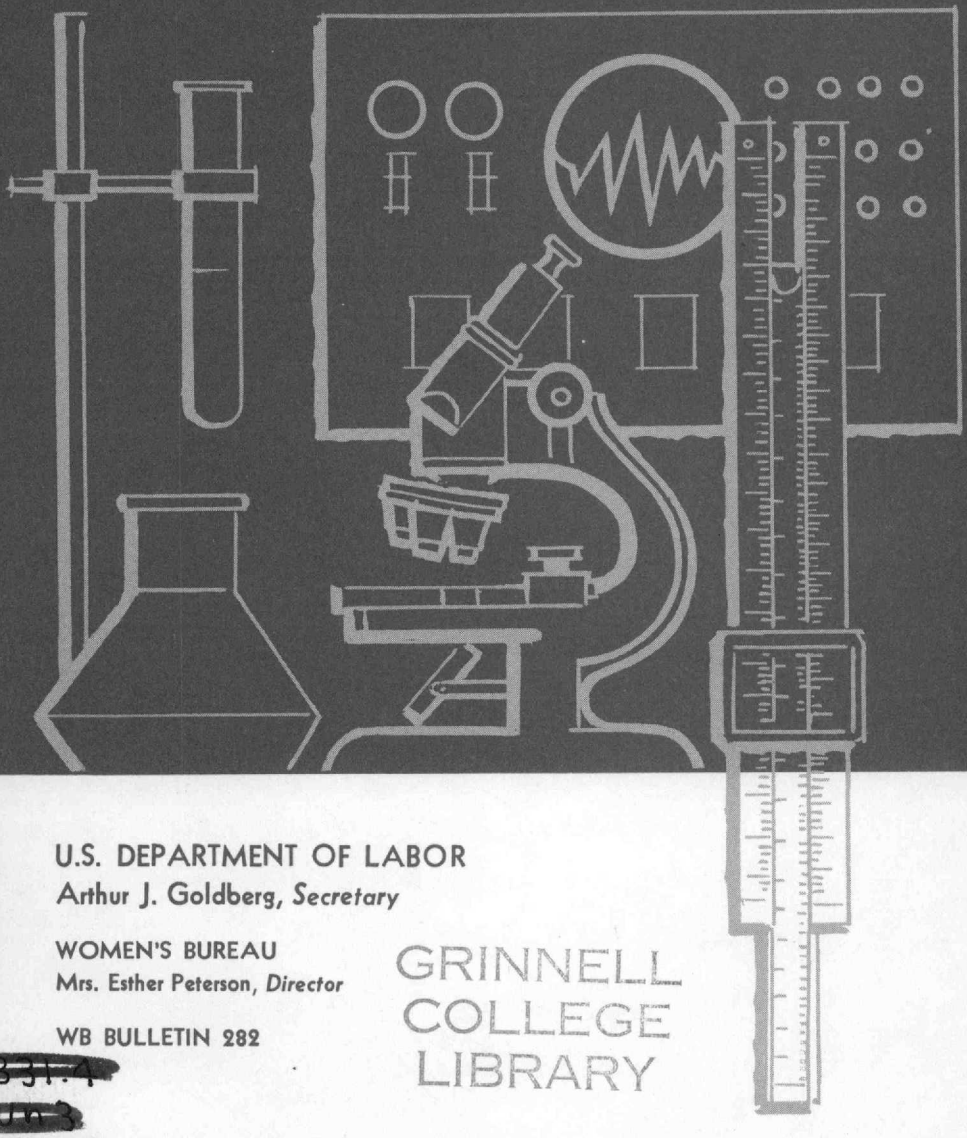
careers for WOMEN as TECHNICIANS



U.S. DEPARTMENT OF LABOR
Arthur J. Goldberg, *Secretary*

WOMEN'S BUREAU
Mrs. Esther Peterson, *Director*

WB BULLETIN 282

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Foreword

As modern society relies more and more on the achievements of science and technology, the need for well-trained technical workers is growing and is spreading throughout the world. Forecasts indicate that the current trend will continue—with technological changes creating a diversity of employment opportunities for those with the pertinent skills and qualifications.

Concern as to whether women and girls are sharing in the expanding opportunities for training and employment in the technical fields prompted the United Nations Commission on the Status of Women to make a study of this subject among its member Nations. In preparing the United States reply to the Commission, the Women's Bureau gathered material which, although not constituting a comprehensive survey, revealed many significant facts, opinions, and suggestions. These findings, and additional related material, are reported here with the hope that they may suggest aspects for others to explore more fully.

Probably the most important result of this study of technical occupations is the indication of an abundance of employment opportunities for women and girls who have the interest and resolve to prepare for them. Counselors, teachers, parents, and young women need to be aware of this situation and to know that women have been successfully trained for technical work and have demonstrated their ability to handle a variety of technical jobs satisfactorily.

We hope that the information presented in this bulletin will encourage many more girls and women to give serious consideration to obtaining suitable preparation which would enable them to take advantage of the many favorable job opportunities becoming available in the technical fields.

ESTHER PETERSON
Director, Women's Bureau

Acknowledgments

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This report was prepared in the Division of Program Planning, Analysis, and Reports, of which Stella P. Manor is Chief. Caryl Holiber and Mary B. Meyer were responsible for gathering the information for the report. It was written by Mary B. Meyer, under the supervision of Jean A. Wells.

Contents

The construction of computer circuitry, where the trend is toward miniaturization, involves precise workmanship.

An Emerging Occupational Field

Technicians comprise a relatively new group of workers in the world of work. Only a few decades ago, few people had heard of them. By the start of the sixties, they had become—both numerically and strategically—among the most important workers in our economy. Because the numbers of technical positions are increasing at a rapid rate, they offer women and girls many new employment opportunities.

