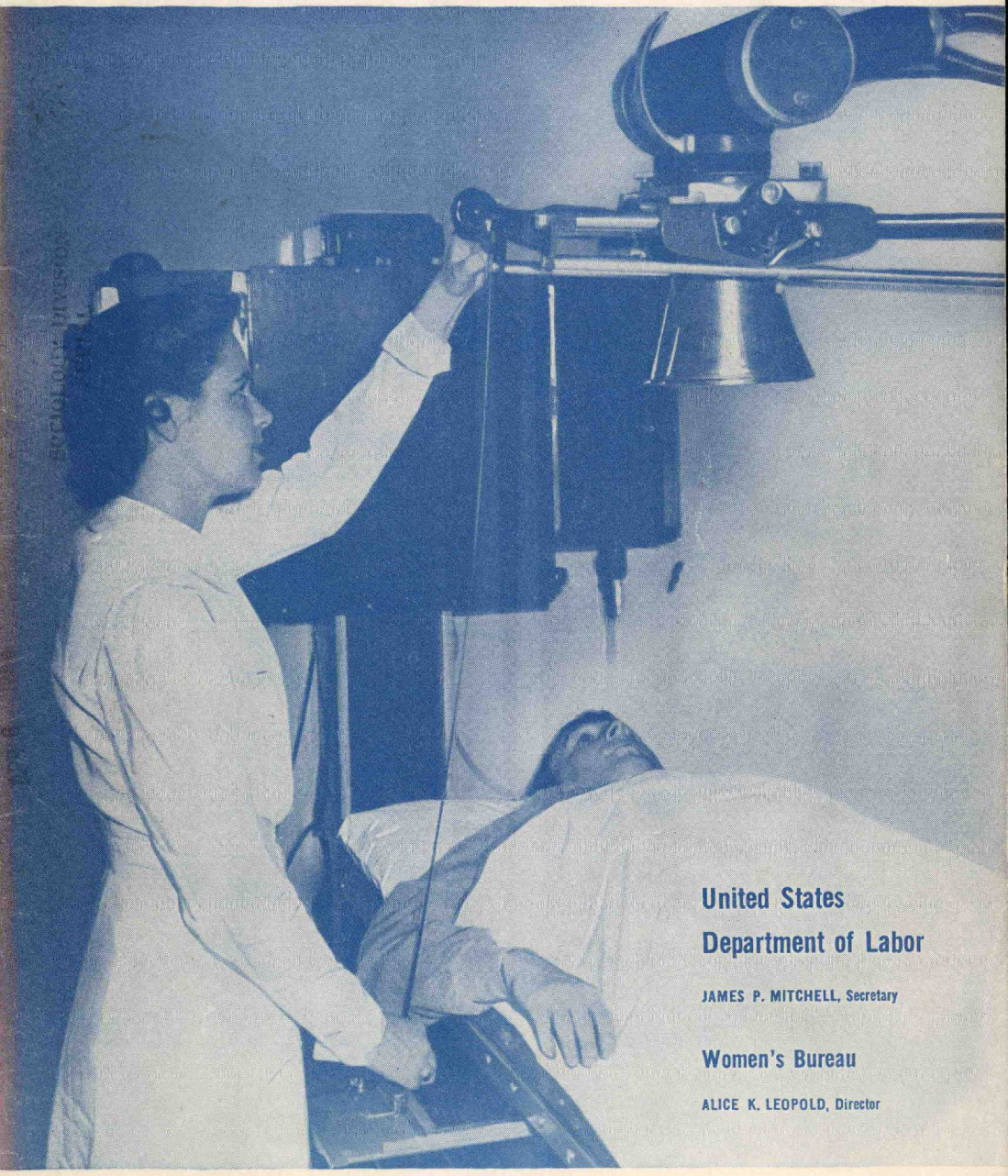
The Outlook for Women as

Medical X-Ray Technicians



United States
Department of Labor

JAMES P. MITCHELL, Secretary

Women's Bureau

ALICE K. LEOPOLD, Director

Medical Services Series, Bulletin No. 203–8 (1954)

UNITED STATES DEPARTMENT OF LABOR
JAMES P. MITCHELL, SECRETARY

WOMEN'S BUREAU
ALICE K. LEOPOLD, DIRECTOR

The Outlook for Women as Medical X-Ray Technicians

Bulletin of the Women's Bureau No. 203–8 (1954)

Medical Services Series

U. S. GOVERNMENT PRINTING OFFICE

WASHINGTON : 1954

For sale by the Superintendent of Documents, U. S. Government Printing Office, Washington 25, D. C. Price 25 cents

THE MEDICAL X-RAY TECHNICIAN

This bulletin deals with the MEDICAL X-RAY TECHNICIAN who is trained to operate several types of X-ray equipment which photograph, or make visible on a screen, any internal part of the body which the physician wishes to examine for the purpose of diagnosing disease or injury. The X-ray is sometimes used to treat disease, especially cancer. Under the direct supervision of a radiologist (a physician specialized in the use of X-rays for either diagnosis or treatment), the medical X-ray technician may assist by operating X-ray machines to take X-ray pictures or for treating patients.

Medical X-ray technicians may be trained in approved hospital courses, in private vocational schools, or on the job, but in order to qualify as registered technicians, and for employment in many hospitals and physicians' offices, they are generally required to have a minimum of 2 years' formal training according to specified standards.

An X-ray technician may add the letters "R. T." (Registered Technician) after her name if she is registered by the American Registry of X-Ray Technicians.

This is Bulletin 203–8 in the

MEDICAL SERVICES SERIES, REVISED

No. 203–1 *The Outlook for Women as Physical Therapists.*
No. 203–2 *The Outlook for Women as Occupational Therapists.*
No. 203–3 *The Outlook for Women in Professional Nursing Occupations.*
No. 203–5 *The Outlook for Women as Practical Nurses and Auxiliary Workers on the Nursing Team.*
No. 203–8 *The Outlook for Women as Medical X-ray Technicians.*

LETTER OF TRANSMITTAL

UNITED STATES DEPARTMENT OF LABOR,
WOMEN'S BUREAU,
Washington, December 18, 1953.

SIR: I have the honor to transmit a new bulletin on the outlook for women as medical X-ray technicians which revises and supersedes the summary under a similar title, issued as Bulletin 203–8 in 1945, and reprinted in 1950.

The present report deals with employment opportunities for X-ray technicians, and concerns itself, more than the previous one, with occupational information of primary interest to young women who are confronted with making an occupational choice.

This study is one of the employment outlook reports in the medical series under current revision. It was prepared by Mildred S. Barber with the assistance of Agnes W. Mitchell, under the supervision of Lillian V. Inke, Chief, Employment Opportunities Branch of the Research Division directed by Mary N. Hilton.

Respectfully submitted.

ALICE K. LEOPOLD, *Director.*

HON. JAMES P. MITCHELL,
Secretary of Labor.

Acknowledgments . . . .

are made to a number of persons and agencies for assistance in the preparation of this bulletin, including:

(1) Consultants at the United States Public Health Service, especially Dr. G. H. Hunt, Assistant Surgeon General and Associate Chief, Bureau of Medical Services; and to Dr. Armand E. Brodeur, Chief of the Radiology Section of the Division of Chronic Disease and Tuberculosis, for his careful technical review;

(2) Officers and staff of the American Society of X-Ray Technicians and the American Registry of X-Ray Technicians, and particularly Alfred B. Greene, B. Sc., R. T., Executive Secretary of the Registry, for his critical review of the manuscript;

(3) Radiologists and X-ray technicians at more than 20 hospitals, clinics, and laboratories, both private and governmental;

(4) Research, medical, and administrative personnel at several Federal agencies, especially the Department of Defense and the Veterans' Administration;

(5) For their courtesy in lending photographs, acknowledgment is made to the Armed Forces Institute of Pathology, Washington 25, D. C. (fig. 3–c); George Washington University, Washington 6, D. C. (cover, figs. 4, 6–b, 3–a, 3–b); Macy's, New York (fig. 1); and U. S. Department of the Army, Washington 25, D. C. (fig. 6–a and fig. 5). The illustration from the book "Madame Curie," published by Doubleday & Co. (fig. 2), is reproduced with the permission of Eve Curie.

CONTENTS

284528°—54——2

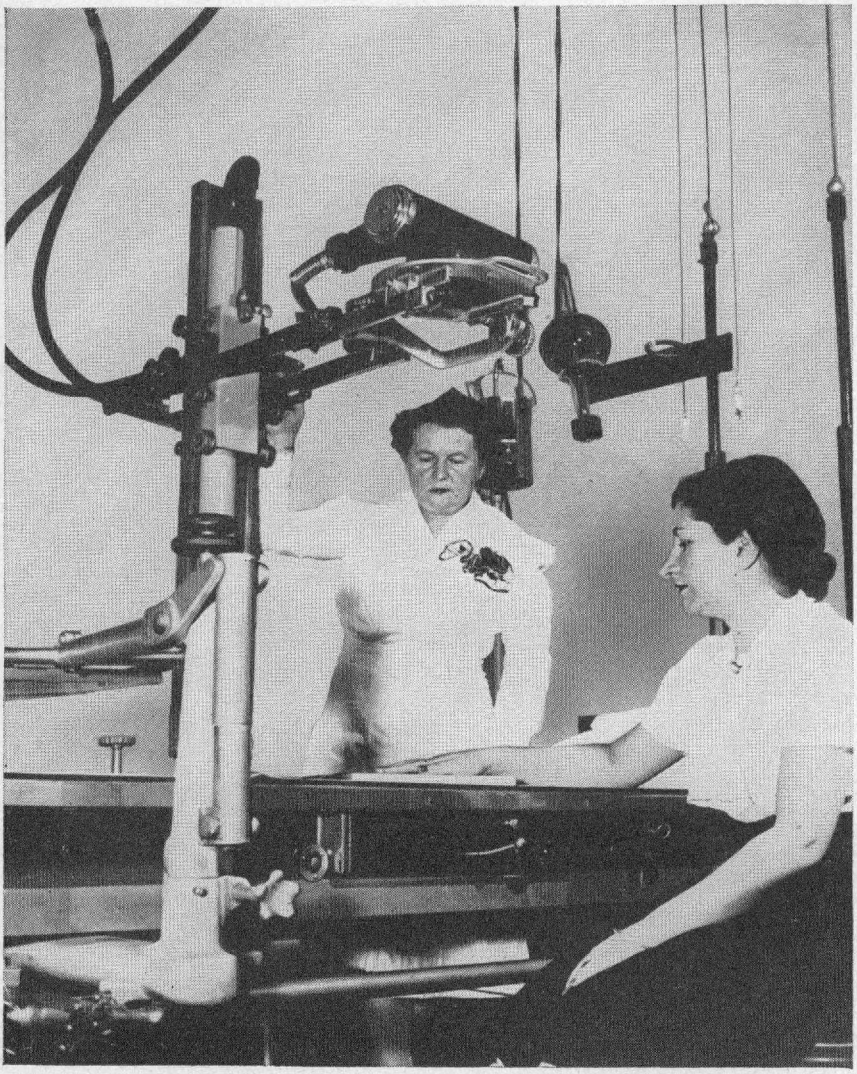


Figure 1.—The medical X-ray technician is trained to operate complex and costly equipment with precision and judgment.

THE OUTLOOK FOR WOMEN AS MEDICAL X-RAY TECHNICIANS

I. SOME HIGHLIGHTS AND A LITTLE HISTORY

A Paramedical Job

A variety of skilled workers in the medical field, in addition to the physician and nurse, contribute important services to the care of the patient. These persons have become known in recent years as *paramedical* workers because some aspects of their work *parallel* or supplement those of the physician and nurse. They include medical social workers, physical therapists, dietitians, medical records librarians, the technicians who work in medical laboratories, and the technicians who operate several different kinds of mechanical or electrical equipment used in the diagnosis and treatment of disease. Among the latter are the X-RAY TECHNICIANS.

A Job for Women

Women have been regarded traditionally as well-suited for work in nursing and in the whole range of paramedical jobs. For this reason it is not surprising to find that almost three-fourths of all medical X-ray technicians today are women. Probably the first women to be trained were hospital nurses singled out for assignments to X-ray equipment in the 1920's, when the use of X-ray for diagnosis, and also for treatment, became more generally available and mechanically adapted for hospitals and clinics. In its early stage, X-ray apparatus was more difficult and dangerous to handle than in recent days, and it was operated usually by a physicist or specially trained physician or scientist.

Dr. Roentgen and the Unknown Ray

It was a German scientist, a physics professor at the University of Wurzburg in Bavaria, who discovered that a certain combination of a vacuum tube and the application of electricity produced rays which were invisible but which had the power to penetrate solid objects and record the outlines of those objects on a chemically treated screen in the darkness. Immediately, it was apparent that this knowledge could be applied to examination of the soft tissues and bone structure of the human body, and this discovery proved to be of immeasurable value to medical science, particularly when it was found that X-rays affected photographic film in the same way as light.

Wilhelm Conrad Röntgen, or Roentgen, as it is usually written in English, who discovered the invisible, unknown rays, called them X-rays. In 1896, one year after he made his discovery, a distinguished meeting of scientists and physicians in Germany who were called together to hear Dr. Roentgen's report, voted that the X-rays be named roentgen's rays in his honor, and the name has persisted. X-ray equipment is therefore very commonly called roentgen apparatus, the science is known as roentgenology and X-ray photography is often called roentgenography. Although these words are more difficult to spell and pronounce than "X-ray," the technician in training soon learns them because of their widespread usage.

Madame Curie and the Mobile Units

It was a very great woman, the Polish-born French scientist and co-discoverer, with her husband, of radium, who did perhaps more than any other single person to make X-ray equipment available for medical purposes. Marie Curie left her research in physics and chemistry during the early part of World War I and undertook the job of convincing the French Government, the manufacturers of medical equipment, and the army physicians that the use of X-ray apparatus would save the lives and advance the recovery of many wounded soldiers. She was familiar with the X-ray principle, but had no first-hand experience with the equipment. Because of the difficulties which Madame Curie met in her project to make X-ray apparatus available, she finally devoted herself personally to assem-

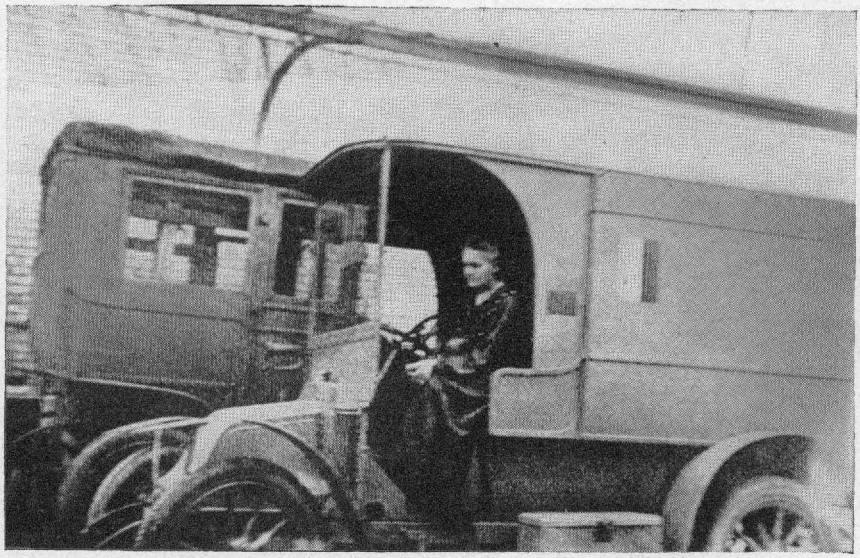


Figure 2.—Marie Curie at the wheel of one of the X-ray trucks she equipped and operated during World War I.

bling equipment on ambulances, trucks, and all types of automobiles, and of directing its movement to front-line medical stations. Thus were the first mobile X-ray units established in France, 20 in all, each with a roentgen apparatus and a dynamo to furnish the electric current from the motor of the car.