To obtain information about women's opportunities for employment as technicians, including training requirements and facilities, earnings, working conditions, and chances for advancement, the Women's Bureau conducted interviews with a selected number of major firms employing women technicians. Information was obtained also from staff and from publications of the Bureau of Labor Statistics and the Bureau of Employment Security (U.S. Department of Labor), the Office of Education (U.S. Department of Health, Education, and Welfare), and the National Science Foundation. In addition, unpublished data on women Federal workers in selected technical occupations were made available by the U.S. Civil Service Commission. This bulletin summarizes the information from all of these sources. It covers primarily technicians working in support of physical scientists and engineers, including those engaged in data-processing operations. It excludes the separately defined occupation of draftsman. Medical and dental technicians and biological science technicians are also outside the scope of this report.

Most of the employer respondents in the Women's Bureau study were favorably inclined toward the employment of women as technicians. Available evidence indicates, however, that few women are working in the types of technical jobs included in this study, and, some employers still have a "show me" attitude toward women. As one employer commented, "We don't know how women technicians would get along in a factory. We haven't seen them at work, so we wonder."

There is a tremendous variety of job possibilities open to those interested in technical work. Whether their particular aptitudes are in physics, chemistry, mathematics, geology, electronics, or some other branch of science or engineering, the broad scope of the technical field can be expected to include their preference. Whether they want to do laboratory testing, product experimentation, drawing-board work,

some phase of computer work, or any of the many other specialized types of jobs in a number of settings, they can almost certainly find employment suited to their interest and talents.

Technicians are a heterogeneous group of workers. They include persons doing widely different kinds of work, with differing degrees of skill and responsibility. Some perform routine and relatively unskilled tasks, such as taking instrument readings on the performance, durability, or uniformity of a product, making minor adjustments as needed, and keeping records of readings and adjustments. At the other end of the scale are technicians with assignments akin to those of scientists and engineers. Some chemical technicians, for example, analyze and characterize chemical contents of materials, share in the planning of some aspects of research, and supervise other less skilled workers. The duties of some factory technicians are hardly distinguishable from those of production workers. Still other technicians are largely office workers and, particularly in the case of some data-processing workers, perform tasks which resemble those of statistical clerks.

With regard to training, there are technicians whose only preparation for their work has been "experience in lieu of training," while others have college degrees, usually in mathematics or science. For many of the technician jobs, however, 2 years of training beyond high school is generally preferred.

Employers reported women technicians in many technical occupations, including the following:

electrical inspector
electronic technician
electronic wireman
engineering technician; engineering aid
glass blowing technician
industrial chemical laboratory technician
instrumentation technician
metallurgical technician
standards aid
technical aid
technical illustrator; technical artist
technician in microscopy
technician in X-ray diffraction and electronic diffraction of solids

These represent only a few occupations selected to illustrate the variety of technician jobs in which women are already employed and to suggest some avenues for further exploration.[1]

[1] Information on the nature or content of these and other technician jobs may be found in Technicians Who Work With Engineers and Physical Scientists (Bureau of Labor Statistics Bull. 1300) and Technical Occupations in Research, Design, and Development (Bureau of Employment Security, BES No. E–194), U.S. Department of Labor, 1961.

Specializations of Technicians

The range of specializations which are considered to be covered by the term "technical work" is in large measure responsible for the diversity of employment opportunity. Some of the specializations are automotive and Diesel technology, chemical technology, civil and construction technology, electric power technology, electronics, industrial technology, tool design, metallurgy, mathematics, cartography, gas turbine technology, optical technology, petroleum technology, photography, steam technology, textile technology, and welding technology.[2]

Even within a given specialization, technicians' duties vary considerably from employer to employer. For example, in the electronics field, firms producing large electronic units often require their technicians to lift and move heavy equipment; they may, therefore, refuse to hire a woman for such work if they think it is beyond her strength. On the other hand, firms manufacturing small delicate electronic units emphasize the importance of finger dexterity and patience in making precise measurements with small instruments and usually consider women better qualified than men for such jobs.

In this respect, it is noteworthy that more small electronic and other units are being developed to operate as effectively as their larger counterparts. This trend toward "miniaturization" is expected to lessen the need for physical strength on some jobs and will thus open to women many positions now barred to them because of physical demands.

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[2] See also Technical Occupations in Research, Design, and Development. BES No. E-194. February 1961. U.S. Department of Labor, Bureau of Employment Security.

Characteristics of Technicians

Technicians, despite the many variations in their backgrounds and duties, are likely to have certain common characteristics. They are typically skilled workers with training beyond the high school level, but not usually with a college degree. Also, most work with professional scientists and engineers.

Most technicians have some theoretical knowledge of their specialization, together with an understanding of the practical applications of the theory. Because they work closely with scientists and engineers, as a team frequently, those particularly in research and development work must be able to communicate mathematically, linguistically, and scientifically. Usually, they must refer to handbooks, records, and drawings. They use various instruments, equipment, and measuring and testing devices. A report by the Bureau of Labor Statistics notes that: "Frequently technician jobs require use of complex electronic and mechanical instruments, experimental laboratory apparatus, drafting instruments, and an understanding of tools and machinery. Almost all . . . technicians . . . must be able to use engineering handbooks and computing devices, such as the slide rule or calculating machines."[3] Technicians often keep records and make reports, and sometimes supervise and instruct others.

A basic requirement for technicians is a liking for thoroughness and precision. As technology and the tools of technology increase in complexity, the costs of mistakes become increasingly high. This applies not only to the higher level jobs but also to many of the more routine jobs, in which an error in measurement or computation, or failure to make a necessary adjustment on a piece of equipment, may result in a large loss of material or equipment or even cause danger to human life. Thus, accuracy and maturity of judgment are essential qualities of all good technicians.