In addition, Marie Curie helped to set up 200 stationary radiological units in hospitals, and trained many operators to assist the physicians who used the X-ray. In order to do this, she had to learn all the details of the equipment and to perfect her own skills, and in this way Marie Curie was the first famous teacher of numbers of X-ray technicians, apart from her very important scientific discoveries in the field of radiology, and her own work with radium, which she and her husband Pierre Curie discovered in 1898.

Radiology and the X-ray Technician

Today radiology has become a highly specialized branch of medical science and uses various adaptations of X-ray equipment to explore and examine the human body and its tissues, as well as radioactive substances in different forms for the treatment of diseases.

After the death of Pierre Curie and also after the war years in France, Madame Curie continued her work in radioactive materials, and her laboratory in Paris became a center for a long series of discoveries about the nature and activity of mineral substances that spontaneously produce light rays known as *fluorescence* (from a Latin word *fluor*, meaning flow). Rays "flow" from substances like radium and uranium without the use of electricity in vacuum tubes, which was necessary to produce the roentgen ray. As a result of the research of uncounted numbers of scientists and investigators through the years, the actions of dangerous radioactive substances became known and were applied, with protective measures for operator and patient, to a great variety of useful services in medicine.

New types of X-ray equipment have also been developed in the years following Dr. Roentgen and the Curies, and other terms have been added to the science of radiology. For instance, a machine in common use for fast X-ray work, especially of the chest, is the *photofluorograph*.

Compared to the learning and skill of the radiologist, or the physician in charge of X-ray and radioactive work, the job knowledge of the X-ray technician is relatively simple. This is true even for those technicians who are learning to assist with work in *radioactive isotopes*. This new development in radiology represents a part of the useful and constructive knowledge that came from recent scientific study of the *atomic energy* created by the breakdown of substances like radium, uranium, thorium, and many others.

In the years ahead, a great deal more skill and scientific knowledge

will surely become available for use in radiology, and the work of the X-ray technician will, as a result, change from time to time. For this reason it is important for young women who plan to become X-ray technicians to learn as much as possible about their jobs under carefully supervised instruction. Suggestions about training are considered later, in chapter V, but immediately following is a discussion of job duties and the qualifications of the woman, young or mature, who wishes to become an X-ray technician.

II. THE JOB ITSELF

A Practical Combination of Arts and Sciences

A medical X-ray technician's job covers an unusual combination of skills, knowledge, and responsibilities, some of which relate to the so-called pure sciences of physics and chemistry, and others to the medical science of anatomy. In addition, the job involves the use of techniques borrowed from the nursing arts, and a considerable amount of mechanical aptitude when it comes to operating a variety of equipment. All the skills and knowledge are directed in a practical way toward work performance.

Among the first things that an X-ray technician student learns are practical applications of *anatomy*, *chemistry*, and *physics* to X-ray technology. A good foundation in anatomy is necessary in order to obtain exact screening of the bone or body tissue which the physician wishes to examine or treat. Physics and chemistry together provide the technician with knowledge of the properties and action of radioactive substances and of the principles of roentgenography. Knowledge of chemistry is applied to the use of materials which may be necessary to render any part of the anatomy opaque, or sufficiently shaded or dense so that it may be seen when the X-rays penetrate it. For example, the patient's digestive system is hard to see, under X-ray, unless it is coated with an "X-ray opaque," a harmless, chemical substance which the patient is often required to drink or eat before or during the X-ray examination. Various parts of the anatomy must be treated in certain ways for proper visibility on a screen or film, and the techniques used are called, in X-ray technology, methods of dealing with *opaque media.*

A knowledge of chemical procedure is necessary also in the use of X-ray film and film processing, which the technician must prepare for the radiologist. And physics is important not only in relation to *radioactivity*, but to *electricity*, for the X-ray technician is required to know the principles of electricity and the pattern of electrical circuits of the apparatus used.

Women whose fingers are "all thumbs," or who are awkward with their hands, are not likely to become good operators, for the *mechanics*

of X-ray apparatus involves a number of fine adjustments. In addition to using her hands, however, the technician must use her head, and also frequently apply some knowledge of *mathematics* and measuring devices to calculate correct positioning and screening with many kinds of equipment except those which are almost completely automatic. Judgment is necessary, too, in the application of *safety rules*, although the danger in using X-ray equipment has been reduced to a minimum with the use of modern improvements in protective methods.

From the nursing arts, the X-ray technician will learn about such things as *sterile technique* so that she can apply it under certain conditions of work where high standards of cleanliness or antiseptic and aseptic (germ-free) practice are required, for the protection of both patients and medical workers. Proper *patient relationships*, involving an understanding of, and sympathy for, persons undergoing examination and treatment are also as much a part of the X-ray technician's requirements as of the nurse's.

A certain amount of *clerical work* is necessary for the X-ray technician's job. This deals mostly with keeping careful and accurate records of all radiology procedures carried out for patients.

In summary, the X-ray technician is primarily an operator of X-ray and photofluorographic apparatus, although she may assist the radiologist in applying various devices which use radioactive substances, particularly as an aid in therapy (treatment). She may also be considered a photographer or, more explicitly, a roentgenographer and film processer. Besides, she is a kind of nursing aide, and part electrician, part practical chemist and part medical secretary.

A detailed description of the duties of a hospital X-ray technician may be found in appendix 1.

Job Specialization and Job Titles

Medical X-ray technicians are trained to work with any part of the anatomy and to use the several varieties of equipment. In most hospital work the technician is likely to be given a wide range of assignments. In specialized hospitals, clinics, or health services, however, an X-ray technician may also become expert in a narrow field, such as dentistry, chest X-ray for tuberculosis, heart X-ray, or cancer detection.

The title most commonly used is *X-ray technician*, but the term *medical X-ray technician* is used here to differentiate the job in medical services from that in industry. (An industrial X-ray technician's job, which is quite different and deals with the examination, by X-ray and fluoroscopic methods, of metals, minerals, plastics, or other substances, is not considered in this bulletin.) Other titles may be found

in medical establishments where X-ray technicians are specialized. A technician who assists in diagnosis alone may be called a *diagnostic X-ray technician* as distinct from a *therapeutic X-ray technician* who helps the radiologist in treatment. Sometimes an X-ray technician is called by the title of the clinical specialization in which she works; for example, if she takes X-rays of bones, she may be referred to as an *osteology technician.* Other common titles are *radiographer* and *radiological technician.* Less common, but found occasionally, is the job title of *skiagrapher.*

More X-ray technicians work in jobs related to medical diagnosis than in treatment, first because of the general availability and use of X-ray diagnostic equipment, and also because radiology therapy often requires the services of a specially trained professional nurse (R. N.), as well as the close supervision of a physician.

There appears to be no particular advantage in specialization of X-ray technique where the procedure has been highly standardized. A technician who is quite skillful in a particular phase of the work is sometimes singled out for learning, or helping to develop, new methods, especially if she works in a medical institution where research in radiology is taking place. Such an experience may end as routine, although it involves a departure from the usual work pattern at first. The small hospital, laboratory, or clinic is likely to provide a greater variety of job duties than the large institution.

New Developments

The use of radioactive isotopes, which encompasses new knowledge that has been transferred to medicine through recent research into nuclear fission and atomic energy, is still experimental. Although it was reported in 1953 that more than 1,100 institutions, colleges, industrial firms, physicians, and government laboratories are using radioactive isotopes, the radiology technicians working in this field are generally required to have much more training, especially in physics and chemistry, than has been established for X-ray technicians. Physicians and medical scientists carry out most of the work in new fields until procedures can be standardized, equipment simplified, and requirements established for technicians. This is the practice today just as it was for the early use of the roentgen apparatus, when no one with less scientific training than a physicist or a doctor of medicine with special training was considered to be a qualified operator.

Nevertheless, it is possible, though still comparatively rare, for an adept X-ray technician with a measure of scientific curiosity to anticipate future opportunities in new applications of the science of radiology, and with additional study and an unusual employment opportunity, help to set the pace for new techniques. In time, of course, new standard procedures will be incorporated into the basic

training for all X-ray technicians, and the study of isotope techniques may one day be part of a standard training course.

Job Combinations

Some X-ray technicians, who work in the hospitals or medical laboratories which provide services to physicians, have learned to operate other kinds of apparatus in addition to that related to radiological work. Equipment for diagnosing heart disease, brain damage, and for determining basal metabolism are among those most commonly found in combination with the operation of X-ray and fluoroscopic apparatus. An X-ray technician may therefore learn, on the job, to operate one or more of the following kinds of equipment which are much simpler to handle and control than most roentgen apparatus: the electrocardiograph, the electroencephalograph and the basal metabolism apparatus. As indicated in the titles by the prefix *electro*, the first two types are electrically controlled and work automatically after they are set up by the operator.

The *electrocardiograph* (*electro*, plus *cardio*, meaning heart, plus *graph*, meaning write—all Greek word roots) records on a continuous sheet of paper, which revolves on a roll or drum, the electric current produced by the heart muscle as it contracts and expands. This is accomplished by attachments of electrodes to the patient's chest and the connection of the electrodes with a needle-like pen which moves on the paper roll. The result is a cardiograph, or a visual record for the physician, of heart action, which is used to diagnose heart ailments.

The *electroencephalograph* (*electro*, plus *encephalo*, meaning brain, plus *graph*, meaning write) is very similar to the electrocardiograph, and records electrical impulses from the brain, or brain waves, in much the same way. Electrodes are attached to the patient's head and a needle connected to the electrodes traces brain waves on a continuous roll of paper.

Descriptions in greater detail for operators of the electrocardiograph and electroencephalograph machines mentioned may be found in appendix 1.

Basal metabolism apparatus is somewhat different from the first two types of equipment. The word *metabolism* is a medical term which describes the complex process of building up and breaking down, or expenditure, of energy that takes place continuously in the body tissues and cells. The amount of heat produced by the body is an indication of the energy spent, and it was found many years ago that this could be measured by the amount of oxygen the body needs in order to produce energy or "burn up" the food intake. Physicians, therefore, use the basal metabolism device to measure the minimum (or basal) energy expenditure of patients. This device consists

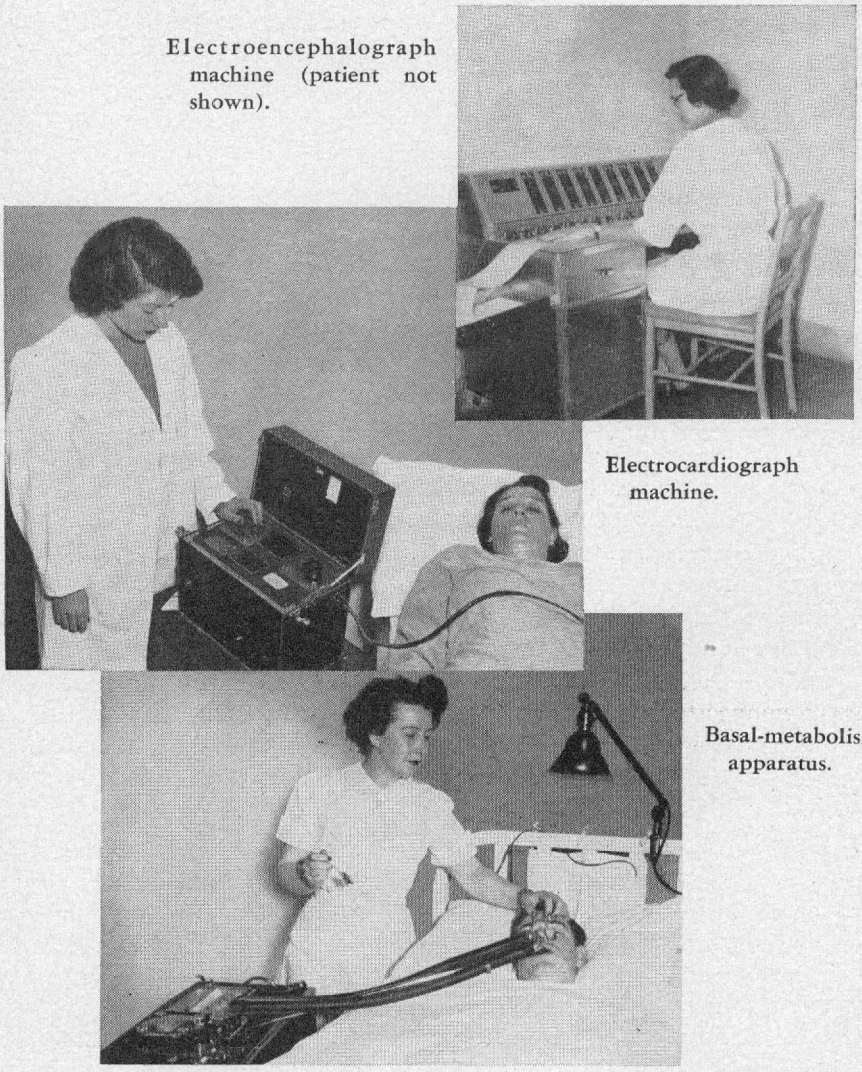


Figure 3.—X-ray technicians are sometimes trained to operate other medical apparatus.

mainly of a tank into which the patient breathes. An operator attaches a hose from the tank to the patient's nose and mouth and records the oxygen used during a specific period of minutes, while the patient is completely at rest, and 14 to 18 hours after he has eaten.

Other types of apparatus which an X-ray technician in a hospital or physician's office may learn to operate are *diathermy* machines, which are used to treat ailments by electrically produced heat, and *hydrotherapy* equipment which involves treatment by means of water.

Nurses and nurse technicians probably operate the apparatus described more commonly than do X-ray technicians, but the addition of such operational techniques creates acceptable job combinations for the X-ray technician, who usually learns them on the job under the direction of a physician.

Hazards of X-ray Work

Work surroundings of the X-ray technician are clean and pleasant, but there is a possibility of injury from radiation unless the technician observes the safety regulations which have been established in medical facilities wherever X-ray apparatus is used.

Anemia, which is a blood disease involving an inadequate supply of red corpuscles, is the most common ailment which anyone is likely to develop as a result of overexposure to X-rays. Women seem to have a greater tendency toward anemia than men. Both men and women may suffer injury to the reproductive organs from too much X-radiation, but if safety measures are used to protect operators against anemia, it is hardly likely that any damage to the health of operators will take place.

Radiology departments have generally adopted methods of checking periodically all persons who work with, or near, X-ray equipment, for signs of anemia. Fortunately, anemia is relatively easy to detect, and in recent years, it has become fairly easy to correct, especially if diagnosed early, before it becomes dangerously advanced. Correction includes following a proper diet, spending some time out of doors in the sunlight, and obtaining adequate rest. If the condition is not readily corrected by the ordinary means, the X-ray technician may be required to change her work assignment for a time, away from the radiation apparatus.