The ability to understand and follow instructions exactly, to work well with others, to be able to report clearly and accurately, and to combine a degree of manual dexterity with some theoretical knowl-

[3] Technicians Who Work With Engineers and Physical Scientists. In Occupational Outlook Handbook, pp. 158–168. BLS Bull. 1300. 1961. U.S. Department of Labor, Bureau of Labor Statistics.

edge—all these are important qualities which most technicians must possess.

Apart from these basic qualities, the range of desirable personal characteristics varies with the great diversity of jobs done by technicians. Those who make certain tests and measurements in factories must be willing to move around on the job, enjoy working with their hands and be willing, as one employer expressed it, "to get their hands dirty once in a while."

Some lower level technical jobs require a high degree of manual dexterity, patience, and ability to tolerate tedium. These include some data-processing and routine testing jobs in various specializations. Since women are usually credited by employers with these characteristics, they are often preferred for such jobs.

The girl who seeks a career as a technician should possess these basic qualities, and, if she is to advance in this field, she must be adequately trained and be able to accept the challenge of a problem and have the persistence to see it through to its ultimate solution.

Employment Opportunities for Technicians

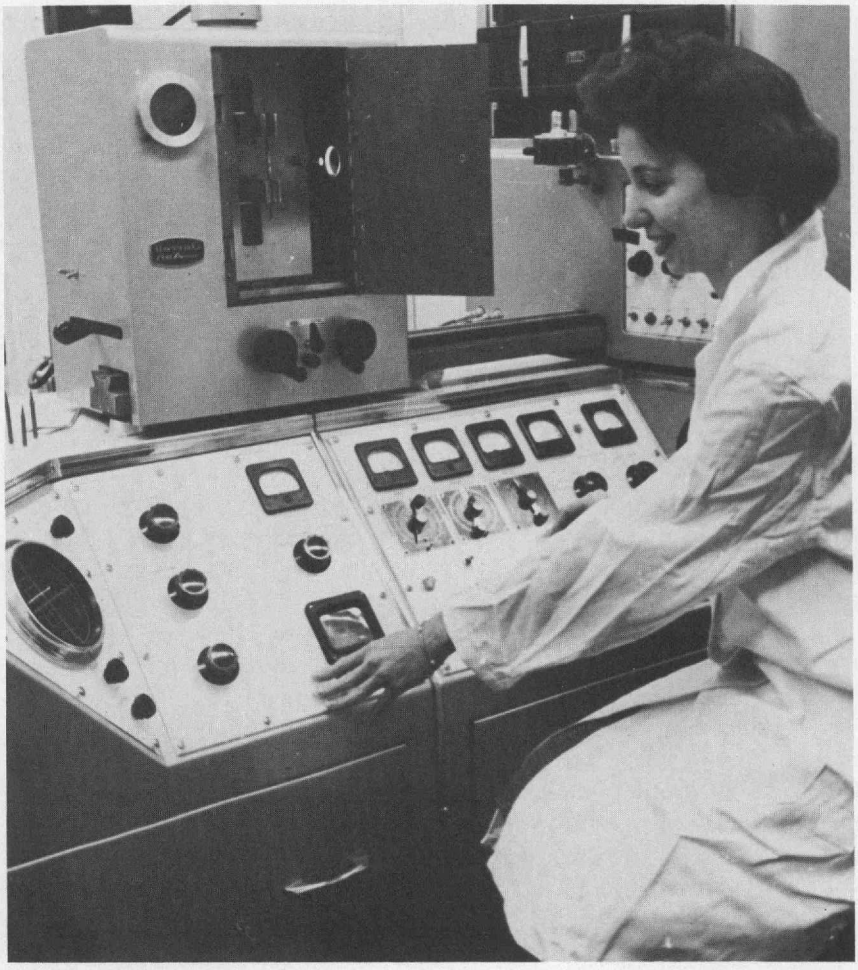
The number of women technicians is not known but is believed to be very small. In 1952, a Bureau of Labor Statistics study reported that less than six-tenths of one percent of electronic technicians were women. The number of all types of technicians (including medical and biological technicians) was estimated by the Bureau of Labor Statistics to total 700,000 [4] in 1959. Of these, about 340,000 were working with physical and earth scientists and engineers. Even these figures, however, are only approximations because of the wide range of occupations, the many types of employers, and the fluid character of many technical jobs, which are not yet fully standardized or defined.

Technicians are employed in all parts of the country. Their employers include many types of industrial establishments, private and public organizations and agencies, and a variety of others. The greatest opportunities, as might be expected, are in the highly industralized States. Technicians are concentrated in the large metropolitan areas of such States as New York, California, Pennsylvania, Ohio, Illinois, Michigan, New Jersey, Texas, and Massachusetts.

Predominant Fields for Women

Some industrial chemical employers reportedly prefer women for many of their chemical laboratory technician jobs. In this field one supervisor reported to the Women's Bureau that women in general are more satisfactory than men for such work as physical testing, and spectograph and quantometer analysis. A chemical research laboratory representative has found women preferable "in micro-analytical work where precise hand skills combined with technical interests are important, and in research supporting fields involving instrumental measurement and characterization of materials."

[4] This figure includes about 225,000 draftsmen, of whom 195,000 were employed in private industry and 26,000–27,000 in government.



The emission spectrograph being used here provides quick chemical analyses of solid materials.

In the various phases of data processing and computer work, women have established their competence. Though still few in number, they have been highly successful in programming for computers. In research laboratories, especially those where precision and handling of delicate instruments are important and where heavy work is infrequent, women are usually readily accepted.