Patients are less susceptible to X-ray injury than are X-ray technicians, because they are exposed to radiation only for short periods. Much of the risk to operators is not only from continuous exposure but from the scattered X-rays which are deflected from the immediate area of the apparatus to the surroundings, and which can penetrate room partitions except those treated with lead.

Patients can be protected from the X-rays by screens or shields of lead compound which may be set over that part of the body which is not being subjected to radiation exposure. Similarly, the technician can be protected by screens and shields, and for some types of high-powered apparatus, a kind of screened-off room or partition is provided with a lead-protected glass window through which the operator can see the procedure and direct it by relatively remote control. Test films, carried or worn by the operator to measure radiation effects, are common protective devices; in addition, periodic medical checkups

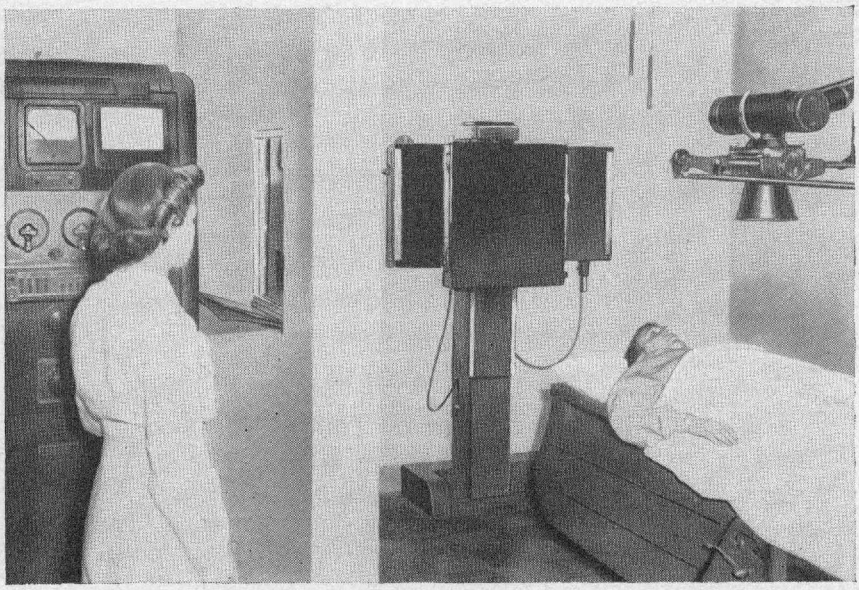


Figure 4.—Patients are not subject to the hazards of scattered X-rays to the same extent as operators. Here, an X-ray technician taking a diagnostic picture controls the apparatus from a separate room which protects her from undue exposure.

are usually provided at the place of work. If the operator wears protective aprons or special clothing, the arms, shoulders, and legs may still be partly exposed to radiation when she works in the same room with the patient.

Radiology departments and technicians themselves, in their professional organizations, are constantly conducting research into hazards and seeking improvements in existing protective methods. In 1953, the invention by a University of Virginia physician of a spun lead glass laboratory gown to be worn by X-ray technicians and radiologists promised to give better protection than the lead rubber aprons in use up to this time.

Dangers which occasionally were present in past years from the electrical parts of the X-ray apparatus, or from the film, have been generally eliminated, so that, while it might be possible for a careless operator to damage equipment, it is far less likely that equipment will be injurious to the operator, except with respect to the effects of scattered rays. In general, X-ray technicians themselves have stated in recent years that their jobs are much safer than many industrial occupations, and that the risk of injuries from scattered rays is under control. The technician can feel secure about her health if the hospital or

medical facility follows established safety procedures, and if she, herself, is careful.

Because women seem to have a slightly greater tendency than men toward developing anemia from X-radiation, it is important for women considering this work to have generally good health and a normal resistance to, or freedom from, anemia. It is probably also a good plan for an X-ray technician to develop related occupational skills in hospital work, so that she may be transferred temporarily to other assignments if anemia is detected.

III. WHERE MEDICAL X-RAY TECHNICIANS WORK

There is no doubt that new developments in medicine have contributed substantially to the diversity of employment of X-ray technicians. As a result, it has become increasingly difficult, in the absence of any central source of data, to estimate very accurately the number of technicians and their places of employment. However, there is some information which is helpful in showing the principal places of employment of X-ray technicians and the changes which have taken place in recent years in the employment distribution.

Hospitals Employ About One-third

Recent data from the American Hospital Association and the American Medical Association indicate that some 12,000 to 13,000 X-ray technicians were employed in hospitals in 1951 and 1952. In addition, estimates provided by the Commission on the Health Needs of the Nation, based on information supplied primarily by the American Society of X-Ray Technicians, showed a total of about 35,500 X-ray technicians in 1951 and 39,000 in 1952 in the United States. This would mean that about one-third of all X-ray technicians were employed in hospitals, and the remaining two-thirds were distributed among clinics, medical laboratories, physicians' and dentists' offices, military establishments, and public health facilities of several kinds. Figures from the same sources show that before World War II (1941) some 7,000 X-ray technicians out of an estimated total of 11,000 (roughly, three-fifths) were employed in hospitals.

This decrease, from approximately three-fifths to one-third of the total, in the concentration of X-ray technicians in hospitals, would seem to indicate that, despite the expansion of hospital facilities and services, a growing proportion of X-ray technicians are finding employment in medical facilities other than hospitals. In view of the widespread use of the X-ray for routine medical examinations in various health, welfare, and industrial programs of preventive medicine, this does not seem a very surprising development. The fact that more and more people are obtaining X-ray diagnostic service

for both medical and dental purposes, apart from the need for hospitalization, undoubtedly accounts for a substantial portion of this shift of X-ray technicians from hospitals to other medical employers.

Hospitals, like most medical employers, use diagnostic X-ray equipment to a much greater extent than other types of radiology apparatus, as can be seen from table 1. It is therefore concluded that the largest number of X-ray technicians in hospitals are employed in jobs related to diagnosis. No conclusions are drawn about the number of job combinations that exist for X-ray technicians in the operation of other kinds of medical equipment, but a glance at the table may show something about the possible opportunities for job combinations in relation to the general availability of services and equipment of several types.

TABLE 1.—FACILITIES AND SERVICES IN X-RAY TECHNOLOGY AND RELATED FIELDS IN 6,076 HOSPITALS: 1952

Facilities and services	Hospitals	
	Number	Percent
X-ray, diagnostic	5,546	91
X-ray, therapeutic	1,859	31
X-ray, routine chest examination on admission	1,898	31
Radioactive isotopes	348	6
Electrocardiograph	4,771	79
Electroencephalograph	789	13
Metabolism apparatus	4,863	80

Source: The American Hospital Association.

About twice as many X-ray technicians are employed in nongovernmental hospitals as in governmental, as may be seen from table 2. And, of all those employed in governmental hospitals, less than 40 percent were in hospitals of the Federal Government.

Two-thirds Work for a Wide Range of Employers

Some 12,500 of the total number of X-ray technicians were employed in hospitals in 1952; 26,500 were distributed among a wide range of other medical employers. Except for those in Federal Government service, it is not possible to estimate the proportions for each class of employer because no accurate count is available. Only the broad type of employment may be described.

In most cities, X-ray diagnostic service and other kinds of laboratory examinations are provided by private medical laboratories supervised and operated by physicians. These are available to individual physicians and also to small hospitals which do not maintain

X-ray equipment. According to the size of the medical laboratory, X-ray technicians are employed on a full-time or part-time basis, and their jobs may vary a great deal from routine X-ray diagnostic work to a combination of X-ray technology and the performance of other kinds of laboratory services.

TABLE 2.—X-RAY TECHNICIANS IN HOSPITALS IN CONTINENTAL UNITED STATES: 1952

Employer control	Total			X-ray technicians employed	
	Number	Percent distribution	Percent distribution by governmental and nongovernmental control	Full time	Part time
Total	12, 412	100		11, 199	1, 213
Total governmental	4, 161	[1] 34	100	3, 851	310
Federal	1, 540	12	37	1, 526	14
State	791	6	19	725	66
County	866	7	21	732	134
City	803	6	19	723	80
City-county	161	1	4	145	16
Total nongovernmental	8, 251	66	100	7, 348	903
Church	2, 924	24	35	2, 647	277
Nonprofit association	4, 370	35	53	3, 890	480
Individual, partner	539	4	7	445	94
Corporation	418	3	5	366	52

[1] Percents do not add to total due to rounding.

Source: American Medical Association.

Some private physicians and a great many privately operated outpatient medical clinics maintain their own X-ray equipment and are able to provide employment to trained X-ray technicians who are not nurses or nurse technicians.

Industrial plants, especially those in manufacturing, which provide industrial health and medical services for their employees, often have X-ray equipment and one or more full-time X-ray technicians on the staff. X-ray facilities are usually available in plants which are not close to medical laboratory centers or which are sufficiently large to require the use of such costly equipment.

Dental surgeons and dental clinics use X-ray apparatus extensively, but an individual private dentist usually operates the dental X-ray

equipment himself or employs a dental assistant to help with what is essentially a routine job because the apparatus is almost fully automatic. For this reason X-ray technicians who work full time in the dental specialization are commonly employed at dental clinics which require a higher degree of X-ray skill; or they may do some part-time dental X-ray work in connection with general diagnostic procedure at hospitals or clinics.

A comparatively limited source of employment, but one which will expand if the student body grows, is the educational field in X-ray technology. Experienced X-ray technicians with ability above the average may obtain positions as instructors in hospital-connected schools for X-ray technicians or in private vocational schools which provide courses in medical X-ray technology. Except where large numbers of students are enrolled, approved hospital schools tend to employ experienced X-ray technicians from the regular hospital staff to supplement instruction given to students under the supervision of the radiologist in charge, and therefore use a limited number of full-time instructors. Probably a greater number of X-ray technician instructor positions are available in private vocational schools.

Jobs in Federal, State, and City Government Agencies

Hospitals of State, county, and city health departments in 1952 employed some 2,600 X-ray technicians. Employment in such hospitals is controlled by the individual State, county, city, or combined city-county government and may be subject to the civil service or merit system of that governmental unit. In addition to hospitals, there are local governmental medical facilities of other types which use X-ray equipment and consequently employ technicians.

In 1952, it was reported that 1,540 civilian X-ray technicians, or less than two-fifths of all those employed by all governmental hospitals, were on the payrolls of a variety of Federal agencies, including the Department of Defense and the Veterans' Administration.

X-ray technicians in the service of the Federal Government are, in most cases, civilian workers. In the hospitals and facilities of the Department of Defense, however, both civilian and military personnel may be employed. With few exceptions, civilian employees of all agencies of the Federal Government are under civil-service regulations, whereas military personnel doing X-ray work are in enlisted ratings or noncommissioned officer classifications of the Army, Navy, or Air Force.

Among the several branches of the Armed Forces, only the Army employs a sizable number of civilian X-ray technicians (215, in 1951). The Army, Navy, and Air Force each train and utilize their own enlisted personnel as X-ray technicians. In September 1953, the Army

reported 50 enlisted women serving as X-ray technicians; the Navy had 23 women technicians; and the Air Force had 36 women technicians.

Civilian technicians employed by the Army are hired from civil-service lists and are preferably graduate technicians; however, because of the shortage of qualified technicians, some inexperienced persons are hired and trained on the job.

All branches of the Armed Forces of the United States, with the exception of the Marine Corps, where medical care is provided by the Navy, were training and utilizing women as X-ray technicians in 1953. Enlisted personnel who have an interest in and aptitude for X-ray work are trained in military hospitals or medical centers; first, in classrooms and later, in X-ray departments where they are given actual experience of the apprentice or learner type. After gaining experience on the job, the technicians are assigned to a military medical facility where they may work side by side with other military personnel and with civilians. Military personnel in such establishments may be scheduled for night duty or be placed on call for emergency. An example of the future usefulness of the training and experience gained in military X-ray work may be found in the fact that some women, after separating from the WAC, WAVES, or WAF, have returned to military hospitals as civilian X-ray technicians.

The Veterans' Administration, which in 1951 employed almost 70 percent of the X-ray technicians in the Federal Government, utilizes the services of these technicians mainly in its hospitals. Positions for X-ray technicians are classified as: General X-ray technician, radiography X-ray technician, therapy X-ray technician, and supervising X-ray technician. A few are combined laboratory and X-ray technicians. In 1951, the Veterans' Administration also employed 134 electrocardiograph technicians and 82 electroencephalograph technicians. The Department of Medicine and Surgery in the Veterans' Administration is responsible for all personnel matters, and employees are recruited by the individual Veterans' Administration hospitals, to which persons seeking job opportunities apply locally.

The Department of Health, Education, and Welfare (Federal Security Agency at that time) employed 149 X-ray technicians in 1951, most of them in the Public Health Service. Some of these technicians were serving in Public Health Service hospitals and others (most of them men) were employed in the mobile X-ray units. Public Health Service hospitals are usually located on coasts and waterways for the purpose of serving selected groups of American seamen and officers and Federal employees.

Men are preferred as X-ray technicians in the mobile units of the public health services (although Madame Curie was the founder of

this kind of service in 1914!). This is probably due to the fact that, under normal conditions, the travel, care of equipment, and driving of X-ray trucks are considered less suitable for women than for men. Because of the expansion of X-ray service and its increased use by the public, however, there is always a possibility that new developments in mass X-ray programs, changes in the physical demands of the job, or increasing shortages of available male technicians, may open this special field to women. By 1952, more than 6½ million X-rays had been taken in some 23 areas of the United States under the mass X-ray programs of the Public Health Service.

The Bureau of Indian Affairs in the United States Department of the Interior is responsible for complete health service for those Indians who are wards of the United States as a result of certain treaties and laws. Medical service is provided to Indians through 56 hospitals and sanatoriums west of the Mississippi River and 8 hospitals in Alaska (for Indians and Eskimos) as well as through community clinics or hospital out-patient stations. Facilities are situated in rural, undeveloped areas and are relatively small, ranging from about 18 to 335 beds. Indians are given preference in hiring, but because few of them qualify for such work, most X-ray technicians come from other groups. At many posts, married women are not employed unless their husbands are employed at the same hospital. Because of the isolation of these facilities, vacancies recur periodically.

A number of other Federal agencies and facilities of the District of Columbia municipal government employ medical X-ray technicians. Among these are: St. Elizabeths Hospital, Soldiers' Home, Freedmen's Hospital, District of Columbia General Hospital, Glenn Dale Sanatorium, the District of Columbia Health Department, the Panama Canal Service, the Tennessee Valley Authority, and the Atomic Energy Commission. Hiring is done by the individual hospital or installation, and most positions are classified under civil service. Both experienced technicians and inexperienced high-school graduates who have majored in science courses are hired by some of the hospitals, and inexperienced technician candidates are trained on the job.

X-ray technicians employed by the Panama Canal Service work in hospitals in the Canal Zone. These hospitals offer service to the Federal employees of the Canal Zone and, as necessary, to persons passing through the Canal. Women X-ray technicians employed by the Tennessee Valley Authority and the Atomic Energy Commission may be assigned to plant installations or construction projects. In actual practice, however, few women technicians work at construction sites.

Geographic Distribution of X-ray Technicians

As might be expected, the largest number of X-ray technicians are found in the most populous States. Nevertheless, although a large

State may have a great number of X-ray technicians, it may actually have fewer in proportion to the population than some of the smaller States. This is shown by figures on the number of X-ray technicians per 100,000 population, by region and State, for 1952 (see appendix 2).

These estimates show an average of 25 X-ray technicians per 100,000 population in the United States, but the proportion in individual States varies from 9.6 per 100,000 in South Carolina to 78.5 in Colorado. Half of the States show ratios below the national average of 25, while the other half are above this average; both large and small States are found in each group. For example, New York (19 X-ray technicians per 100,000 population) and Rhode Island (16 per 100,000) have less than the national average; California (41 per 100,000) and Arizona (36 per 100,000) have more than the national average.

Since no estimates are available as to the necessary or desirable ratio of X-ray technicians to persons in the population, it cannot be concluded solely from these figures that any given State has too few or too many X-ray technicians. However, it is obvious that some States have far more X-ray service in proportion to population than others (see appendix 2).

The need for X-ray technicians generally follows the expansion and development of health facilities. Since a great deal of effort is presently being expended by interested groups in attempting to bring more and better medical services to areas where they are most needed, ratios such as those given above may help to indicate the likely areas of future demand for X-ray technicians.

IV. WHAT X-RAY TECHNICIANS EARN

Salaries paid to X-ray technicians compare favorably, on the whole, with the wages in woman-employing occupations such as nursing and social work, which require more training. This is not to say that the financial returns are large, but they were probably as good, if not better, than those for many professional nurses on general hospital duty in the early 1950's, and little less than those for a number of beginning social workers (case aides) who are generally required to have at least twice as much educational preparation beyond the high-school level.

Although only scattered salary data are available, they are nevertheless useful in indicating the general level of earnings for the work of the X-ray technician. Among the factors affecting the individual technician's salary are the locality, the size of the establishment or institution, the number of technicians employed, and, of course, the individual technician's training and experience.

Recent salary data for two large cities—one in the East and one in the Midwest—showed beginning salaries for X-ray technicians with-

out experience ranging from $180 to $250 per month. Generally, the salaries above $225 to start are paid to registered technicians or to technicians who have some college training. Above the starting level, the usual practice was to grant periodic increases for satisfactory work—after each 3 or 6 months of uninterrupted service—to a maximum of about $300 per month. Salaries for chief X-ray technicians who have supervisory responsibilities and administrative duties to perform varied from about $300 to $400 per month.

In general, salaries in metropolitan areas tend to be higher than in rural areas for the same work. However, since the technician in the X-ray department of a large metropolitan hospital is one of many and may do only routine X-ray work, she is likely to receive a lower salary than a single technician in a small city or rural institution whose work is more varied and who may be required to have responsibility and experience in related work assignments. Institutions in isolated areas frequently attempt to attract employees or compensate for the lack of recreational or social opportunities offered in large cities by paying higher salaries or by granting room, board, laundry service, or other benefits.

A survey conducted by the Bureau of Labor Statistics in 1951[1] showed that almost half of the medical X-ray technicians employed by agencies of the Federal Government were classified in positions for which the minimum salary was $2,875 and the maximum was $3,355 per year, and a third were in positions with a salary range of $3,100 to $3,850 per year. Some X-ray technicians were classified in positions with salary ranges as low as $2,200 to $2,680 per year, and some were in positions with pay as high as $3,825 to $4,575 per year. The average annual salary for federally employed civilian X-ray technicians was $3,194 per year.[2] Increases above the minimum starting salary for Federal positions are granted at regular intervals for satisfactory service.

Pay scales are the same for all branches of the Armed Forces, beginning at $78 per month base pay for the untrained private or lowest ranking recruit with less than 4 months of service. In addition to the base pay, enlisted women are provided with food, quarters, clothing, and medical and dental care. The recruit who takes her basic military training and then completes the specialized courses for X-ray technicians becomes eligible for promotion to higher-paying positions.

---

[1] Federal White-Collar Workers, June 1951. Bureau of Labor Statistics, Bulletin 1117. 1953.

[2] Since the salary schedule for Federal workers was revised subsequent to the survey by the Bureau of Labor Statistics, current salary ranges for X-ray technicians in the Federal service are somewhat higher than those given above. The revision provided that the salary schedule be increased by 10 percent of the minimum rate for each grade, with a minimum increase of $300 and a maximum of $800.

Part-Time Work Rates

X-ray technicians who are employed on a part-time basis are usually paid by the hour for their services. A Women's Bureau study [3] of part-time jobs for women in 10 cities showed that in 1950 the most common hourly rate for part-time laboratory technicians (a classification which included X-ray technicians and other medical laboratory workers) in hospitals in these cities was $1.25 to $1.50 per hour. This exceeded by 25 cents an hour the rate paid to many nurses doing part-time work. The most usual hours of part-time workers in hospital laboratories were 3 to 5 hours daily and 20 to 24 hours weekly.

Part-time work is accepted and fairly common among X-ray technicians. The part-time technician is used to supplement regular staffs during peak loads of the day, week, or month as well as during times when regular technicians are off duty, on vacation, or ill. She may also be used for emergency calls or in X-ray departments where the work load does not warrant a full-time technician.

Some part-time workers are married women or older women who are not available for full-time work. Some women plan to resume full-time work at a future date and, therefore, want to keep up with changing techniques by means of current work experience. Many women who have had to leave full-time jobs recognize the need for workers with specialized skills in the medical field and are helping to alleviate the shortage of X-ray technicians by arranging to work when they can.

In 1952, about 10 percent of the X-ray technicians employed in hospitals were working part time. Of the total X-ray technicians employed in nongovernmental hospitals, some 11 percent worked on a part-time basis, whereas only 7 percent of those in governmental hospitals were part-time workers (see table 2, p. 13). In the Women's Bureau study of 1950 women X-ray technicians were also found in part-time employment in sanatoriums and clinics.

"Fringe" Benefits

The kind and amount of "fringe" benefits provided for X-ray technicians depend upon where and by whom the technician is employed. Some X-ray technicians receive, in addition to their salaries, such benefits as retirement payments, vacations with pay, sick leave with pay, uniforms, laundry service, room, board, free medical care, or annual bonuses.

All Federal, most State, and many city agencies, as well as many private employers, provide for retirement benefits, vacations with pay, and sick leave with pay. Food, quarters, clothing, and free medical

[3] Women's Bureau Bulletin 238, published in 1951.

and dental care for enlisted personnel in the Armed Forces, in addition to retirement pay, insurance privileges, and special purchasing rights, may be considered partly as salary and partly as "fringe" benefits.

Although a great deal of variation may be found in the practices of individual employers, most X-ray technicians receive some vacation and sick leave with pay and have the opportunity to participate in the social-security program.

Pay Differentials Between Men and Women

In general, women and men X-ray technicians are paid the same rates, and the need for X-ray technicians, both before and since 1950, has helped to equalize pay.

Sometimes, however, the woman X-ray technician is paid less than the man. This is largely dependent upon the local practices of individual employers. Employers give as reasons for the pay differential the fact that women are likely to leave the job because of marriage or home responsibilities; or that men are more useful in the performance of incidental manual labor, when it is required; or that men can work overtime, on night shifts, or on emergency calls in some localities where women are restricted by laws which govern hours and conditions of work.

For positions in the Federal service and in the Armed Forces, the pay rates were the same for men and women in 1953, but women were not being hired for jobs in the mobile units of the Public Health Service because it was thought that the additional requirements for driving automobiles and doing some manual work called for men employees. The salary range for these mobile unit jobs was $2,750 to $3,230 a year.

The Workweek

For technicians working full-time schedules, the working day is usually 8 hours and the workweek 40 or 44 hours, depending upon the type of institution in which the technician is employed. Since hospitals operate on a 24-hour basis, they must arrange to have technicians on duty or on call at all times. Arrangements are usually made so that the day staff does not have to be on duty at night or over weekends.

A survey of 16 X-ray departments in hospitals and private laboratories in a large eastern city revealed a number of arrangements for work schedules. Workweeks in these institutions varied from 38 hours to 44 hours—5 had a 44-hour week; 3 had a 42-hour week; 7 had a 40-hour week; and 1 had a 38- or 39-hour week. In general, workweeks were longest in hospitals and shortest in public-health laboratories. Most of the Government hospitals had a 40-hour workweek, with overtime pay for hours worked beyond 40.

Some institutions required the whole staff to work on Saturday morning and permitted each technician a half day off during the week. In one hospital, each technician was on call 1 week in 6 for night duty and weekend duty, and was paid overtime rates, if called.

Students and part-time workers were used in some institutions for hours outside the regular workweek. In others, one technician was assigned to regular night duty; one private laboratory provided for complete rotation of the staff for day and night duty.

V. TRAINING FOR THE JOB

Age Requirements

Young women are preferred at schools of X-ray technology, and some hospital schools do not like to accept trainees who are over 30. The American Society of X-Ray Technicians in 1953 reported the age range 18 to 35 as acceptable for candidates for hospital schools. Private vocational schools do not generally specify maximum age limits for students. Whether some hospital schools may accept individual women who are older than their customary student group is a matter for further exploration. If the shortage of trainees continues, the upper age limits may, in time, be modified.

Admission Requirements for Training Schools

Schools of X-ray technology generally require a minimum of 4 years of high school for admission. The student may either submit a diploma from an accredited high school or may be required to show evidence of having passed a high-school equivalency test.

Of 328 approved hospital schools, 21 required more than the 4 years of high school in 1953, and some as much as 2 years of college.[4] One accepted only registered nurses for training. (See list of approved schools in appendix 3.)

High-School Courses

Science and mathematics courses are important building blocks in the X-ray technician's high-school education, especially physics, chemistry, algebra, geometry, and biology (or botany and zoology). Without this kind of foundation, the X-ray technician trainee would find it difficult to complete the vocational course, which is based upon previous knowledge of most of these subjects.

Courses in psychology or human relations are helpful to the trainee because they extend her understanding of personal relationships and can be applied to contacts with patients.

---

[4] Detailed information on approved schools relates to 326 of the 328 approved schools; data were not provided on 2 schools.

English studies are valuable, not only because writing and spelling are required for the recordkeeping part of the technician's job but also because they contribute to a well-rounded education and increase opportunities for exchanging ideas and experience with others.

High-school counselors should be consulted by the prospective X-ray technology student concerning electives or free-choice subjects. Many high schools offer different combinations, and some will be more suitable than others.

Variations in Vocational Training

There are four general ways in which an X-ray technician may obtain her training. The least expensive method, and an accepted procedure for qualified technicians, is to attend an approved hospital school for a period of from 12 to 24 months. Another means of training is through a private vocational school. It is also possible for a technician to obtain her training by on-the-job experience under the supervision of a radiologist, but this method is less common than it was in the period following the First World War, before hospital schools in X-ray technology developed and set up standards. Although the first technicians had to obtain their training in this way, today's student would find it difficult to compete for employment opportunities without formal training. Finally, it is possible for a young woman to obtain her medical X-ray technician training during military service in the Army, Navy, or Air Force.

The school for X-ray technicians which is conducted by an approved medical school, general hospital, or X-ray department affiliated with a general hospital is probably the most widely known and accepted training course, particularly among medical-institution employers. However, this does not mean that X-ray technicians trained in other schools or on the job cannot be successfully employed. A great deal depends upon the interest, application, and aptitude of the student, as well as the requirements of individual employers.

Hospital Schools of X-ray Technology

In September 1953, there were 328 approved schools for X-ray technicians located in 42 States, the District of Columbia, and Hawaii. (See appendix 3.) Practically all of these schools were conducted by hospitals; a few were conducted by medical schools affiliated with hospitals, but all follow standards established by the Council on Medical Education and Hospitals of the American Medical Association.

Length of training in approved schools ranged from 12 to 24 months, with the exception of one school which combined its training with 4 years of college. Almost half of the schools had training courses of only 12 months, the minimum required for approval. The enrollment capacity of the 326 approved schools reporting was 2,247 students, an

average of 7 students per school; a few schools could accommodate 30 or more students and some, only 2 students.

Almost two-thirds of the approved schools for X-ray technicians charged no tuition, and an additional 81 schools charged only $15 to $100 for the complete course. In the remaining schools, tuition ranged widely, the most expensive being $700 for a 2-year course. On the other hand, of the 326 approved hospital schools, 162 paid some sort of stipend to students. Students unable to afford tuition fees may wish to explore the possibility of securing training in hospital schools in exchange for services performed.

Students are required to wear uniforms, which are usually purchased by the student herself; however, uniform laundering may be provided by the hospital. Board and room and other personal expenses, also, are usually paid for by the student, but routine medical care may be provided by the hospital. Holidays and vacation periods are scheduled by the individual schools and vary from place to place.

Training schedules and methods may also vary somewhat among approved schools; however, standards established by the approving Council of the American Medical Association provide that—

> The following subjects should be adequately presented: elementary anatomy and physiology, physics, X-ray equipment, darkroom chemistry and procedures, X-ray techniques, ethics, recordkeeping and general office or departmental work. * * *
>
> The instruction should follow a planned outline and should include lectures or informal discussions, demonstrations, supervised practice, text assignments, and suitable examinations.
>
> Adequate hospital experience should be provided.

One example of a prescribed course of study is outlined below; this was cited by an approved school for X-ray technicians conducted by a large hospital in the East. The training program described takes 2 years, and courses are given by members (both professional and technical) of the staff of the department of radiology and by other instructors, such as professional nurses, under the direction of the head of the department of radiology. The courses are listed as follows:

1. Radiological physics, including construction of X-ray equipment and the formulation of X-ray technique charts.
2. Anatomy and physiology.
3. Film processing; chemistry of processing, etc.
4. Technical and medical ethics, including responsibilities of technician, information on registration and fields of radiological technology.
5. Sterilization of instruments and instructions in aseptic technique as related to radiological procedures.
6. Bookkeeping, filing, patient interviews, office procedures, preparation for X-ray procedures, etc.
7. Care and attention in handling patients for roentgen procedures.
8. Roentgen technique.

9. Care and handling of patients for roentgen therapy. Instruction in roentgen therapy setups.
10. Care and handling of patients for radium therapy. Radium therapy setups.
11. Radiation hazards and protection.
12. Supervised training in diagnostic and therapeutic radiological techniques.

Private Vocational Schools for X-ray Technicians

Of the private vocational schools which offer training courses for X-ray technicians, the exact number is not known nor is a list of such schools available; however, one or more will be found in most large cities.

Customarily, the private vocational school owns and operates its own facilities, employs its own staff of instructors, and utilizes its own equipment and supplies. Student practice may be provided for through the clinical practice of physicians on the teaching staff or through the school's affiliation with a privately owned laboratory.

Both daytime and evening courses may be offered by private vocational schools, and the length of training ranges from 3 months to a year. The cost of training in private vocational schools varies widely; for example, the tuition at four different schools in four cities for 1953 ranged from $150 to $350. Additional charges other than for tuition at these schools (such as for matriculation, diploma, breakage, books, health service, and laboratory) ranged from about $35 to $150.

Students are usually required to wear uniforms, which they themselves purchase. Board and room, medical care, laundering, and other expenses are the responsibility of the individual student. Complete or partial scholarships and student loans are sometimes available through the school.