There are indications that many firms recruit women for the lower level technician occupations. One manufacturer, however, observed that women applicants for technician jobs at his firm tend to be better qualified than male applicants. He speculated that women recognize the fact that they need more formal training and higher qualifications than men do for entrance into fields in which men predominate.

Although women are not now employed in large numbers as technicians, there is considerable evidence that more could be so employed if they were qualified. For example, the Minnesota Department of Employment Security had reported in 1958 that all electronic technician jobs in the Twin Cities Metropolitan Area were held by men, but that a number of employers had expressed willingness to hire women if they were qualified. Just a year later—in January 1959—a report by the same Department stated that one of every five chemical technicians in their area was a woman. On the other hand, a 1958 publication by the Michigan State Employment Security Commission declared that many employers were unwilling to hire women because so many of them left after only 3 or 4 years on the job.

The physical requirements of some technical jobs make them unsuitable for a woman. Jobs in this category include those that require heavy lifting, the wearing of protective equipment of unusually heavy weight, or extraordinary physical exertion, like climbing to reach equipment on roof-tops. As indicated previously, however, the number of jobs with heavy physical demand is likely to decrease as technological improvements shift heavy work from men to machines.

It is interesting to compare the experience of various firms included in the Women's Bureau study. One firm reported it does not hire women as electronic technicians because the work involves lifting and moving heavy units. On the other hand, another firm, in which the electronic technicians work with very small units, declared that women would be very readily hired if they were qualified—but no women have ever applied for such a job.

The obstacle of traditional thinking appears to affect some employers as well as some women. A representative of one State employment office reported to the Women's Bureau that employers in the local area almost always specified men on their job orders for technicians. However, placement officers at that office noted that employers seemed to be willing to hire women when they were referred. It had apparently not occurred to some employers that women might be available for such work.

In its study, the Women's Bureau had no reports of women technicians having difficulty finding jobs when they had the necessary training and qualifications. This absence of reports on discrimination lends support to statements of employers that they are interested in hiring the best qualified workers, regardless of sex. It leads to the conclusion, therefore, that in this field, where a shortage of qualified workers exists, when a woman is qualified for a technical job, she will be given favorable consideration for employment.

Part-Time Work

For technicians, opportunities for part-time work are comparatively unusual. Among the establishments included in the Women's Bureau study, only one research laboratory reported that it occasionally hired women on a part-time or temporary basis. The mature women in the group were both trained and experienced. However, the firm also hired men and women university students, principally graduate students, for part-time work. Women were not on the regular technician staff because the contract work handled by this laboratory at times requires considerable physical strength on the part of the technicians.

Information gained from the above company and other sources confirms the belief that some part-time jobs are available for qualified technicians. Women whose family responsibilities preclude full-time employment but who want to work and retain their skills are advised to seek out local employers who might have temporary or part-time opportunities, and make known their availability for work. Some research laboratories are experimenting with part-time schedules.

Principal Employers of Technicians

Private Industry

By January 1960, American industry employed about 594,000 technicians,[5] an increase of approximately 8 percent over the January 1959 figure of slightly less than 550,000. Engineering and physical science technicians showed a greater increase—almost 14 percent—than any other group of technicians. There were 284,600 such workers in industry in January 1960, as compared with 250,300 in January 1959. Of all the technicians included in the National Science Foundation's survey of January 1960 employment, 44 percent worked for firms with 5,000 or more employees, and 38 percent for firms with less than 500 employees. The remaining 18 percent were with firms in the 500—4,999 employee group.

The 284,600 engineering and physical science technicians in private industry were widely distributed industrially, but were most concentrated in the electrical equipment, telecommunications and broadcasting, aircraft, and machinery industries. Industries undergoing rapid technological change and those producing and using new types of equipment—notably those making and using automated machinery—were found to have need for large numbers of technicians.

The field of research and development has been of continuing and growing importance in scientific fields, and the National Science Foundation estimated that 160,600 technicians—27 percent of all technicians employed in private industry—were engaged primarily in such activity. Over three-fifths, 62 percent, of technicians employed by aircraft and aircraft parts firms were assigned to research and development. Other industries that used large proportions of their technicians in research and development were paper and allied products—46 percent, chemicals and allied products—45 percent, and electrical equipment—41 percent. In contrast, only 20 percent of all technicians employed in the machinery (excluding electrical) industry and 8 percent of those in engineering and architectural services were in research and development work. The proportion of technicians doing research

[5] Scientific and Technical Personnel in Industry, 1960. National Science Foundation. 1961. NSF 61-75.

Some employers want their technicians to have some college training, especially employers who look to their technical staff as a potential source for professional scientists and engineers. In areas where training facilities are widely available, employers are often able to obtain an adequate supply of technicians who have taken some college courses.

As technical occupations become somewhat better established and defined, and as the supply of trained workers increases, the standards for employment are expected to rise and a longer amount of formal training will be required. In some cases, college graduates with degrees in fields other than engineering are now being hired for technical work in support of that being done by engineers. There is little doubt that many technicians in the future will find their promotional opportunities much improved if they have a degree; this is especially true in fields in which an advanced degree is a usual requisite for professional advancement. Adequate training is especially important for women entering what has traditionally been considered a man's field.

Types of Training Facilities

So varied are the jobs of technicians it is not surprising that their training may be obtained in many different ways. Formal training is available in junior or community colleges, extension divisions of colleges and universities offering special technical programs, technical institutions, technical high schools, apprenticeship programs, and also through courses offered by industry and by the Armed Forces. In addition, some technicians take correspondence courses and others may receive more or less informal instruction on their job.

Training, for the most part, is available to women on the same basis as to men. Nonetheless, available information indicates that very few women are being trained as technicians.