Wide variations exist in the training courses offered by private vocational schools for X-ray technicians and, therefore, only by writing for a catalog or by visiting the school can the student secure full information concerning the courses, facilities, and fees. If a student who is interested in attending a particular private vocational school looks forward to employment in a medical institution later, it might be helpful for her to check with several prospective medical employers to determine whether the standards of the school under consideration are acceptable. Or if she is interested in being listed with the American Registry of X-Ray Technicians after completing her training, the student may check registration requirements against the training offered. (See p. 35 for registry qualifications.)

Learning on the Job

Some women have been successful in learning the skills of the X-ray technician by taking training on the job, especially if they supplement this kind of training by attending courses in related subjects after

working hours. Of necessity, such training varies widely, since it depends almost entirely upon the individual instructor and the conditions under which the training is provided.

A woman who plans to acquire her training on the job must canvass the employers of X-ray technicians in her locality for the purpose of finding a training opportunity. Employers of X-ray technicians include radiologists, hospitals, clinics, and X-ray laboratories. She may begin by taking a job as a darkroom helper, or by doing some type of routine laboratory or hospital work and, over a period of time as arranged by her employer, be assigned to other jobs where she can learn the skills of the X-ray technician.

On-the-job training may not fully qualify a person for the X-ray technician career; it may not be acceptable to many employers, and it can create for the trainee a serious disadvantage in competition with technicians who have been trained in recognized schools. If an individual woman must take her training on the job and has a good opportunity to do so, she should attempt to minimize possible future employment problems by securing training which will meet the requirements for registration with the American Registry of X-Ray Technicians. This means that at least 1 year of the training or experience must be under the direction of a diplomate of the American Board of Radiology, or a recognized radiologist having equal qualifications. In addition, the trainee must have sufficient additional training or experience to meet the requirements for registration. X-ray technicians who obtain training or experience solely from other X-ray technicians or, since July 1, 1951, without the direction of a recognized radiologist are not eligible for registration.

Training in the Armed Forces (as of 1953)

The three major branches of the Armed Forces—the Army, Navy, and Air Force—offer opportunities to enlisted women to train as X-ray technicians. The Wac begins her training as a medical corpsman; the Wave starts out as a hospital corpsman; and the Waf beginner is known as a medical helper.

The Wac to be trained in the medical field is required first to take basic military training for 8 weeks at the WAC Training Center, Fort Lee, Va. She is then sent to Brooke Medical Center, Fort Sam Houston, Tex., where the training course for X-ray technicians lasts 16 weeks.

Her courses include indoctrination in Army medical service, administrative procedures in X-ray clinics, darkroom principles and techniques, clinical radiography, special radiographic procedures, anatomical terminology used in radiographic work, together with a variety of related subjects.

Figure 5.—Women may be recruited by the Armed Forces as fully trained medical X-ray technicians, or they may obtain training after enlistment if they qualify and are needed to fill vacancies.

Upon entering the Navy, all Waves are sent to a recruit-training center for 9 weeks of indoctrination and basic training, guidance, and classification. Those interested in and selected for the Medical Corps are then trained for at least 20 weeks in a Hospital Corps school. Here they are taught anatomy, physiology, elementary chemistry, hygiene, bacteriology, and such elementary laboratory techniques as urinalysis and blood counts. Those who meet minimum requirements are qualified to specialize as X-ray technicians by taking an additional 6 months of training.

In the Air Force, the medical specialties are comparatively new for women, and were opened to them in 1950. All Wafs are sent initially to an indoctrination center for 8 weeks of basic training and career guidance, during which period the recruit's qualifications for special training are evaluated.

After completing her indoctrination, the Waf who is to become an X-ray technician is sent either to formal basic courses from which she can graduate as an apprentice or to a military organization where she can serve as a helper in order to gain skill and experience by

on-the-job training and study. Typical of the subjects taught in formal courses for X-ray technicians are the following: X-ray clinics, darkroom work, clinical radiography, skeleton, physics, and operation of X-ray machines. The self-study courses for airmen (unclassified men or women recruits) are made available through the United States Armed Forces Institute.

It should be kept in mind by the young woman who may seek to obtain X-ray technician training through enlistment in military service that no individual guaranty can be given to a recruit into the Armed Forces for any specific type of vocational training. Recruits are selected for various types of training according to the projected needs of the military services for specialized personnel. In the women's branches of the Armed Forces close attention is also given to the qualifications of recruits, which are not analyzed in detail, as a rule, until the basic training or indoctrination period. An effort is made, wherever feasible, to consider the vocational choices or interests of the enlisted woman, but it is not possible to determine assignments solely on the basis of job interest.

VI. LOOKING AHEAD

Employment and Training Prospects

Continuing trends in medical X-ray services point toward increases in the number of job openings for technicians in the 1950's. New employment opportunities have been created since World War II, not so much in relation to population growth as to social and technological advances. Of especial significance are (1) increased public acceptance of the X-ray in the diagnosis of many diseases and injuries, (2) extension of medical service in a number of communities, and (3) increased manufacture of standardized X-ray equipment.

In the field of radiological treatment, improved methods using known principles are continually tried. The possibilities for treatment based upon the use of radioactive materials in completely new, and medically helpful ways have just begun to be explored. Although the degree of resulting employment expansion for X-ray technicians cannot be predicted, it is safe to say that, as new X-ray procedures are standardized at the operator's or technician's level, more work will be created.

Recent information obtained from the Report of the President's Commission on the Health Needs of the Nation indicated that the total number of X-ray technicians had increased by an average of 4,000 each year since 1949; and that there were 25 X-ray technicians for each 100,000 persons in the Nation in 1952 as compared with 4 technicians per 100,000 in 1937. Nevertheless, a 1952 survey of the American Hospital Association reported more than 2,000 current

vacancies for X-ray technicians in hospitals, and an estimated need for nearly 6,500 additional hospital X-ray technicians during the next 5-year period.

Except for the estimate made for hospital X-ray technicians, no estimates are available either as to the current adequacy of the number of X-ray technicians or the anticipated need. If other employers such as laboratories, clinics, and private physicians were confronted proportionately with the same need as hospitals for medical X-ray technicians, the over-all estimate of shortage could be put at about 6,000 in 1952. Proportionately, also, the anticipated need for the 5 years following 1952 could be as much as three times this figure.

Unfortunately, there are no reliable sources for determining the number of position openings with employers other than hospitals. Physicians, clinics, and private agencies use a great many different avenues for recruiting technicians: Private and public employment agencies, newspaper advertisements, the help-wanted columns of medical, professional, and institutional journals, and direct recruitment at training schools.

Similarly, it has not been possible to obtain a count of the number of medical X-ray technicians in the Nation's labor force from the decennial census reports. This is because X-ray technicians were counted in the 1950 census in the group classified as medical and dental technicians, many of whom, especially dental technicians, do not work with X-ray; and in the 1940 census a great variety of medical and industrial technician classifications were grouped and counted together. The best estimate available of the number of medical X-ray technicians in 1951 was made by the Commission on the Health Needs of the Nation, which reported approximately 35,500. If this estimate and the Commission's recent estimate of 11,000 medical X-ray technicians employed in 1941 are reasonably correct, the number of X-ray technicians more than trebled during the decade 1941–51. And, in the year 1951–52, 3,800 additional medical X-ray technicians were reported, according to estimates from the same sources.

Neither the estimate of recent increases in the number of medical X-ray technicians nor the estimate of future needs takes into account the new developments in radiology which have not yet affected employment among X-ray technicians as a group. To what extent new types of assignments or even new jobs can be expected, and how soon, it is difficult to predict. Among radiologists and medical personnel generally, however, there is some feeling that today's technicians may be called upon tomorrow for new responsibilities; in fact, the Report of the Commission on the Nation's Health Needs suggests that there is at present a quality, as well as a quantity, shortage among X-ray technicians. This has some bearing upon employment op-

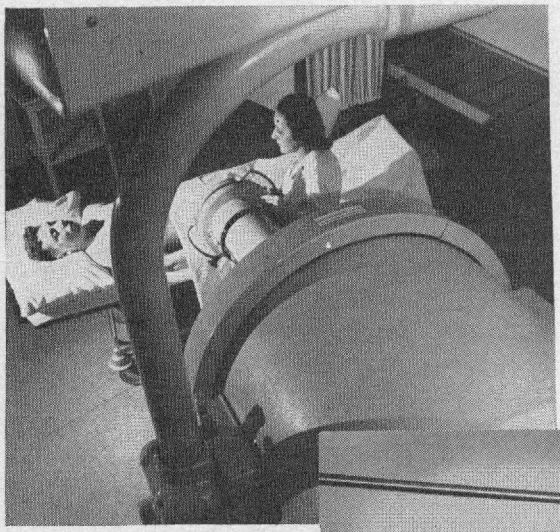
portunities, but more especially upon the training of X-ray technicians. It is possible that a number of positions for X-ray technicians remain unfilled each year because job applicants are unable to meet the training standards required.

Although there were 3,800 more X-ray technicians reported for 1952 than for 1951, it is reliably estimated that fewer than 1,000 X-ray technicians were graduated annually from approved hospital schools prior to 1951 and only slightly more than 1,000 in 1951. The other 2,800 or so technicians must have received their training in private vocational schools, or on the job, or during military service. It is likely that those hospitals and other medical institutions that report current vacancies will not employ X-ray technician graduates who do not meet their standards, including graduation from an approved hospital school or registration. On the other hand, a period of shortage of qualified personnel often forces a temporary lowering of standards, and standards of employment vary from place to place. Many employers of X-ray technicians must have been hiring partly trained or even untrained technicians. In some cases, the technicians employed are probably provided with the opportunity to complete their training on the job.

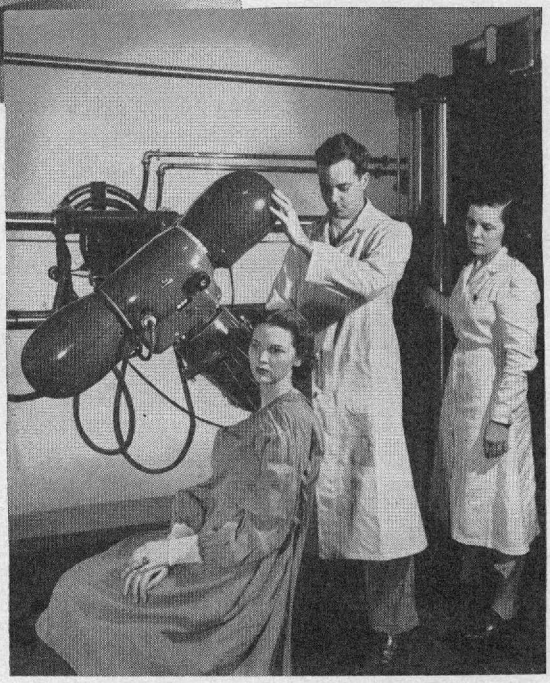
For the woman who is considering the kind of training to take for an X-ray technician's career, the implications of the shortage of qualified personnel are clear. As discussed in the chapter on training in this report, it was certainly possible to obtain employment as a result of one of several courses of training in 1953, and many employers were assisting the novice with the completion of training which they considered below the optimum standards to meet job requirements. It is difficult to predict, however, how long these conditions will continue. It would, therefore, be sound planning to select the best possible technical preparation available in terms of standards set forth by the American Society of X-Ray Technicians and by the Council on Medical Education and Hospitals of the American Medical Association.

Training which includes college-level courses in physics and chemistry would also provide a good foundation for the anticipated new developments in X-ray and radiology which the technician may wish to learn for job advancement or, possibly, in later years be required to learn. In further support of this suggestion, it is noted that the President's Commission on the Health Needs of the Nation reported in 1952 that the trend in X-ray technician training was toward establishing a minimum of 10 to 12 months of academic training plus 12 to 15 months of internship in approved hospitals. This program, if standardized, would go beyond the present minimum for many approved hospital schools.

In summary, the employment demand for X-ray technicians



With a million-volt therapy machine such as this, a professional nurse usually prepares the patient and then the radiologist takes charge.



In deep X-ray therapy, the technician may assist the radiologist with operation of the machine, but it is the radiologist who makes the adjustments of machine to patient.

Figure 6.—X-ray therapy offers some opportunities for the technician but is more limited than diagnostic work.

promised to continue, through the 1950's, to be greater than the supply of qualified job applicants. Training opportunities in 1953 were abundant, and hospital schools were engaged in programs to recruit students at comparatively reasonable tuition fees. A great many student X-ray technicians were finding shortcuts to the recommended preemployment training and were able to obtain jobs in which they could complete their preparation. At the same time, anticipated

developments in the field of X-ray technology suggest that increasing demands may be made, during the decade, for higher standards of work and training for those who wish to go beyond current diagnostic or therapeutic practices.

Some Observations About Women Technicians

There is no question about the adequacy of women X-ray technicians, for they have predominated in numbers over men employed in this field for many years. As recently as 1948, women were estimated to be 80 percent of all X-ray technicians. In 1953, it appeared that an increasingly larger proportion of men had entered this occupational field, although accurate estimates of the proportion were by no means easy to obtain, due to inadequacy of available data.

The 1950 census showed that women were 60 percent of the total of medical and dental technicians, among whom X-ray technicians were classified. Since it is known that the majority of dental technicians are men, the proportion of women X-ray technicians in the census group was certainly substantially higher than 60 percent and probably close to 75 percent. Women medical X-ray technicians were estimated by the American Registry of X-Ray Technicians at approximately 76 percent of the total in 1950.

There may have been an increase in men X-ray technicians since 1950 as a result of the number of men released from military service who were trained as X-ray operators or who entered training under the GI bill after World War II. It was too early to determine, in 1953, whether there was a positive, long-range trend toward a changing proportion of men and women in this occupation.

There were also changes between 1940 and 1950 in the Nation's population, particularly with respect to the age groups from which X-ray technician trainees are ordinarily drawn. According to the decennial census there were about 320,000 fewer women 18 and 19 years of age in 1950 than in 1940, and it was not expected that the declining trend in the number of young women in this age group in the population would be reversed until 1960. Also in 1950, 52 percent of all women 18 to 24 years of age were married (with husbands present) as compared with 40 percent in 1940. In this same decade, the number of children under 5 years of age increased by almost 55 percent. Both these factors affect the employment mobility of young women, and therefore the supply of young women available for training as X-ray technicians and the amount of turnover among those already employed. Although no estimates were available on the number of withdrawals of women from X-ray jobs because of marriage or family, many employers reported such withdrawals as a major problem in staffing.

In 1950, women technicians were younger than men technicians in the medical and dental classifications, and slightly more than half of all employed women technicians were single—as compared with the fact that more than half of all women in the labor force were married. This means that not many mature women or women with home responsibilities were entering technician occupations. Yet one solution to the shortage problem lies in the possibilities for using more women X-ray technicians on a part-time basis, as working hours, particularly in hospital jobs, can be more readily adjusted than in many types of work. This makes it a good occupation for many women with home responsibilities who need to supplement the family income.

Among all the employed technicians, it is of some interest to note that women showed a much higher degree of educational attainment than men. Of all employed persons in 1950, a slightly greater proportion of women (18 percent) than men (14 percent) had received some college training. Among technicians the contrast was much greater—61 percent of the women, but only 32 percent of the men, had some college training. For this reason, employers with relatively high job standards should have preferred to draw qualified X-ray technicians from the group of trained women.

There is certainly every reason to continue to expect that women's opportunities in medical X-ray technician work should be as good as men's, or better, if they can meet general employment qualifications in the 1950's. There remains, of course, the question in many an employer's mind as to whether a man is not a better risk than a woman, given equal qualifications, because of the possibility that the woman will leave the job for marriage. If this factor does not affect hiring, it is likely to affect a woman's chances for promotion to supervisory jobs. This may point to a need, on the part of women entering the field, to obtain the best possible training in order to offset any reluctance about hiring a woman on the part of the employer who is looking for someone with supervisory potential.

The Outlook for Women in Minority Groups

There are no data available to indicate the extent to which Negro women have found employment as X-ray technicians, but a look at the 1950 decennial census report reveals that 1,522 nonwhite women were employed in the group termed medical and dental technicians and that 1,317 of these were Negroes. Thus, Negro women constituted about 87 percent of the nonwhite workers, but only 3 percent of all the women employed in such jobs.

As in other occupations where serious shortages exist, opportunities for Negro women as X-ray technicians have increased—except, of course, in those localities where racial restrictions are rigidly en-

forced. Negro women are working as X-ray technicians in a number of large hospitals and laboratories in metropolitan areas, and employers have found many of them to be outstanding in their work.

The extent to which Negro women may find career opportunities as X-ray technicians is, obviously, closely related to the training opportunities open to them. In 1952, 238 of the 310 approved hospital schools for X-ray technicians reported to the Council on Medical Education and Hospitals of the American Medical Association that they accepted Negroes. It could be expected, in accordance with the general trend toward increased opportunities for minority group members, that a growing number of hospital schools would open their doors to all students, regardless of racial identities. In fact, there is a very positive conviction, among persons and agencies concerned with the problem of job futures for minorities, that the opportunities for training and employment in the medical service field have not been recognized adequately among Negro women themselves, or that the appropriate information about training and employment prospects in new or nontraditional occupations has not been made available to a sufficient degree.

Women Over 35: Open and Closed Doors

As observed earlier, women medical and dental technicians in general (including the X-ray technician group) were younger than men in the same work in 1950, but this does not mean that employers will not hire qualified older women. Many outstanding older women who took their training in earlier years are successfully maintaining their jobs, and the American Registry of X-Ray Technicians does not impose any age limit on certification.

On the other hand, training opportunities in 1953 appeared to be definitely restricted, by hospital schools, to women under 35 years of age. Several hospital schools which were questioned on this limitation presented different reasons. One school preferred women under 30 who could be maintained by their families while they were in training. Another school thought that the training period was too demanding physically for older women. A third was willing to accept older women if they wanted to "work without pay," which probably meant that trainees were required to give some service in lieu of tuition. A reason not given by the schools, but which may be important, is that women who have been out of high school for a number of years may need to take refresher training in high-school science courses in order to meet training standards.

In general, the occupation of X-ray technician presents attractive aspects for the mature woman who wishes to enter training for either a first, or a different career from one she has held before, because the

vocational preparation will probably not take more than 2 years, at the maximum (and less, in many cases), and salaries are equal to those for some jobs which demand a longer period of training.

Further, the work demands some maturity and a large measure of judgment, and it is possible that many of the same employers who are willing to accept older women in nursing jobs (many of which are more physically demanding than X-ray work), by placing restrictions on the age of training candidates, are overlooking some opportunities for recruiting qualified personnel into a shortage occupation. Because the general trend of a shortage of young women 18–19 years of age is not expected to change until 1960, and because a number of training agencies have, as a consequence, had to revise their upper age limits for candidates in other occupations, approved hospital schools for medical X-ray technicians may be encouraged to follow the same practice.

It should also be noted that private vocational schools do not generally restrict students because of age, and it is possible that older women who obtain training in these schools will find their way into suitable employment.

Possibilities for Advancement

On the whole, opportunities for advancement for X-ray technicians are fairly limited. The X-ray field is not one in which specialization leads to increased income or prestige. As a matter of fact, authorities in the field have expressed the opinion that job opportunities for X-ray technician specialists may not be as abundant or as lucrative as jobs which require a variety of skills in the field of X-ray technology.

Since the only direct avenue of promotion open to the X-ray technician is the one leading to jobs involving supervision or instruction, the size of the X-ray department and the employer for whom the technician works are important factors. X-ray technicians employed in large X-ray departments usually have a chance to qualify for the job of chief X-ray technician or, perhaps, assistant to the chief. They also may be able to advance in their positions by qualifying to teach X-ray techniques to students in training at their place of employment.

Technicians employed in large hospitals and laboratories may find an opportunity to add skills such as the operation of the electrocardiograph, electroencephalograph, or basal metabolism apparatus to their own X-ray techniques by securing training on the job. Additional skills such as these may command a higher salary among some large hospital employers, and may be in sufficient demand among smaller organizations that prefer technicians who are versatile because they frequently employ only one technician.

X-ray technicians may find it possible to take advantage of on-the-job training opportunities, or to supplement their educational background by taking courses outside of working hours and thereby qualify for newly developed, or more complex standardized, jobs in therapeutic radiology.

VII. INFORMATION FOR THE X-RAY TECHNICIAN

Qualifications for the "R. T."

Many employers require applicants for the job of medical X-ray technician to be registered or eligible for registration with the American Registry of X-Ray Technicians. Registration entitles the technician to use the letters "R. T." after her name and indicates an established level of achievement. In 1953 there were about 13,000 registered X-ray technicians in the United States.

In order to qualify for registration, the X-ray technician is required:

(1) To be a citizen of the United States or to have filed a declaration of intention;[5] to be of good moral character; and to have had a high-school education or the equivalent thereof.

(2) To have had at least 1 year of training or experience under the direction of a diplomate of the American Board of Radiology, or of a recognized radiologist having equal qualifications.

(3) To have had, in addition to the 1 year of training or experience under the direction of a radiologist, at least 1 year of experience in an acceptable X-ray department under the direct supervision of a doctor of medicine specializing in radiology. (Experience under the direction of a nonradiologist may be substituted on a half-value basis for this second year.)

(4) To pass an examination (given semiannually in May and November) consisting of (a) written questions on anatomy, physics, and techniques, and (b) practical demonstration of ability.

Prospective X-ray technicians who want to know whether the training and experience which they plan to undertake will qualify them for registration may write to the American Registry of X-ray Technicians, 2900 East Minnehaha Parkway, Minneapolis 6, Minn.

Health and Liability Insurance

Because the X-ray technician may be injured on the job or may be held liable for injuries to patients, she should ask her employer whether she is adequately covered by insurance.

Some X-ray technicians are covered by State workmen's compensation laws which provide benefits to employees injured on the job;

[5] A reciprocal agreement with Canada and Great Britain permits recognition of their certification by the ARXT without further examination.

however, coverage varies from State to State, and it is important for the X-ray technician to determine the kind of coverage she has for a specific job.

Some employers of X-ray technicians carry liability insurance which protects all of their employees against claims from injury to patients through mistakes, negligence, or incompetence. If the employer does not provide such protection, the X-ray technician should inquire whether she needs professional liability insurance and what arrangements for it can be made. A legal adviser or the American Society of X-Ray Technicians can be of assistance in this matter.

Organization Membership

The professional organization for X-ray technicians is the American Society of X-Ray Technicians, which was organized in 1920 and now has local societies in all 48 States, the District of Columbia, Alaska, Hawaii, Puerto Rico, the Canal Zone, the Virgin Islands, and a number of foreign countries. The society reported some 4,000 members in 1952, of whom about three-fourths were women. Any X-ray technician who has been certified by the American Registry of X-Ray Technicians and who is willing to maintain the code of ethics established by the society is eligible for membership.

Objectives of the society are: "To promote the science and art of radiography, and to study and discuss all the subjects pertaining thereto." The society endeavors to raise the standards of training and to obtain recognition for efficient, well-qualified technicians. It sponsors meetings, conferences, and committees to explore certain phases of radiography practice, as, for example, the improvement of protective devices for both patient and operator, and the development of skills in specialized X-ray work.

The official journal of the society is *The X-Ray Technician*, which is published bimonthly, and presents information about the activities of the national society and affiliated societies, as well as reports on new developments in radiography.

Inquiries about membership may be directed to the American Society of X-Ray Technicians, 16 Fourteenth Street, Fond du Lac, Wis.

Finding a Job

In 1953, the graduate medical X-ray technician, in most cases, had no difficulty in finding a job because of the number of unfilled vacancies. She had to devote some time, of course, to investigating prospective employers and their practices and arranging for personal interviews, in order to find the right job. In large cities, an X-ray technician could often apply directly to the hospital of her choice and find an opening.

Common sources of information about position openings are news-

paper "want ads," and a variety of professional journals and magazines in the medical or hospital field. Through its placement bureau the American Society of X-Ray Technicians maintains information on job openings for X-ray technicians.

In addition, State employment service offices in hundreds of communities throughout the United States provide free placement and counseling service to job applicants of all kinds. Private placement offices also provide information on job openings, but nearly all of these charge an applicant fee.

APPENDIX 1

Job Description for X-ray Technician in Hospitals

X-RAY TECHNICIAN 0–50.04[1]

radiographer

JOB SUMMARY

Takes X-ray photographs of various portions of body to assist medical officers in detection of foreign bodies and diagnoses of diseases and injuries: Positions patient under X-ray machine and regulates controls to expose film. Develops and dries film. Assists in X-ray and radium therapy (treating diseased and affected areas of body by exposure to X-rays or radium), working under direct supervision of RADIOLOGIST. Maintains record of X-rays taken. Performs related duties.

PERFORMANCE REQUIREMENTS

Responsibility for: Care and safety of patient undergoing treatment. Use of equipment to minimize hazards of electric shock, burns, and extraneous radiation to patients and personnel. Care and operation of expensive X-ray equipment, and safe handling of X-ray film to prevent deterioration. Diagnostic quality of X-ray films. Maintenance of records, stock of supplies, and organization of work schedules.

Physical Demands: Stands, turns, and stoops while operating equipment and developing films. Reaches for, lifts, and carries equipment which is usually light. Handles equipment, controls, film, and chemicals. Assists patients into position.

Special Demands: Willingness to work with realization that errors may have serious consequences for patient, and to work with a variety of types of patients, many of whom are in disturbed conditions. Tact and sympathy in dealing with patients. Close attention to details for short periods of time. Alertness to detect conditions dangerous to patient or personnel. Maintenance of position of trust relative to disclosure of information. Considerable initiative and judgment involved in determining proper anatomical posture for patient depending on areas to be photographed, calculating exposure settings, avoiding unnecessary discomfort and handling of patient, and planning work schedules. Works under general supervision, adhering closely to established procedures.

QUALIFICATIONS

Education: Graduation from an approved school for X-RAY TECHNICIANS after completion of one of the following:

(A) Four years of high school with courses in physics, algebra, geometry, and chemistry;

(B) College entrance examination for admission to an accredited college or university; or

(C) Graduation from a school of nursing recognized by State board of nurse examiners.

[1] Code number used in U. S. Department of Labor's *Dictionary of Occupational Titles.*

The Council on Medical Education and Hospitals of the American Medical Association, and American Society of X-Ray Technicians, maintain lists of approved hospital schools.

Training and Experience: Two years' experience under a qualified RADIOLOGIST is usually required plus registration by American Registry of X-Ray Technicians; or 1 year under a qualified RADIOLOGIST and 2 years under a qualified M. D.

Job Knowledge: Must have good working knowledge of anatomy; understand principles of physics, electricity, and methods of exposure to obtain clearly defined films; and be able to set up and operate equipment. Knows how to develop and process films. Knowledge of methods and techniques of X-ray therapy, and of hazards involved. Knows how to maintain system of records. Understands variations of anatomical postures, such as supine, prone, laterally recumbent, and erect. Has sufficient knowledge of psychology, patient care, and sterile techniques to deal with all types and conditions of patients.

Employment Variables

Special Techniques:

- All types of roentgenography
- Body-section roentgenography
- Fluoroscopy
- Kymography
- Opaque media
- Operating-room roentgenography
- Photoroentgenography
- Stereoscopy
- Sterile technique

Professional Affiliations:

- American Registry of X-Ray Technicians
- American Society of X-Ray Technicians
- State and local affiliated societies

Areas of Specialization:

- Arthrology
- Circulatory system
- Dental
- Digestive system
- Endocrine system
- Nervous system
- Osteology
- Respiratory system
- Urogenital system

Working Environment

Works in clean, well-lighted, heated, and ventilated X-ray room. Spends considerable time in damp, roentgenographic darkroom. There is little danger from electric shock unless equipment is not shockproof. Exposure to extraneous rays may result in injuries, such as burns, dermatitis, destruction of blood cells, and inhibition of glandular activity, unless all precautions are taken. Persons with tendency toward anemia should avoid this type of work.

Job Relationships

Source of Workers: [D. O. T. codes]

- Professional Nurses ---------- 0–33
- Physical Therapists ---------- 0–52.22
- High-school or college graduates

Promotion from: May be promoted from DARKROOM HELPER after additional formal training and experience.

Promotion to: X-RAY TECHNICIAN, CHIEF.

Supervised by: X-RAY TECHNICIAN, CHIEF.

Workers Supervised: DARKROOM HELPER; clerical assistants.

Interrelationship: Some aspects of job are similar to those of ELECTROCARDIOGRAPH TECHNICIAN; MEDICAL TECHNOLOGIST; NURSE, STAFF; and PHYSICAL THERAPIST.

Work Performed

Prepares patient for roentgenographic examination, fluoroscopy, or therapy requested by physician: Determines most suitable anatomical posture to roentgenograph affected area of body, and positions patient so that area to be examined is between anode of X-ray tube and film. Considers possibility of aggravation of injury and distortion of organs due to position assumed by patient. Sets up angle board to provide supportive surfaces for patient in sinus, mastoid, and lateral mandible roentgenography. Assists patient to remove all ray-opaque articles of clothing or jewelry that are near site for study. Administers chemical mixtures or drugs, orally or as enemas, to render organs more opaque. Fixes lead plates to patients to protect unaffected areas from X-rays. Adjusts immobilization devices, such as sandbags, binders, and special brackets, to prevent voluntary motion on part of patient.

Sets up and operates stationary and mobile X-ray equipment: Wheels mobile equipment to patient's bedside as required. Centers X-ray tube at proper angle and height over area to be roentgenographed. Adjusts cone, grid, and diaphragm to absorb and minimize extraneous and secondary radiation, and to produce smallest X-ray beam that will cover anatomical area under consideration. Measures density of area to be roentgenographed, using calipers, and sets kilovolts, milliamperes, and exposure time to produce film of proper detail, density, contrast, and lack of distortion. Places X-ray film of proper size in position, and captions it with identifying lead letters. Turns on machine. Makes necessary roentgenographs.

Assists in treating diseased or affected areas, under supervision of RADIOLOGIST, by exposing prescribed area to specified concentrations of rays for specified lengths of time. May assist in radium therapy by removing capsule or needle after specified length of time. In radium therapy works under direct supervision of RADIOLOGIST. Takes all necessary precautions for protection of patients and personnel from electric shock and penetration of rays.