Formal Training Courses

Formal training programs which provide technical instruction normally last from 1 to 3 years in educational institutions—with 2 years the usual length. An annual survey of graduations from organized curriculums of at least 1 year but less than 4 years' duration has been conducted by the Office of Education since the academic year 1955–56. During this period, the number of women graduates has fluctuated somewhat but has been consistently very low. In the academic year 1958–59, there were only 99 women among the 15,751 graduates

from engineering-related curriculums—only about one-half of one percent. (Table 2.)

Federal funds to help finance programs of technical education have been made available by the George-Barden Act of 1946 and the National Defense Education Act of 1958. Section VIII of the NDEA has as its express purpose the training of youth and adults at less than the college level ". . . to fit them for useful employment as highly skilled technicians in recognized occupations requiring scientific knowledge . . . in fields necessary for the national defense."

In the academic year ending June 1960, over 7,000 girls and women received technical training in courses made available under these two acts. More than two-fifths of the women took courses in data-processing and computer programming and another one-fifth, in electronic and electrical technology, chiefly electronic. Other technologies in which 100 or more women were enrolled were aircraft, chemical, design, mechanical, instrumental, laboratory, and production technology. (Table 3.)

Courses receiving Federal funds are of two general types—preparatory courses for those seeking to enter a field and extension courses for those already working but taking further training for advancement. Of the women students receiving technical instruction, about 87 percent were enrolled in extension courses, with some variation by specialization. In both data-processing and electronics courses (the two with the largest number of women) 99 percent and 87 percent, respectively, of the women were enrolled in extension courses. On the other hand, 66 percent of the women students in chemical and metallurgical technology, 97 percent in design technology, and 69 percent in electrical technology were enrolled in preparatory courses.

Only in three subject areas—data processing and computer programming, laboratory technician work, and design technology—did women comprise a substantial proportion of the total students. Their proportions were 26 percent, 28 percent, and 20 percent, respectively. In all other specializations, they were less than 5 percent of the total.

In the Armed Forces, women who have demonstrated aptitude through the Armed Forces testing and placement programs are enrolled in coeducational training courses. Although both the number and proportion of women in such courses are apparently very small, the fact that some women are enrolled is of special significance.

In-Plant Training

Technical training offered by employers may be of various types, ranging from formal courses given in a classroom to informal instruction relating to the specific job to be done. Even technicians who

have taken courses in a technical school or other formal training facility usually receive some additional on-the-job training. Many employers find it necessary to supplement broad basic skills and background knowledge with the particular skills required in their operation.

Some companies provide technical instruction through formal training programs. A few very large employers have an impressively long and varied list of training courses, usually open to both men and women. Smaller firms which do not maintain regular formal training programs sometimes organize such courses as needed. For instance, when these employers are unable to obtain technical personnel from the available labor supply, they sometimes hire untrained workers and establish training courses to teach them the needed skills.

The qualifications of those selected for in-plant training are set by each employer, either independently or in consultation with labor unions. In some companies, production workers who show interest and aptitude are the preferred source of potential technical workers. Other employers select their trainees from among high school graduates with an aptitude for technical work and a strong background in science and mathematics.

Statements from employers included in the Women's Bureau inquiry ranged from those who were glad to offer in-plant technical training to women who were capable and interested, to those who were reluctant to invest in training time if a woman's work life were to be terminated early. A woman supervisor of a large laboratory stated that few women in her organization had the required background for selection as trainees in the company's training program in drafting and design. But in this same company, women with a bachelor's degree in science or mathematics are considered valuable as senior technical aids and fill most of these positions.

A representative from the aircraft and missiles field said that he did not consider that the labor turnover of women should militate against their selection as trainees because there is, generally, high mobility among all electronic technicians. His view is substantiated by a Bureau of Labor Statistics study which revealed that the average electronic technician changed jobs every 4 years during the 12-year period (1940–1952) covered by the survey.[8]

One or two employers indicated that in identifying production workers for in-plant training, they are unlikely to select women, chiefly because women are rarely in the kinds of jobs regarded as good background for technical work. Such comments were reinforced by suggestions that women interested in technical careers should obtain as much scientific and mathematical instruction as possible and should work for a while at a production job—for instance, an assembly line

[8] The Mobility of Electronic Technicians, 1940–1952. BLS Bull. 1150. 1954. U.S. Department of Labor, Bureau of Labor Statistics.

job. The background and experience gained in production work might make them eligible for further in-plant training and for future advancement.

Tuition Plans of Employers

Women are usually eligible along with men to participate in tuition plans of employers. The courses for which some employers reimburse their employees enable them either to prepare for technical work or to advance in their technical jobs. The instruction may be obtained at technical institutes, universities, colleges, or even, in some cases, from correspondence schools.

Company policies vary with respect to the amount contributed by employers. Some pay one-half or three-fourths of the total amount of tuition for courses successfully completed by employees. The most generous plan reported included not only the employees' tuition but also all book costs and incidental fees.

Earnings

Comprehensive earnings data are not available—either separately for women or for all technicians. However, for most technician occupations, wage rates are set by job and are not likely to have differentials based on sex. Moreover, technicians are largely employed in mass production industries, where wages are determined mainly by collective bargaining. Union representatives and employers interviewed by the Women's Bureau reported that contract rates of technicians apply to all employees, regardless of sex.

Scattered reports indicate that the earnings of qualified technicians are relatively high. The exact rates depend upon such factors as the technical specialization, the job level, the geographic area, and the wage policies of the individual employer.