Develops exposed film: Develops, fixes, and washes film in accordance with established darkroom procedures, by immersing film in a series of chemical baths for prescribed lengths of time. Hangs film on racks to dry, or uses special drying cabinet. Prepares developing and fixing (hypo) solutions according to standard formulas.

Prepares and maintains records: Identifies and places developed film in protective envelopes. Files films and physicians' requests for X-rays for future reference. Forwards X-rays and physicians' diagnoses to interested hospital departments. Prepares and maintains records of all X-rays according to individual patient's name and physician's diagnosis. Maintains crossfiles. Schedules appointments and develops work schedules. Many hospitals employ clerical assistants to perform routine clerical functions.

Performs related duties: Assists in making fluoroscopic examinations by preparing barium sulfate solutions and administering them to patients as prescribed by a physician. Also assists in fluoroscopy of heart, chest, bones, etc., by preparing and positioning patient; adjusting controls; and watching exposure factors closely.

Maintains X-ray equipment in efficient operating condition; cleans apparatus; and corrects minor faults, such as replacing fuses, wires, circuit breakers, and

X-ray tubes, and checking the transformer oil levels. May, as qualified, perform duties in other departments, such as physical therapy, basal metabolism, and electrocardiography. May instruct nurses, interns, and students in X-ray technique, under direction of qualified RADIOLOGIST.

Job Description for Electrocardiograph Technician

ELECTROCARDIOGRAPH TECHNICIAN 0–50.05 [2]

e. k. g. technician

Job Summary

Records, as irregular wave tracings on an electrocardiograph, electromotive variations in action of the heart muscle, for use in diagnosis of heart ailments: Straps electrodes to specified areas on patient's body. Manipulates switches, and moves chest electrode to successive positions across chest to record heart action in graph form on continuous roll of paper. Includes graph as part of patient's record. Performs related duties.

Performance Requirements

Responsibility for: Recognizing and reporting malfunctioning before serious damage occurs. Sympathetic attention to patients. Care of equipment.

Physical Demands: Sits and walks within limited area most of working day. Reaches for and manipulates electrical controls and switches. Stoops, lifts, and carries relatively light equipment. Pushes and pulls machine. Visual acuity to discriminate among wave patterns.

Special Demands: Willingness to work with realization that errors may have serious consequences for patient, and to work with disturbed patients and those seriously ill. Attention to details for short periods of time. Alertness to detect evidence of irregularities in recording as well as malfunctioning of equipment. Considerable initiative and judgment involved in securing cooperation of patient, noting abnormalities in recordings, and in obtaining complete and properly designated electrocardiograms. Works under general supervision, performing duties that are well standardized.

Qualifications

Education: High-school graduation or equivalent, including courses in physical sciences, is essential.

Training and Experience: Three to six months' on-the-job training under supervision of an experienced technician or cardiologist is usual way in which this technique is learned.

Job Knowledge: Must be thoroughly familiar with operation of an electrocardiograph, and be able to recognize abnormal wave patterns, and malfunctioning of the machine.

Employment Variables

None.

Working Environment

Works in clean, well-lighted, heated, and ventilated laboratory. Frequently works at patient's bedside.

---

[2] See footnote 1, p. 38.

JOB RELATIONSHIPS

Source of Workers:	[D. O. T. codes]
Nurse Aide	2–42. 20
Nurse, Student	0–33. 27
Medical Technician	0–50. 01
X-ray Technician	0–50. 40
Laboratory Technician and Assistants	0–50

Persons who have repaired and operated radio and radar equipment are also considered a good source of workers.

Promotion from: Job is usually filled by trainee known as apprentice electrocardiograph operator.

Promotion to: No formal line of promotion.

Supervised by: ASSISTANT ADMINISTRATOR for administrative purposes, and ASSISTANT ADMINISTRATOR, MEDICAL for technical practices.

Workers supervised: None.

Interrelationship: Some aspects of this job are similar to those of X-RAY TECHNICIAN. May perform electroencephalograph or basal metabolism tests.

WORK PERFORMED

Prepares for test: Instructs patient to recline on table and to remove sufficient clothing to expose chest and ankles. Pastes or otherwise attaches electrodes to specified areas of patient's ankles and wrists. Connects leads from electrocardiograph to electrodes with small clamps or screw attachments.

Administers test by operating electrocardiograph to record electrical currents emanating from heart muscle: Turns on power and manipulates selector switch to secure tracing of electromotive variations in action of specific areas of heart muscle. Identifies sections of tracings by pressing a small marker button, number of marks signifying electrode positions. Removes electrodes from patient and tracings from electrocardiograph after administering test.

Cuts tracing into small sections, after physician has studied tracing, pastes or staples sections to patient's record, and files record.

Keeps electrocardiograph in working order by replenishing supply of tracing paper and ink and reporting malfunctioning of machine to repairman.

Performs related duties: Types diagnoses. Forwards bills for electrocardiograph test to business office for inclusion in patient's account.

Job Description for Electroencephalograph Technician in Hospitals

ELECTROENCEPHALOGRAPH TECHNICIAN 0–50.14 [3]

e. e. g. technician

JOB SUMMARY

Measures, by means of an electroencephalograph, impulse frequencies and differences in electrical potential between various areas of the brain, to obtain data for use in diagnosis of brain disorders: Attaches electrodes to specified positions on patient's head. Turns on machine and rotates switches to obtain tracings of impulses from various parts of brain. Studies characteristics of tracings to detect waves which indicate brain disorders, and eliminates traces

[3] This code number has been newly assigned and therefore does not appear in the 1949 edition of the *Dictionary of Occupational Titles*. It will be published in future releases of the Dictionary.

caused by outside interferences. Removes electrodes and tracings at end of test. Reviews tracings and writes or types analysis for use by physicians.

Performance Requirements

Responsibility for: Recognition of acute illness such as convulsive seizure which may occur during test and summon medical assistance. Proper functioning of a complex and expensive electronic device. Recognizing and reporting serious malfunctioning of equipment and outside interferences of wave patterns. Sympathetic attention to patient.

Physical Demands: Sits and walks within limited area most of working day. Reaches for and manipulates electrical controls and switches. Stoops, lifts, and carries relatively light equipment. Visual acuity to discriminate among wave patterns.

Special Demands: Willingness to work with realization that errors may have serious consequences for patient, and to work with disturbed patients. Attention to details for periods up to 1 hour frequently required. Alertness to detect irregularities in waves indicative of brain disorders, as well as to note malfunctioning of equipment. Considerable initiative and judgment involved in securing cooperation of patient, and determining length of test to secure adequate results. Works under general supervision performing duties that are highly standardized.

Qualifications

Education: High-school graduation or equivalent including courses in the physical sciences is essential. Some college work in such subjects as neuroanatomy is desirable.

Training and Experience: Three months' formal training in electroencephalography at a hospital having an e. e. g. department is generally considered adequate. However, an informal apprenticeship requiring 3 to 6 months, depending upon the trainee's background, is a common way to learn this technique.

Job Knowledge: Must be thoroughly familiar with operation of an electroencephalograph, to recognize malfunctioning and make minor repairs. Is able to locate and distinguish tracings indicative of brain disorders and recognize and discount outside interferences which affect tracings.

Employment Variables

None.

Working Environment

Works in clean, well-lighted, heated, and ventilated laboratory.

Job Relationships

Source of Workers:	[D. O. T. codes]
Nurse Aide	2–42. 20
Nurse, Student	0–33. 27
Laboratory Technicians and Assistants	0–50

Promotion from: Job is usually filled by trainee known as apprentice electroencephalograph operator.

Promotion to: No formal line of promotion.

Supervised by: ASSISTANT ADMINISTRATOR for administrative purposes, and ASSISTANT ADMINISTRATOR, MEDICAL, for technical practices.

Workers Supervised: None.

Interrelationship: Some aspects of the job are similar to X-RAY TECHNICIAN. May perform electrocardiograph or basal metabolism tests.

WORK PERFORMED

Prepares for test: Analyzes patient's medical record to obtain such information as history of head injury or epilepsy in order to be alert for evidence of their symptoms during test. Positions patient on cot. Attaches electrodes of electroencephalograph to predetermined positions on forehead, scalp and ears, using electrode paste and either collodion or a special Bentinite paste. Instructs patient how to relax and cooperate during test.

Operates electroencephalograph to record patient's brain waves: Sets battery of selector switches and turns on machine which records simultaneously, a number of irregular waves indicative of impulse frequencies and differences in electrical potential between various parts of brain. Studies wave characteristics during test to detect evidence of brain disorders and may mark graph accordingly for study by physician. Detects and eliminates from consideration all artifacts (waves of larger amplitude caused by such activities as opening the eyes or turning the head).

Removes electrodes from patient at end of test and cleans off remaining paste with a cloth dipped in alcohol. Removes graph from machine and writes patient's name, attending physician, and date for identification.

Writes up test report for physician: Studies characteristics of tracings at length to detect any evidence not noted during test. Writes report, indicating unusual wave characteristics shown on tracings. May indicate exact position on tracing to facilitate examination by individual using report. Note: The skill in this job lies in worker's ability to distinguish curve characteristics caused by brain disorders, as well as to recognize and eliminate from consideration all artifacts. Worker does not interpret wave patterns.

Performs related dutes: Make minor adjustments and repairs, such as replacing tubes, condensers, and electrodes, using small hand tools. Removes larger and more complex electronic units when trouble is detected and forwards them to factory or repair laboratory. Writes report to accompany part stating how unit failed to operate satisfactorily and probable reason for failure.

APPENDIX 2

ESTIMATED NUMBER OF ACTIVE X-RAY TECHNICIANS AND NUMBER PER 100,000 POPULATION, BY REGION AND STATE, 1952

Region and State	Active X-ray technicians	
	Total number	Number per 100,000 population
United States	39, 196	25. 0
New England	2, 484	26. 5
Central Atlantic	7, 064	19. 5
Southeast	5, 220	16. 2
Southwest	2, 980	25. 3
East North Central	8, 612	27. 8
West North Central	5, 056	35. 5
Rocky Mountain	1, 748	49. 1
Far West	6, 032	39. 7
New England:		
Connecticut	768	37. 7
Maine	180	20. 2
Massachusetts	1, 168	24. 7
New Hampshire	144	27. 0
Rhode Island	128	16. 1
Vermont	96	25. 7
Central Atlantic:		
Delaware	60	18. 2
District of Columbia	232	28. 6
Maryland	548	22. 4
New Jersey	876	17. 6
New York	2, 852	19. 0
Pennsylvania	2, 260	21. 4
West Virginia	236	11. 8
Southeast:		
Alabama	532	17. 5
Arkansas	488	25. 5
Florida	664	22. 4
Georgia	424	12. 2
Kentucky	380	13. 0
Louisiana	592	21. 5
Mississippi	264	12. 0
North Carolina	576	13. 9
South Carolina	204	9. 6
Tennessee	688	20. 7
Virginia	408	12. 1

ESTIMATEE NUMBER OF ACTIVE X-RAY TECHNICIANS AND NUMBER PER 100,000 POPULATION, BY REGION AND STATE, 1952—Continued

Region and State	Active X-ray technicians	
	Total number	Number per 100,000 population
Southwest:		
Arizona	288	35. 8
New Mexico	156	22. 2
Oklahoma	492	21. 7
Texas	2, 044	25. 6
East North Central:		
Illinois	2, 836	32. 2
Indiana	972	24. 1
Michigan	1, 524	23. 3
Ohio	1, 772	22. 0
Wisconsin	1, 508	43. 4
West North Central:		
Iowa	808	30. 8
Kansas	732	37. 5
Minnesota	1, 208	40. 3
Missouri	1, 292	32. 0
Nebraska	512	38. 0
North Dakota	208	34. 4
South Dakota	296	45. 7
Rocky Mountain:		
Colorado	1, 080	78. 5
Idaho	228	38. 6
Montana	204	34. 6
Utah	128	18. 1
Wyoming	108	36. 6
Far West:		
California	4, 568	41. 4
Nevada	44	25. 7
Oregon	648	41. 6
Washington	772	31. 8

Source: *Building America's Health*, A Report to the President by The President's Commission on the Health Needs of the Nation, Volume 3.

APPENDIX 3

Approved Schools for X-ray Technicians, September 1953

(The prospective student may secure complete details regarding admission and training in a particular school by addressing a letter directly to the radiologist in charge of the school.)

Alabama

Birmingham: Jefferson-Hillman Hospital.
Gadsden: Holy Name of Jesus Hospital.

Arizona

Phoenix: Memorial Hospital; St. Joseph's Hospital.

Arkansas

Little Rock: University Hospital.

California

Berkeley: Herrick Memorial Hospital.
Los Angeles: California Hospital; Cedars of Lebanon Hospital; Children's Hospital; College of Medical Evangelists;* Los Angeles County Hospital.*
National City: Paradise Valley Sanitarium and Hospital.
Pasadena: Collis P. and Howard Huntington Memorial Hospital.*
Sacramento: Mercy Hospital.*
San Francisco: Children's Hospital; Franklin Hospital; Stanford University Hospitals; University of California Hospital.*

Colorado

Colorado Springs: Glockner-Penrose Hospital.
Denver: Colorado General Hospital; Denver General Hospital; General Rose Memorial Hospital; Presbyterian Hospital; St. Anthony Hospital; St. Joseph's Hospital;* St. Luke's Hospital.
Grand Junction: St. Mary's Hospital.
Greeley: Weld County Public Hospital.*

Connecticut

Hartford: Hartford Hospital.
New Haven: Memorial Unit, Grace-New Haven Community Hospital; New Haven Unit, Grace-New Haven Community Hospital; Hospital of St. Raphael.

Delaware

Wilmington: Delaware Hospital.

District of Columbia

Washington: Eastern Dispensary and Casualty Hospital; Georgetown University Hospital.

Florida

Jacksonville: Duval Medical Center.
Pensacola: Sacred Heart Hospital.

Georgia

Atlanta: Crawford W. Long Memorial Hospital; Georgia Baptist Hospital; Grady Memorial Hospital; Piedmont Hospital.
Augusta: University Hospital.
Columbus: Columbus City Hospital.

Source: Council on Medical Education and Hospitals of the American Medical Association, 535 North Dearborn Street, Chicago 10, Ill.

*Schools which require more than 4 years of high-school education. Students should address the school for further information.

Emory University: Emory University Hospital.*
Marietta: Kennestone Hospital.

Idaho

Boise: St. Alphonsus Hospital; St. Luke's Hospital.
Nampa: Mercy Hospital; Samaritan Hospital.

Illinois

Chicago: Alexian Brothers Hospital; Augustana Hospital;* Chicago Memorial Hospital; Cook County Graduate School of Medicine; Edgewater Hospital; Englewood Hospital; Evangelical Hospital; Lutheran Deaconess Hospital; Michael Reese Hospital; Mount Sinai Hospital; Norwegian-American Hospital; Provident Hospital; Ravenswood Hospital; Research and Educational Hospitals; St. Anne's Hospital; St. Bernard's Hospital; St. Elizabeth Hospital; St. George's Hospital; St. Joseph Hospital; St. Luke's Hospital;* St. Mary of Nazareth Hospital; South Chicago Community Hospital; Woodlawn Hospital.
Dixon: Dixon Public Hospital.
Elmhurst: Memorial Hospital of Du Page County.
Evanston: St. Francis Hospital.
Harvey: Ingalls Memorial Hospital.
Moline: Moline Public Hospital.
Peoria: John C. Proctor Hospital; Methodist Hospital of Central Illinois; St. Francis Hospital.
Rockford: Rockford Memorial Hospital; St. Anthony's Hospital; Swedish-American Hospital.
Rock Island: St. Anthony's Hospital.
Springfield: Memorial Hospital; St. John's Hospital.