Industry Rates

For technical jobs in private industry, it is not possible to compare wage rates on the basis of job title alone, since some titles have very different meanings for different employers. For example, in one firm visited by a Women's Bureau representative, engineering aids were essentially statistical clerks who assisted engineers. In another firm, engineering aids must have a knowledge of the principles of engineering and must at times perform some of the less complex duties of a graduate engineer.

The available information indicates that wage rates in the engineering and physics fields are somewhat higher than those in chemistry for technicians with the same level of training. This has special significance for women, who are employed in greater numbers in chemistry than in engineering or physics.

Hourly rates were reported by several companies to range from $1.35 an hour for entry occupations like technical aids and beginning chemical laboratory technicians, to $3.00 and $3.50 an hour for the more skilled jobs, including senior designers, engineering technicians, technical artists and illustrators, and electronic research technicians. There were some women among those being paid the higher rates.

One firm paid rates of $1.80 to $3.00 per hour to chemical and electronics technicians and even higher rates—up to $3.50 per hour—to junior programmers. As in many other companies, the senior programmers must be college-trained and are classified as professional, rather than technical, staff. Junior programmers are required to have only a course or two of post high school training; they do subprofessional work and are classified as technicians.

A firm employing about 20 women technicians hired those with at least 2 years of training and no experience at $360 per month. Most of the women had some college training and were assigned to chemical or electronics work. By merit review, they could earn up to $500 per month, although rates were higher for those with additional education.

Government Rates

In the Federal Government, salaries are determined on the basis of job duties and responsibilities and of knowledge, skill, and experience requirements. The salary schedule for women is exactly the same as for men.

The majority of women technicians, when surveyed by the Civil Service Commission on October 31, 1959, were classified in Grades 4 through 9, as established by the Classification Act of 1949, as amended. For these grades, the entry salaries effective July 10, 1960, ranged from $4,040 to $6,435 per annum. Median salaries of the two largest groups covered by this study were: $4,956 a year for women cartographic aids and $4,613 a year for women physical science technicians. (Table 4.)

Possibilities for Advancement

Advancement for technicians can lead to three types of positions: another technician job at a higher level, a supervisory post in the technician category, and a job in the professional ranks. Advancement depends, as in most types of work, upon such factors as job performance, capacity for higher level work, education, and seniority. Many companies have formal promotion plans assuring consideration of the capabilities, accomplishments, and potential of employees for advancement.

Employers interviewed by the Women's Bureau generally indicated a willingness to promote qualified women, and there were a few reports of women in some of the higher rated technician jobs. None of the firms, however, employed women as supervisors in their technician groups, although no employer expressed any prejudice against so doing if a woman were qualified.

Often promotion depends not only upon ability but upon the acquisition of additional training. But reports from several employers indicate that women—who frequently have home responsibilities in addition to their jobs—are less likely than men to seek such additional training. One personnel manager noted that at his plant it was not unusual for men production workers to take training courses which enable them to transfer to technicians jobs, and even for some men to continue their studies and advance to professional work. Although the company encourages this practice by financing virtually all of the training costs, only a few of the women employees take advantage of this opportunity to improve their job status.

A woman personnel director of another company noted a reluctance to staff any single technical occupation with a large proportion of women. Since it was company policy to obtain top staff members from within its own work force, men were preferred to women, who might leave in a short time. Nonetheless, she said that women with satisfactory ability and qualifications who were interested in progressing would be given favorable consideration for higher classifications, including supervisory posts.

Statements made to Women's Bureau representatives indicate that some firms attempt to determine the "career-mindedness" of the women technicians they employ. Those with limited job goals are

given assignments with limited opportunities for promotion, while those who think in terms of a work career and advancement are placed in positions with development potential.

Even women with the appropriate training, ability, interest, and seniority, however, may find the road to supervisory status blocked by the limitations of their work experience. According to some personnel officers, supervisory positions in many technical fields require a breadth of experience that few women have. They repeated the often mentioned suggestion that women interested in a technical career should acquire some experience in production work. For further advancement to professional status, and sometimes even to the top supervisory ranks, a college education is usually required.

Outlook

The employment outlook for technicians appears to be excellent. Utilized by some of the fastest growing industries in our economy, technical workers are expected to be needed in increasing numbers as technology and science advance at a rapid pace.

According to the U.S. Office of Education: "It is anticipated that more than 800,000 additional technicians capable of working with engineers and scientists will be needed by 1975." Any estimate of anticipated demand for technicians, however, is only a rough approximation. Most of the estimating difficulties are inherent in the nature of the field. Since technicians are a relatively new and still-evolving occupational group, there is a lack of precedent upon which to base estimates. Also, since technological developments are resulting in sudden and speedy introduction of many new products and processes, the effects upon the demand for technical workers are often widespread but difficult to predict.

It is assumed, however, that future demand for technicians will continue strong in a variety of specializations and at many levels of skill and responsibility. Particularly marked is the expansion expected in the fields of data processing and computer programming and also in electronics—all areas in which many women are currently employed. Research and development activities, in which women are often accepted readily, are also expected to provide increasing numbers of job opportunities.

As a group, technicians are relatively young. The Bureau of Labor Statistics study of the mobility of electronic technicians revealed that over two-thirds of the workers employed in this occupation in 1952 had entered it since 1940. Many had come directly from school or military service. In view of the relative youth of technical workers, therefore, job vacancies resulting from deaths or retirement may be expected to be somewhat lower than usual. Some vacancies will be created, however, as a result of job mobility.

Conclusions

There is no simple explanation for the low numbers of women technicians at present. Undoubtedly, a major factor is the small number of women who prepare for technical work, which can be related to numerous circumstances.

Although information obtained by the Women's Bureau indicated that there are no significant formal restrictions on women's access to technical training, their desire to obtain training is frequently restrained by the attitudes of parents, counselors, and educators—as well as by women themselves. Many technical jobs are the kinds which have traditionally been regarded as "men's work." In addition, many women probably feel they do not have much chance for employment and advancement in such jobs.

The very newness of technical jobs, however, is responsible to some extent for the limited amount of information known about them—and also for the small numbers of women now doing technical work. This lack of knowledge about opportunities for women in technical work extends to both young girls and those who advise them. Inquiries received by the Women's Bureau indicate that counselors are becoming more aware of the need for such information, and it may be that, in the future, more women will prepare for and be hired as technicians.

Most of the employers interviewed by the Women's Bureau expressed a willingness to hire qualified women. It has been their experience, however, that they have received few applications for technical jobs from women and some even reported that no women had ever applied for such jobs. When asked whether they would actually hire any women applicants if given the opportunity, employer answers ranged from a cautious, "Well—we don't know whether they'd work out, but we'd hire them if they were good," to an enthusiastic, "I wish we could get some women technicians. We need them!"

Suggestions offered by those who train and employ women were many and varied but contained several similar basic points. A young woman considering a technical career was advised, first of all, to learn whether she has an aptitude and liking for technical work. If so, she should plan her high school curriculum to include as much science and mathematics as possible. Courses in typing and mechanical drawing are also considered helpful. If possible, she should seek summer

employment as a production worker in the industry of her special interest. The experience acquired should be very valuable for subsequent technical work and advancement.

A formal course at a technical institute or college that offers technical training is a good investment for those considering a technical career. Some employers expressed a preference for workers with two years of college education, including courses in science and mathematics. For women with this background, there are excellent opportunities for employment and advancement. With some additional training, they may be able to advance to the professional level in their specializations.

Efforts to encourage more women and girls to prepare for technical work must take into consideration early hobbies and interests, which help to mold vocational choices. A Bureau of Labor Statistics study of electronic technicians revealed that many had had related hobbies that led them to this vocational field. About 51 percent of those surveyed had been interested in electronics long before they started making their vocational plans. Hobby work was mentioned specifically by 36 percent. While boys are often given an early start toward technical careers with hobbies and toys of a technical nature, these are unlikely to be a part of most girls' experience.

In addition, some men who are technicians have come from the ranks of those who started training for professional careers in such fields as engineering, electronics, mathematics, physics, or chemistry. Unable to fulfill their plans, many have taken subprofessional jobs in the same or related fields of work. Since women are a relatively small proportion of those studying these professional subjects, this would not constitute a major source of women technicians.

There are many reasons for women to include technical work in their career considerations. Job opportunities, already numerous, are expected to become even greater, and should appeal to people with a wide diversity of interest because of the numerous and varied specializations. Both the financial returns and the job satisfactions can be very good for the woman who is interested, well-trained, and competent, and the qualified worker can advance in her job. There is the added satisfaction of contributing to the country's scientific and technological progress. The combined opportunity of doing needed, useful work and having a job in an expanding field should encourage many women to consider employment in a technical position.

Appendix A

TABLE 1.—*Federal Employment in Selected*[1] *Technical Classifications, Continental United States, 1959 and 1954*

Classification (CSC)	October 1959			October 1954		
	All employees	Women		All employees	Women	
		Number	Percent of total		Number	Percent of total
Total	57,760	3,465	6	41,102	2,757	7
Agricultural aid	422	14	3	472	20	4
Agricultural technology	24	13	54	24	11	46
Cartographic aid	3,812	626	16	4,251	787	19
Digital computer programming	2,366	483	20	(2)		
Digital computer systems administration	471	45	10	(2)		
Digital computer systems analysis	108	9	8	(2)		
Digital computer systems operation	1,034	262	25	(2)		
Electronic technician	9,369	45	(3)	4,141	40	1
Engineering aid and technician	16,096	353	2	9,346	240	3
Equipment specialist	8,014	126	2	5,327	106	2
Fingerprint identification	883	234	27	1,069	364	34
Fishery aid and technician	145	23	16	93	11	12
Forest and range fire control	2,724	69	3	4,141	59	4
Forestry aid	2,367	1	(3)	1,556	2	(3)
Herbarium aid	6	4	67	6	5	83
Irrigation system operation	476	1	(3)	482		
Mathematics aid	436	325	75	510	414	81
Meteorology technician	2,274	281	12	1,092	175	16
Ordnance equipment technician	224			144		
Park ranger	458			863	1	(3)
Photo-optical equipment technician	46			(2)		
Physical science technician	2,263	548	24	2,350	521	22
Plant disease and insect control	239	2	1	164		
Range conservation	674	1	(3)	470	1	(3)
Soil conservation aid	2,829			4,601		

Source: U.S. Civil Service Commission, Employment Statistics Branch.

[1] The selection, obtained from several major categories of the CSC classification series, covers occupations considered to be within the scope of the Women's Bureau study. It is possible that not all those included in these classifications are performing technical work.

[2] These classifications had not been established in 1954.

[3] Less than 1 percent.

TABLE 2.—*Graduates from Engineering-Related Curriculums of at Least 1 Year but Less than 4 Years, by Major Type, 1955–56 through 1958–59*

Type of engineering-related curriculum	1958–59		1957–58		1956–57		1955–56	
	Total	Women	Total	Women	Total	Women	Total	Women
Total	15,751	99	12,985	73	13,315	170	11,742	80
Aeronautical	1,875	1	1,310		1,139	3	1,092	1
Air conditioning, heating, refrigeration	303		347		346		412	
Architectural, civil	1,322	2	1,123	8	1,223	15	1,017	10
Chemical	273	40	226	30	209	49	210	33
Electrical	6,720	15	5,433	6	5,319	6	4,054	9
General engineering technology	616	6	507	1	566	74		
Industrial	518	10	479	3	360	5	331	2
Mechanical	3,453	16	2,972	24	3,253	6	2,949	8
Metallurgical	111		65		95	3	73	
Other	560	9	523	1	805	9	1,604	17

Source: U.S. Department of Health, Education, and Welfare, Office of Education: Organized Occupational Curriculums, 1955–56 through 1957–58, and unpublished data.