Indiana

East Chicago: St. Catherine Hospital.
Fort Wayne: St. Joseph Hospital.
Gary: Methodist Hospital.
Indianapolis: Indiana University Medical Center; Methodist Hospital.
Terre Haute: St. Anthony Hospital.

Iowa

Cedar Rapids: Mercy Hospital; St. Luke's Methodist Hospital.
Council Bluffs: Mercy Hospital.
Des Moines: Broadlawns, Polk County Hospital.
Dubuque: Finley Hospital; St. Joseph Mercy Hospital; Xavier Hospital.
Iowa City: Mercy Hospital; University Hospitals.
Ottumwa: St. Joseph Hospital.
Sioux City: St. Joseph Mercy Hospital; St. Vincent's Hospital.

Kansas

Kansas City: Bethany Hospital; St. Margaret's Hospital; University of Kansas School of Medicine.*
Wichita: St. Francis Hospital; Wesley Hospital; Wichita-St. Joseph Hospital.

Kentucky

Covington: St. Elizabeth Hospital.
Louisville: Kentucky Baptist Hospital; Louisville General Hospital; Norton Memorial Infirmary; St. Joseph Infirmary.

Louisiana

New Orleans: Charity Hospital of Louisiana; Touro Infirmary; U. S. Public Health Service Hospital.
Shreveport: Shreveport Charity Hospital.

Maine

Lewiston: Central Maine General Hospital; St. Mary's General Hospital.
Portland: Maine General Hospital.

Maryland

Baltimore: Baltimore City Hospitals; Johns Hopkins Hospital; University Hospital.
Hagerstown: Washington County Hospital.

*See p. 47.

Massachusetts

Boston: Massachusetts Memorial Hospitals; Peter Bent Brigham Hospital.
Holyoke: Providence Hospital.
Lawrence: Lawrence General Hospital.
Pittsfield: St. Luke's Hospital.
Quincy: Quincy City Hospital.
Springfield: Mercy Hospital; Springfield Hospital; Wesson Memorial Hospital.
Worcester: St. Vincent Hospital.

Michigan

Ann Arbor: St. Joseph Mercy Hospital.
Battle Creek: Leila Y. Post Montgomery Hospital.
Benton Harbor: Mercy Hospital.
Detroit: Detroit Memorial Hospital; Jennings Memorial Hospital; Mount Carmel Mercy Hospital; Saratoga General Hospital.
Eloise: Wayne County General Hospital and Infirmary.
Flint: Hurley Hospital; St. Joseph's Hospital.
Grand Rapids: Blodgett Memorial Hospital.
Marquette: St. Luke's Hospital.

Minnesota

Duluth: St. Luke's Hospital; St. Mary's Hospital.*
Minneapolis: Eitel Hospital; Fairview Hospital; Minneapolis General Hospital; St. Mary's Hospital; Swedish Hospital; University of Minnesota Hospitals.*
St. Cloud: St. Cloud Hospital.
St. Paul: Bethesda Hospital; Charles T. Miller Hospital; St. Joseph's Hospital.

Mississippi

Jackson: Mississippi Baptist Hospital.
Vicksburg: Lutheran Hospital; Mercy Hospital-Street Memorial.

Missouri

Independence: Independence Sanitarium and Hospital.
Kansas City: Kansas City General Hospital No. 1; Kansas City General Hospital No. 2; Menorah Hospital Medical Center; Research Hospital; St. Luke's Hospital.
St. Louis: De Paul Hospital; Evangelical Deaconess Hospital; Homer G. Phillips Hospital; St. Louis University School of Nursing; St. Mary's Infirmary; Washington University School of Medicine.
Springfield: Burge Hospital.

Nebraska

Grand Island: St. Francis Hospital.*
Lincoln: St. Elizabeth Hospital.
Omaha: Creighton Memorial, St. Joseph Hospital;* St. Catherine's Hospital; University of Nebraska College of Medicine.

New Hampshire

Concord: Concord Hospital.
Hanover: Mary Hitchcock Memorial Hospital.
Laconia: Laconia Hospital.

New Jersey

Jersey City: Jersey City Medical Center.
Paterson: Paterson General Hospital.
Summit: Overlook Hospital.
Trenton: Mercer Hospital; St. Francis Hospital.

New York

Albany: Albany Hospital.
Buffalo: Edward J. Meyer Memorial Hospital; Mercy Hospital; Millard Fillmore Hospital.
Dunkirk: Brooks Memorial Hospital.
Elmira: St. Joseph's Hospital.
Glens Falls: Glens Falls Hospital.
Hornell: St. James Mercy Hospital.

*See p. 47.

New York: New York Hospital; New York Polyclinic Medical School and Hospital; St. Clare's Hospital.
Rochester: Rochester General Hospital; St. Mary's Hospital; Strong Memorial Hospital.
Syracuse: General Hospital.

North Carolina

Asheville: Memorial Mission Hospital.
Charlotte: Mercy Hospital.
Concord: Cabarrus County Hospital.
Durham: Duke University School of Medicine; Watts Hospital.*
Winston-Salem: Bowman Gray School of Medicine; City Memorial Hospital; Kate Bitting Reynolds Memorial Hospital.

North Dakota

Bismarck: Quain and Ramstad Clinic; St. Alexius Hospital.
Minot: Trinity Hospital.

Ohio

Akron: City Hospital.
Canton: Mercy Hospital.
Cincinnati: Cincinnati General Hospital; Good Samaritan Hospital; Our Lady of Mercy Hospital.
Cleveland: City Hospital; Cleveland Clinic Hospital; Mount Sinai Hospital; St. Luke's Hospital; St. Vincent Charity Hospital; University Hospitals.
Cleveland Heights: Doctors Hospital.
Columbus: Ohio State University Hospital.
Dayton: Good Samaritan Hospital; Miami Valley Hospital; St. Elizabeth Hospital.
East Cleveland: Huron Road Hospital.
Elyria: Elyria Memorial Hospital.
Hamilton: Mercy Hospital.
Lima: St. Rita's Hospital.
Lorain: St. Joseph Hospital.
Newark: Newark Hospital.
Youngstown: Youngstown Hospital.

Oklahoma

Oklahoma City: Mercy Hospital; St. Anthony's Hospital; University Hospitals; Wesley Hospital.
Tulsa: St. John's Hospital.

Oregon

Pendleton: St. Anthony's Hospital.
Portland: Portland Sanitarium and Hospital; University of Oregon Medical School Hospitals and Clinics.

Pennsylvania

Chester: Chester Hospital.
Danville: Geo. F. Geisinger Memorial Hospital and Foss Clinic.
Darby: Fitzgerald-Mercy Hospital.
East Stroudsburg: General Hospital of Monroe County.
Erie: St. Vincent's Hospital.
Hazleton: St. Joseph Hospital.
Johnstown: Conemaugh Valley Memorial Hospital.
Philadelphia: Germantown Dispensary and Hospital; Graduate Hospital of the University of Pennsylvania; Hahnemann Hospital; Hospital of the University of Pennsylvania; Jefferson Medical College Hospital; Jewish Hospital (Northern Division—Albert Einstein Medical Center); Nazareth Hospital; Philadelphia General Hospital.
Pittsburgh: Elizabeth Steel Magee Hospital; Mercy Hospital; Western Pennsylvania Hospital.
Reading: Reading Hospital.
Scranton: Scranton State Hospital; West Side Hospital.
Sharon: Sharon General Hospital.
West Chester: Chester County Hospital.
Wilkes-Barre: Wilkes-Barre General Hospital.

*See p. 47.

South Carolina

Anderson: Anderson County Memorial Hospital.
Charleston: Roper Hospital.
Columbia: Columbia Hospital.
Orangeburg: Orangeburg Hospital.
Spartanburg: Spartanburg General Hospital.
Sumter: Tuomey Hospital.

South Dakota

Aberdeen: St. Luke's Hospital.
Sioux Falls: McKennan Hospital; Sioux Valley Hospital.
Yankton: Sacred Heart Hospital.

Tennessee

Knoxville: East Tennessee Baptist Hospital; Knoxville General Hospital.
Madison College: Madison Sanitarium and Hospital.*
Memphis: University of Tennessee College of Medicine.
Nashville: Meharry Medical College.*

Texas

Beaumont: Baptist Hospital of Southeast Texas; Hotel Dieu Hospital.*
Dallas: Baylor University Hospital; Methodist Hospital; Parkland Hospital; St. Paul's Hospital; Veterans' Administration Hospital.
Fort Worth: All Saints Hospital.
Galveston: University of Texas Medical Branch.
Houston: Hermann Hospital; Methodist Hospital; St. Joseph's Hospital.
Port Arthur: St. Mary's Hospital Gates Memorial.
San Antonio: Santa Rosa Hospital.
Temple: Scott and White Hospital.
Tyler: Mother Frances Hospital.

Utah

Ogden: St. Benedict's Hospital.
Salt Lake City: Salt Lake County General Hospital.

Vermont

Burlington: Mary Fletcher Hospital.

Virginia

Charlottesville: University of Virginia Hospital.*
Newport News: Riverside Hospital.
Richmond: Medical College of Virginia Hospital Division; St. Luke's Hospital.

West Virginia

Bluefield: St. Luke's Hospital.
Charleston: Kanawha Valley Hospital; McMillan Hospital; St. Francis Hospital.
South Charleston: Herbert J. Thomas Memorial Hospital.

Wisconsin

Ashland: St. Joseph's Hospital.
Beloit: Beloit Municipal Hospital.
Janesville: Mercy Hospital.
La Crosse: St. Francis Hospital.
Madison: Madison General Hospital; St. Mary's Hospital; University of Wisconsin Medical School.*
Milwaukee: Columbia Hospital; Evangelical Deaconess Hospital; Milwaukee Hospital; Mount Sinai Hospital; St. Joseph's Hospital; St. Mary's Hospital.
Wausau: St. Mary's Hospital.

Hawaii

Honolulu: St. Francis Hospital.

*See p. 47.

BIBLIOGRAPHY

American Congress of Radiology. The science of radiology. Springfield, Ill., and Baltimore, Md., Charles C. Thomas, 1933. 450 pp.

American Hospital Association. Administrators' guide issue. *Hospitals* 27 : 26, June 1953, Part II.

American Medical Association, Council on Medical Education and Hospitals. Approved schools for X-ray technicians. Chicago, Ill., the Council, 1953. 6 pp.

American Registry of X-Ray Technicians, 1952–53. Minneapolis 6, Minn., the Registry, 1952. 11 pp.

American Society of X-Ray Technicians. Official Roster, 1953. Fond du Lac, Wis., the Society, 1953. 74 pp.

Arestad, F. H., and McGovern, Mary A. Hospital service in the United States. *Journal* of the American Medical Association 152 : 143–163, May 9, 1953.

Berkovich, I. Chemistry debt to Röntgen. *Chemical Age* 58 : 684–686, May 15, 1948.

Cahoon, John B. Formulating X-ray technics. Durham, N. C., Duke University Press, 1953. 59 pp.

Corwin, Edward H. L. The American Hospital. New York, N. Y., The Commonwealth Fund, 1946. 226 pp.

Curie, Eve. Madame Curie. (Translated by Vincent Sheean.) New York, N. Y., Doubleday, Doran & Co., Inc., 1937. 393 pp.

Eaton, Jeanette. Leaders in other lands. Boston, Mass., D. C. Heath & Co., 1950. Pp. 206–240 (juvenile).

Freeman, Lucy. It's your hospital and your life. New York, N. Y., Public Affairs Committee, Inc., 1952. 32 pp.

Fundamentals of radiography. Rochester, N. Y., Eastman Kodak Co., 1951. 116 pp.

Historic researches. *Engineer* 185 : 560, June 11, 1948.

Horowitz, Caroline and Horowitz, H. H. Treasury of the world's great heroines. New York, N. Y., Hart Publishing Co., 1951. Pp. 157–163.

Ingraham, Samuel C., et al. Reactor-produced radioactive isotopes. Public Health Reports 68 : 609–615, June 1953.

McGibony, John R. Principles of hospital administration. New York, N. Y., G. P. Putnam's Sons, 1952. 540 pp.

Perieux, Mary. One hundred great lives. New York, N. Y., Greystone Press, 1948. Pp. 662–667.

President's Commission on Health Needs of the Nation : America's Health Status, Needs and Resources, vol. II, December 1951 ; Statistical Appendix, vol. III, December 1951. Washington, D. C., the Commission. U. S. Government Printing Office, 1953.

Protection of X-ray personnel. Taken from Department of Air Force, Office of the Surgeon General, Preventive Medicine Division. *Medical Technician Bulletin*, March–April 1952, pp. 68–69.

Schnittkind, Henry Thomas, and Schnittkind, D. A. Life stories of great inventors. New York, N. Y., Garden City Publishing Co., 1948. Pp. 185–198.

Seidman, Roy M., M. D. Radiologic protection. *Medical Technician Bulletin* 3 : 211–212, September–October 1952.

Shenk, W. P. Roentgen and the X-ray. *Science Digest* 30: 87–91, October 1951.

Stanbro, William W. Medicine's penetrating rays. *The Courier* of the George Washington University Hospital, Washington, D. C., September 1950, pp. 14–18.

United States Department of Commerce, Bureau of the Census. 1950 Census of Population. Series P–C1 U. S. Summary. Washington, D. C., U. S. Government Printing Office, 1953.

—— —— 1950 Census of Population. Unpublished data.

—— National Bureau of Standards. Medical X-ray protection up to two million volts. Handbook 41 (supersedes Handbook 20), Mar. 30, 1949. 43 pp.

United States Department of Health, Education, and Welfare [Formerly Federal Security Agency], Bureau of Old-Age and Survivors Insurance. Your social security. Washington, D. C., the Bureau, October 1952. 47 pp.

United States Department of Labor, Bureau of Employment Security. Job descriptions and organizational analysis for hospitals and related health services. Washington, D. C., U. S. Government Printing Office, 1952. 532 pp.

—— Bureau of Labor Statistics. Federal white-collar workers—their occupations and salaries, June 1951. Washington, D. C., U. S. Government Printing Office, 1953. Bull. 1117. 43 pp.

—— Women's Bureau. Part-time jobs for women—a study in 10 cities. Washington, D. C., U. S. Government Printing Office, 1951. Bull. 238. 82 pp.

Walter, J. and Miller, H. A short textbook of radiotherapy for technicians and students. London, J. & A. Churchill Ltd., 1950. 444 pp.

Wanamaker, Pearl A. Short stories of famous women. New York, N. Y., Noble & Noble, 1949. Pp. 248–255.

Woglom, W. H. Discoverers for medicine. New Haven, Conn., Yale University Press, 1949. Pp. 160–176.

X-Ray Technician. Official Journal of the American Society of X-Ray Technicians. Published bimonthly at St. Paul 14, Minn.