TABLE 3.—*Women Enrolled in Technical Education Programs,*[1] *by Type of Technology, 1959–60*

Technology	Students in all courses		Preparatory courses		Extension courses	
	Total	Women	Total	Women	Total	Women
All courses	142,734	7,017	41,273	945	101,461	6,072
Air conditioning	852		145		707	
Aircraft	3,172	131	1,117	2	2,055	129
Automotive	181	1	160		21	1
Chemical and metallurgical	5,352	175	1,576	115	3,776	60
Communications	1,386	43	334	10	1,052	33
Construction and civil engineering	2,613	10	1,157	4	1,456	6
Cost estimating	734	13			734	13
Data processing and computer programming	12,689	3,281	63	32	12,626	3,249
Design	1,469	294	735	285	734	9
Electrical	8,560	154	3,810	107	4,750	47
Electronics	59,381	1,446	19,460	185	39,921	1,261
Engineering	3,890	33	758	1	3,132	32
Highway engineering	825	2	32		793	2
Inspection, production, and manufacturing	1,569	58			1,569	58
Instrumentation	2,716	101	1,061	57	1,655	44
Laboratory	1,580	450	58	7	1,522	443
Mechanical	24,672	329	9,447	131	15,225	198
Oil and gas heating	794	4	220		574	4
Production	4,474	202	185	3	4,289	199
Testing	548	15			548	15
Others	5,277	275	955	6	4,322	269

Source: U.S. Department of Health, Education, and Welfare, Office of Education, Division of Vocational Education.

[1] Covers programs reimbursed under Title I of the Vocational Education Act of 1946 and Title VIII of the National Defense Education Act of 1958.

TABLE 4.—*Average Annual Salaries and Grades of Women Federal Employees* [1] *in Selected Technical Classifications, 1959*

Classification (CSC)	Number of women	Grade distribution								Average annual salary
		Under 4	4	5	6	7	8	9	Over 9	
Total	[2] 3,476	462	527	752	415	634	31	368	167	
Agricultural aid	15	4	6	3						$3,957
Agricultural technology	13	3	7	1		1		1		4,345
Cartographic aid	628	52	54	132	152	131	5	58	3	4,956
Digital computer programming	484		7	51		149	2	150	116	6,219
Digital computer system administration	46			8	3	8	1	11	15	6,660
Digital computer systems analysis	9					1		1	7	7,504
Digital computer systems operation	263	24	15	82	1	82	4	19	4	4,956
Electronic technician	45	1	14	6	1	16		5	2	5,077
Engineering aid and technician	354	73	68	56	43	49	7	25	6	4,716
Equipment specialist	127	1	18	21	6	26		43	11	5,662
Fingerprint identification	236	55	36	74	56	13				4,485
Fishery aid and technician	23	17	5	1						3,739
Forest and range fire control	69	59	10							3,825
Forestry aid	1	1								3,815
Herbarium aid	4	3	1							3,877
Irrigation system operation	1	1								3,815
Mathematics aid	325	51	105	90	41	35	2	1		4,449
Meteorology technician	281	12	84	67	29	54	3	33		4,847
Physical science technician	549	105	95	160	83	70	7	21	2	4,613
Plant disease insect control	2		2							4,139
Range conservation	1								1	7,553

Source: U.S. Civil Service Commission, Employment Statistics Branch.

[1] Includes women employed by the Federal Government both inside and outside the United States.
[2] Includes some women whose grade was not specified.

Appendix B

Federal Government Publications With Information Concerning Technicians

The publications for which prices are listed can be purchased from the Superintendent of Documents, U.S. Government Printing Office, Washington 25, D.C.

U.S. Civil Service Commission. *Occupations of Federal White-Collar Workers, Oct. 31, 1959.* 1961. (Pamphlet No. 56–3, price 50 cents.)

U.S. Department of Labor, Bureau of Employment Security. *Technical Occupations in Research, Design, and Development.* 1961. (BES No. E–194, price 50 cents.)

U.S. Department of Labor, Bureau of Labor Statistics. *Occupational Outlook Handbook, 1961 Edition.* Pages 158–168. (Bull. No. 1300, price $4.50.)

U.S. Department of Labor, Bureau of Labor Statistics. *Technicians Who Work With Engineers and Physical Scientists.* 1961. (Reprint from Occupational Outlook Handbook.)

U.S. Department of Labor, Bureau of Labor Statistics. *The Mobility of Electronic Technicians, 1940–1952.* 1954. (BLS Bull. 1150, price 50 cents.)

U.S. Department of Labor, Women's Bureau. *Training Opportunities For Women and Girls.* 1960. (W.B. Bull. 274, price 30 cents.)

National Science Foundation. *Employment of Scientific and Technical Personnel in State Government Agencies. Report on a 1959 Survey.* Washington. G.P.O. 1961. 67 pp. (NSF 61–17, price 45 cents.)

National Science Foundation. *Scientists and Engineers in the Federal Government, Oct. 1958.* 1961. (NSF 61–43, price 35 cents.)

National Science Foundation. *Scientific and Technical Personnel in American Industry, 1960.* 1961. (NSF 61–75, price 45 cents.)

National Science Foundation. *The Long-Range Demand for Scientific and Technical Personnel.* 1961. (NSF 61–65, price 50 cents.)

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